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Politics and Policy Along an Indonesian Commodity Frontier:
Reconstructing Four Decades of Land Use, Land Cover and Livelihood Change in
Southeast Sulawesi

by

Lisa Cailin Kelley

A dissertation submitted in partial satisfaction of the

requirements for the degree of

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in the

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of the

University of California, Berkeley

Committee in charge:

Professor Nancy Lee Peluso, Co-Chair

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Abstract

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Since the 1980s, Sulawesi, Indonesia has been the site of one of the most significant smallholder cacao booms in recent global economic history. Beginning in the early 2000s, however, conditions of boom turned to bust. With pest and pathogen outbreak driving significant yield losses, many producing households began to find that the costs of production outstripped revenues. In this context, there have been significant investments in a “sustainable intensification” of smallholder cacao production, generally involving the dissemination of new planting materials; the establishment of farmer field schools; and movement towards more direct trade relations between smallholders and agribusiness. My dissertation responds to these developments, advancing an historical, multi-scalar and integrated socio-environmental assessment of cacao expansion and associated development policies and politics over the past four decades.

Chapter One draws on over 150 Landsat images from 1972-2014 and a novel cloud-based computing platform to reconstruct patterns of land cover change in Southeast Sulawesi, the site of 16% of cacao production in Indonesia and the focal site of my analyses. I use these data to demonstrate the significant relationship between smallholder cacao production and forest cover loss over the past four decades, particularly in alluvial lowland regions. I also show, however, that smallholder tree crop plantings helped to revegetate long-fallowed grasslands, driving gross rates of tree cover gain three times higher than gross loss rates from 1972-1995 and equal to gross loss rates from 1995-2014. These results demonstrate the multiplicity of land cover change trajectories in tropical commodity frontiers and advance the use of novel remote sensing methodologies in capturing fuller histories of landscape change.

Chapter Two grounds these dynamics in fourteen months of ethnographic research to identify the antecedent practices, policies and institutions which drove cacao expansion. Challenging the notion that the state played a “hands-off” role throughout the course of cacao boom, these data suggest that state actors and institutions played a critical role in shaping expansion pathways at nearly every step of the way, simultaneously driving high

rates of forest cover loss and high differentiation along lines of class and ethnicity. These results highlight the need to more fully recover histories of state engagement in agricultural landscapes, even as corporate and civil society actors come to play a larger role in shaping agricultural development policies.

Chapter Three turns to contemporary policy propositions, focusing on how sustainable intensification initiatives are shaping ongoing processes of agrarian change. Drawing on in-depth interviews and land surveys, I demonstrate how current policies maintain a narrow sectoral focus on cacao in this region, albeit this time in service of corporate-driven rather than state-led development agendas. I show that despite the proliferation of support for and investment in smallholder cacao production over the past fifteen years, growers are largely turning away from the crop, transitioning to new commodities. These data illustrate that even high levels of public and private buy-in and investment will not enable greater sustainability in Sulawesi's cacao production landscapes if current initiatives do not address local labor constraints and better compete with smallholders' emergent market opportunities.

This dissertation thus supports three key findings about the nature of sustainable intensification initiatives in Sulawesi. First, my findings illustrate how current initiatives emerge out of and respond to earlier practices and effects of state territorialization, or strategies to control land, people and resources. Second, my findings demonstrate that current policies in the sector are failing to achieve many of their stated goals, i.e. an intensification of cacao production, and through this, improvements in smallholder livelihoods and reduced smallholder clearances of forested lands. Finally, my analyses show that while the dominant narratives surrounding cacao expansion and development are not necessarily *untrue*, they are partial, obscuring other important dynamics that have shaped socially and spatially differentiated trajectories of cacao boom and cacao bust. These data thus speak broadly to diverse debates surrounding agricultural expansion and development, simultaneously advancing a methodological approach for the integration of remotely sensed analyses and ethnographic data.

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INTRODUCTION

1. Introduction and Overview

Processes of rapid agricultural expansion are fundamentally reconfiguring the social and natural fabric of tropical regions (Hall et al., 2011; Phalan et al., 2013; Laurence et al., 2014; Meyfroidt et al., 2014). Though contemporary debates have emphasized large-scale corporate and state appropriations of land for industrial agricultural production (DeSchutter, 2011; Borras et al., 2011; McCarthy et al., 2012; McMichael, 2012), smallholder producers have been key participants in many agricultural commodity booms (Sikor, 2012; Hall, 2011; Hall et al., 2011; Fox and Castella, 2013; Li, 2014). This is particularly true in Indonesia, where smallholders' adoption of crops such as cacao, oil palm and rubber has been integral to agrarian change over past three decades (BPS, 2014; FAOSTAT, 2014). The establishment of export-oriented agricultural economies has reconfigured agrarian societies and livelihoods, more fully incorporating people into both nation states and global markets. It has also driven profound and conflictual changes in the biophysical landscape. Agricultural expansion is associated with high rates of land use and cover change (Gibbs et al., 2010; Hansen et al., 2013; Carlson et al., 2013); losses in forest-dependent biodiversity (Sodhi et al., 2004; Fitzherbert et al., 2008; Wilcove et al., 2013); and, in many cases, increases in greenhouse gas emissions (Danielsen et al., 2009; Carlson et al., 2012).

In response to these effects, many policies and management interventions have emerged to promote greater social and environmental sustainability in agricultural landscapes. In Indonesia, such initiatives include the \$1 billion dollar REDD+ agreement between Indonesia and Norway (Government of Indonesia and Government of Norway, 2010); actions supported through the Roundtable for Sustainable Palm Oil (RSPO) (Roundtable on Sustainable Palm Oil, 2017); and nearly fifteen years of investment in the “sustainable intensification” of the cacao sector (Sustainable Cocoa Production Program, 2017). Such responses come after-the-fact however and do not explain the origin of problems associated with agricultural production. Fully understanding tropical agriculture, as well as the constraints and possibilities of contemporary policies, requires examining: (i) the antecedent policies, institutional changes and social practices that have shaped agricultural expansion; (ii) associated socio-environmental changes (both intended and unintended); and (iii) the imbrications between contemporary policies and existing society-nature relations.

My dissertation addresses these research needs, assessing the origins and implications of rapid cacao expansion and associated development policies and politics in Sulawesi, Indonesia. Up from almost no production in the late 1970s, Indonesia produced more than 600,000 tons of cacao annually by 2002. More than 90% of this production was generated by smallholder producers on the island of Sulawesi managing just under two hectares of cacao on average (FAOSTAT, 2014; BPS, 2015). Despite this remarkable boom, considered to be “*one of the most spectacularly efficient [smallholder cacao booms] in the world*” (Ruf and Siswandputro, 1995), cacao yields began to decline by the mid-2000s. Yield loss has been driven predominantly by growing pressure from pests and pathogens, including Cacao Pod Borer, Black Pod Rot and Vascular Streak Dieback

(Neilson, 2007; Clough et al., 2009). Since the first documented outbreak of the Cacao Pod Borer in Sulawesi, Indonesia, the pest has generated losses on the order of \$290 million in yields and \$60 million in quality (Neilson, 2007: 229-230). As of 2014-2015, the time of this research, cacao production in Indonesia remained above 700,000 tons (FAOSTAT, 2014). This figure however reflects an expansion in cacao holdings despite sustained declines in yields. From a high of 1,132 metric tons/hectare in 2002, average yields in the sector had dropped to 422 metric tons/hectare by 2014 (ibid).

In this context, there have been significant investments in the “sustainable intensification” of smallholder cacao production in Indonesia. Most partnerships in Sulawesi have established farmer field schools to train growers in agro-ecological methods of pest and pathogen management (Neilson, 2007; Saxbol, 2015; Wijaya et al., 2016). Recent programs have also distributed new planting materials to growers and worked to establish closer trade linkages between smallholders and multi-national processors and manufacturers, with certification under UTZ or Rainforest Alliance schemes planned (ACDI/VOCA, 2005; Neilson, 2007; Kindornay and Higgins, 2012; Sustainable Cocoa Production Program, 2016)¹. Diverse actors and institutions have supported these investments, including bilateral donor agencies, conservation and development-oriented civil society organizations and most major manufacturers and processors along the cacao commodity chain (Bitzer et al., 2012; Hafid and McKenzie, 2012; Moriarty et al., 2014). To date, public-private investors have engaged at least 300,000 hectares of land and 500,000 households (Direktorat Jenderal Perkebunan, 2014).

Investments in Indonesia’s smallholder cacao sector follow broader global trends and discourses. According to Howard Yana-Shapiro, Global Director of Plant Science and External Research at Mars, and Evan Rosenquist of the United States Department of Agriculture (USDA), the looming global “crisis” of cacao production was made evident by the outbreak of witches broom in 1989 in Bahia, Brazil, then the largest site of cacao production in South America (Shapiro and Rosenquist 2004: 455). According to John Lunde, Director of International Environmental Programs for Mars, Incorporated, “[n]o one had seen devastation like this before. We were thinking that if this spreads to Africa, the results would be catastrophic. Brazil’s experience opened everyone’s eyes to the fact that a global, cooperative effort was needed to protect cocoa” (ibid). Bust in Brazil in the 1980s, says Prakash Hebbar, a researcher with Mars and the USDA, demonstrated that cacao production was “an 18th century system not adapted to a 21st century industry” (Hebbar 2007: 1658).

Major bust in Brazil in the 1980s was followed by major crop busts in Malaysia in the 1990s and Cote d’Ivoire, Ghana and Indonesia in the 2000s (FAOSTAT, 2014). These

¹ The UTZ labeling system was established in 1999 by Ahold Coffee Company and is now used widely in the coffee, tea and cocoa sectors, overseen by diverse public and private actors and institutions (Chiputwa et al. 2015; UTZ 2017). The Rainforest Alliance labeling system was first used for timber in 1989 and then expanded into agricultural production in the 1990s; unlike UTZ, Rainforest Alliance is overseen by an environmental NGO. Whereas the UTZ system focuses on the adoption of “Good Agricultural Practices,” the Rainforest Alliance certification focuses on the environmental dimensions of production (Rueda and Lambin, 2013; Chiputwa et al. 2015).

dynamics, coupled to growth in global demand for raw cacao beans and emerging consumer bases for chocolate in the Asia-Pacific, have led analysts to claim that there will be a one million ton shortage of raw cacao beans by 2020 (ICCO, 2013), a claim propagated in the popular media (**Figure 1**).



Figure 1. An article from the *New York Times* published on March 30, 2015. The piece begins by telling readers: “*The next time you eat a piece of chocolate, slow down and savor every bite. There could be a day when this relatively cheap treat is a lot more expensive and harder to find. That’s because the rate at which people are gobbling up chocolate far outpaces the rate at which farmers can produce cocoa, its key ingredient*” (9).

Claims of supply crisis are dubious. While bust in the sector has long been an important local and national problem for producing countries (Ruf and Siswandputro, 1995; Leiter and Harding, 2004), no evidence suggests it became a global problem in the late 1980s. Analyzing global production over the past fifty years suggests that while busts in Malaysia and Brazil were important national events, there has been a steady increase in production volumes over the past fifty years (FAOSTAT, 2014). Production losses in Malaysia and Brazil, for instance, were quickly compensated (at a global scale) by growth in Indonesia and Cote d’Ivoire’s cacao sectors (ibid). Perhaps most indicatively, expanding production over the past thirty years has coincided with a strong downward trend in price, evidence usually understood to signify overproduction (ICCO, 2013).

Production crisis however has serious implications for producing regions (Shapiro and Rosenquist, 2004; Nielson, 2007; Clough et al., 2009). Not only are many regional economies nearly fully dependent on cacao but eighty-five percent of the world’s raw cacao is sourced from smallholders operating on less than five hectares of land (Shapiro and Rosenquist, 2004). Unlike coffee production, known for diverse agroforestry production, the majority of cacao-growing households globally manage their fields in mono-type (Ruf, 2011); the corollary is that smallholders often have high dependence on income from this primary commodity crop. Further, most of the 7 million hectares of land in cacao globally are believed to have been sourced from forested land (Nieston et al., 2004). Analysts suggest that a failure to maintain production in existing lands will lead to further pressure on forest frontiers both near and far (Nielson, 2007; Clough et al., 2009;

Tscharntke et al., 2011). This is often depicted as nearly inevitable given the crop’s agro-ecology and the high yields it produces (or “forest rent”) when planted in freshly felled or thinned forested lands (Ruf and Siswandputro, 1995; Ruf and Schroth, 2004).²

These dynamics shape broad support for sustainable intensification initiatives among bilateral donors, civil society organizations, academic analysts, and most industry actors, including major processors and manufacturers in the sector. As Neilson (2007: 230) has written of Indonesia’s production crisis, for example:

“The concern, therefore, is that Sulawesi cocoa farms have exhausted their ‘forest rents’ and that, after widespread conversion of forest lands to cocoa, the region’s cocoa sector is now on the brink of serious decline. It is clear that some form of intervention is required for it to remain globally competitive. In particular, intervention is needed to address technological issues related to pest management, information dissemination to improve farm practices, and enhanced supply chain efficiency to ensure that farmers are appropriately rewarded for quality production. Left to market forces alone, the ‘mining’ of cocoa regions will in all likelihood continue unabated across tropical frontiers until all potential cocoa lands have been physically exhausted.”

In 1984, there was one public-private partnership focused on achieving economic and environmental sustainability in the cacao sector globally. Today there are 55 (Bitzer et al., 2012). Many of these partnerships are a component of major corporate sustainability initiatives advanced by leading firms in the sector, including Cargill, Mars, Mondaléz, Nestlé, Blommer and Hershey. While public-partnerships have engaged diverse production regions globally, Sulawesi has been a focal site of these investments (Hafid and McKenzie, 2012; Moriarty et al., 2014). Not only is Sulawesi the third largest producer of raw cacao globally (**Table 1**), it is also a site of relative political stability vis-à-vis West African producing nations and the only major producing region in the Asia Pacific. As one corporate representative expressed to me: *“Sulawesi is like the cradle of cocoa sustainability work. We have used this place like a playground, and when it’s successful, we export it to West Africa”* (personal communication, July 2013).

Table 1. Key Cacao-Producing Countries & Aggregate Production

Country & Rank	Production in 2014 (metric tons)
1. Cote d’Ivoire	1,434,077
2. Ghana	858,720
3. Indonesia	728,400
4. Brazil	273,793
5. Cameroon	269,902
6. Nigeria	248,000

² As Ruf and Schroth (2004: 108) write: *“Where [cacao boom-and-bust cycles] started, they led to the opening up of new forests, sometimes at a tremendous speed. Where they ended, they left behind, in the best cases, disease-infested groves of low productivity in a secondary forest environment but often only poor fallows and pastures.”*

7. Ecuador	156,216
8. Peru	81,651
9. Dominican Republic	69,633
10. Colombia	47,732

This table ranks countries in terms of aggregate production volumes as of 2014 based on government-reported data shared with the United Nations Food and Agricultural Organization (FAOSTAT, 2014). Indonesia is the third largest producer globally and the only major site of production in the Asia-Pacific. The country has accordingly become a focal site for burgeoning global investments in cacao sustainability.

Both globally and in Sulawesi, public-private partnerships to sustainably intensify smallholder cacao yields have been posited as a *win-win-win*: It is argued that intensifying smallholder yields will not only enable sustained corporate growth, ameliorating inflexibilities in supply. It will also protect growing households dependent on the crop for income, “spare” the need for new conversions of forested lands for cacao by maintaining production on existing lands, and help growers to transition away from input-intensive, monotypic production (Ruf and Zadi, 1998; Shapiro and Rosenquist, 2004; Neilson, 2007; Clough et al., 2009; Sustainable Cacao Production Program, 2016).

Current initiatives in Sulawesi thus exemplify broader global trends in the governance of agricultural commodity production. From roundtables to support sustainable oil palm and soy economies (Schouten et al., 2012) to voluntary certification programs (Cashore et al., 2006), public-private partnerships to promote “sustainable development” have grown in number and investment volumes over the past decade, celebrated as a means of addressing persistent gaps in the implementation and orientation of resource governance (Reinicke et al. 1998; Benner et al. 2003; Biermann et al. 2007). While the inclusion of industry is claimed to make up for deficiencies in the volume and orientation of state funding for agricultural development (World Bank, 2015; USAID, 2015), many analysts have raised concerns about the legitimacy and efficacy of novel governance arrangements (Dauvergne and Lister, 2011; Glasbergen, 2011). Critics have argued that corporate engagement creates a case of the fox guarding the henhouse, enabling further consolidation of industry power along agricultural supply chains – ultimately to the detriment of agrarian livelihoods and landscapes (Clapp and Fuchs, 2007; Fuschs et al., 2011; McMichael, 2013; Patel, 2013).

These debates underscore the importance of examining the historical conditions under which investments in sustainable cacao intensification have emerged, and how they are affecting both smallholder livelihoods and landscapes. My dissertation addresses this research need throughout three linked research phases, focusing on the case of Southeast Sulawesi, Indonesia, the site of 16% of cacao production in Indonesia and a focal site for current investments in sustainable intensification (Direktorat Jenderal Perkebunan, 2014, Sustainable Cacao Production Program, 2016).³ First, I analyzed remotely sensed

³ Since 2000, at least six programs have operated in Southeast Sulawesi province, all nominally seeking to enhance the sustainability of smallholder cacao production. These programs include the SUCCESS program (2000-2003); the Integrated Pest Management Farmer Field School (2002); the SUCCESS Alliance (2003-2005); the AMARTA Sulawesi Cacao Alliance (2006-2009); GERNAS, or the National Cacao Movement (2009-present); and the Sustainable Cacao Production Program (2012-2015). These programs, treated more fully in **Chapter Three**, have been financed and supported by diverse public and

imagery and secondary data for Southeast Sulawesi province overall, reconstructing trajectories of land use and land cover change over a four-decade period (1972-2014). I then selected four lowland villages in mainland Southeast Sulawesi where significant cacao expansion had occurred and which were characterized by comparable recent histories of investment in sustainable intensification. I used oral histories and household surveys to reconstruct specific trajectories of crop expansion in each of these villages, identifying the specific practices, institutions and policies which had guided observed land use and cover changes in each. Finally, to understand how current investments in sustainable intensification were affecting growers' livelihood and production ecologies at present, I conducted in-depth interviews with program representatives to understand the nature of programs and used in-depth interviews and land use surveys to understand forms of grower engagement.

Taken collectively, these data support three broad conclusions about the nature of current public-private partnerships in the region and their capacity to support greater social and environmental sustainability. First, my findings illustrate how current initiatives emerge out of and respond to earlier practices and effects of state territorialization, or strategies to control land, resources and people within state boundaries (see, e.g., Vandergeest and Peluso, 1995 for a seminal treatment). State territorialization, I show, not only enabled smallholder production crises by encouraging monotypic, input-intensive production; it also generated high rates of forest cover loss and high smallholder livelihood dependence on cacao. These are key dynamics to which contemporary investments in sustainable intensification respond. These results illustrate the sustained relevance of recovering histories of state engagement in tropical agricultural landscapes, even as corporate and civil society actors come to play a larger role in shaping contemporary agricultural development policies.

Second, my findings demonstrate that current policies are failing to achieve many of their stated goals, i.e. an intensification of cacao production, and through this, improvements in smallholder livelihoods and reduced smallholder clearances of forested lands. My analysis shows that this is because there is not a crisis of cacao sustainability *per se*; there is a crisis of cacao price. In Indonesia, producers captured roughly 23.7% of value along the cacao chain between 1976-1985. Between 1996-2005, their share was down to an estimated 8.1% (Gilbert, 2006: 20). Today's global average is 6.6% (Cocoa Barometer, 2015). Despite inflexibilities in the supply of raw cacao, these inequities in value capture have enabled windfall profits for lead processors, manufacturers and retailers of chocolate, evidenced by rapid industry consolidation over the past three decades. Taken alongside pest and pathogen pressures, the full risks of which are borne by smallholders, price inequities engender sustained crises of accumulation for smallholders.

Interviews reveal that investments in sustainable intensification to date have *increased* the labor inputs associated with cacao production. Simultaneously, they have driven only

private actors and institutions. All programs however have trained growers in integrated pest and pathogen management using diversified production techniques (e.g. compost application, pruning and crop hygiene, and intercropping). Since 2007, all programs have also supported the distribution of new cacao planting materials, generally distributed in the form of vegetative grafts.

modest improvements in producer profits over the past fifteen years. In response, household and land surveys demonstrate that many smallholders are now converting their cacao fields to alternative commodities. These findings recast the proposition of the win-win-win, suggesting that investments are doing little to resolve smallholder crisis. These findings also indicate that even high levels of buy-in and investment are unlikely to improve smallholder returns or agrarian ecologies if current initiatives do not better address local labor constraints and better compete with emergent market opportunities. More broadly, these data suggest that the capacity of public-private engagements to promote agricultural sustainability will be dictated not by investment volume but by *how* or *how not* investments are able to redistribute the benefits and costs of commodity production.

Finally, my analyses demonstrate that current policy debates have narrowly circumscribed the “cacao problem” in this region. Current policy propositions center environmentally destructive smallholder management practices as well as inadequate planting technologies. These framings not only misread history. They actively obscure other dynamics more relevant to the long-term sustainability of both smallholder livelihoods and their agrarian environments. As my data illustrate throughout three linked research chapters, such dynamics include: racialized histories of inequitable resource access; protracted conflict over land and resource rights; and long-term trajectories of tree cover *gain* and landscape *revegetation* that are obscured by a fixation on the forest cover loss associated with cacao production. By invisibilizing these socio-political and environmental dynamics, current policy propositions foreclose a more holistic assessment of agrarian change over the past four decades. By doing so, they also foreclose an assessment of other policy responses that might more meaningfully support both people and their environments.

These data thus provide an historical, multi-scalar and interdisciplinary examination of agricultural expansion and contemporary agricultural development policies and politics. They illustrate that while dominant policy narratives are not necessarily *untrue*, they are partial, obscuring other important dynamics that have shaped socially and spatially differentiated trajectories of cacao boom and cacao bust – dynamics which at present converge to shape the limited impact of current public-private investments in a sustainable intensification of smallholder cacao.

2. Study Area

Southeast Sulawesi province spans an area of roughly 15,000 square miles and is characterized by a wet–dry climatic pattern and a diversity of habitats, including many agricultural lands and a diversity of forests (peat swamp, mangrove, lowland, montane and karst) (Whitten et al., 1987, Direktorat Jenderal Perkebunan, 2014). People and economic activity in this region were historically concentrated on two islands off the southern coast of mainland Southeast Sulawesi, Muna and Buton. Beginning in the 1960s, however, there have been important demographic and economic shifts to the mainland (Potter and Lee, 1998), the focal site of my analyses in the province (**Figure 1**).



Figure 1. Map of Indonesia with Southeast Sulawesi denoted in red and the mainland lowlands of Southeast Sulawesi (the focal region for village case study analyses and the primary region of cacao expansion) denoted with a black box.

Tolaki people native to the mainland of Southeast Sulawesi have historically practiced diverse livelihood strategies, which included swidden rice production, swamp fishing, sago palm cultivation and forest product collection (de Jong, 2011; Tarimana, 1989). Since the mid-1980s, many Tolaki people have adopted tree crop production, as have Bugis migrants from South Sulawesi (Kelley, 2013; Martini et al. 2013). Many Bugis migrants began to arrive in the late 1970s, often seeking land for cacao and bringing experience from time spent as day laborers on the plantations in Malaysia during an earlier boom in the region (Durand, 1995). More households in Southeast Sulawesi adopted cacao than any other crop, though the area held in cashew nut, coconut and peppercorn has also increased (Direktorat Jenderal Perkebunan, 2014).

Southeast Sulawesi has been subject to various political reconfigurations and associated forms of political violence over the past century. These include the onset and elaboration of Dutch colonial rule (1907-1942); a brief but violent occupation by the Japanese army during the second World War (1942-1945); political violence and warfare associated with the Darul Islam Indonesia/Tentara Indonesia (DI/TII) insurgency (1950s-1960s); and the formal establishment of Southeast Sulawesi province in 1964 under the newly established Indonesian government, then ruled by the authoritarian Suharto dictatorship (1962-1998) (Potter and Lee, 1998; de Jong, 2011; Kelley et al., 2016). After the fall of the Suharto dictatorship in 1998, President Habibie oversaw the decentralization of many decisions surrounding natural resource management and governance to the district level. Importantly for this study, rights to state forest land were not decentralized. However, until 2004 when final decentralization policies were promulgated, the governance of natural resources throughout Indonesia was characterized by an ambiguity of administrative authority and associated violence and political turmoil (see, e.g., McCarthy et al., 2004). Accordingly, during this political window, access to forested land became possible for many individuals previously subject to arrest or imprisonment for using or converting state forests into agricultural production.

Elsewhere in Indonesia, work has generally located the roots of cacao boom in this region in rapid in-migration, abundant forested land, and a weak and “hands-off” state in the sector (Jamal and Pomp, 1993; Pomp and Burger, 1995; Ruf and Siswandputro, 1995;

Akiyama and Nishio, 1996; Erasmi, 2004; Steffan-Dewenter et al., 2009). In contrast, as I further explicate in **Chapter Two**, I find close connections between cacao expansion and at least three state policies often overlooked in discussion of cacao boom. First, since 1967, over 600,000 hectares of land have been claimed by the Ministry of Forestry for production forestry, limited production forestry and conservation (BPS, 2015). Second, since the 1960s, the Indonesian government has sponsored the resettlement of over 260,000 people in Southeast Sulawesi from elsewhere in Indonesia through the Transmigration Program (Departemen Tenaga Kerja dan Transmigrasi, 2015). State-sponsored transmigration thus supplemented the “spontaneous” migration of Bugis farmers. Third, since the late 1980s, Southeast Sulawesi has been the site of multiple efforts to promote tree crop production. Programs included: (i) The Rejuvenation and Rehabilitation of Export Crops (*Peremajaan dan Rehabilitasi Tanaman Ekspor*); (ii) Plantation Development in Special Areas (*Pengembangan Perkebunan Wilayah Khusus, PK2W*); (iii) Plantation Development in Transmigration Regions (*Pembangunan Perkebunan Daerah Transmigrasi*); and (iv) the Sulawesi Rain-Fed Agricultural Development Program (SRADP) (*unpublished data*; Asian Development Bank, 2004).

3. Research Approach

On the basis of these socio-environmental and socio-political histories, I developed an iterative case study approach that would allow me to reconstruct both land uses and land covers as well as longer histories of resource control and livelihood change. I began by reconstructing trajectories of crop expansion and in-migration at the provincial scale using remotely sensed data and secondary data over a four-decade period. To ground these analyses in specific geographical and historical contexts, I then triangulated across multiple lines of evidence (literature review, initial site visits and interviews, secondary data and initial remote sensing analyses) to select four lowland villages for comparative case study analysis. Within each village, I used oral histories and in-depth interviews to examine the local scenarios of land governance that contributed to crop adoption and to trace the articulations of earlier governance regimes with the sustainable intensification initiatives described above. Randomized household and land surveys in all four locations allowed me to assess and quantify associated socio-environmental changes.

While the specific methods I use are further detailed in the following chapters, I approach all analyses within the framework of a case study approach. I use the guiding interpretive logic of the case study to document how society-nature relations have shifted over time through methods of historical reconstruction (guided for example by Peluso, 1992; Fairhead and Leach, 1996; Carney, 2001). I selected this approach because historically-grounded case study approaches enable rich portraits of causation; allowing particular factors or variables to intervene in given areas or at different historical moments without implying the determinacy of a particular causal relationship across all space or all moments (Ragin, 1987; Ragin and Becker, 1992). The use of four villages further enables comparative analysis nested within the broader case. The four villages I selected bear important similarities: all share similar lowland forest ecologies; have long histories of Tolaki settlement and land use; and many households who re-organized their livelihood strategies around cacao production at some point over the past three decades. However each village has different specific histories of in-migration and cacao adoption. This

allows me, for example, to analyze the early demarcation of state forests in Taosu village vs. the removal of use restrictions on state forests in Andowengga village while noting similarities in the orientation of forest policy enforcement in both.

I further outline the specific methodological techniques employed in the three chapters that follow. Before doing so, I turn to the broader debates within the fields of land systems science and political ecology that structure my analyses, simultaneously providing a brief overview of the specific interventions my three research chapters make.

4. Reconstructing Agricultural Expansion and Development

4.1 Pathways of Commodity Crop Expansion & Land Use and Cover Change

Land acquisitions and conversions for export-oriented agricultural commodities such as cacao, coffee, oil palm, soy, and rubber have sky-rocketed over the past several decades. This is particularly true in tropical regions, where commodity croplands expanded by an estimated 48,000 km² over the period 1999-2008 (Phalan et al., 2013). In this context, understanding pathways of commodity crop expansion, and their inscriptions (Bailey and Bryant, 1997) in both landscapes and livelihoods, has become a core focus among geographers (Rudel et al. 2005; Borrás et al. 2011; Hall et al., 2011; Sikor, 2012; Brando et al. 2013; DeFries et al., 2013; Meyfroidt et al., 2014).

Much scholarship on commodity crop expansion has been located within land systems science and political ecology (Turner, 1999; Turner et al., 2007; Turner and Robbins, 2008). Within land systems science, work has often focused on documenting rates and patterns of land use and cover change associated with agricultural expansion. An extensive literature, for example, has explored linkages between forest cover loss and crop expansion (Morton et al., 2006; Rudel et al. 2009; Gibbs et al., 2010; Carlson et al., 2012; Meyfroidt et al., 2013; Davis et al., 2015). Associated work has explored the causal drivers of agricultural expansion in different broad sectors as well as market and governance contexts (Lambin et al., 2001; Geist and Lambin, 2002; Lambin and Geist, 2008, Burgess et al., 2012). Informed by statistical approaches from agricultural economics, this literature demonstrates that patterns of land use and land cover change at global, national and sub-regional scale often bear strong relation to global commodity price indices, agro-climatic suitability and conducive market and policy contexts (Nelson and Geoghegan, 2002, Rudel, 2007, 2009; Gaveau et al., 2009, Goers et al., 2012, Chimeli et al., 2012; Burgess et al., 2012). Such analyses are often used to inform policy. For example, econometric analyses of forest cover loss dynamics vis-à-vis commodity price signals have been used to identify the “opportunity costs” of forest clearance in payment for ecosystem services schemes (see, e.g., Angelsen and Rudel, 2013 for a review) and to analyze potential forest cover loss dynamics vis-à-vis divergent agricultural development strategies (see, e.g., Koh and Ghazoul, 2010).

As work from political ecology has shown, however, the explanations rendered by such accounts often break down at descending scales of analysis (Turner, 1999; Perz, 2007; Turner and Robbins, 2008). By situating land use among historically and geographically specific people, practices and power relations, political ecologists have shown that the same explanatory factor often does not operate similarly in different locations or for

different social actors because the path from policy to practice or from market incentive to market engagement is not automatic. Rather, land use is shaped by the differentiated ways people experience policies and market incentives. Differentiated land use practices are also shaped by how markets and governance intersect with forces that can be impossible to model or understand in abstract – including cultural norms, pre-existing differentiations along lines of gender, class or ethnicity, and the quality and orientation of institutional support (Hall 2011; Hall et al., 2011; Robbins, 2012; and specific to cacao see, e.g., Li, 2002; Li, 2014).

To analyze and explain commodity crop expansion, political ecologists have thus focused on documenting specific conjunctures, or sets of elements, processes and relations that shape crop adoption in particular places and at specific moments in time (Vandergeest, 1999; Hall, 2004; Sikor and Vi, 2005; Hall et al., 2011; Sikor, 2012; Fox and Castella, 2013; Li, 2014). This approach has been found to better explain *how* change proceeds, rather than simply *how much* a particular factor may matter in driving change (Bardhan and Ray, 2006; Ray, 2006). An additional merit of this approach is that – through commitment to documenting local politics and power relations – such work has been better able to comment on how the costs and benefits of changing land uses are distributed, both socially and spatially (McCusker and Carr, 2006; Turner and Robbins, 2008).

My dissertation combines the unique methodological and theoretical strengths of both disciplines to document rates and patterns of commodity crop expansion while simultaneously assessing the specific socio-political and socio-environmental dynamics that have produced these changes. **Chapter One** draws on over 150 Landsat images from 1972-2014 and a cloud-based computing platform (Google Earth Engine) to reconstruct patterns of land cover change for Southeast Sulawesi province. Combining these data with secondary data on tree crop production, soil quality, elevation and in-migration in **Chapter Two**, I draw on techniques from land systems science to demonstrate the statistically significant relationship between smallholder cacao production and forest cover loss over the past four decades, particularly in alluvial lowland regions. However, I also show that smallholder tree plantings helped to revegetate long-fallowed grasslands. While tree cover loss constitutes the single largest net change over the period 1972–2014, I find that that gross rates of tree cover gain were three times higher than gross loss rates from 1972 to 1995 and equivalent to loss rates from 1995 to 2014.

Chapter Two then draws on theoretical and methodological approaches from political ecology to analyze and reconstruct the broader socio-political processes and conjunctures shaping observed land use and cover changes. To do this, I analyze 14 months of ethnographic research conducted while living in four lowland villages where a majority of people had adopted cacao at some point over the period 1980-2000. Combining oral histories, in-depth interviews and household surveys, I focus in particular on how the demarcation of extensive state forest reserves in the region shaped pathways of cacao expansion, responding to a gap in the existing literature on cacao production in Indonesia. Drawing on theories of state territorialization from political ecology (described more fully in **Chapter Two** but see also, e.g., Vandergeest and Peluso, 1995 and Peluso and Vandergeest, 2001), I show how state actors and institutions enabled cacao expansion and

shaped the specific pathways of cacao expansion observed. State territorialization practices, including the establishment of transmigration initiatives, the allocation of logging and rattan concessions, and block-grant programs to promote value-added crops throughout the 1980s not only drove much of the forest cover loss commonly associated with the tree crop economy. They engendered high inequities in land access along lines of class and ethnicity, shaping the high levels of socio-economic differentiation that now characterize the smallholder cacao economy in all four villages.

These results contribute to the broader debates detailed above in three key ways. First, by foregrounding not only dynamics of forest cover loss but also dynamics of tree cover gain, they illustrate the multi-directional trajectories of land cover change associated with agricultural expansion. Second, they advance an historically-oriented methodological approach for reconstructing land cover change using the full extent of existing Landsat satellite imagery. By exposing how such techniques can be leveraged to reconstruct tree cover gain, they challenge and nuance a methodological fixation on refining estimates of recent tropical forest cover loss that has characterized recent literatures. Third, they corroborate understandings of how neoliberal and state-led development regimes have shaped the formation of commodity frontiers (Hecht, 1993; Rudel, 1993; De Koninck, 1996; Angelsen and Kaimowitz, 2001; Lambin and Geist, 2001; Geist and Lambin, 2002). Taken together, they advance an integrated and historical socio-environmental assessment of the patterns, drivers and implications of commodity crop expansion in this region.

4.2 Agricultural Development Projects: Current Trends and Broader Considerations
Programs to intensify agricultural production, i.e. to raise agricultural yields per unit hectare, have long influenced smallholder agricultural landscapes, particularly during the Green Revolution (1930s-late 1960s). The past two decades have seen resurgent support for agricultural intensification policies, many of which have focused on agricultural landscapes throughout the tropics, and most of which have been depicted using the contested language of “sustainable intensification.” Growing investments from the World Bank, bilateral donors (including DFID and USAID), private philanthropic organizations (most notably the Bill and Melinda Gates Foundation), and transnational corporations (IAASTD, 2009; Gillis, 2011) are driving this trend; responding, in some sense, to gaps in state-led agricultural development spending incurred under structural adjustment programs (SAPs) and other neoliberal policy reforms throughout many countries in the 1980s and 1990s.

There is considerable continuity between contemporary initiatives in sustainable intensification and their historical counterparts. However, present approaches diverge from their antecedents in two ways. First, there is generally greater emphasis on agro-ecological or organic tenets of production (Conway, 1997; Pretty et al., 2011). Past efforts to intensify smallholder systems were primarily pursued according to a strict productivist model emphasizing industrial efficiency. The long-term social and environmental externalities associated with this model are now well-recognized (Patel, 2013). Many contemporary approaches thus emphasize the importance of effecting yield increases with greater attention paid to biodiversity conservation and carbon storage (Garnett et al., 2013).

These tendencies are exemplified by current public-private partnerships to promote sustainable intensification in the cacao sector. Most cacao globally is managed utilizing a monotypic, input-intensive and full-sun approach, often on cleared forested land; an approach shaped by earlier agricultural development policies in many regions (Nieston et al., 2004; Ruf, 2011; Kelley, 2013; Kelley et al., 2016). Public-private partnerships in the cacao sector now commonly center a *diversified* production ideal, encouraging intercropping, compost application, reduced use of agrichemical inputs and organic methods of pest and pathogen management (Shapiro and Rosenquist, 2004; Sustainable Cacao Production Program, 2016; Wijaya et al., 2016).

Second, mainstream policy discourses have centered a greater role for agribusiness in supporting contemporary agricultural intensification initiatives. The United States Agency for International Development and World Bank, for example, have claimed that agribusiness inclusion can increase the efficacy and scalability of agricultural development policies; providing novel technologies, developing more favorable trade arrangements, and generally, supporting greater investment volumes than is possible through public finance alone (World Bank, 2009; USAID, 2015). As the USAID (2015: 8) writes, *“There is growing recognition that the most intractable international development challenges will not be solved by aid alone. It will take collective action across sectors to leverage the required skills, assets, technologies, and resources to deliver effective and sustainable development. Donor engagement with the private sector is not a luxury, but a necessity.”* These remarks showcase the broader ideological shifts in development policy that are informing contemporary governance arrangements. Unlike the state-led development approach common during peak Green Revolution era interventions, today’s policy context is distinctly neoliberal.

It is widely agreed that food and agriculture are central to any policies to promote sustainability (IAASTD, 2009; World Bank, 2009). However, many critical scholars and activists have contested corporate engagements in sustainable intensification, particularly in smallholder economies. Most agricultural supply chains are marked by increasingly high levels of corporate consolidation (Friedmann and McMichael, 1989; Friedmann, 1994; Bonanno et al. 1994; McMichael, 2009). In the cacao sector, though 85% of global production is believed to be produced by smallholders on less than five hectares of land (Shapiro and Rosenquist, 2004: 453), two firms control 70-80% of end processing, eight firms control 60-80% of intermediary processing, and six firms control 40% of all manufacturing (Cocoa Barometer, 2015). Consolidation over the past 30 years, facilitated by global market deregulation, technological improvements in shipping and logistics, and the growing use of cacao futures as a speculative financial instrument, has given lead firms in the sector more share of global market supply than any single producing nation (Fold, 2002; Cocoa Barometer, 2015). These same dynamics have driven sharp declines in smallholders’ share of value along cacao value chains. In Indonesia, producers captured roughly 23.7% of value along the cacao chain between 1976-1985. Between 1996-2005, their share was down to an estimated 8.1% (Gilbert, 2006: 20). Today’s global average is 6.6% (Cocoa Barometer, 2015).

Sustainability is a term with vague referents. In the context of corporate sustainability commitments, this ambiguity can be deployed strategically; leveraging a rhetoric of inclusivity and win-win-wins to depoliticize the agenda being advanced (see, e.g., Clapp and Fuschs, 2009). McMichael (2013:11) argues that investments in intensification in smallholder economies should be understood as “*value-chain projects,*” likely to draw producers further into “*competitive markets over which they have no control... increas[ing] their exposure to debt and dispossession*” (2013: 11)⁴. Other researchers argue that even where agribusiness-driven “agriculture for development” schemes do not directly result in dispossession, they enable greater corporate control over agricultural systems to the long-term detriment of producers and their environments (Amanour et al., 2012; Huggins, 2014). These critiques are relevant to an analysis of sustainable intensification initiatives in Indonesia, particularly given indications that current programmatic interventions are moving towards a model of contract farming arrangements (elaborated further in **Chapter Three**).

The above perspectives highlight the need to further untangle how sustainable intensification initiatives are operating and who stands to win and lose from their implementation. Deepening corporate control over people and landscapes, however, (understood in terms of their capacity to dictate or govern resource management and processes of agrarian change) does not inevitably follow from corporate engagement. Rather, as agrarian scholars have long emphasized, agricultural landscapes are a tricky place to make a profit (Mann and Dickenson, 1978; Kloppenberg, 1988); agricultural production “*involves long periods of time, and is highly unpredictable, due to natural forces such as weather, pests and the perishable nature of food*” (Howard 2009: 1268).

These insights are relevant to smallholder cacao production both in Indonesia and globally. Most cacao production has yet to be mechanized, and most cacao-growing households still sell raw cacao to local traders who collect the product in burlap sacks, load it onto pick-up trucks, and transport them to warehouses miles from growing regions (Talbot, 2002). These production dynamics, far from the Fordist ideal often associated with industrialized forms of agricultural production (Goodman and Watts, 1994), engender uncertainties that have thus far historically precluded considerable consolidation in cacao production. Cacao remains a smallholder crop in part because smallholders’ flexible and situated knowledge of the vagaries of production within their fields is hard to replicate under a plantation model using wage labor.

The nature of the crop and its production ecology introduce further constraints on corporate consolidation and capital accumulation in the sector. Not only is cacao a perennial tree crop, which must be planted 3-4 years before it yields fruits, but, it is highly susceptible to pests and pathogens, particularly when grown at volume. The susceptibility of cacao to pest and disease has been observed from 16th century Mexico to 18th century Trinidad to 20th century Ghana (Leiter and Harding 2004: 117). Like other boom crops, such as oil palm and rubber, cacao is highly susceptible to the rapid

⁴ Scholars further point to the fact that such programs, particularly where they engage the distribution of new technologies, will likely secure livelihood returns for those people who already have sufficient footing (see, e.g., Patel, 2013 for a review of the evidence).

onset of heavy production losses associated with ever-changing and spatio-temporally specific pest and pathogen regimes. As resources concentrate on the landscape and age, it is believed physiological stress and a scenario of resource abundance for pests facilitate rapid disease transmission, often helping to drive “bust.” Further, individual trees are highly variable in their yields. Recent research suggests that “as few as 5% of the trees on the farm produce about 50% of the cocoa harvest while the other 95% occupying the land are poor-performing plants that are susceptible to pests and diseases” (Traore et al. 2011: 1).

Managing production losses in Indonesia is particularly complicated given that each of the dominant pest and pathogens to affect production have different ecological regimes. Cacao Pod Borer is an insect pest which burrows into cacao pods, laying larvae in the pulpy interior from which beans are also harvested. As larvae emerge and eat the pulp, they suction off nutrients from cacao beans, ultimately reducing yield and engendering a hard, difficult to extract bean (Lim et al., 1982). Black Pod Rot is a fungal pathogen with four types of spores that are produced on infected fruit or leaves, stems, roots; which can germinate on the plant or in the soil; which can persist in nearby sources of water; and which can persist for months in dead plant material or in the soil, even in the absence of a host. The fungal pathogen quickly progresses once established on a cacao pods, ultimately destroying the beans and mummifying the pod. It thrives in moist conditions; conditions which ironically deter the Cacao Pod Borer (Vanegtern et al., 2015). Vascular Streak Dieback is also caused by a fungal pathogen, and first manifests in leaf senescence. Eventually the fungus can grow down through the tree’s xylem into the main stem, killing the entire tree (Guest and Keane, 2007). The corollary of these divergent pest and pathogen ecologies is the need for occasionally counter-valent management strategies.

Given the above considerations, **Chapter Three** builds upon the historical analyses presented in **Chapters One** and **Two** to examine how contemporary investments in “sustainable intensification” intersect with and inform smallholder land use and livelihood strategies at present. Here I identify dominant patterns of smallholder engagement with programmatic support, linking these to an analysis of ongoing management transitions. To do this I combine the ethnographic research described above with in-depth interviews with program representatives and a randomized survey of cacao plots in four villages to assess dominant management strategies.

These data demonstrate that current policies maintain a narrow sectoral focus on cacao in this region, albeit this time in service of corporate-driven rather than state-led development agendas. However, despite the proliferation of support for and investment in smallholder cacao production over the past fifteen years, growers are largely turning away from the crop. I suggest that limited grower engagement can be understood with respect to five key dynamics: (i) the elevated labor costs and decreasing profits associated with cacao production; (ii) household labor scarcities; (iii) limited access to synthetic inputs; (iv) the unpredictability of smallholder investments in new planting technologies; and (v) more attractive commodity crop opportunities.

These data thus contribute to the broader debates detailed above in three key ways. First, supplementing a long body of critical agrarian studies, they demonstrate the constraints to corporate accumulation in agricultural landscape that persist despite current investments in sustainable intensification, from the intractability of current pest and pathogen regimes to current technologies to the alternate economic aspirations of smallholders. Second, and relatedly, they illustrate that even high levels of public and private buy-in and investment will not enable greater sustainability in Sulawesi's cacao production landscapes if current initiatives do not address local labor constraints and better compete with smallholders' emergent market opportunities. Third, they illustrate how, even if such schemes do not enable greater corporate control over land, resources and producers, they may broadly foreclose other policy responses.

5. Audience

This dissertation is designed as a series of three stand-alone articles. Some of the material contained throughout is thus redundant at various points. For example, information on study area and context is at times redundant throughout the three chapters, as is information on methodology or on particular dimensions of cacao expansion and development policy. While broader coherent understandings across the three chapters are possible to identify by reading throughout, the introduction and conclusion address these most explicitly. The audiences that will probably be most interested in this dissertation include communities of researchers within land systems science and political ecology and civil society organizations and activists participating in debates surrounding ongoing agrarian change in tropical landscapes. I particularly engage with debates surrounding tropical land use and cover change as well as economic development, land use and conservation policies.

CHAPTER ONE

Richer histories for more relevant policies: 42 years of tree cover loss and gain in Southeast Sulawesi, Indonesia*

Abstract:

Understandings of contemporary forest cover loss are critical for policy but have come at the expense of long-term, multi-directional analyses of land cover change. This is a critical gap given (i) profound reconfigurations in land use and land control over the past several decades and (ii) evidence of widespread “woodland resurgence” throughout the tropics. In this paper, we argue that recent advancements within the field of land change science provide new opportunities to address this gap. In turn, we suggest that multi-decadal and multi-directional analyses of land cover change can facilitate richer social analyses of land cover change and more relevant conservation policies and practice. Our argument is grounded in a case study from Southeast Sulawesi, Indonesia. Using a novel analytical platform, Google Earth Engine, and open access to high-quality Landsat data, we map land cover change in Southeast Sulawesi, Indonesia from 1972-2014. We find that tree cover loss constitutes the single largest net change over the period 1972-2014 but that gross rates of tree cover gain were three times higher than gross loss rates from 1972-1995 and equivalent to loss rates from 1995-2014. We suggest the smallholder tree crop economy likely produced both forest loss and *Imperata* grassland restoration in this region. This case points to the need to expand rather than collapse the baselines used to study carbon and biodiversity change in tropical regions. It also demonstrates the possible utility of applying such methods to other regions.

*This article has previously been published (Kelley et al., 2016). I have obtained permission from my co-authors and from the Graduate Division to use this article in my dissertation.

1. Introduction

Dramatic changes in land use, land access and land control are fundamentally reconfiguring the social and natural fabric of rural areas throughout the Global South. The past few decades have seen a widespread shift from food to cash crop cultivation (Hecht, 2010), from relatively more centralized to relatively more decentralized forms of natural resource governance (McCarthy, 2004), and, for many people, from livelihood strategies primarily oriented around agricultural production to livelihood strategies constituted by a diversity of income sources, many of which are earned off-farm (Bryceson, 2002; Rigg, 2006).

These developments have profound and contradictory implications for land use and land cover change (LULCC) in tropical regions. Though the expansion of export-oriented commodities, particularly oil palm, soy and cattle, has been associated with significant forest cover loss (Gibbs et al., 2010; Carlson et al., 2013), there is evidence that many landscapes have been revegetated as smallholder-driven tree crop markets have formed. The development of off-farm economies has facilitated revegetation in some scenarios, not necessarily because land is abandoned, but because smallholders' land uses change in relation to other pursuits (Angelsen & Kaimowitz, 2001; Rudel et al., 2002; Lambin & Meyfroidt, 2010). For example, Hecht and Saatchi (2007) found that the infusion of cash into rural areas via remittances from family members working internationally has supported widespread "woodland resurgence" throughout El Salvador. Significant evidence now suggests that forest recovery is a more definitive of contemporary land cover changes in certain parts of Latin America and Asia than is forest clearance (Rudel et al., 2002; Chazdon, 2014; Hecht, 2014).

Despite the diversity of change trajectories underway, work within the fields of remote sensing and land change science continues to focus on refining estimates of forest cover loss, particularly recent rates of tropical forest cover loss. Information on either loss or gain over multi-decadal time periods remains limited (for a valuable exception, see Gibbs et al., 2010). Information on tropical tree cover gain historically is particularly lacking. We found very few studies that documented tree cover gain in the tropics and could not find any that did so before 1990. Only two of the top 10 most cited studies on land cover change in Indonesia, the site of this study, extend beyond a 15 year time range, with very little work utilizing Landsat data that predates 1990. A valuable recent contribution documents four decades of forest loss for all of Borneo using satellite data from 1973, but does not include information on tree cover gain processes (Gaveau et al., 2014).

Limited information on long-term change limits both social and environmental analysis. In the Indonesian context, the most recent 15 years do not include the 1997-1998 fall of the Suharto dictatorship which set off a wave of changes in forest policy that still shape developments in forested landscapes (McCarthy, 2004). It does not capture land cover change associated with the demarcation of state forest reserves through the 1970s and 1980s, or the initial formation of timber, oil palm and cacao markets (Potter & Lee, 1998; Barr et al., 2002). It also does not capture the development processes which reordered rural societies and landscapes throughout the Suharto regime, including planned and spontaneous migrations, infrastructural developments, forced resettlements, and a

reorientation of many smallholder agricultural systems around more sedentarized, mechanized, and input-dependent approaches (Li, 2007; Dove, 2011).

A fixation on recent forest loss also impedes conservation policy and practice. This is true in the broadest sense. A fixation on forests, particularly tropical forests, obscures the value of other anthropogenic environments (including working agroforests, old-growth grasslands, savannas, and settlements) (Hecht, 2010). It is also true with more narrow reference to contemporary debates (e.g. the land sharing vs. land sparing literature). To significant extent, these debates presume the original baseline ecosystem against which tropical agriculture plays out has been a primary tropical forest. There is a need to expand our sense of the actual diverse contexts in which contemporary changes have unfolded by examining broader geographies and deeper histories.

Three recent advancements within land change science make it increasingly possible to fill these gaps, capturing gain and loss across large regions and multi-decadal time periods. First, over the past 10 years, there has been an unprecedented expansion in access to remotely sensed imagery. Landsat imagery was previously acquired on an at-cost and per-scene basis, a limitation which disincentivized long-term historical analyses in regions of little apparent forest cover change. In 2008, the USGS began to provide free access to all satellite imagery (Wulder et al., 2008, 2012). Analyses reliant on large stacks of Landsat imagery are newly feasible.

Second, in connection with the release of Landsat archives, the National Aeronautics and Space Administration (NASA) has developed the Global Land Survey (GLS) databases. The development of these databases for each of five reference years (1975, 1990, 2000, 2005, 2010) was based on realizations that large-scale monitoring of land cover change depended on collections of satellite imagery that had been consistently corrected for radiometric and geometric distortions specific to the platform and sensor utilized in capturing the image (Hansen & Loveland, 2012). Landsat satellite imagery dates to the 1970s. Until recently, however, working with historical imagery required investment in complicated image correction procedures and created additional computing and storage burdens. The development of the 1975 dataset means that analysts now have access to high-quality historical imagery with limited need for pre-processing or pre-screening.

Third, tremendous computing capacity and data storage leaps have been effected by the development of a cloud-based platform for earth observation analyses, Google Earth Engine (GEE). GEE hosts the entire Landsat data archive (including the GLS datasets) and stores these datasets within Google's data centers. GEE provides tools and an application program interface for summoning, processing and analyzing this imagery via Python and JavaScript. To reduce the processing time associated with heavy computing tasks, all analyses are also run in parallel across many machines in Google's cloud-based processing platform. These advancements make it possible to easily summon and analyze petabytes of data on-the-fly. This capacity enables analysis over long periods of time and across large areas. The potential of these technologies is evidenced by the work of Hansen et al. 2013, who piloted the use of GEE to produce global maps of tree cover loss and gain from 2000-2012 using high-resolution Landsat data.

In this paper, we utilize these capacities to map tree cover loss and gain over a 42-year period in Southeast Sulawesi, Indonesia. We focus on Southeast Sulawesi for two reasons. First, Sulawesi has been the site of one of the most significant smallholder-led tree crop booms globally since the 1980s (BPS, 2014; FAOSTAT, 2014). In this regard, Southeast Sulawesi speaks to many other regions throughout the tropics now organized around export-oriented smallholder tree crop economies. Second, as elsewhere in the tropics, most conservation attention has focused on environmental changes in forested lands. A longer history of land cover change in this region may inform other important sites of analysis and advocacy.

In this paper we aim to understand (i) historical rates of change and (ii) the extent to which tree cover loss has been coincident with tree cover gain. We do this by analyzing Landsat imagery from 1972-2014 using GEE. Our analysis is structured as follows. First, we outline the materials and methods that guide our land cover change analysis. Second, we present our results on 42-years of tree cover loss and gain in Southeast Sulawesi. Third, we synthesize these findings and analyze them in relation to this region's recent agrarian history. Fourth, we discuss the policy import of our conclusions in Sulawesi and beyond, suggesting the value of multi-decadal and multi-directional land cover change analyses in other regions.

Our argument, in brief, is that an analysis of 42 years of land cover change in Southeast Sulawesi demonstrates significant tree cover gain as well as loss. This, we argue, points to the need to better understand and document the relatively more silent histories of tree cover gain also driving processes of social and environmental change throughout the tropics.

2. Materials and Methods

2.1 Study Area

The entire province of Southeast Sulawesi was used as our boundary for the land cover change analysis (**Fig. 1**). This includes Muna and Buton, two islands off the southern coast of the provincial mainland. Southeast Sulawesi is characterized by the same wet-dry climactic pattern characteristic of many tropical regions, and a diversity of land covers which range from peat swamp forest, to mangrove forest, to lowland forest to montane and karst forest (Whitten, 2013).



Figure 1. Study Area. Map of Indonesia, with Southeast Sulawesi Province highlighted.

2.2 Definitions

Tree cover is defined as vegetation >5m in height and was classified into three categories per 60m by 60m pixel, an area corresponding to 0.36 ha: (i) <25% tree cover; (ii) 25-75% tree cover; and (iii) >75% tree cover. These categories represent our focus on assessing net tree cover change over time. We acknowledge that tree cover is only one of many variables relevant to a description of land cover. These land cover categories were also selected because without historical training data it was considered impossible to accurately classify Landsat MSS/TM data more discretely. Loss and gain statistics represent pixels moving between tree cover categories across time periods (**Table 1**). These statistics do not differentiate between permanent and temporary loss or gain and refer to changes in land cover rather than land use.

Table 1. Land Cover and Land Cover Change Typologies

Classification	Descriptor
>75% tree cover	Tree-Dominant
25-75% tree cover	Mixed
<25% tree cover	Tree-Sparse
<i>from</i> <25% <i>to</i> >25% or <i>from</i> 25-75% <i>to</i> >75%	Tree Cover Gain
<i>from</i> >75% <i>to</i> <75% or <i>from</i> 25-75% <i>to</i> <25%	Tree Cover Loss

These descriptors depict the three classes identified through this analysis. Descriptors have been selected to help us present results simply and directly. We use the phrase “tree-dominant” to reflect the fact that not all land held in >75% tree cover is forest and that land held in other categories may also be considered forest in many cases. We acknowledge that land in <25% tree cover can represent a range of land covers, from old-growth grasslands to settlements to irrigated rice fields.

2.3 Data Sources and Satellite Image Pre-Processing

This analysis was conducted using Landsat satellite data. Our 1972 analyses used seven Landsat MSS scenes from the GLS 1975 image database, six of which were collected in the year 1972, and one from 1973. These images were provided pre-processed, i.e. orthorectified and pre-calibrated by converting the raw values of pixels using top of

atmosphere reflectance values. This provides systematic radiometric and geometric accuracy (within 250 meters for low-relief areas) (Hansen & Loveland, 2012).

For the 1995 and 2014 reference years, we used multi-date image compositing for time-series analysis to circumvent issues of cloud cover which often plague the tropics. This approach uses median pixel values for an area over multiple observations within a given time range. In data-poor environments such as Indonesia, creating relatively gap-free maps over large areas requires composites constructed with images from more than one year (Hansen et al., 2008; Broich et al., 2011; Potapov et al., 2012). For this reason, 1995 and 2014 composite images were collected over two two-year periods (1994-1996 and 2013-2015, respectively) utilizing over 150 individual images. The high data computing and storage demands from processing large stacks of imagery were facilitated by automated Landsat data processing and mosaicing in GEE (Broich et al., 2011, Hansen et al., 2013). Composites were then prepared for analysis by (i) resampling images to 60m resolution; (ii) converting raw digital values to Top of Atmosphere Reflectance using values computed by Chander et al. (2009) (this calibration corrects for the amount of reflectance measured by different Landsat sensors and enables comparison between images from different time periods or satellites); and (iii) screening imagery for clouds. No prioritization was given to growing season imagery, as there are no senescence or dormant seasonal periods in the study region.

Two other geospatial data layers aided analysis. Elevation data were generated at 90-m resolution using data from the Shuttle Radar Topography Mission (<http://eros.usgs.gov/>). Soil data were prepared by Cannon et al. (2007) based on maps produced by the Indonesian government's Pusat Penelitian Geologi (Geology Research Center) in Bandung, Indonesia and consist of four broad classes, three of which (alluvial, limestone, and mafic) have a known effect on tree distribution.

2.4 Training & Classification

The land cover types in the 1972-1973, 1994-1996, and 2013-2015 (hereafter 1972, 1995 and 2014, respectively) were classified using a supervised Supported Vector Machine (SVM) algorithm that utilized non-parametric classifiers. SVM algorithms have been shown to perform well in places like Sulawesi where rugged topography often generates complex spectral dynamics as vegetation and illumination change with higher altitudes. SVM algorithms deal with this by fitting hyperplanes to different features guided by training samples (Kuemmerle et al., 2008). SVM classification algorithms also excel at delineating forested from non-forested land covers (Huang et al., 2008).

Each of the three time periods were separately trained and classified. Classifying change between time periods would involve classifying 27 different change categories (this analysis spanned three land cover classes and three time periods, meaning there are 3 x 3 x 3 possible directions of change). Given limitations in developing a representative training sample for each change class, we determined that a post-classification comparison was most appropriate for this analysis, i.e. we assessed change *a-posteriori* after determining land cover in each image product separately. The training sample for each image was generated using human visual interpretation of a random sample of 5000

points across the entire study area. This number was selected based on past work which has demonstrated that classification accuracy tends to stabilize at roughly 500 points per class for an area the size of one Landsat scene (Kuemmerle et al., 2009). QuickBird imagery was used to train human visual interpretation as were repeat field visits.

2.5 Validation

Validation was performed independently of mapping. For the 2014 Landsat composite image, QuickBird imagery from the time period 2013-2015 was randomly sampled, categorized, and compared to classified products. Our pixel level accuracy was 90% across all three classes. Land cover classifications from 1972 and 1995 were assessed in two broad ways. First, archival maps were collected and qualitatively compared to the 1972 land cover classification. Data from this study were also compared to publicly accessible data on forest cover and forest cover change since 2000 (Cannon et al., 2007; Hansen et al., 2013; Miettinen et al., 2011).

3. Results

3.1 Dominant changes from 1972-2014

The loss of tree-dominant lands (i.e. those in >75% tree cover) constituted the single largest net change over the entire study period, declining from an estimated 81.6% to an estimated 54.0% of all land cover in Southeast Sulawesi from 1972-2014. However, gross rates of tree cover gain were three times higher than gross tree cover loss rates from 1972-1995 and roughly equivalent to loss rates from 1995-2014 (Fig. 2, Table 2a, Table 2b).

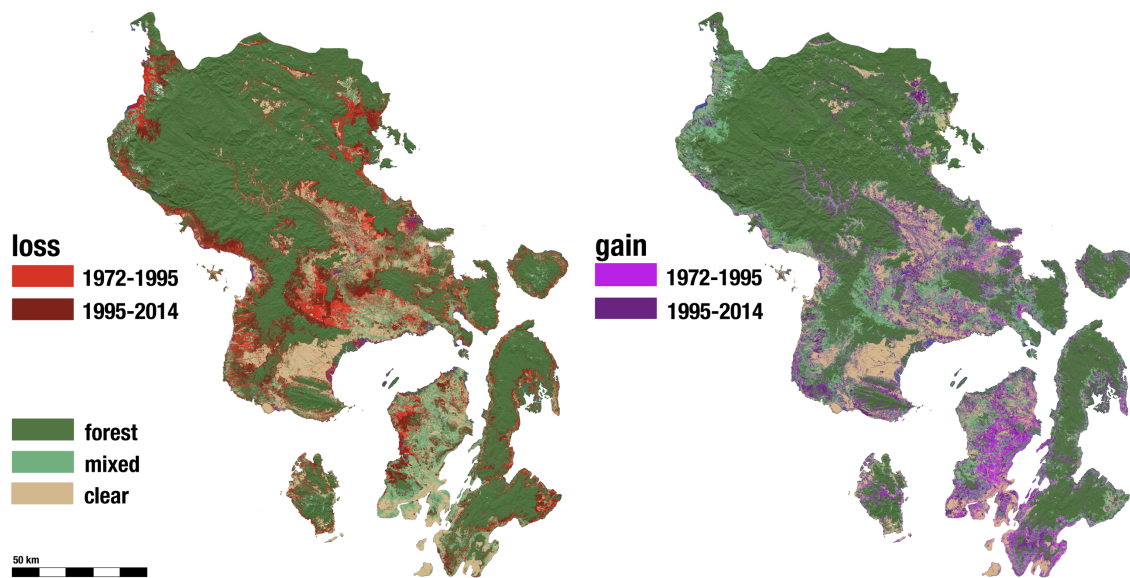


Figure 2. Loss and gain from 1972-1994 and 1994-2014.

Most tree cover loss occurred in areas previously dominated by tree cover (i.e. >75% coverage). Most tree cover gain during the time period 1995-2014 occurred on landscapes that had been held in less than 25 percent tree cover since before 1972.

Tree cover loss

Tree cover loss in regions of >75% tree cover constituted roughly 90% of all loss in both time periods with loss concentrated in relatively few sub-districts (*kecamatan*). Over 50%

of forest cover loss occurred in just 12 and 13 of 68 sub-districts for the time periods 1972-1995 and 1995-2014, respectively. Tree cover loss was also overwhelmingly concentrated in known areas of lowland alluvial forest (i.e. forests at <400m elevation on fertile alluvial soils) (**Supplemental Materials 1**). Tree cover loss tended to expand outward from lowland alluvial valleys or inward from lower coastal regions.

Tree cover gain

Tree cover gain during both time steps was driven by an increase in tree cover on previously tree-sparse lands. Over the time period 1995-2014, only 28.0% of tree-sparse lands experiencing tree cover gain were tree-sparse because had been cleared over the time period 1972-1995. In other words, most tree cover gain during the time period 1995-2014 occurred on landscapes that had been held in less than 25 percent tree cover since before 1972. Tree cover gain on tree-sparse and mixed lands was also overwhelmingly concentrated in the lowlands, particularly on the limestone soils of Muna and Buton islands from 1972-1995 though more evenly dispersed across alluvial, intermediate and limestone soil lowland zones from 1995-2014 (**Supplemental Materials 1**).

Table 2. Tree cover loss and gain, 1972-2014.

(a) loss

	1972-1995				1995-2014			
	TD*	TD*	Mixed	<i>All</i>	TD*	TD*	Mixed	<i>All</i>
	to TS*	to Mixed	to TS*		to TS*	to Mixed	to TS*	
Area loss (km²)	944.2	1828.7	283.2	3056.0	801.4	4767.6	941.7	6510.7
Gross loss rate	0.16%	0.30%	1.10%	0.48%	0.17%	1.03%	1.05%	1.17%
Net loss rate	0.13%	0.25%	0.03%	0.41%	0.12%	0.72%	0.14%	0.99%

(b) gain

	1972-1995				1995-2014			
	TS*	TS*	Mixed	<i>All</i>	TS*	TS*	Mixed	<i>All</i>
	To Mixed	To TD*	To TD*		To Mixed	To TD*	To TD*	
Area gain (km²)	1329.5	675.2	252.5	2257.1	1877.6	109.0	230.8	2217.4
Gross gain rate	1.20%	0.61%	0.98%	1.65%	1.80%	0.10%	0.24%	1.11%
Net gain rate	0.18%	0.09%	0.03%	0.30%	0.28%	0.02%	0.03%	0.34%

All rates reflect an average yearly rate of change. Net rates of change refer to change relative to all categories of classified land. Gross rates of change are relative to prior classifications. For example, gross gain rates from tree-sparse to mixed land are calculated by dividing gain experienced over all land held in tree-sparse cover in either 1972 or 1995, respectively. *TD in this table refers to tree-dominant lands, i.e. those with >75% tree cover and TS refers to tree-sparse lands, i.e. those with <25% tree cover.

4. Discussion

4.1 Overview of land cover change analysis

In this paper we document a much longer trajectory of gain and loss than ever before presented for this region. By utilizing Landsat MSS imagery from the GLS 1975 collection and wall-to-wall mapping with over 150 Landsat ETM+/TM images within Google Earth Engine, we document 42-years of change across 78.9%, 88.1%, and 99.7% of the province's geographical extent in the years 1972, 1994, and 2014, respectively. Our results suggest significant loss of lowland forest since 1972. They demonstrate however that tree cover gain has also been an important component of ecosystem transformation.

These findings are broadly comparable with recent analyses of change reliant on wall-to-wall mapping or sub-sampling techniques. Comparable with our observation of a 0.99% net loss rate from 1995-2014, Miettinen et al. (2011) found an average annual rate of 1.1% and 1.2% forest cover loss in Sulawesi overall and in lowland evergreen forests respectively from 2000-2010. Similarly, our findings of loss and gain follow the geographic contours of those observed by Hansen et al. (2013) over a similar but shorter time period, 2000-2013. We report higher rates of tree cover loss than do Hansen et al. (2013) but this is logical given the inclusion of 1995-2000 in our analysis. This period included the Asian Financial Crisis, the fall of Suharto and the onset of decentralization – all of which shaped profound upheaval in Indonesian forests and significant forest clearance (Barr et al., 2002; Hansen et al., 2005; McCarthy, 2004).

4.2 Social and political context

Beyond documenting the multiple trajectories of change shaping tropical landscapes, a second goal of this paper is to suggest how longer histories of land cover change may also support richer analyses of (i) what drives LULCC and (ii) what such changes imply, socially and environmentally. We make this point by offering a preliminary interpretation of our findings with reference to the recent agrarian history of the province's mainland.

Through the 1970s and 1980s, Tolaki peoples dominant in mainland Southeast Sulawesi generally practiced a long-fallow version of swidden agriculture supplemented by livestock production, swamp fishing, and forest product collection (Tarimana, 1989; de Jong, 2011). Forested landscapes were often deliberately burned as part of this livelihood system to stimulate grass growth for livestock and to attract deer which could be hunted (ibid; Henley, 2002). *Imperata* grasslands could also emerge from repeated swidden cultivation in the same area. Once established, *Imperata* grasslands were difficult to reincorporate into swiddening systems given the labor demands required to extract grass roots from the soil (Garrity et al., 1996). This ecological transition likely compelled whole settlements to shift to new areas (Henley, 2002). In other cases, secondary forests regrew when settlements were abandoned to fallow lands or to seek better fortune elsewhere. Lowland forests were preferred but highland forests were also occupied and cultivated, particularly in times of disease, warfare or political violence (de Jong, 2011). Even where not occupied, forest product extraction and exchange connected the highlands to the lowlands for centuries (de Jong, 2011; Sutherland, 2015).

Customary practices of diversified swidden agriculture – and attendant practices of settlement and resettlement – have by now fully disappeared from many regions. Forest

extractions for timber have intensified. Swidden agriculture, particularly from the 1960s-1980s, was forcibly discouraged by both official prohibitions and the burning of swiddeners' hillside settlements (Potter & Lee 1998, unpublished data). Over 600,000 hectares of land were demarcated as state forests (BPS, 2014), transferring use and ownership rights of these lands to the state and providing a juridical basis for excluding swidden agriculturalists from the forest (Peluso & Vandergeest, 2001). Many state forests, though nominally established for the sake of protection, have been used for logging and mining operations controlled by local elites with strong connections to the ruling regime (until 1998, Suharto's New Order dictatorship). In the lowlands, state development monies have supported the development of wet rice agriculture. Populations of transmigrants, typically poor, landless people from Java or Bali, were often allocated this land as a means of encouraging seditarized agriculture and achieving rice self-sufficiency in Indonesia (in other regions, see e.g. Li, 2007; Sunderlin & Resosudarmo, 1999).

Simultaneously, the smallholder agricultural economy has been reoriented around tree crop production, particularly cacao, cashew nut and coconut (BPS, 2014). Cacao now dominates both revenues and land use within the province, comprising 49.7% of all trade revenues from primary production. In addition to being economically more significant than any other crop, e.g. rice or coconut, cacao is more significant to the provincial economy than the entire mining, fishery, and forestry sectors on their own (BPS, 2014). Unlike other parts of Indonesia where export-oriented agriculture is dominated by corporate production and large-scale plantations, the average household growing cacao in Southeast Sulawesi holds just over 1.75 hectares of land in cacao (Direktorat Jenderal Perkebunan 2015).

Histories of Southeast Sulawesi's smallholder cacao economy suggest that it has developed both inside and outside forested landscapes. The trend, in general, has been for lowland state forests to *first* be used for logging or rattan extraction. Subsequent to these extractions (or alongside them), state forest lands have often been (i) parceled out to local people and migrants by the same elites that have already used the land for these operations and now seek to profit from land sales; (ii) claimed by individuals who assert their ancestral or *de facto* rights to the land; or (iii) officially reallocated to whole communities as a means of resolving long-standing conflicts and tensions. In all of these ways, forested lands (which in this analysis most aptly correspond to lands with >75% tree cover) have been enrolled into the smallholder tree crop economy (Ruf & Siswoputranto, 1995; Li 2002, 2014; Gerard & Ruf, 2013).

Importantly, not all state forests actually contain trees, although many do. Some were *Imperata* grasslands designated for state reforestation programs or timber production (Potter & Lee 1998). Some smallholders planted trees in these regions. Though less attractive in some regards than the fertile forest, grasslands were often in the flatlands close to settlements. These areas were often less strictly policed than the forested estate. Planting in forested lands was more likely to bring arrest and imprisonment. On land outside the domain of official state forest, too, many grasslands, home gardens and croplands were also converted to tree crop production (Kelley, 2013; Ruf & Zadi, 1998).

Past work has suggested that grassland to cacao conversions were made more possible (i.e. less labor intensive and more profitable) by subsidized herbicides widely available through Indonesia's Green Revolution policies and programs (ibid).

Our data on land cover change – coupled with this social history – points to smallholder tree crop production as central but not fully determinative of loss and gain processes in the provincial mainland, particularly prior to 2005. A significant amount of land was held in less than 25% tree cover as of 1972, most of which was located in the alluvial lowlands along the banks of the Konawe River. Southeast Asia has no significant occurrence of old-growth carbon-rich grasslands (Dixon et al., 2014). It is likely that most of these areas were active or former settlements characterized by the presence of *Imperata* grasslands. Left fallow, *Imperata* grasslands do not naturally revegetate (ibid). That 70% of all areas cleared as of 1972 are now held in 25-75% tree cover suggests that most such areas were actively rehabilitated.

Our evidence suggests however that the smallholder cacao economy also drove considerable forest clearance, likely more clearance than revegetation. Many people planted cacao in forests selectively logged to provide timber for export markets. Many others obtained or re-opened long-fallowed swidden plots that had regrown into dense secondary forests by the 1980s and 1990s. Three of the sub-districts that drove both loss and gain across both time steps lead the province in cacao production: Watubangga in the coastal lowlands, and Lambuya and Ladongi in alluvial lowlands. Loss also predominantly occurred in tree-dominant lands in the alluvial lowlands, areas long considered ideal for agricultural pursuits given their fertility. Finally, to the extent that our data suggest high rates of forest clearance from 1995-2000, they correspond with the period of most significant land conversion for tree crops, particularly cacao (Direktorat Jenderal Perkebunan 2015).

The correspondence between smallholder cacao adoption and forest loss from 1995-2000 makes sense for at least two reasons. First, many decisions around land and resource management were decentralized in the wake of the 1997 Asian Financial Crisis and the overthrow of the Suharto regime. In the midst of administrative ambiguity about who had the right to allocate forest use rights, two things happened. First, smallholders took it upon themselves to open the forest, no longer afraid of the violent retribution promised them under the Suharto regime. Second, village elites and district officials began to sell the forested land to migrants, capturing value from state lands before stability was recovered and they continued to be managed as such (McCarthy, 2004). Coinciding with this was the spectacular devaluation of the Indonesian Rupiah during the Asian Financial Crisis. People trading crops on the global market and against the dollar made a windfall, driving further conversions and infusing cash into rural areas (Gerard and Ruf, 2013).

Our interpretation and our findings need to be substantiated with more discretely classified analyses of change in the current decade and by more systematic collection of oral histories throughout the province. There is also a need to illuminate the specific agrarian histories that have rendered change pathways highly uneven across the region. To substantiate the argument above and further suggest the value of long-term analyses in

guiding an explanation of LULCC, **Figure 3** reconstructs LULCC dynamics in Lambuya district, synthesizing oral histories and in-depth interviews collected by the first author over one year spent living in the region and four months' spent working in this specific district.

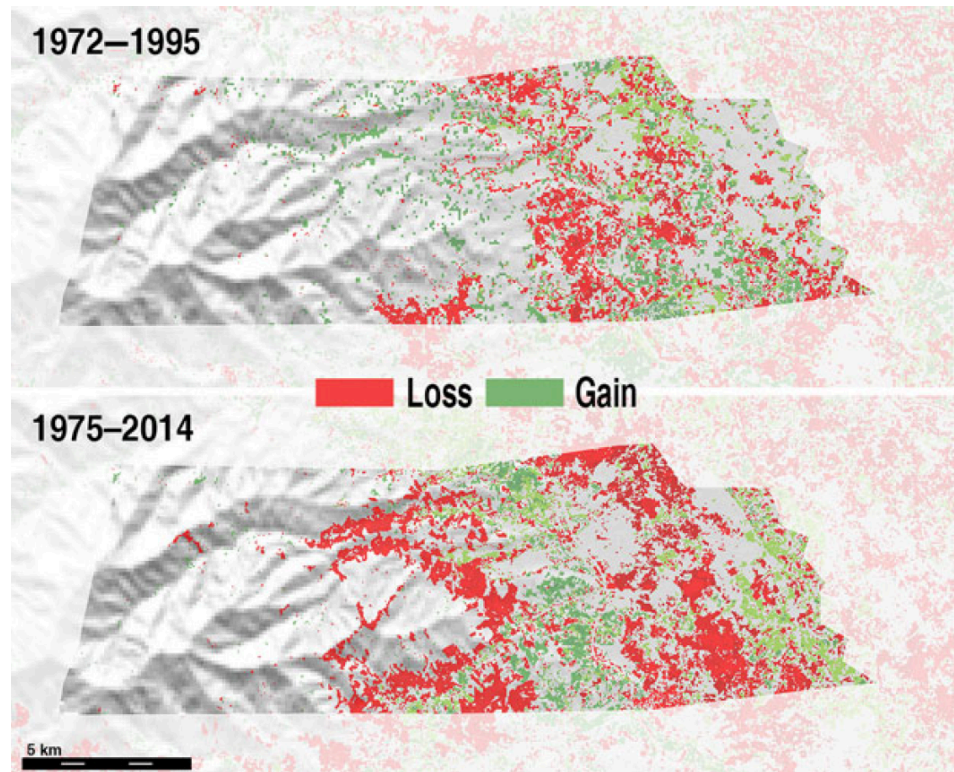


Figure 3. Situating Land Cover Change in Socio-Political Context in Lambuya District, Southeast Sulawesi.

Loss and gain from 1972-1995 and 1995-2014 in Lambuya district, a leader of loss and gain dynamics through both time periods. This region has been settled by various settlements of Tolaki swiddeners pre-dating Dutch occupation of the province in 1907. The lowlands have historically been used for sago palm groves, unirrigated rain-fed wet rice production, swidden rice cultivation and buffalo or cattle grazing. Since Dutch occupation, various Tolaki settlements have been relocated to the main road (where a colonial or government presence has existed) or have fled into the forest during at least three periods of political violence: (i) Dutch occupation (1907-1942) (ii) Japanese occupation (1942-1945) and (iii) the Darul Islam insurgency (~late 1950s- ~late 1960s). Since 1967, most land in this district has been declared state forest, with concrete poles installed in the 1980s to visibly demarcate state lands. Communities of Tolaki swiddeners attempting to use forested lands for swidden rice production were forcibly evicted from the forest, often with burning of swidden houses and plots. This was driven in part by the desire of at least two local leaders who aimed to develop the area into an orderly village characterized by sedentary and intensive wet rice production. The area continued to be logged after most swiddeners had been evacuated: logging drove most loss from 1972-1995. Gain during this time was driven by Tolaki tree crop plantings in the long-fallowed grasslands of the flatlands (at this time, most people planted cashew nut). When Suharto fell in 1998, village elites began to sell forested lands closer to the hills to Bugis migrants looking for land on which to grow cacao. Migrant chainsaws used to open the forest were seized by district officials, and the migrants returned temporarily to South Sulawesi. Sustained ambiguity surrounding decentralization and the death of a former district official allowed clearances to proceed in 2004. Migrants returned, reopening the land for cacao. Many Tolaki families joined, planting cacao alongside Bugis migrants. Clearances for cacao drove forest cover loss as well as gain over the period 1995-2014. Gain during this time has also been

driven by the fallowing of unsuccessful cashew nut farms. A second process driving tree cover loss during both periods of time, particularly in the flatlands, has been the conversion of sago palm groves into irrigated wet rice. These lands have been opened by Buginese migrants, Tolaki individuals, and have been allocated by the state to communities of Balinese and Javanese transmigrants.

4.3 Policy import in Sulawesi and beyond

To the extent that we are correct in our broad interpretation of change, our findings deepen existing accounts and approaches in at least three ways. First, our findings support the conclusion that multiple change trajectories are shaping tropical ecosystems (Rudel et al. 2005; Chazdon, 2014; Hecht, 2014). Although tree crops have been broadly treated and analyzed as a driver of deforestation (cacao, for example, is considered a “deforestation crop” in Sulawesi and elsewhere, e.g., CI, 2004; Clough et al., 2009; Steffan-Dewenter et al., 2009), our findings suggest that in this case, Sulawesi’s smallholder tree crop economy also helped to revegetate and reforest *Imperata* grassland ecosystems. This supports claims of tree-crop facilitated revegetation beyond Sulawesi (Rudel et al., 2002, 2005; Klooster, 2003; Hecht & Saatchi, 2007; Lambin & Meyfroidt, 2010; Chazdon, 2014; Hecht, 2014; Schroth et al., 2015).

Second, our findings point to the need to expand rather than collapse the baselines used to understand biodiversity and carbon outcomes. Given the dominance of the cacao sector in Southeast Sulawesi, approaches to managing environmental change in Sulawesi have overwhelmingly focused on smallholders’ agricultural practices, focusing in particular on the relative merits of simplified, monocultural production vs. diversified agroecological production vis-à-vis biodiversity and carbon (Bos et al., 2007; Clough, 2009; Clough et al., 2011; Steffan-Dewenter et al., 2007; Tschardt et al., 2011). These analyses compare the merits of tree crop systems against a presumed tropical forest baseline. While it is true that carbon and biodiversity gains do not scale linearly with tree cover (new growth forests or agro-forests are not comparable with old growth forests of similar overall tree cover), our findings suggest the need to also understand tree crop systems vis-à-vis the carbon and biodiversity supported within *Imperata* grasslands. This suggestion is likely not only applicable to Sulawesi but to other regions of the tropics as well.

Third, our findings point to the intersectionality of multiple change drivers and suggest that histories of extraction build on one another. Spatially and temporally, our data suggest multiple processes of gain and loss playing out in relation to one another. Though we believe most tree cover gain has been driven by smallholder tree crop adoption, tree cover gain was also widespread in Asera where tree plantings for logging, pulp and paper production, and recently, oil palm production, dominate. Similarly, tree cover loss in the mountainous northeast (associated with logging) and the coastal lowlands (associated with irrigated rice production) shaped loss dynamics across both time periods. Our data suggest that patterns of clearance can build on one another, pointing in particular to the connections between logging and cacao in this region. Analyses of change are often organized around a particular system of change (e.g. oil palm plantations, cattle ranching, smallholder tree crops). Our data suggest a promising next step would be to more deeply analyze how multiple systems and contexts of change intersect both spatially and temporally to shape environmental change.

5. Conclusions

Applying these techniques elsewhere will likely unearth other histories of tree cover gain in the tropics. A bias towards analyzing contemporary imagery can inadvertently overcapture tree cover loss relative to gain. Unlike stand felling, which appears in back-to-back remote sensed images as a sudden change in spectral reflectance values, the changes associated with tree growth are much more gradual. Changes in spectral reflectance values are subtle in back-to-back images, and only profound when analyzed over longer periods of time given the long-term nature of growth. Spanning 42 uninterrupted years is part of what allowed us to capture a previously undocumented level of tree cover gain in this region.

Additionally, tree cover gain from household or smallholder tree planting produces a spatial pattern much less visible from the ground than do consolidated forest clearances, particularly those now emblematic of plantation and commodity crop expansion (e.g. a 3000 hectare clearance for oil palm) (Rudel, 2007). Utilizing open access to Landsat imagery and GEE to create relatively cloud-free wall-to-wall maps of Southeast Sulawesi allowed us to broadly survey change rather than focusing on regions of acute forest cover loss. In turn, we were able to capture areas of more dispersed activity, such as tree growth in the alluvial lowlands of the mainland, an area dominated by smallholder cacao, cashew and coconut production (BPS, 2014).

We do not intend to overplay the historical value of new datasets and new approaches, either in terms of adding richness to analyses of change or in terms of adding visibility to historical processes of tree cover gain. It will not be possible to document such a long interrupted sequence of change everywhere. Landsat data, even within the GLS 1975 collection, remains poor for some regions. The best first cut available for many landscapes only begins in the 1980s. New techniques to composite multiple images do not circumvent the invisibilities imposed by consistent and heavy cloud cover in certain regions. An extra twenty years of land change visibility also does not push us closer to an understanding of the centuries of human activity which have built tropical ecosystems (Mann, 2005; Chazdon, 2014).

Even bearing in mind these important qualifications, we believe the broader argument of this article holds. Developments over the past several decades, including trade liberalization, export market formation, and ongoing resource decentralization are dramatically reconfiguring the relationship between markets, societies and landscapes. An as-yet unprecedented methodological opportunity exists for producing histories of land cover change in the midst of such reconfigurations. Where the possibility exists, new datasets and approaches might help us to get a handle on the diversity of land cover change trajectories shaping tropical histories and futures. They might also help us to deepen our sociological analysis of change, contributing new insights into conservation policy and practice.

Eco-Type	Net Tree Cover Loss Rate (annual average)		Net Tree Cover Gain Rate (annual average)	
	1972-1995	1995-2014	1972-1995	1995-2014
lowland alluvial	1.2%	1.4%	0.2%	0.6%
lowland intermediate	0.6%	1.2%	0.2%	0.4%
lowland limestone	0.5%	0.9%	0.5%	0.5%
lowland mafic	0.3%	1.2%	0.0%	0.1%
upland intermediate	0.0%	0.3%	0.0%	0.0%
upland limestone	0.0%	0.2%	0.0%	0.0%
upland mafic	0.0%	0.0%	0.0%	0.1%

Supplemental Materials 1. Net loss and gain by eco-type.

Net rates of change refer to change relative to all categories of classified land. Lowlands include all areas <400 meters in elevation. Eco-types are formed by intersecting elevational data with soil data provided by Canon et al. (2007).

CHAPTER TWO

Reconstructing Agricultural Expansion Along a Smallholder Commodity Frontier: Looking Back to Move Forward

Abstract

Many policies now aim to effect greater sustainability in agricultural landscapes. The design and implementation of such policies, however, is often constrained by weak understandings of the socio-political structures and processes guiding agricultural development. This study addresses this gap in Southeast Sulawesi, Indonesia's smallholder cacao sector. Over the past four decades, Southeast Sulawesi has been home to one of the world's most remarkable smallholder cacao booms. The province is also a focal site for ongoing investments in the sustainable intensification of cacao production. Despite the scope of these investments, the historical determinants of cacao expansion remain poorly understood, as do associated land cover and livelihood dynamics. This paper combines fourteen months of ethnographic research with four decades of remotely sensed and secondary data to address these gaps. Results demonstrate prior policies not only enabled cacao production, they also produced many of the challenges to which sustainable intensification initiatives respond, including high rates of forest cover loss and high livelihood dependence on cacao in some growing areas. This case highlights the need to better understand histories of state engagement in agricultural landscapes, even as corporate and civil society actors come to play a larger role in designing and implementing agricultural development policies.

1. Introduction

Processes of rapid agricultural expansion are fundamentally reconfiguring the social and natural fabric of tropical regions (Hall et al., 2011; Phalan et al., 2013; Laurence et al., 2014; Meyfroidt et al., 2014). The establishment of export-oriented agricultural economies has reconfigured agrarian societies and livelihoods, more fully incorporating people into both nation states and global markets. It has also driven profound and conflictual changes in the biophysical landscape. Agricultural expansion is associated with high rates of land use and cover change (Gibbs et al., 2010; Hansen et al., 2013; Carlson et al., 2013); losses in forest-dependent biodiversity (Sodhi et al., 2004; Fitzherbert et al., 2008; Wilcove et al., 2013); and, in many cases, increases in greenhouse gas emissions (Danielsen et al., 2009; Carlson et al., 2012).

In this context, understanding pathways of commodity crop expansion, and their inscriptions in both landscapes and livelihoods, has become a resurgent focus within geography (Rudel et al. 2005; Borrás et al. 2011; Hall et al., 2011; Sikor, 2012; Brando et al. 2013; DeFries et al., 2013; Meyfroidt et al., 2014). This has been particularly true within two related literatures. First, a body of work within Marxian political economy and political ecology advancing a multi-scalar understanding of the governance dynamics underpinning agricultural expansion and associated changes in agrarian livelihoods. Second, a literature advancing state-of-the-art techniques for understanding and measuring associated land use and cover changes.

Political ecologists have shown how agricultural expansion is mediated not only by markets and governance, but by how these dynamics intersect with forces that can be impossible to model or understand in abstract, including cultural norms, pre-existing differentiations along lines of gender, class or ethnicity, and the quality and orientation of institutional support (Hall 2011; Hall et al., 2011; Robbins, 2012; and specific to cacao see, e.g., Li, 2002; Li, 2014). Drawing on situated, historically-oriented and ethnographic research in specific locations, this work has also exposed the socially and spatially *differentiated* costs and benefits associated with land use change (McCusker and Carr, 2006; Turner and Robbins, 2008). In turn, techniques within land systems science, including wall-to-wall mapping techniques, novel computing platforms and multi-date compositing, have allowed for associated changes in the biophysical landscape to be mapped at ever increasing spatial and temporal scale and resolution (Gaveneau, 2014; Kelley et al., 2016). This work has exposed the linkages between commodity crop expansion and trajectories of both forest cover loss and “woodland resurgence” (Rudel, 2002; Hecht and Saatchi, 2007; Gibbs et al., 2010; Carlson, 2012).

Despite sharing a multi-scalar emphasis on land use and land use change, these two literatures have often remained disparate. A growing body of “Critical Physical Geographies” (Lave et al., 2014) of land use change demonstrate the promises of deeper integration (Turner, 1999; Arce-Nazario, 2007; Lukas, 2014). Turner (1999)’s work, for example, illustrates how mixed-methods research approaches can enable a better theorization of the power-laden and highly contingent dynamics driving simultaneous land use and livelihood changes.

This paper builds on this literature, integrating across ethnographic research and remotely sensed analyses to reconstruct the origins and implications of rapid cacao expansion in Sulawesi, Indonesia. Up from almost no production in the late 1970s, Indonesia produced more than 600,000 tons of cacao annually by 2002 (FAOSTAT, 2014). More than 90% of this production was generated by smallholder producers on the island of Sulawesi managing just under two hectares of cacao on average (BPS, 2015). Despite this remarkable boom, considered to be “*one of the most spectacularly efficient* [smallholder cacao booms] *in the world*” (Ruf and Siswandputro, 1995), cacao yields began to decline by the mid-2000s, driven by growing pressure from various pests and pathogens (Neilson, 2007; Clough et al., 2009). From a high of 1,132 metric tons/hectare in 2002, average yields in the sector had dropped to 422 metric tons/hectare by 2014 (FAOSTAT, 2014).

Since 2000, and in the context of growing pest and pathogen losses in the sector, there have been significant investments in the “sustainable intensification” of smallholder cacao production in Indonesia, to date, engaging at least 300,000 hectares of land and 500,000 households (Direktorat Jenderal Perkebunan, 2014). Most partnerships in Sulawesi have established farmer field schools to train growers in agro-ecological methods of pest and pathogen management (Neilson, 2007; Saxbol, 2015; Wijaya et al., 2016). Recent programs have also distributed new planting materials to growers and worked to establish closer trade linkages between smallholders and multi-national processors and manufacturers, with certification under UTZ or Rainforest Alliance schemes planned (ACDI/VOCA, 2005; Neilson, 2007; Kindornay and Higgins, 2012; Sustainable Cocoa Production Program, 2016).

Despite the scope of these investments, the socio-political determinants of cacao expansion in Indonesia remain poorly documented in lowland forests where the bulk of cacao expansion took place. I address this research gap in Southeast Sulawesi Province, the site of 16% of all cacao production in Indonesia and a focal site for contemporary investments in sustainable intensification. Drawing on four decades of wall-to-wall remotely sensed analyses at the provincial scale, I first reconstruct the relationship between cacao expansion and forest cover loss, testing the proposition that cacao expansion was a key proximate driver of forest cover loss in the region. I then situate observed patterns of land cover change in four lowland villages, drawing on oral histories and in-depth interviews conducted over fourteen months to reconstruct the practices, policies and institutions that drove cacao expansion.

The rest of the paper is as follows. First, I introduce existing research on cacao expansion in Southeast Sulawesi and the hypotheses which guide these analyses. Second, I introduce my methodological approach. Third, I present results. Finally, I discuss the research findings, reflecting on the implications of these histories for interpreting sustainable intensification policies moving forward.

2. Cacao Expansion in Southeast Sulawesi, Indonesia: Existing Research and Known Gaps

Existing explanations of Sulawesi’s cacao boom have foregrounded three core dynamics.

First, Sulawesi's vast lowland forest reserves at the onset of boom (Ruf and Siswandputro, 1995; Ruf and Yoddang, 1996; Ruf and Zadi, 1998; Erasmi et al., 2004; Tscharncke et al., 2011). Cacao (*Theobroma cacao* L.) thrives when planted in forested, or recently cleared forest lands, particularly in alluvial areas with high soil fertility, a fact which has led some analysts to posit a near inevitable linkage between cacao expansion and deforestation. As Ruf and Schroth (2004: 108) write: "*Where [cacao boom-and-bust cycles] started, they led to the opening up of new forests, sometimes at a tremendous speed. Where they ended, they left behind, in the best cases, disease-infested groves of low productivity in a secondary forest environment but often only poor fallows and pastures.*" Case study analyses have linked cacao expansion to extensive forest cover loss in growing regions throughout Sulawesi (Erasmi et al., 2004; Steffan-Dewenter et al., 2007, 2009; Erasmi and Twele, 2009), and forest cover loss is widely considered to be the number one environmental problem in smallholder cacao economies (Neilson, 2007; Clough et al., 2009).

Second, Sulawesi's cacao boom is explained as a function of the rapid in-migration of (Jamal and Pomp, 1993; Pomp and Berger, 1995; Ruf and Siswoputranto, 1995; Erasmi et al., 2004; Steffan-Dewenter et al., 2007) into forest frontiers, a commonly cited ingredient in commodity booms (Ruf and Siswoputranto, 1995; Clarence-Smith and Ruf, 1996; Ruf and Zadi, 1998; Lambin et al., 2001). Specific to Sulawesi's cacao boom, work has suggested that migrants of Bugis ethnicity played a particularly important role in driving expansion for three reasons. First, Bugis migrants often brought knowledge of production or even seedlings from earlier work as day laborers on Malaysian cacao plantations (Durand, 1995). Second, many Bugis migrants were able to sell inherited wet rice lands in the established land markets elsewhere only to reinvest the money in "cheap" plots of forested land in frontier regions (Ruf and Siswandputro, 1995). Third, given the volume of Bugis migrants into particular growing regions, even those migrants who lacked capital could generally forge transactions with neighbors or kin utilizing customarily recognized practices of land leasing (*gadaikan*) and sharecropping (*bagi tanah, bagi hasil*) (Jamal and Pomp, 1993; Pomp and Berger, 1995; Erasmi et al., 2004; Steffan-Dewenter et al., 2007).

Third, prior work has highlighted the "hands-off" nature of prior state engagement in the sector (Akiyama and Nishio, 1996; Ruf and Yoddang, 2001; Neilson, 2007). With little history in cacao production and virtually no domestic lobbying pressure, Indonesia's government imposed few trade or taxation policies in the sector (Ruf and Siswandputro, 1995; Neilson, 2007). This fact was seen to be particularly critical in enabling some of the highest farm-to-gate profits ever observed globally (Ruf and Siswandputro, 1995). At the time, Indonesia's cacao sector was celebrated by the World Bank as a model of a liberalized economic development (Akiyama and Nishio, 1996). These dynamics are thought to have enabled particularly rapid cacao expansion during the Asian financial crisis of 1997-1998. The intense devaluation of the Indonesia Rupiah during this time, coupled with strong international demand for chocolate, led some growers to make profits that were double or triple what they would receive in later years (Gérard and Ruf, 2013).

While these analyses are not inaccurate, work from other smallholder commodity frontiers in Indonesia and Southeast Asia suggests that they may obscure other important socio-political dynamics. Following the second World War and throughout the mid-1980s, many newly independent governments, including Suharto's authoritarian New Order regime within Indonesia (1966-1998), sought to gain greater territorial control over forested regions. These regions were often seen as "peripheries," "frontiers" or "borderlands," and as such, potential sites for violent and destabilizing insurgencies, common through the region in the 1950s and 1960s (Peluso and Vandergeest, 2011). Forested areas also came to be critical sites for state revenue generation and to pursue national security and economic development goals, e.g. through an expansion or intensification of agricultural production (de Koninck, 1996; Lambin et al., 2001; Geist and Lambin, 2002). In most countries in Southeast Asia, including Indonesia, the pursuit of these goals was anchored in the designation of all lands deemed to be underutilized or unused as property of the state (Vandergeest and Peluso, 1995; Peluso and Vandergeest, 2001). This designation included most forested land, allowing customary practices to be "reinscribed as Customary Rights and criminal practices in huge chunks of the rural landscape" (Peluso and Vandergeest, 2001). The designation of most lands as state property also facilitated colonization initiatives, with state lands allocated to communities of migrants or trans-migrants to support greater territorial control in frontier regions and to encourage economic development in these areas (Booth 1989; McCarthy et al. 2012).

This literature led me to hypothesize connections between cacao expansion and at least three state policies in Southeast Sulawesi untreated in prior accounts of cacao expansion. First, over 600,000 hectares of land in Southeast Sulawesi had been claimed by the Ministry of Forestry for production forestry, limited production forestry and conservation since 1967, supported by the Basic Forestry Law (BPS, 2015). Second, since the 1960s, the Indonesian government had sponsored the resettlement of over 260,000 people to Southeast Sulawesi from elsewhere in Indonesia through the Transmigration Program (Departemen Tenaga Kerja dan Transmigrasi, 2015). State-sponsored transmigration, generally of Javanese and Balinese people, thus supplemented the "spontaneous" migration of Bugis farmers. Third, since the late 1980s, Southeast Sulawesi has been the site of multiple efforts to promote tree crop production. Programs included: (i) The Rejuvenation and Rehabilitation of Export Crops (*Peremajaan dan Rehabilitasi Tanaman Ekspor*); (ii) Plantation Development in Special Areas (*Pengembangan Perkebunan Wilayah Khusus*, PK2W); (iii) Plantation Development in Transmigration Regions (*Pembangunan Perkebunan Daerah Transmigrasi*); and (iv) the Sulawesi Rain-Fed Agricultural Development Program (SRADP) (*unpublished data*; Asian Development Bank, 2004).

3. Methodical Approach

To reconstruct pathways of land use and cover change and assess their connection to cacao expansion and prior development regimes, I first combined oral histories, in-depth interviews and household surveys conducted in three villages over 14 months of work (5/12-7/12, 8/14-8/15). To situate observed trajectories of change in broader geographical context, I integrated these data with four decades of remotely sensed analyses and secondary data at the provincial scale.

Southeast Sulawesi province spans an area of roughly 15,000 square miles and is characterized by a wet–dry climactic pattern and a diversity of habitats, including many agricultural lands and a diversity of forests (peat swamp, mangrove, lowland, montane and karst) (Whitten et al., 1987, Direktorat Jenderal Perkebunan, 2014). Tolaki people native to the mainland of Southeast Sulawesi have historically practiced diverse livelihood strategies, which included swidden rice production, swamp fishing, sago palm cultivation and forest product collection (de Jong, 2011; Tarimana, 1989). Since the mid-1980s, however, many Tolaki people have adopted tree crop production, as have migrants from diverse parts of Indonesia, including Java, Flores, Bali, and South Sulawesi (Kelley, 2013; Martini et al. 2013). More households in Southeast Sulawesi have adopted cacao than any other crop. However, the area held in cashew nut, coconut and peppercorn has also increased, and more modest booms in cashew nut and coconut preceded cacao expansion in some areas (Direktorat Jenderal Perkebunan, 2014).

To ground my analyses, I selected three villages for case studies. I selected these villages using preliminary remotely sensed analyses, six weeks of initial site visits, and analysis of production data at provincial and district levels. Andowengga, Taosu and Lawonua (**Figure 1**) were selected because each village embodied the known quintessential characteristics of cacao expansion in the province. Each location had experienced significant Bugis in-migration over the past three decades and held significant lowland forest estate at the onset of cacao boom. All three villages also spanned the lowland valley of Southeast Sulawesi province, sharing broadly similar lowland forest ecologies.



Figure 1. Map of Indonesia with Southeast Sulawesi denoted in red and the mainland lowlands of Southeast Sulawesi (the focal region for village case study analyses and the primary region of cacao expansion) denoted with a black box.

Within each village, I first performed oral histories with approximately 25 individuals, roughly split between Tolaki inhabitants and in-migrants to each area. Respondents were asked a set of questions about their personal histories followed by open-ended discussion about their life and key events. Next, various open-ended questions were asked to understand village and settlement history, including questions surrounding key events (e.g. moments of significant in- or out-migration). Oral histories were supplemented with in-depth interviews within villages and at higher levels of governance (sub-district, district and province). Past and present government leaders or officials were asked about

the design and implementation of state policies and programs found to have operated in specific villages. In total, 36 in-depth interviews were conducted.

To visualize patterns of cacao adoption and understand associated land use, land cover and livelihood changes at the village level, I conducted randomized household surveys with an estimated 25% of all households in each village. Household surveys detailed all land currently or formerly held by members of the household in question as well as household demographics and livelihood strategies. Questions on land access for cacao included questioning on (i) current uses and management strategies; (ii) date and mode of acquisition; (iii) prior land covers and land uses; (iv) the tenurial claims associated with that land, past and present; (v) its location within the village and general descriptors of its quality; and (vi) price of purchase, if relevant.

To situate observations from the four villages in provincial context, as well as visualize the patterns of land cover change characteristic of the four villages, data on forest cover loss, tree cover gain, cacao expansion and other tree crop expansion was collated for five time steps spanning the onset of cacao adoption and the extent of available data (1972-1995, 1995-2000, 2000-2005, 2005-2010, 2010-2013). Data on land cover change cover change were drawn from two published sources (Hansen et al., 2013; Kelley et al., 2016). These two sources used the same classification criteria and provide wall-to-wall coverage for all of Southeast Sulawesi using high-resolution Landsat data for the periods 1972-1995 and 1995-2000 (Kelley et al., 2016) and annually over the time period 2000-2013 (Hansen et al., 2013). Data on factors of known relevance to cacao expansion were then collated for each sub-district and for each time step (all data sources are summarized in **Table 1**).

Linkages between cacao expansion, hypothesized determinants of cacao expansion, and land cover change were assessed using AIC (Akaike information criterion) stepwise model selection. AIC stepwise model selection allows all variables to be provided for possible incorporation into a statistical model explaining forest cover loss. AIC stepwise model selection was considered suitable because it discourages overfitting, or the tendency for more data to improve model fit simply because it increases the number of parameters included. Model parameters were fit using a linear mixed model with random effects incorporated for both time step and district.

Table 1. Data Sources for AIC Stepwise Modeling.

Variable	Source
Forest cover loss & tree cover gain	Kelley et al., 2016, Hansen et al., 2013
Area of land in cacao	Badan Pusat Statistik, Direktorat Jenderal Perkebunan
Area of land in other tree crops	Badan Pusat Statistik, Direktorat Jenderal Perkebunan
Area of land in forest cover	Kelley et al. 2016, Hansen et al. 2013
Area of land in alluvial soil	Cannon et al., 2007

Mean elevation	Shuttle Radar Topography Mission (http://eros.usgs.gov/)
Bugis migrants (person/km ²)	Indonesian census data (www.ipums.org)
Transmigrants (person/km ²)	Departemen Tenaga Kerja dan Transmigrasi

This table describes assessed variables and data sources for a statistical assessment of cacao expansion and linked dynamics of forest cover loss. Data on in-migration were drawn from two sources, enabling spontaneous Bugis in-migration to be isolated from formal transmigration initiatives.

4. Results

4.1 Assessing the Linkages between Cacao and Forest Cover Loss

Reconstructions of cacao expansion at the village scale corroborate the association between cacao expansion and forest cover loss, demonstrating that direct household clearances of forested land for cacao greatly outstripped the conversion of grasslands or other croplands (e.g. rice or vegetable crops) (**Figure 2**). AIC stepwise model selection suggests this patterns was also true across the broader province. Model results indicate that cacao expansion was significantly correlated with forest cover loss over the time period 1972-2013, particularly in densely forested alluvial lowlands home to significant transmigrants.

Table 2. AIC Stepwise Modeling Results.

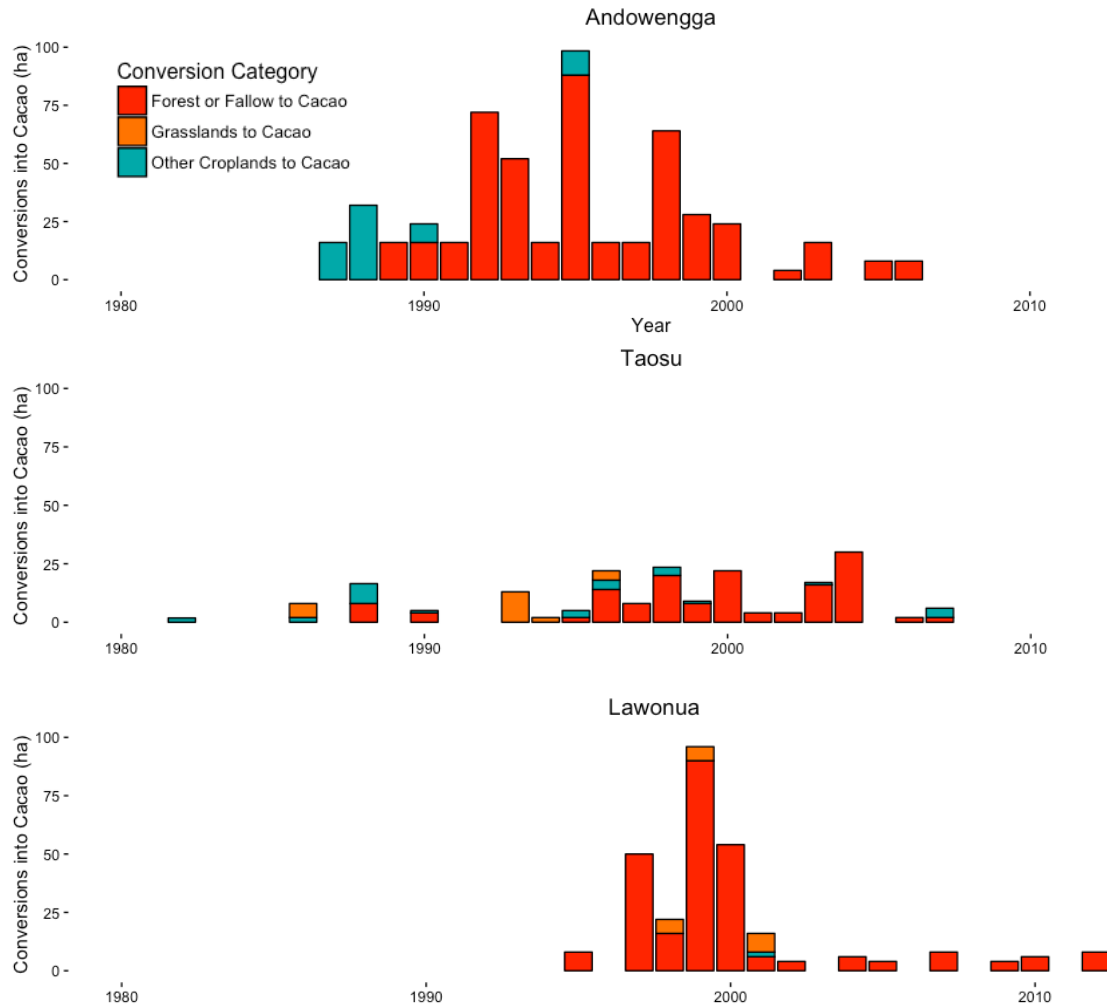
Variable	Estimate	Std. Error	p value
Area cacao expansion	0.11	0.02	<0.001
Area other tree crop expansion	0.01	0.02	0.53
Area of land in forest cover	0.24	0.04	<0.001
Area of land in alluvial soils	0.05	0.02	<0.005
Mean elevation	-0.08	0.02	<0.001
Bugis in-migration (person/km ²)	0.00	0.06	0.99
Transmigration (person/km ²)	0.09	0.04	<0.05

Results from top model explaining forest cover loss, selected using stepwise AIC and modeled over five time steps from 1972-2014. All variables are shown scaled to enable comparisons between effect sizes. Marginal R^2 was 0.37 and Conditional R^2 was 0.80. Unit of analysis is *kecamatan* (sub-district) (N=284). Tests to assess model assumptions indicate that residuals are normally distributed and indicate an absence of both heteroscedacity and serial autocorrelation.

These analyses thus broadly corroborate prior accounts of cacao expansion, suggesting particular connections between cacao and forest cover loss in lowland alluvial regions. However, village-level data suggest considerable variability in cacao expansion pathways in different production localities, a variability reflected in the highly uneven pathways of forest cover loss and cacao expansion apparent in the provincial data. Many of the province's 203 sub-districts marked by alluvial soils, high levels of forest cover and high volumes of Bugis in-migration historically have *not* experienced rapid conversion to cacao. Fifty-six percent of all land held in cacao production is located within Kolaka Utara and Kolaka Timur, though these two areas comprise only 27% of land in Southeast

Sulawesi and contain only 16% of Southeast Sulawesi’s population. Production data also indicate that 18% of this land is located within a single sub-district (which holds only 3% of all land in Kolaka Timur district). What explains the variability in cacao expansion and associated landscape inscriptions?

Figure 2. Village-Level Reconstructions of Cacao Expansion.



This figure depicts household conversions of land for cacao from the early 1980s through 2014, visualized using data collected from a randomized household survey with 25% of all inhabitants in each village. This graph reveals that land conversions for cacao contributed to forest cover loss in these locations but that aggregate rates of cacao expansion and linked forest cover loss were variable in both timing and magnitude. This variability relates primarily to (i) when state forests could be cleared for cacao and (ii) the availability of institutional support for cacao at the onset of expansion. These factors are treated in section 4.2.

To develop these understandings, the next section begins by documenting the establishment of state control over forested resources from roughly the late 1950s to the 1980s. This history illustrates three points that guide an eventual interpretation of cacao expansion and forest cover loss. First, this history illustrates that state claims to the land were not incidental to forest use, even in a frontier region characterized by relatively

weak state institutions and governance structures. Second, this history demonstrates that state control over forested land helped to produce the factors believed important in dictating cacao expansion – the “ample lowland forest” core to most accounts of cacao expansion as well as the motivated populations of in-migrants with experience in intensive commodity crop production. Third, this history begins to elaborate the idiosyncratic ways this control manifested in each of the three villages – differences which help to explain observed variance in cacao expansion and associated rates of forest cover loss.

4.1. Histories of State Control in Forested Lands

State control over forested lands in this region emerged after and through violence associated the Darul Islam/Tentara Islam Indonesia (DI/TII) insurgency and counter-insurgency through the 1950s and 1960s. Led by Abdul Kahar Muzakkar, DI/TII fighters crossed the Gulf of Bone by boat from South Sulawesi, aiming to consolidate territory that would become the basis for the Indonesian Islamic State (*Negara Islam Indonesia*). They arrived Southeast Sulawesi in the late 1950s, beginning in Kolaka and waging guerrilla warfare from lowland forests. The Government of Indonesia sent army battalions to meet the guerrilla fighters and control the region, establishing army barracks along the main road.

Most people in the area at the time were dispersed in settlements throughout the lowland forests, generally practicing swidden agriculture though supplementing this with swamp fishing, buffalo raising and some rain-fed rice production. Those people living in forest-based settlements who had not been killed or who had not fled independently were often forcibly relocated by army troops to nearby rural towns during the DI/TII insurgency. Swiddeners from Andowengga were relocated to the flatlands near military barracks along the main road. Forced resettlements nominally secured the safety of the population but also to cut off support to guerrilla fighters from swidden fields and settlements in the hills as the army waged war from their barracks along the road. Some resettled Tolaki swiddeners were granted land during this upheaval but most found the land they were granted untenable. Many recount making as little as twenty liters of rice in a harvest of rain-fed rice. Most remember regular famine. Other people worked as day laborers on the wet rice fields of established rural elite in these areas.

As disrupted settlements of Tolaki swiddeners attempted to return to historically claimed swidden plots and forest fallows through the 1960s and 1970s, many learned that their lands had been claimed by the nascent provincial government. On the basis of state claims, swiddeners’ use of forested lands was criminalized and made subject to arrest. In Andowengga, the re-entry of swiddeners into the area was resisted until Tolaki people marched in a group of over 100 through the night carrying torches, forcing the hand of the sub-district head (*Pak Camat*). Tolaki land claimants who returned to these areas were re-settled into formal villages, organized into neat row houses (contrasted with denigrated stilt houses characteristic of dispersed swidden settlements). In each village, Tolaki agriculturalists were allocated half-hectare plots of grassland or swampland intended for irrigated wet rice production. At the time, and through the mid-1980s, these were sustained by rain (in Lawonua, no support for irrigation ever materialize).

Though the enforcement of restrictions on forest use was technically the mandate of the forestry department, the presence of the forestry department was not consistent across regional space. Southeast Sulawesi had only formally been designated as a province in 1964 and many state forests remained inaccessible by road during this time period. The staffing and strength of the forestry department tended to be greatest in those locations – such as Wonuaha – most proximate to administrative centers established during Dutch colonial times and reinforced as army bases during counter-insurgency efforts. Not a single forestry department official visited Lawonua until it was formally established as a village in 1981.

Regardless of the strength of the forestry department, however, local leaders used the authority they derived from their position as arbiters of state rule to govern the use and allocation of forested land. Thus in Lawonua, state claims to the forest were enforced by the village head who would confiscate grasslands allocated for rice production (and the house attached to this land) if a household member was caught using forested lands. As he remembers telling inhabitants: “*If you don’t inhabit the land [i.e. if you instead continue to rely on the forest], go ahead and depart, other people will be found to inhabit it again.*” Between 1978 and 1981, over 400 families from flooded areas and failed transmigration schemes elsewhere in the province were resettled in Lawonua by the Social Welfare Division and by local leaders. Some were granted new settlements. However, many others were settled in houses ‘abandoned’ by Tolaki agriculturalists who had established temporary forest dwellings to enable rattan collection and swidden rice production.

Violence also featured prominently, particularly because former military leaders and police officials engaged in counter-insurgency efforts were frequently installed as village heads by district or sub-district leaders. Andowengga was overseen by a village head who had been an army general during the counter-insurgency. He had remained in the area following the restoration of peace. Acting in conjunction with his men (“*anak buah*”), former or active police and military officials, he enforced forest use restrictions through implied violence. This was done by having his *anak buah* draw red X’s on the doors of those disobeying his general strictures on resource use. These X’s referenced the communist purges in Indonesia in the mid-1960s and indicated violence could follow.

Many Tolaki people nonetheless continued to try to use and access forested resources, particularly in Lawonua where people lacked irrigation networks to facilitate sustained rice production on infertile plots of grassland. Many Tolaki people opened plots in far stretches of the forest. Historically, people had collectively opened the land, relying on shared systems of labor organization (*gotong royong*) to fell regrown trees and bamboo and burn remaining scrub. Parting with historical practices, each household located their farm in a different site, far from other plots. This was done to decrease the likelihood of being caught by local leaders and forestry department officials. One neighborhood leader (*kepala rumpun keluarga*) from this time repeats the rehearsed answers he would coach other swidders to give if caught farming lands in the hills. “*Who ordered you to do*

this?” “No one. I just wish to farm.” “Will this land be joined to the land of others?” “No. I act on my own.” People found could be arrested and jailed.

One Tolaki leader from Lawonua during this period describes their motivations: “*We looked around at what could be eaten and I felt forced to order the opening of lands for rice plantings. Later, if we’d already eaten rice, people were encouraged. What did the government know? The government didn’t know we would die of hunger if we didn’t struggle to find food. Better we try to plant the land -- as farmers -- than steal.*” His use of the word farmer is indicative. It reflects the distinction drawn within Indonesian language between swidden agriculture (*berkebun liar*, a derisive term) and farming (*bertani*), a term generally only used to refer to sedentary agriculture.

Many Tolaki people, if not still practicing swidden agriculture covertly in the hills, began to abandon unirrigated wet rice holdings. Many people left the villages during this period, seeking land elsewhere or traveling to Kendari or Unaaha, nearby urban centers, for work as construction coolies (*kuli*, their description). In part to shore depleted rural populations created by forced resettlements, local leaders and institutions tended to be broadly supportive of both spontaneous and planned in-migration initiatives during this time period. Most in-migrants to Southeast Sulawesi during this time were Javanese transmigrants or spontaneous Bugis migrants from South Sulawesi. These migrants generally had more experience with wet rice production and provided remaining Tolaki neighbors with much desired support and advice on how to farm. Tolaki people often supported in-migrants, many of whom suffered to survive alongside them.

Transmigrant programs in Lawonua and Taosu supplemented the rural labor force, existing systems of forest extraction were generally intensified. In Taosu, the logging and rattan bosses that controlled these industries were synonymous with the local government: logging state forests required strong connections to the ruling Suharto regime and capital to advance debt to workers and product to buyers. However, Lawonua demonstrates how these trade networks could flourish even in the absence of a strong local boss. Given the remoteness of the area and the lack of roads through this time period, few buyers wanted to establish timber processing facilities nearby. As dependence on swidden agriculture declined, systems of rattan extraction intensified, collected at peoples’ risk inside the state forest and transported by raft to the trade town of Poahara.

4.2 Uneven Pathways of Cacao Expansion

The above histories thus primed each village for cacao expansion in four core ways by the late 1980s. First, insurgency, counter-insurgency and associated forms of political violence “freed” the forests of prior claimants, establishing the forests later used for cacao expansion. Second, state property claims then criminalized customary agricultural practices, reinforcing this dispossession and making state actors and institutions the arbiter of land transactions. Third, timber and rattan extraction networks, as well as colonization initiatives reinforced and extended the trade relations between these areas and nearby rural towns, in some areas initiating the construction of road networks. Fourth, transmigration and “spontaneous” migration together reconfigured the

demographic make-up of these areas. Specifically, while the population of indigenous Tolaki land claimants tended to be diminished by the late 1980s due to out-migration, populations of Javanese and Buginese in-migrants with experience in commodity cropping had grown.

By the late 1980s, three additional factors primed each of these villages for rapid cacao expansion. The first were formal state efforts to expand tree crop production in these regions, which involved the distribution of seedlings and advice from agricultural extension agents in each village. In all areas, these efforts either followed or included the construction of roads into nearby towns. The second was the arrival of more Bugis migrants during these time periods to all three villages, many of whom explicitly sought land on which to grow cacao. The third was the establishment of a 3,000 hectare state cacao plantation less than day's travel from each of these villages. Many villagers from each area obtained work on this plantation as wage laborers. Through this work they obtained knowledge on how to grow the crop and access to what were considered to be superior cacao varieties, contrasted with those obtained from local trees.

While these histories are reflected in a modest number of cacao plantings in grasslands and other croplands in several of the villages, only in Andowengga did these three conditions enable rapid cacao expansion into forested lands by the late 1980s and early 1990s. In contrast, cacao would not expand until the late 1990s in Taosu and Lawonua. Only in Lawonua, then, did boom dynamics result in a high magnitude of forest clearances (**Figure 2**). The next section draws on the broader regional history presented above to detail why these pathways of cacao expansion and forest cover loss exhibited such variability. Detailing the onset of cacao expansions in each of these locations, I suggest that variance in the magnitude of cacao adoptions and forest cover loss dynamics observed across these three cases is linked to two core dynamics: (i) at what point in time state claims to the forest could be overcome and (ii) the quality and orientation of state support for production at that point in time.

The core factor enabling cacao expansion in Andowengga during this time was the strong support of the village head for cacao production, which enabled growers to access forested land for cacao as early as the 1980s. On the basis of his support (which only extended to lands already depleted of valuable timber species), he obtained a letter of land clarification (SKT, *Surat Keterangan Tanah*). The SKT in turn was used by the village head as the basis for administering land sales to those settlers or migrants that could afford “measurement fees” (*pembayaran ukuran*) of 10,000 Rupiah. Payment receipts signed by the village head provided those converting forested lands for cacao with the capacity to refute potential arrests by forestry department officials. As one Forestry Department official during this time reflects, “*Land claimants would say: why would the Bupati [district head] have issued these if it wasn't legal?*” (*Interviews*, June 2015).

The second factor enabling cacao expansion was the village head's connections to communities of established Bugis cacao growers in South Sulawesi and elsewhere in Southeast Sulawesi. Of Bugis ethnicity himself with former residence in these regions

through his work in the army, he used two scoping trips to invite growers to populate Andowengga, perceiving cacao (and migrant growing communities) to be the basis of long-term development for the area. Though Tolaki and Javanese settlers in this area were not precluded from buying forested land in Andowengga for cacao, they were less able to afford the costs of land measurement. For such individuals, the 10,000 Rupiah charged for land measurement fees were generally considered astronomical. As point of comparison, 100 kilograms of rattan collected from the forest at this time, processed into 4 meter lengths, and transported to nearby rural towns – at times under rick of arrest – earned collectors only 40 Rupiah. Most Bugis migrants, however, sold inherited or purchased land in more densely populated and well-established land markets elsewhere, often wet rice lands in South Sulawesi. This enabled them to bring sufficient capital of either South Sulawesi or elsewhere to invest in blocks (*kapling*, roughly 2 hectares) of “cheap land” in Southeast Sulawesi. Rapid expansion in Andowengga thus not only reflects the recruitment of interest growers to this area; it also reflects the capacity of the earliest cacao adopters to accumulate land and capital rapidly.

In contrast, growers who tried to convert forested lands to cacao in Taosu or Lawonua in the 1990s might experience arrest or even imprisonment. As the senior official of the forestry department from Taosu explains, describing his message when cutting down smallholders’ cacao trees: *“You with the cacao farm someday plan to draw yields. But the reforestation lands are already the forest territory of the state, it’s already been planted in pine that will be cut down by the state. I gave a simple example like that so the people would easily understand. I told them it was like the farm of the government (adalah kebunnya pemerintah) because there we had a levy that would enter the state coffers (ada retribusi yang masuk ke kas negara).”*

Arrests of smallholders attempting to plant commodity crops in the forest persisted until the collapse of the Suharto dictatorship immediately following the Asian Financial Crisis of 1997-1998. Beginning in 1998, President Habibie oversaw the decentralization of many decisions surrounding natural resource management and governance to the district level. Importantly, rights to state forest land were not decentralized. However, until 2004 when final decentralization policies were promulgated, the governance of natural resources throughout Indonesia was characterized by an ambiguity of administrative authority and associated violence and political turmoil (see, e.g., McCarthy et al., 2004). Accordingly, during this political window, informal access to forested land became possible for many individuals previously prohibited from using forested lands or previously unable to buy forested lands.

In Taosu, forested lands began to be occupied by Tolaki land claimants by 1997. By the late 1990s, violent riots also emerged, leading to the murder of several former officials. At the root of these protests was a rejection of the notion that forests should be held and allocated by the state, or that Tolaki land claimants should have to buy their access to land. These prolonged protests and *de facto* occupations of forested lands ultimately led one local forestry department official to travel to the provincial capital, proposing Taosu as a site for a pilot community forestry initiative to enable access to state-claimed forests and reforestation lands. Thus by the 2002, in addition to informal means of accessing

state forests, many households with ancestral claims to the land also obtained the right to use forested land (i.e. not ownership or sale rights).

This point in time, however, was poorly timed for people to succeed with new cacao plantings given the broader financial depression triggered by the Asian Financial Crisis and the ecology of the crop itself. Prices for cacao remained sky-high at this moment in time against the devaluation of the Rupiah. However, few people who did not already trade cacao or other export crops against the dollar had sufficient capital to undertake production. Cacao plantings require that growers to forgo income from the land for three to four years while they wait for tree crops to yield. Many people were unable to do this in the context of diminished off-farm work opportunities and higher expenses for rice and other foods.

The appearance of pests and pathogens throughout the area several years later, particularly Cacao Pod Borer, however, further dis-incentivized plantings of cacao. It led many growers to believe they needed expensive synthetic inputs to ensure the success of their crop, including regular fertilizer. In Taosu, state lands allocated via use rights through the community forestry scheme thus instead tended to be used for subsistence agriculture during this time period. In cases of distress, they were also “sold” through a secondary market in land leases. Those cacao lands brought into production in many cases are now fallowed.

Lawonua illustrates the capacity of further production support to spur boom conditions despite the economic and ecological challenges wrought by the late 1990s. Despite similar conditions in Lawonua by the late 1990s, cacao boom was enabled by a program known as the *Sulawesi Rainfed Agricultural Development Program*. This program operated throughout the province at a cost of \$43.8 million dollars, targeting 31,000 hectares of land. In *Lawonua*, program was invited to operate in the area by the village head (*Pak Desa*) after the district head had permitted initial sales and conversions of forested land among Tolaki people and in-migrants. Cacao quickly became accessible to all villagers, even those lacking capital, spurring a race to clear and claim land. All villagers could enter up to two hectares of land into the program, receiving title to the land, salary for planting the land in cacao and a full suite of inputs, including seedlings, fertilizers and pesticides. Nearly all villagers raced to adopt cacao, as did in-migrants who arrived during this time. As one woman remembers, “*people were happy again to manage the lands themselves. It was guaranteed support. People were paid by the government to do it.*”

5. Discussion

This paper has reconstructed pathways of cacao expansion in Southeast Sulawesi, Indonesia, illustrating their linkages to forest cover loss and reconfigurations in agrarian livelihoods. From roughly the 1950s through the 1980s, state foresters’ land claims and forced evacuations of indigenous Tolaki swiddeners helped “free” forested land for conversion to cacao production. Colonization programs and forest industries populated rural areas with in-migrants and drove initial encroachments into the forest, deepening market linkages between rural areas and nearby towns. In many areas, support for

production and agricultural development initiatives then provided growers with inputs, information and tenurial security as they planted forested lands in cacao. State engagements not only enabled smallholder production crises by encouraging monotypic, input-intensive production; they also generated high rates of forest cover loss and high smallholder livelihood dependence on cacao – key dynamics to which sustainable intensification policies respond.

These findings speak to a long body work on the role of state development regimes in enabling the formation of commodity frontiers throughout many tropical landscapes in the post-WWII period (Hecht, 1993; Rudel, 1993; Angelsen and Kaimowitz, 2001; Lambin and Geist, 2001; De Koninck, 1996; Peluso and Vandergeest, 2011). My findings contribute to this work by exposing the heterogeneity and uneven nature of state territorialization processes even within the same category of land use and control: state forest lands (Peluso and Vandergeest, 1995). Concretizing the notion that history matters, these data illustrate how different historical manifestations of political violence and different configurations of state actors and institutions have contributed to divergent scenarios of cacao expansion, smallholder market success and landscape change in three otherwise broadly similar settlement regions. Remotely sensed analyses and secondary data help to “zoom out,” suggesting that these dynamics likely informed the highly disparate patterns of cacao expansion observed across the province.

These data suggest that there will remain a need to understand histories of state engagement *despite* the growing engagement of civil society and private sector actors in agricultural landscapes. Some have suggested that new governance arrangements, which include a significant role for private sector and civil society actors, will shift the state from a role of government to governance, wherein states play a subsidiary role alongside other actors (Harvey, 2005). This case, however, demonstrates some of the ways state engagement will nonetheless remain inextricably “inscribed” (Bryant and Bailey, 1997; Lukas, 2014) in agricultural landscapes. In Southeast Sulawesi, these inscriptions include the degraded production ecologies which confront growers; overlapping claims to forested land and ongoing resource conflict; and the high rates of rural inequality and out-migration that define the exclusion of many people from the smallholder agricultural economy.

Such data thus support a preliminary interpretation of current sustainable intensification initiatives in the sector in two regards. First, data suggest that by extending a long history of support for the sector, both direct and indirect, current policies may reinforce resource inequities exacerbated by earlier policy regimes. While cacao was a development success story for many people, particularly Bugis in-migrants, many other people have experienced the formation of the cacao economy “adversely” (Hickey and du Toit 2007; McCarthy, 2010). This includes those people who have found ancestral land holdings enclosed over the past fifty years and who have been excluded from the frenzy of boom. It also includes those people who have found their agrarian ecologies and economies organized around a crop they do not wish to grow. Corroborating Li’s finding of socio-economic differentiation in the sector (2002; 2014), these histories suggest further support for smallholder cacao production in this region will exacerbate existing

differentiations along lines of class and ethnicity.

Furthermore, data suggest that investments in sustainable intensification may reinforce the broadly uneven processes of rural development that have defined the past several decades. Market incorporation took variable shapes, shaped by idiosyncracies of local politics, the presence or absence of subsidies or state support for production, and the particularities of forest land tenure and conflict in each of the specific locations. Current investments employ a targeting approach, seeking to maximize return on investments by targeting those areas where cacao production is currently greatest. To the extent they channel development monies into top producing districts, they are likely to reinforce a regionally uneven process of development.

Finally, and most broadly, these data suggest that understanding how current policies will operate, and with what implications for people and forests, requires pulling these histories and realities into the forefront of the analytical frame rather than assuming them. This case demonstrates one methodological approach for so doing while simultaneously situating observed dynamics within a broader geography of biophysical change.

CHAPTER THREE

Sustainable Intensification and Implications for Smallholder Land Use and Livelihood Strategies: Evidence from Southeast Sulawesi, Indonesia

Abstract

Public-private partnerships to promote sustainable development have been lauded as a means of addressing persistent gaps in the implementation and orientation of resource governance. The inclusion of industry in such partnerships, however, has raised concerns about their legitimacy and efficacy. Despite active debate, little work has explored (i) the conditions under which such policies emerge or (ii) their grounded impacts on ongoing land use and livelihood changes in specific regions. This paper presents a case from Southeast Sulawesi, Indonesia, focusing on a growing number of investments to ‘sustainably intensify’ smallholder cacao production. Drawing on in-depth interviews with program representatives, I first demonstrate that public-private initiatives in Indonesia largely respond to corporate concerns surrounding stagnant cacao supplies and new markets in the Asia Pacific as well as resurgent protectionism within Indonesia’s domestic cacao economy. These factors have motivated nearly fifteen years of policy support for smallholder cacao production and high levels of corporate buy-in and investment. Drawing on household surveys and grower interviews in two village case studies, however, I find that smallholder participation in programmatic initiatives has generally been limited, marked by the highly variable uptake of recommended management and production practices. I argue that these data reflect growers’ long-term transition *away* from cacao, a transition that can be understood with respect to five key dynamics: (i) the elevated labor costs and decreasing profits associated with cacao production; (ii) household labor scarcities; (iii) limited access to synthetic inputs; (iv) the unpredictability of smallholder investments in new planting technologies; and (v) more attractive commodity crop opportunities. These findings indicate that the capacity of private sector engagements to promote agricultural sustainability will be dictated by *how* or *how not* investments in sustainability are able to redistribute the benefits and costs of commodity production. They further indicate that even high levels of buy-in and investment will not enable greater cacao sustainability if current initiatives do not better address local labor constraints and better compete with emergent market opportunities.

1. Introduction and Overview

Cacao bust has closely followed cacao boom throughout history, marked by the dramatic and often sudden onset of production losses. Indonesia, the site of the world's most significant contemporary boom in global cacao production, is no different than other countries in this regard (Ruf and Siswandputro, 1995; Leiter and Harding, 2004; Ruf and Scroth, 2004). Up from almost no production in the late 1980s, Indonesia had become the world's third largest producer of cacao globally by the early 2000s, 90% of this on farms an average of just under two hectares (FAOSTAT, 2014; BPS, 2015). In the early 2000s, however, smallholder⁵ cacao yields began to dramatically decline under growing pressure from pests and pathogens, including Cacao Pod Borer, Black Pod Rot and Vascular Streak Dieback (Neilson, 2007; Clough et al., 2009). From a high of 1,132 metric tons/hectare in 2002, average yields in the sector had dropped to 422 metric tons/hectare by 2014 (FAOSTAT, 2014).

While producers and producing nations have long attempted to address cacao (*Theobroma cacao* L.) losses regionally or locally, industry interest in stabilizing global production has peaked over the past three decades. In 1984, there was one public-private partnership focused on achieving economic and environmental sustainability in the cacao sector. Today there are 55 (Bitzer et al., 2012), many of which are a component of major corporate sustainability initiatives advanced by lead processors and manufacturers in the sector, including Cargill, Mars, Mondaléz, Nestlé, Blommer and Hershey. Sulawesi, the largest site of production within Indonesia, is considered a thought-leader in the development of these initiatives (Hafid and McKenzie, 2012; Moriarty et al., 2014). As one corporate representative expressed to me: "*Sulawesi is like the cradle of cocoa sustainability work. We have used this place like a playground, and when it's successful, we export it to West Africa*" (personal communication, July 2013).

Approaches to date, framed as investments in sustainable intensification, have operated on over 300,000 hectares of land and have engaged nearly 500,000 households (Direktorat Jenderal Perkebunan, 2014). Most partnerships in Sulawesi have established farmer field schools to train growers in agro-ecological methods of pest and disease management (Neilson, 2007; Saxbol, 2015; Wijaya et al., 2016). Recent approaches have also distributed new planting materials to growers and worked to establish closer trade linkages between smallholders and multi-national processors and manufacturers, with certification under UTZ or Rainforest Alliance schemes planned (ACDI/VOCA 2005; Neilson, 2007; Kindornay and Higgins, 2012; Sustainable Cocoa Production Program, 2016). Associated program documents have generally highlighted synergies between corporate and smallholder prosperity. For example, programs documents for the recently-announced "Green Prosperity Sustainable Cocoa Production Program" that will operate in Indonesia from 2015-2018 suggest that farmer field schools and improved access to

⁵ As Rigg and Salamanca (2016: 121) detail, many terms can be used delineate farms limited in spatial extent, including "family farms," "peasant farms," and "small farms." The term smallholder is used here to denote farms small in size, generally below two hectares in size (Hazell and Rahman, 2014). Smallholder as a term is used as shorthand in this paper and is not intended to homogenize people within or across growing households with different relationships to agriculture or with highly differentiated access to land and land-based markets.

credit and inputs can “*enable farmers to increase their productivity, and thus their income, and improve household livelihoods,*” while simultaneously, “*strengthen[ing] commercial relationships between service providers, input suppliers, cocoa smallholder farmers, and cocoa supply chains.*” Researchers and program representatives further suggest that sustainable intensification investment can reduce the environmental costs of production, enabling a diversification of the monotypic and input-intensive management practices that characterize the sector and potentially even lower rates of forest clearance for new commodity crops (Ruf and Zadi, 1998; Shapiro and Rosenquist, 2004; Neilson, 2007; Clough et al., 2009; Sustainable Cocoa Production Program Indonesia, 2016).

Current initiatives in Sulawesi thus exemplify broader global trends in the governance of agricultural commodity production. From roundtables to support sustainable oil palm and soy economies (Schouten et al., 2012) to voluntary certification programs (Cashore et al., 2006), public-private partnerships to promote “sustainable development” have grown in number and investment volumes over the past decade, celebrated as a means of addressing persistent gaps in the implementation and orientation of resource governance (Reinicke et al. 1998; Benner et al. 2003; Biermann et al. 2007). Proponents of these approaches have celebrated their potential to produce *win-wins* and *win-win-wins*. The inclusion of industry in formulating and enacting such initiatives, however, has raised concerns about their legitimacy and efficacy (Dauvergne and Lister, 2011; Glasbergen, 2011). Critics have argued that corporate engagement creates a case of the fox guarding the henhouse, enabling further consolidation of industry power along agricultural supply chains – ultimately to the detriment of agrarian livelihoods and landscapes (Clapp and Fuchs, 2007; Fuchs et al. 2011; McMichael, 2013; Patel, 2013).

Despite active debate, however, and despite the scope of investments in smallholder cacao production globally, little work has examined the conditions under which investments in sustainable cacao intensification have emerged. Further, little work to date has explored how these investments are playing out in practice (but see Wijaya et al., 2016) or with what implications for agrarian livelihoods and environments. This paper addresses this gap, tracing the growth, elaboration and implications of investments in sustainable intensification in East Kolaka, Southeast Sulawesi, a focal site of cacao production and extension in Indonesia. I begin by analyzing in-depth interviews with program representatives and programmatic documents on all programs that have operated in the study area over the past fifteen years, focusing on tracing dominant programmatic emphases across the broad range of programs that have operated in the study area over the past fifteen years. I then use household and land use surveys as well as in-depth interviews with growers to evaluate how sustainable intensification initiatives are informing ongoing land use transitions in the study area.

I use these data to advance three linked claims about the nature of current investments in sustainable intensification and their implications for agrarian livelihoods and environments. First, I argue that ongoing corporate investments are most usefully understood as a response to broader corporate concerns surrounding emergent markets in the Asia-Pacific and resurgent protectionism within Indonesia’s domestic cacao economy. These concerns have shaped nearly fifteen years of sustained corporate

investment in the study area. They have also explicitly informed a growing programmatic emphasis on establishing more direct trade linkages between corporate buyers and smallholder growers. Second, I show that investments in sustainable intensification are failing to produce their intended goals, i.e. an intensification of smallholder yields, and through this an improvement in smallholder income. Management practices promoted through sustainable intensification investments *increase* the labor inputs associated with cacao production. Simultaneously, they have driven only modest improvements in producer profits over the past fifteen years. Third, closely linked to the above, I show that sustained smallholder crises of accumulation are shaping smallholders' transition out of cacao and into new commodities. Household and land surveys demonstrate that many smallholders have begun to convert their cacao fields to alternative commodities. Interview data indicates that smallholders are transitioning to crops more amenable to their labor and capital constraints; crops which produce better returns per unit of labor invested.

These findings indicate that the capacity of private sector engagements to promote agricultural sustainability will be dictated by *how* or *how not* investments in sustainability are able to redistribute the benefits and costs of commodity production. They further indicate that even high levels of buy-in and investment will not enable greater cacao sustainability if current initiatives do not better address local labor constraints and better compete with emergent market opportunities. Below I further introduce debates surrounding sustainable intensification and private sector engagement in agricultural development policy more broadly. I then describe my research approach, present results, and examine the broader implications of the case study findings.

2. Theory and Background

2.1 Private Sector Engagement in Agricultural Development Policy: Trends and Critiques

Programs to intensify agricultural production, i.e. to raise agricultural yields per unit hectare, have long influenced smallholder agricultural landscapes, particularly during the Green Revolution (1930s-late 1960s). The past two decades have seen resurgent support for agricultural intensification policies, many of which have focused on agricultural landscapes throughout the tropics, and most of which have been depicted using the contested language of 'sustainable intensification.' Growing investments from the World Bank, bilateral donors (including DFID and USAID), private philanthropic organizations (most notably the Bill and Melinda Gates Foundation), and transnational corporations (IAASTD, 2009; Gillis, 2011) are driving this trend; responding, in part, to gaps in state-led agricultural development spending created under structural adjustment programs (SAPs) and other neoliberal policy reforms throughout many countries in the 1980s and 1990s.

There is considerable continuity between contemporary initiatives in sustainable intensification and their historical counterparts. However, present approaches diverge from their antecedents in two ways. First, there is generally greater emphasis on agro-ecological or organic tenets of production (Conway, 1997; Pretty et al., 2011). Past efforts to intensify smallholder systems were primarily pursued according to a strict

productivist model emphasizing industrial efficiency. The long-term social and environmental externalities associated with this model are now well-recognized (Patel, 2013). Many contemporary approaches thus emphasize the importance of effecting yield increases with greater attention paid to biodiversity conservation and carbon storage (Garnett et al., 2013). This tendency is exemplified by current public-private partnerships to promote sustainable intensification in the cacao sector. Most cacao globally is managed utilizing a monotypic, input-intensive and full-sun approach, often on cleared forested land; an approach shaped by earlier agricultural development policies in many regions (Nieston et al. 2004; Ruf, 2011; Kelley, 2013; Kelley et al., 2016). Public-private partnerships in the cacao sector now commonly center a *diversified* production ideal, encouraging intercropping, compost application, reduced use of agrichemical inputs and organic methods of pest and pathogen management (Shapiro and Rosenquist, 2004; Sustainable Cacao Production Program, 2016).

Second, mainstream policy discourses have centered a greater role for agribusiness in supporting contemporary agricultural intensification initiatives. The United States Agency for International Development and World Bank, for example, have claimed that agribusiness inclusion can increase the efficacy and scalability of agricultural development policies; providing novel technologies, developing more favorable trade arrangements, and generally, supporting greater investment volumes than is possible through public finance alone (World Bank, 2009; USAID, 2015). As the USAID (2015: 8) writes, *“There is growing recognition that the most intractable international development challenges will not be solved by aid alone. It will take collective action across sectors to leverage the required skills, assets, technologies, and resources to deliver effective and sustainable development. Donor engagement with the private sector is not a luxury, but a necessity.”* These remarks showcase the broader ideological shifts in development policy that are informing contemporary governance arrangements. Unlike the state-led development approach common during peak Green Revolution era interventions, today’s policy context is distinctly neoliberal; marked by the increasing orientation of policies around market logics and faith in the private sector as the appropriate steward of various functions previously assumed by or assumed to be the role of the state.

It is widely agreed that food and agriculture are central to any policies to promote sustainability (IAASTD, 2009; World Bank, 2009). However, many critical scholars and activists have contested corporate engagements in sustainable intensification, particularly in smallholder economies. Most agricultural supply chains are marked by increasingly high levels of corporate consolidation (Friedmann and McMichael, 1989; Friedmann, 1994; Bonanno et al. 1994; McMichael, 2009). In the cacao sector, though 85% of global production is believed to be produced by smallholders on less than 5 hectares of land (Shapiro and Rosenquist, 2004: 453), two firms control 70-80% of end processing, eight firms control 60-80% of intermediary processing, and six firms control 40% of all manufacturing (Cocoa Barometer, 2015). Consolidation over the past 30 years, facilitated by global market deregulation, technological improvements in shipping and logistics, and the growing use of cacao futures as a speculative financial instrument, has given lead firms in the sector more share of global market supply than any single producing nation

(Fold, 2002; Cocoa Barometer, 2015). These same dynamics have driven sharp declines in smallholders' share of value along cacao value chains. In Indonesia, producers captured roughly 23.7% of value along the cacao chain between 1976-1985. Between 1996-2005, their share was down to an estimated 8.1% (Gilbert, 2006: 20). Today's global average is 6.6% (Cocoa Barometer, 2015).

Sustainability is a term with vague referents. In the context of corporate sustainability commitments, this ambiguity can be deployed strategically; leveraging a rhetoric of inclusivity and win-win-wins to depoliticize the agenda being advanced (see, e.g., Clapp and Fuschs, 2009). McMichael (2013:11) argues that investments in intensification in smallholder economies should be understood as "*value-chain projects*," likely to draw producers further into "*competitive markets over which they have no control... increas[ing] their exposure to debt and dispossession*" (2013: 11)⁶. Other researchers argue that even where agribusiness-driven "agriculture for development" schemes do not directly result in dispossession, they enable greater corporate control over agricultural systems (Huggins, 2014, Amanour et al., 2012) – to the long-term detriment of producers and their environments. These critiques are relevant to an analysis of sustainable intensification initiatives in Indonesia, particularly given indications (elaborated further below) that current programmatic interventions are moving towards a model of contract farming arrangements.

2.2 Constraints to Corporate Control and Capital Accumulation in Cacao Production Landscapes

The above perspectives highlight the need to further untangle how sustainable intensification initiatives are operating and who stands to win and lose from their implementation. Deepening corporate control over people and landscapes (understood in terms of their capacity to dictate or govern resource management and processes of agrarian change) does not inevitably follow from corporate engagement. Rather, as agrarian scholars have long emphasized, agricultural landscapes are a tricky place to make a profit (Mann and Dickenson, 1978; Kloppenborg, 1988); agricultural production "*involves long periods of time, and is highly unpredictable, due to natural forces such as weather, pests and the perishable nature of food*" (Howard 2009: 1268).

These insights are relevant to smallholder cacao production both in Indonesia and globally. Most cacao production has yet to be mechanized, and most cacao-growing households still sell depend on family labor and hand-harvest, selling raw cacao to local traders who collect the product in burlap sacks, load it onto pick-up trucks, and transport them to warehouses miles from growing regions (Talbot, 2002). These production dynamics, far from the Fordist ideal often associated with industrialized forms of agricultural production (Goodman and Watts, 1994), engender uncertainties that have thus far historically precluded significant consolidation in the production node of the conventional chocolate commodity chain. Cacao remains a smallholder crop, in part, because smallholders' flexible and situated knowledge of the vagaries of production

⁶ Scholars further point to the fact that such programs, particularly where they engage the distribution of new technologies, will likely secure livelihood returns for those people who already have sufficient footing (see, e.g., Patel, 2013 for a review of the evidence).

within their field is hard to replicate under a plantation model using wage labor (Talbot, 2002).

The nature of the crop and its production ecology introduce further constraints on corporate consolidation and capital accumulation in the sector. Not only is cacao a perennial tree crop, which must be planted 3-4 years before it yields fruits, but, it is highly susceptible to pests and pathogens, particularly when grown at volume. The susceptibility of cacao to pest and disease has been observed from 16th century Mexico to 18th century Trinidad to 20th century Ghana (Leiter and Harding 2004: 117). Like other boom crops, such as oil palm and rubber, cacao is highly susceptible to the rapid onset of heavy production losses associated with ever-changing and spatio-temporally specific pest and pathogen regimes. As resources concentrate on the landscape and age, it is believed physiological stress and a scenario of resource abundance for pests facilitate rapid disease transmission, often helping to drive “bust.” Further, individual trees are highly variable in their yields. Recent research suggests that “as few as 5% of the trees on the farm produce about 50% of the cocoa harvest while the other 95% occupying the land are poor-performing plants that are susceptible to pests and diseases” (Traore et al. 2011: 1).

Managing production losses in Indonesia is particularly complicated given that each of the dominant pest and pathogens now affecting production have different ecological regimes. Cacao Pod Borer is an insect pest which burrows into cacao pods, laying larvae in the pulpy interior from which beans are also harvested. As larvae emerge and eat the pulp, they suction off nutrients from cacao beans, ultimately reducing yield and engendering a hard, difficult to extract bean (Lim et al., 1982). Black Pod Rot is a fungal pathogen with four types of spores that are produced on infected fruit or leaves, stems, roots; which can germinate on the plant or in the soil; which can persist in nearby sources of water; and which can persist for months in dead plant material or in the soil, even in the absence of a host. The fungal pathogen quickly progresses once established on a cacao pods, ultimately destroying the beans and mummifying the pod. It thrives in moist conditions; conditions which ironically may deter the Cacao Pod Borer (Vanegtern et al. 2015). Vascular Streak Dieback is also caused by a fungal pathogen, and first manifests in leaf senescence. Eventually the fungus can grow down through the tree’s xylem into the main stem, killing the entire tree (Guest and Keane, 2007). The corollary of these divergent pest and pathogen ecologies is the need for occasionally counter-valent management strategies.

Given the above considerations, the remainder of this paper adopts a two-fold approach to evaluating current investments and their implications in East Kolaka, Southeast Sulawesi, Indonesia. I begin by exploring the nature of investments to date, examining the conditions under which they have emerged in this region. I then ask how investments are playing out in practice. Here I examine to what extent smallholders are participating in such programs and why smallholders’ engagements are taking the forms observed.

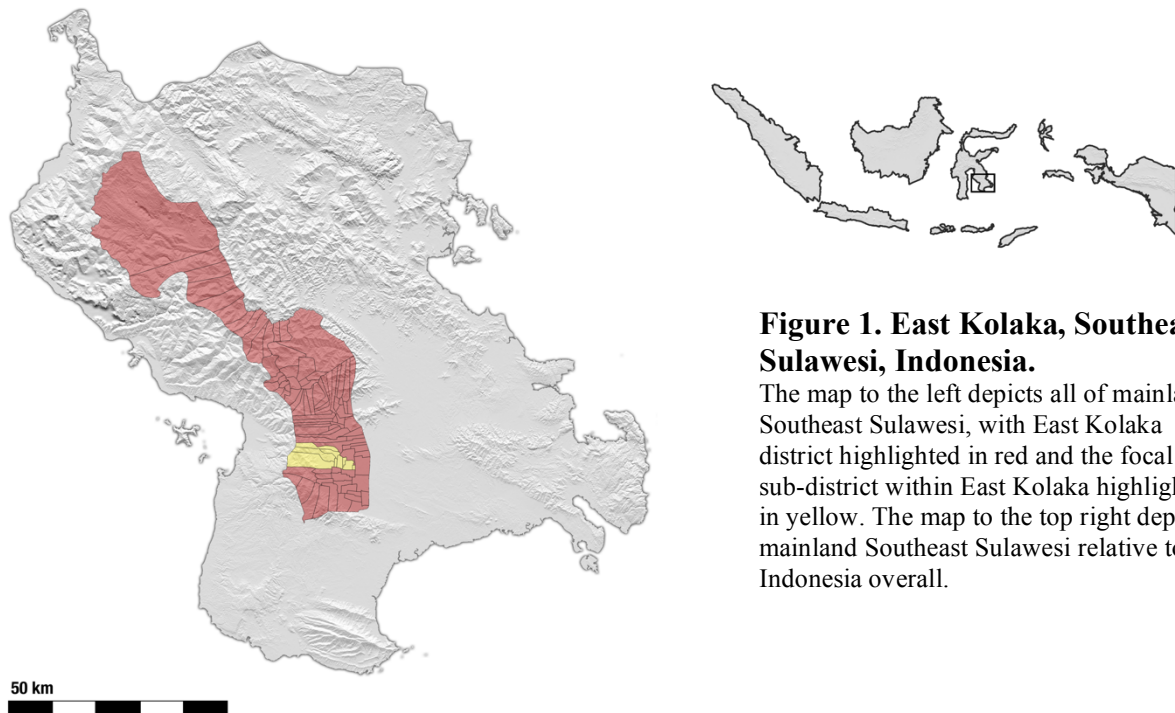
3. Research Approach

All fieldwork for this project was conducted between 05/2012-07/2012, 05/2013-

08/2013, and 08/2014-08/2015. Approximately eight months of this time were spent living in the case study region.

To understand the operation and implementation of programs, I first used key informant interviews with 18 program designers and representatives. Semi-structured interviews took an open-ended format and aimed to understand representatives' perspectives on the goals and efficacy of their programs. I supplemented in-depth interviews with participant observation at two industry-wide conferences: the 23rd annual World Cocoa Foundation meeting in Washington D.C. in 06/2013 and the 6th annual Indonesian Cacao Association meeting in Bali, Indonesia in 06/2014. These conferences attracted significant industry participation, including that of most lead firms in the industry. In Indonesia, the conference also attracted key government ministers and agency representatives. For each program operating in the study area, I also reviewed all available programmatic materials and evaluations.

I then triangulated across multiple lines of evidence (literature review, initial site visits, provincial statistics, and key informant interviews at the district level) to select two villages within the administrative district of East Kolaka, one of two priority production regions for all of Southeast Sulawesi province (**Figure 1**).



In each of the two selected villages, I conducted a survey with roughly 25% of village households. In each of the two villages, 50 and 55 households were surveyed, respectively. Household surveys contained both structured and semi-structured questions. Standard questions were asked about household demographics; all adult household members' primary and past livelihood strategies and sources of income; and household land uses and access to or control of land. I also asked standard questions of each

household to assess their history of engagement with cacao production and extension and approaches to cacao management. I supplemented these data with a variety of additional questions designed to understand the motivation or origins of particular practices.

Subsequent to the completion of surveys between 10/2014-01/2015, I conducted in-depth interviews with select cacao growers to further understand their decision-making processes with respect to cacao production and extension. I conducted 40 interviews; 20 with program participants and 20 with non-participants. Interviewees were selected purposively to capture important sites of variability ascertained through household surveys; including variability vis-à-vis land access, ethnicity, and history of engagement with cacao. Some interviews lasted only 20-30 minutes while others continued over 2-3 hours across multiple days. Most interviews took place within growers' fields so I could better understand the specific management techniques being referenced.

Lastly, I conducted a land use survey designed to capture management shifts in smallholders' cacao fields. In this survey, I was assisted by two farmer leaders trained in the two most recent extension programs. We evaluated visible management practices within 150 randomly selected cacao fields. The survey complemented and cross-validated management shifts reported within household surveys. Surveyed management practices included pruning strategies or practices; the presence or absence of new varieties (marked by the installation of vegetative grafts); the presence or absence of major diseases and pests including Cacao Pod Borer, Black Pod Rot and Vascular Streak Dieback; signs of farm abandonment (evidenced by long-unharvested trees or impenetrable weed growth); complete conversion to other crops (evidenced by remaining cacao tree stumps); and intercropping (evidenced by woody perennial crops that had been planted within the past five years)

4. History and Overview of Cacao Production in East Kolaka

Livelihoods in the study area have long consisted of a diverse mix of farming and off-farm work, and cacao has constituted an important part of this mix since the late 1980s, with household adoption of cacao peaking in this area in the late 1990s but continuing through the 2000s.

Growth in cacao production over this period was enabled by diverse policies, including the sub-division and allocation of state-claimed lands to households with sufficient capital; the development of market and trade infrastructure; state-sponsored colonization initiatives; and the facilitation of tree crop development in the late 1980s through various block grant programs (discussed further in **Chapter Two**). Cacao production also accelerated during the Asian financial crisis of 1997-1998. The intense devaluation of the Indonesia Rupiah, coupled with strong international demand, meant that farmers received incredibly high returns per kilo for their cacao, sometimes double or triple what they would receive in later years (Gérard and Ruf, 2013). The fall of the Suharto regime and subsequent confusion in administrative authority in 1998 further propelled the last wave of cacao adoptions in the early 2000s.

These dynamics shaped the differentiated terms of engagement with cacao observed across growing households at present. Those households with sufficient capital to pay

“land measurement” fees and access productive land for cacao in the 1980s – typically Bugis in-migrants with capital from land sales in more established agricultural markets elsewhere in Indonesia – experienced a strong early adopter’s effect. Not only did they capture the high shares of producer value associated with the crop in the 1980s and the windfall profits enabled by the Asian Financial Crisis; they also experienced an ecological subsidy. Growers who adopted the crop in the early 2000s experienced pest and pathogen pressures nearly as soon as their trees began to yield. In contrast, early adopters of cacao benefited from nearly 15 years of “extraordinary” (*luar biasa*) yields without any external inputs.

These dynamics are reflected in differentiated household access to and control of cacao lands at present. As has been observed elsewhere (e.g., Li, 2002; Li, 2014), the role of cacao in constituting peoples’ livelihoods is highly differentiated along lines of ethnicity with indigenous Tolaki people and Javanese in-migrants generally possessing less overall land and cacao land than Buginese in-migrants. They are also reflected in aggregate declines in household cacao holdings over the period 2004-2014. Many households adopted the crop in the early 2000s only to immediately abandon production (**Table 1**).

	<i>Land Owned (ha) (2014)</i>	<i>Cacao Managed (ha) (2014)</i>	<i>Cacao Managed (ha) (2004)</i>
Tolaki (n=20)	1.13 ± 0.42	0.62 ± 0.14	1.31 ± 0.62
Javanese (n=18)	0.96 ± 0.17	0.53 ± 0.12	1.17 ± 0.24
Bugis (n=67)	2.81 ± 0.29	2.00 ± 0.20	3.64 ± 0.39

Table 1. Land and Cacao Holdings by Ethnicity in Two Periods.

This table depicts differences in both land ownership and cacao management along ethnic lines. It also depicts the decrease, on average, of cacao holdings among surveyed households over the period 2004-2014.

Prior policy regimes also informed smallholder land use practices in the sector in varied ways. As is true elsewhere, most cacao in this region was first planted in a monotypic and full-sun approach, which many early growers suggest they learned from either participation in a block grant program or earlier work on a nearby parastatal cacao plantation (Kelley, 2013; Kelley et al., 2016). In the 1980s and early 1990s, growers generally did not see synthetic inputs as necessary. By the early 2000s, nearly all growers began to observe declining soil fertility as well as pests and pathogens, particularly Cacao Pod Borer. In early years, pest and pathogen losses as well as declines in soil fertility were seen as manageable with synthetic inputs, particularly as trees were young and yields remained relatively high. This further contributed to the differentiation described above; households already established in production generally had greater capacity to purchase such inputs⁷.

Cacao pods can be harvested throughout the growing season, but peak harvest generally occurs over a one month period from May through June. Pods are left to rest for several days, then split open, with cacao beans extracted from their pulp. Following this, cacao beans are dried, usually on tarps spread in front of houses. Though cacao beans can be

⁷ Common brands for fertilizers include *Urea*, *NPK*, *SP36*, *TSP*; *Phonska*; for pesticides/insecticides include *Alika*, *Amistar Top*, *Dithane*; for herbicides include *Gramaxone*, *Noxone*, *Round-Up*, and *Rambo*.

fermented for up to eight days between extraction and drying, most cacao from this region has historically been traded as unfermented bulk cacao, mixed with high quality cacao from elsewhere but used as filler for low quality chocolates given its high fat content and low cost (*Interviews with traders* but see also Panliburton and Meyer, 2004). Growers have sold raw cacao beans to local traders or collection points, where it is purchased by mid-tier traders or licensed buying companies. These smaller scale collectors trade to fewer than eight multi-national traders, predominantly Cargill, Blommer Chocolate and Olam (Panliburton and Meyer, 2004; Saxbol, 2015). Most cacao from this region is processed and manufactured into retail chocolate in the US and EU though a growing volume of processing now takes place regionally.

5. A Brief Chronology of Public-Private Investments in Cacao in East Kolaka

Formal support for smallholder cacao production in the region began almost immediately following the initial onset of pests and pathogens in 2000 (**Table 2**). The litany of programs described in **Table 2** illustrates both continuous and evolving facets of cacao extension over the past fifteen years. While both past and present programs have emphasized training growers in agro-ecological methods of pest and disease management, the trajectory of extension over time indicates the growing focus of programs on enabling more direct trade linkages between corporate buyers and growers.

Program	Duration	Stated Purpose	Implementing & Donor Agencies
The SUCCESS Program	2000-2003	Training in PsPSP method of cacao pest and disease management	Implementation & Funding: ACDI/VOCA (international agriculture development NGO); American Cocoa Research Institute (ACRI)
SLPHT (<i>Sekolah Lapangan Pengendalian Hama Terpadu</i> , Integrated Pest Management Farmer Field School)	2002	Training in PsPSP method of cacao pest and disease management	Implementation: Direktorat Jenderal Perkebunan Funding: National and Provincial Budgets (Anggaran Pendapatan dan Belanja Negara maupun Anggaran Pendapatan dan Belanja Daerah), Asian Development Bank
The SUCCESS Alliance program	2003-2005	Training in PsPSP method of cacao pest and disease management; training in grafting techniques; training in “Farming as a Business” focused on “business management, marketing and economic aspects of cocoa farming” (ACDI/VOCA 2005: 8).	Implementation: ACDI/VOCA (international agriculture development NGO) Funding: United States Department of Agriculture; United States Agency for International Development;

			World Cocoa Foundation; Mars Corporation.
AMARTA Sulawesi Cacao Alliance	2006-2009	Training in pest and disease identification and PsPSP method of cacao pest and disease management; training in grafting techniques; training in “Farming as a Business”; training in post-harvest processing and upgrading bean quality. 11 local buying stations established by Olam and Blommer.	Implementation: Local NGOs, local government officials, Olam International and Armajaro Funding: United States Agency for International Development End Purchaser: Olam International; Blommer Chocolate Company;
GERNAS	2009-present	Depending on farm age, grafted new cacao varieties onto existing cacao trunks and distributed fertilizers and pesticides to growers. Growers were also compensated for loss of yields associated with pruning branches to facilitate the growth of new varieties.	Implementation: Direktorat Jenderal Perkebunan (sub-district level staff with support from provincial staff) Funding: Nestlé National and Provincial Budgets (Anggaran Pendapatan dan Belanja Negara maupun Anggaran Pendapatan dan Belanja Daerah),
SCPP	2012-2015	Training in pest and disease identification and PsPSP method of cacao pest and disease management; training in grafting techniques; training in “Farming as a Business”; training in post-harvest processing and upgrading bean quality; training in certification under UTZ labelling scheme. Local buying stations and village co-operative and community development center currently being established.	Implementation: Swisscontact (International development agency funded by the Swiss private sector) Funding: United States Agency for International Development End Buyers: Cargill Mondaléz

Table 2. Cacao Extension 2000-present.

This table presents the foci of major programmatic interventions in the sector in this particular study areas. Programs listed here are broadly representative of many regions in Sulawesi, as these programs generally operated throughout the region.

5.1 Overview of programmatic activities

Training in pest and disease identification, generally delivered by program representatives or trained “Farmer Leaders,” has been a component of most programs since 2000, generally using the PsPSP method of pest and disease management (**Table**

3). PsPSP (*Panen sering, Pemangkasan, Sanitasi dan Pemupukan*) was first identified as a promising approach elsewhere in the region during the “Cocoa Pod Borer Management Program” from 1995-1998 (ACDI/VOCA 2005: 19) and combines frequent harvests, pod sanitation, and recommended fertilization and pruning practices. Beginning with the SUCCESS Alliance, growers also began to be trained in “Farming as a Business”, or in the “*business management, marketing and economic aspects of cocoa farming*” (ACDI/VOCA 2005: 8). This included training in household economic management, savings and finance, and has been a component of all subsequent programs except GERNAS.

Technique	Purpose
Frequent Harvest (<i>Panen sering</i>)	Frequent harvesting has been recommended on the order of once per week during peak harvest season or once every one to two weeks outside peak harvest season. This technique is believed to decrease the population of Cacao Pod Borer by removing them from the field before they reach maturity, potentially achieving the same results vis-à-vis pest reduction as can pesticide application (e.g., Darwis, 2004; Tay, 1987; Mumford and Ho, 1988; Wood, 1987).
Pruning (<i>Pemangkasan</i>)	Pruning is taught to growers as a technique necessary to manage farm micro-climate (preventing overly humid conditions which foster Black Pod Rot, a fungal pathogen), as well as to ensure that tree resources are allocated to fruiting and that most branches receive equal sunlight, ensuring balanced growth.
Sanitation (<i>Sanitasi</i>)	Sanitation refers to the removal of any pod husks or vegetative material, including pruned branches, afflicted by any pest or pathogen; ideally through burning in a contained area at the edge of the farm (<i>rorak</i>) at the edge of a farm.
Fertilization (<i>Pemupukan</i>)	Fertilization is recommended given the likelihood of soil depletion during the course of the harvest season and is ideally done by spreading fertilizer in shallow depressions created by hoeing a small ring around the base of each tree. Growers are also recommended to provide trees with their first fertilization at the onset of the growing season.

Table 3. Overview of the PsPSP method of pest and disease management. This table summarizes the scientific basis for the PsPSP method taught to farmers through five programs of cacao extension in the study area since the year 2000.

While training in business and farming practices remains a core emphasis of recent programs, extension has increasingly promoted the adoption of new cacao varieties. In this area, given that most trees are still relatively young, varieties have largely been distributed as grafts installed into the sides of existing tree trunks, ultimately growing to replace existing branches. Beginning with the AMARTA program in 2007, growers were trained in side grafting techniques and graft nurseries were established. GERNAS in 2009 saw the fuller elaboration of this approach, wherein grafts and graft installation on

growers' fields were paid for through a joint partnership between Nestlé and the Government of Indonesia. The distributed varieties are thought to be more resistant to Cacao Pod Borer. For graft development to succeed, however, growers generally must prune or cut top branches to allow for sufficient soil nutrients, water and sunlight to be channeled to grafts.

Extension has also increasingly focused on establishing direct trade linkages with major exporters, processors and manufacturers. The SUCCESS Alliance initiated this focus, “*thus paving the way for increased vertical integration within the industry, leading to quality increases over time*” (ACDI/VOCA 2005: 10). In Southeast Sulawesi, meetings began to be held under the SUCCESS project between Blommer (the largest cocoa processor in North America) and Continaf/PT Mitra Celebes (a cocoa exporter) in 2005 (ACDI/VOCA 2005: 61). In East Kolaka, the AMARTA project in 2007 then institutionalized the alliance between USAID (the funding agency), Blommer Chocolate and Olam International (a larger cocoa exporter and trader). Through this program, growers were told that they would receive higher prices for high quality fermented cacao if sold directly to buying stations established by Olam International (*Interviews*, see also Kindornay et al., 2012: 83-84). Even if not receiving higher prices for fermented cacao, program representatives claim that producers will capture a higher share of the value distributed along the cacao commodity chain by circumventing the network of smaller traders and warehouses in the region.

The most recent program, SCPP, emphasizes certification for the first time. Supported by Cargill (the largest processor globally) and Mondaléz (a major manufacturer and end buyer), the SCPP program aims to train growers in methods of production for eventual certification under the UTZ labeling scheme⁸. Growers have been trained in reducing their use of synthetic inputs, replacing these with organic substitutes, including compost, and diversifying farms through intercropping. The SCPP program also aims to extend low-interest credit for inputs to smallholders in coming years, as well as to develop a grower cooperative that forms an intermediary where certified beans are first assessed before being purchased by Cargill at premium. These modes of engagement are only partially assessed in this paper as the implementation of these programs was only just beginning at the time of field research.

5.2 Tracing the emergence and elaboration of current public-private initiatives

Interviews with program representatives suggest that public-private partnerships in East Kolaka and elsewhere in Sulawesi were relatively ad-hoc in earlier years, primarily constituting a generic response to industry concerns about the long-term supply of raw cacao from Sulawesi (see also Neilson, 2007). However, companies' concerns regarding supply were aggravated by the Government of Indonesia's introduction of a 10% tax on the export of unprocessed raw cacao in April 2010 (Mortiaty et al. 2014: 18). Most lead firms with a foothold in processing and in Indonesia, including Cargill (Reuters, 2013);

⁸ The UTZ labeling system was established in 1999 by Ahold Coffee Company and is now used widely in the coffee, tea and cocoa sectors, overseen by diverse public and private actors and institutions (Chiputwa et al. 2015; UTZ 2017). The UTZ system focuses on the adoption of “Good Agricultural Practices” and does not articulate a minimum price floor as does the Fair Trade label (Chiputwa et al. 2015).

Mars (Engbers, 2013); Barry Callebaut (Nieburg, 2013); and Olam (Harrison-Dunn, 2014), opened multi-million dollar processing plants in response, as did various domestic processing entities, including PT. Kalla in Southeast Sulawesi (Jakarta Globe, 2012). Interviews suggest this dynamic has led to the exit of medium sized and local processors and warehouses.

The growth in Indonesia's domestic processing industry has informed the trajectory of sustainability initiatives in two ways. First, it has increased processors' need for high quality fermented cacao within Indonesia to enable complete processing and eventual manufacture within Indonesia. Promoting fermentation and proper post-harvest production was encouraged to mitigate processors' need to source higher quality cacao from West African markets, incurring steep import tariffs (*Interviews*, Saxbol, 2015). Second, it increased competition over Indonesia's still-stagnant and limited supply of unfermented cacao (Mortiarty et al. 2014, Saxbol, 2015).

Simultaneously, further consolidation in the sector and flat demand for chocolate in Western markets has inspired intense competition among firms over two emerging markets: those countries with rapidly growing middle and upper classes such as India and China (Nieburg 2013a), and those consumers in the West and elsewhere who increasingly seek "sustainable" consumption choices (Wijaya et al., 2016). At present, much demand for both these market niches continues to be met through exports from manufacturing complexes located in Western Europe and the US. Many believe that the capacity to establish regional manufacturing complexes in Asia over the next 3-5 years is "how the winners will be determined" (Nieburg 2013b). As one industry consultant remarked:

"For the confectionary industry the dream has been that the next region of growth is going to be the Far East. So there has been a bit of a land rush mentality over the past 10-15 years to get there first. Because the cocoa industry small, rather insular and highly competitive, the 3-4 firms that have emerged as the dominant multinationals are fighting to get a foothold in that world and able to establish factories in that region."

Sulawesi is not only the only major site of production in Asia and the only global production site capable of supplying Asian markets on a just in time basis. It is also relatively free from some of the concerns surrounding child labor and political volatility that plague the other largest producing nations in West Africa (Neilson, 2007). Sulawesi, and its long-term viability in sourcing cacao for both markets, has thus taken on new strategic importance for industry, a fact reiterated by multiple industry representatives and discussed openly at industry conferences. These considerations, coupled to the above dynamics, help to explain what Neilson (2007: 241) has characterized as the, "...movement towards the entwinement of private extension, input credit and purchasing through contract farming" that began to take place in 2007 in East Kolaka. To date, no contractual binding exists between growers and end buyers however, and such direct-purchasing programs have (i) been contested by Indonesia's domestic trading lobby and (ii) are legally ambiguous within Indonesia (*Interviews with Direktorat Jenderal Perkebunan Sulawesi Tenggara*, Neilson, 2007).

Official company documents reiterate the freedom of choice growers experience as a good⁹. Unofficially, companies consider investment areas (and the cacao contained within it), to be “*their territory*” (Interview, 06/13). This fact is also illustrated by the development of SCPP, the most recent public-private partnership in the sector. Whereas earlier years saw lead firms engaged across diffuse production regions, firm “territories” have been stabilized under SCPP, which spans 29 major cacao-producing districts in Indonesia. The SCPP consortium nominally represents an industry-wide partnership. In practice, lead processors and manufacturers have delineated particular regions as their own. In Southeast Sulawesi, Cargill and Mondaléz have been the key private actors involved, building on a legacy of Cargill’s engagement in establishing buying stations in the area.

These data suggest that investments serve, at least in part, as a means of (i) facilitating greater corporate access over smallholder cacao from the region in the context of stagnant regional cacao supplies and emergent market opportunities and (ii) facilitating greater corporate access to high-quality fermented cacao to counter resurgent protectionism within Indonesia’s domestic cacao economy. The next section demonstrates why the success of these investments and broader corporate accumulation strategies cannot be taken for granted. Drawing on land and household surveys, I show that formal participation in programmatic initiatives has generally been limited, and that despite widespread awareness of recommended management and production practices, their uptake has been highly variable among growing households.

6. Smallholder Perceptions of and Engagement with Cacao Extension

6.1 Participation in and Perception of Cacao Extension

Despite the repetitive nature of these programs over the past fifteen years, recent programs continue to emphasize growers’ need for support. As an SCPP progress report articulates, “*Many cocoa farmers have limited knowledge of good agricultural practices and lack access to resources needed to apply this knowledge to improve their business*” (2016. 02.22-CL-D-2015 Progress Report; 64:17). Potentially corroborating this, results indicate that only 40.3% and 30.6% of cacao-producing households, typically the land-wealthy (**Table 4**), have participated in or otherwise received support from GERNAS and SCPP across the study area, with only 50.5% of households having participated in some form of extension over the past fifteen years, inclusive of these two programs.

Table 3. Participation in Extension vis-à-vis Land and Cacao Ownership.

	GERNAS		SCPP	
	<i>Yes</i>	<i>No</i>	<i>Yes</i>	<i>No</i>
<i>% Cacao Producing Households</i>	40.3%	59.7%	30.6%	69.4%
<i>Average Cacao Ownership (2014)</i>	2.45 ±	1.70 ±	2.68 ±	1.71 ±

⁹ For example, Peter Blommer of Blommer Chocolate (2011: 23) argues that “...farmers have much greater access to exporters to market their good cocoa through the 11 Blommer/Olam buying centers...It is important to point out that farmers are free to sell their cocoa to the highest bidder and do not have any obligation to Blommer/Olam.”

	0.26	0.26	0.39	0.20
<i>Average Land Ownership (2014)</i>	3.49 ± 0.66	2.39 ± 0.33	3.58 ± 0.49	2.51 ± 0.28

This table depicts modest rates of engagement in extension, generally among land-wealthier households.

Despite relatively low formal participation in extension, almost all growers purport to know recommended techniques. As one grower expressed:

“At this point, farmers’ knowledge is already complete, our understanding is already sufficient... every year we are given programs, every year. Even if it’s just a demonstration. Almost every day extension agents meet us in our fields. They ask: what problems do you have? What problems can we overcome together? The problem is that farmers are rarely satisfied [with results from extension].”

Interviews among participating households reveal that even highly engaged households now feel fatigued by time commitment required to participate in formal programs. Testament to the regularity of cacao extension in the area, many households find it difficult to differentiate between programs given the similarity of trainings and because all extension is officially channeled through farmer groups. As many trainings are led by designated farmer group leaders, themselves neighbors and other villagers, most households feel that they can obtain access to this knowledge regardless of formal participation. Not only do growers frequently work alongside one another through reciprocal labor arrangements (*gotong royong*) but, as neighbors, they frequently socialize and exchange information. Their production challenges, therefore, are not a result of limited knowledge, a governance “gap” commonly centered in policy documents.

Pressures to organize and host events are particularly intense for farmer leaders. One farmer leader complained:

“People [program representatives] come and they don’t stay. It’s been a revolving door of people with the ability to leave. After a while we get tired of seeing so many people, of new people coming in to take data and names.”

This farmer leader also provided an example from one month prior, when participants in the SCPP farmer group he oversees were promised a Westerner (*orang Barat*) would visit their fields to check on progress towards certification. He prepared all morning, organizing an event with food and drink. But no guest appeared, making it seem like he’d lied to his group members. Baso describes mornings spent messaging and rounding up people to make sure trainings are well attended. At times, he has also covered some portion of the food and drink expenses.

Other people, including those who grow cacao but do not participate formally in extension, resent the exclusive fixation of development support in the region on cacao:

“How many times have we asked for irrigation support? If we had irrigation, those of us with land at the edge of the swamp would be able to produce our own rice. We could draw water from the river, water isn’t an issue here. So many times we’ve requested it, but they [the government] don’t want to focus on this.”

Nonetheless, most people feel that extension has communicated valuable means of addressing and understanding ongoing production losses, providing advice consistent with their own observations and intuitions. For example, with respect to fertilizer, many growers have mentioned that protracted use of urea fertilizer eventually makes the surface of the land so hard (*tanah keras*) that water does not percolate. This is consistent with the lessons of extension specialists who explain that the urea fertilizer initiates plasmolysis, raising the temperature of the topsoil and killing micro-organisms. With respect to pesticides, growers have noticed a growing resistance of the Cacao Pod Borer to chemical pesticides, a reality explained to them in terms of the pest’s evolutionary ecology by cacao specialists from various programs. Furthermore, during interviews, people regularly highlighted ‘success stories,’ or instances where growers they knew personally had fully adopted recommended techniques and have achieved yield increases. Many people believe that, if fully implemented and followed as practiced, recommended production practices can generate higher yields and profits, particularly where accompanied by planned price premium under certification. This further illustrates that growers do not lack knowledge of recommended techniques. It also indicates that the variegated adoption of techniques I describe below is not motivated (at least for most people) by a distrust of the potential efficacy of such approaches.

6.2 Adoption of Recommended Management and Production Practices

Despite wide awareness and acceptance of proposed techniques, however, their adoption has been variegated. Land surveys indicate that roughly 40% of cacao farms have been grafted (a figure roughly correspondent with participation in GERNAS) and reveal that 49% of smallholder fields show evidence of regular pruning, recommended for managing Cacao Pod Borer. However, cacao trees have been cleared from roughly 8% of farms; 20% of farms show signs of fallowing, marked by secondary regrowth of scrub and brush and long-unharvested cacao pods; 51% of cacao fields show no evidence of pruning; and 73% of cacao farms have been intercropped in new commodity crops over the past five years. Only seven of 150 surveyed fields showed evidence of recommended disease sanitation techniques, indicated by a designated area to burn pathogen infected planting refuse. Further, nearly all farms are still characterized by experience high pest and pathogen loads, indicating that despite fifteen years of investments in overcoming such issues, they have had limited efficacy in decreasing pest and pathogen pressure in the smallholder sector overall (**Table 5**).

Pest and Pathogen Incidence

	<i>Extremely High</i>	<i>Present</i>	<i>Not Present</i>
<i>Cacao Pod Borer (n=129)</i>	32.6%	65.1%	2.3%

<i>Vascular Streak Dieback</i> (n=146)	21.2%	52.1%	26.7%
<i>Black Pod Rot</i> (n=138)	26.1%	70.2%	3.6%

Observed Management Practices within Cacao Fields

	<i>All Trees</i>	<i>Some Trees</i>	<i>No Trees</i>
<i>Graft Installation</i> (n=150)	26.0%	14.0%	60.0%
<i>Felling of Cacao Trees</i> (n=150)	1.3%	7.3%	91.3%

	<i>Yes</i>	<i>No</i>
<i>Apparent Fallowing</i> (n=150)	20.7%	79.3%
<i>Pruning</i> (n = 148)	48.6%	51.4%
<i>Intercropping New Commodity Crops</i> (n=150)	73.8%	26.2%
<i>Disease Sanitation</i> (n=150)	4.7%	95.3%

Table 5. Overview of Land Management Trends.

This table summarizes data from a randomized survey of 150 cacao fields.

Surveys and in-depth interviews with cacao-growing households corroborate field observations, suggesting that 90% of households who have adopted grafts did so only because they were provided free of charge through GERNAS. Household survey results suggest slightly higher rates of pruning and disease sanitation (60% and 11% respectively), but do not indicate significant differences between households who participate in extension versus those who do not. Finally, household surveys indicate that similar rates of intercropping, again with no significant difference observed between households participating in programs and those who do not. This further suggests the limited impact of current sustainable intensification initiatives.

Specific to fermentation and post-harvest production practices, grower interviews nearly all suggest that the higher prices of fermented beans are not sufficient to justify the extra labor. As one person explained:

Farmers have to move fast. Why on earth would we ferment cacao? Ferment it several days, actually I've fermented it up to a week. The money's the same. If the difference is just going to be 1-2,000 Rupiah [US \$0.07-\$0.15 per kilogram of raw cacao beans], I'll let it be."

Some growers have participated in direct purchasing arrangements in the past but argue that future direct purchase schemes will only be helpful if they do not require growers transport their beans to purchase stations individually, as is currently the practice. Where buying stations are far from growers' households, growers incur transportation costs (and forgone labor time) that can undermine observed price premium. This is particularly true over the past three years, a time of cacao scarcity in local markets. Given relatively high prices at present, small-scale local traders now generally compete for beans, pushing prices higher for growers. "Chocolate is more sure than gold," one grower remarked. "If I put chocolate in front of the house, traders come to me. If I mine gold, I have to take it

to market.”

Potential credit schemes and certification have been proposed as ways to increase the premiums growers obtain for cacao and facilitate access to capital for labor costs, organic fertilizers, and other production costs in the lean months before full harvest. These approaches are not yet fully developed under the SCPP program, making it hard to quantify their impact in the study area. However, evidence of only modest trajectory towards certification is indicated by household survey results, which demonstrate that most households in the program continue to use pesticides and herbicides. Only 10% of those households participating in SCPP have adopted organic pesticides or herbicides¹⁰ and only 8% of participating households have replaced synthetic fertilizer with compost.

SCPP program representatives acknowledge the modest movement towards of certification. As one representative stated:

“There are growers whose management is correct, those whose management is almost correct, and yes, maybe there are many who would consider their management routine though it is not. So when we meet to discuss with them, we ask: how can you fulfill those things you’re supposed to, even if they’ve already fallen off. We have more communication. I tell them that the companies will be interested, and will provide an appropriate price (harga yang pantas), if only they can produce a bean that passes certification.

The above data indicate that although support for cacao production has continued to be elaborated and extended over the past fifteen years, household engagement in extension is limited, with variable uptake of proposed technologies and techniques. The next section argues that these dynamics in fact reflect most growers’ long-term transition *away* from cacao.

7. Explaining The Transition Out of Cacao

The disconnect between public-private investment and grower divestment in cacao, treated more fully in this section, can be understood with respect to five key dynamics: (i) the elevated labor costs and decreasing profits associated with cacao production; (ii) household labor scarcities; (iii) limited access to synthetic inputs; (iv) the unpredictability of cacao investments; and (v) new commodity crop opportunities. Degraded agro-ecological circumstances underpin these dynamics.

7.1 Elevated labor costs and declining profits associated with cacao production

Contrary to the argument that growers need to be trained in running their farms like a business, many growers abandoning cacao production are doing so because they feel it

¹⁰ One farmer is combining wild cassava, water from tobacco, and various leaves (e.g. clove leaves) to create an organic pesticide, drawing on lessons learned through SCPP as well as government extension agents. Some growers are also experimenting with primarily organic herbicides, for example, using fermented water from cacao mixed with a portion of synthetic herbicide (*Gramoxone*).

represents a declining economic proposition. Household surveys suggest that although cacao prices are currently high, 92% of growers find that their yields remain more than 50% lower over the past three years than they were at peak production. This is despite nearly 15 years of extension to support cacao production in the area. Furthermore, interviews reveal that even where only a modest number of recommended management techniques are adopted, the cost associated with labor and capital inputs can exceed expected profits. As two growers relate:

“When cacao is young, it produces well and doesn’t require too much work. After it’s mature, it produces little and requires too much work. Meanwhile the price of chocolate goes up and down. As soon as my peppercorn trees yield, I will leave it.”

“How can we make money if the price of cacao is only 20,000 Rupiah? If the yield is what it is, I lose. I hire laborers to work my field. It’s different from those who work the fields themselves because they don’t know how much money they’re spending [on labor]. So I can count: okay, if I prune the trees, if I fertilize the fields, if I use laborers continuously, I can count up my expenses and see if they are less than what I get per year in tons. It doesn’t balance out.”

Another grower stated similar, explicitly connecting it to current extension:

“If we’re only given this advice, these grafts, chocolate production in Indonesia will continue to go down. Except among dumb farmers. Indonesia doesn’t have any more companies growing chocolate. That’s proof it’s a bad investment. The expenses don’t match the costs.”

7.2 Labor Scarcity

Among those growers who remain invested in cacao, many simply lack the labor power (whether physically, or in terms of the ability to hire wage laborers) to manage their fields in accordance with recommended practices. Adopting proposed pest and pathogen management techniques requires well-timed labor inputs, particularly at the beginning of the growing season when fields are ideally fertilized following the first rains. It also requires long-term labor investments (e.g. tending livestock to produce organic compost; digging drainage ditches within their fields to improve water retention; installing grafts where previous varieties have failed; or managing intercropped species). Many growers cannot afford to invest this labor given the sustained depression in cacao yields and cacao-related incomes. Many growing households report they now generally depend more on off-farm income than when cacao was first planted. As one person remarked:

“When there isn’t enough chocolate, where there isn’t any other work, we leave the village [to look for work].”

Ideally growers would only out-migrate when farm tasks were minimal. However, most people do not choose when to work. Most people instead wait for a *panggilan* (a call, or a

request for work from a known labor recruiter). Calls may provide work for 2-4 weeks in construction or logging, occasionally longer. In many cases, households are in debt to labor bosses that they are required to pay off through their labor when work becomes available. A refusal to work when requested can result in threats and in worst cases, violence or property confiscation. The predominance of male rather than female out-migration for work in the region further constrains households' ability to engage in recommended practices. Not only are men more likely to participate in farmer groups and receive trainings, but most recommended management techniques, including pruning, fertilization, livestock maintenance and compost production, are considered to be male tasks per local gender norms.

The above describes the experience of households experiencing relative economic distress. However, even wealthier households now often experience labor scarcity. Most of the wealthiest households planted cacao in the late 1980s or early 1990s, a common pattern in smallholder commodity frontiers: Yields were high during this time, land was cheap and accumulation was rapid. The heads of these households are now older and many have sent their children to college. Many of their children have translated their college education into high-paying jobs in rural towns or urban areas in the province or elsewhere in Indonesia, “delinking” their livelihoods from their land (Rigg, 2006; Rigg, 2012) and reducing the supply of household labor available to manage fields. While these labor constraints are theoretically possible to surmount by hiring waged labors, wages from cacao are so low that few growers are willing to pay others to manage their fields.

7.3 Lack of Access to Synthetic Inputs

Growers almost ubiquitously believe that if regular pruning, harvesting, farm sanitation and composting is not undertaken, synthetic inputs are necessary, even despite their declining efficacy. In recent years, however, agri-chemical inputs have become more difficult to obtain, largely given the decline in capital availability associated with yield declines. The lack in capital to afford farm inputs is particularly acute early in the growing season when inputs are most needed and when cacao income from the prior growing season is nearly expired. As one person explained:

“There are fewer people anymore who fertilize because our stomachs need fertilizer (kampung tengah saja mau dipupuk).”

SCPP has responded to this by partnering with local banks to facilitate low-interest credit. Growers, however, indicate that they are unwilling to take cash loans for cacao given the unpredictability of yields. Historically, loans from small-scale cacao traders circumvented this by extending inputs to growers in return for a share of future harvest. However, lenders have stopped doing this in recent years. “*The traders are scared,*” one person stated, corroborating interviews with farm store owners and operators:

“Before if we wanted to borrow two sacks [of fertilizer] we were usually given 10. Now there’s too little trust between traders and farmers because too many are defaulting on their loans. But how can growers repay them in yields if they have no yields?”

Even where growers have capital or are willing to take credit for farm inputs, synthetic fertilizer has been difficult to obtain over the past two years. A recent regulation from the Provincial Plantation Department (*Dinas Perkebunan Sulawesi Tenggara*), designed to circumvent fraudulent fertilizer sales and incentivize farmer group membership, requires that all fertilizer be purchased through a single authorized dealer and only sold to members of existing farmers groups (*kelompok tani*). Not only do limited fertilizer supplies quickly sell out, but many people who grow cacao are not members of farmer groups.

7.4 Unpredictability of Investments

Asked about their limited engagement in current programs, growers also point to the failure of past investments in cacao, which they attribute not necessarily to bad advice but to growing climactic uncertainty and the interplay between different pests and pathogen regimes. One grower explains that if the rains are going to be heavy, he wants to prune so that sun can dry the moist vegetative material, preventing the outbreak of fungal spores conducive to Black Pod Rot. Yet if he does and the rain suddenly stops, as it has in recent growing seasons, he further exposes his trees physiological stress from the sun, increasing likelihood of both Cacao Pod Borer and Vascular Streak Dieback, and potentially killing young buds in the case of drought. “*You see the problem?*,” he laughs. Irregular wet and dry seasons over the past five years have compounded yield losses and contributed to grower uncertainty.

The variable quality of cacao grafts has also driven cacao and aid fatigue. Most growers who grafted their trees did so with GERNAS support. However, at the time their trees were grafted, few high quality certified tree nurseries existed. Furthermore, rushed implementation of the program led some grafts to be installed right before the rainy season, nearly ensuring their failure. Some grafts have succeeded and have encouraged others to install them independently. However this constitutes a major labor expenditure (roughly 10 minutes per tree x 200 trees/ha; usually done once but also subsequently monitored and cared for, including through investments in pruning). Mixed results with grafts have dissuaded more growers from undertaking this independently.

7.5 New Commodity Crop Opportunities

In contrast, peppercorn, clove and oil palm all make increasingly good financial sense. Another grower, explaining this phenomenon, states:

“If we compare the price of cacao... it’s only 30,000 Rupiah/kilo. What’s more, it’s a pain. Now, peppercorn, the price is 150,000-180,000 Rp/kilo and it’s not too hard. That’s what actually makes farmers run to peppercorn. Economic factors.”

For the most part, these new crops are more amenable to growers’ labor constraints, outside the initial period of establishment. Peppercorn, one of the most commonly planted species, is a flowering vine that growers plant on gamal (*Gliricidia sepium*), a fast-growing and nitrogen-fixing tree species. While the work of managing and

establishing peppercorn cuttings on gamal trunks can be time-intensive, most of the associated labor, with the exception of planting host trees, is done by women. Peppercorn provides households with a supplemental source of work and income despite male out-migration. More financially secure growers tend to plant long-term tree crops such as clove and oil palm, temporarily managed alongside cacao but over the long-term seen as incompatible with cacao production. These tree crops can involve significant upfront investments, but generally do not require much work after planting, allowing for other pursuits in the 3-4 years before they yield. Furthermore, because peppercorn, clove and oil palm are relatively new to the region at scale, all can currently be managed without pesticides or fungicides. Peppercorn can also be managed without fertilizer.

Interviews reveal that most people maintain cacao trees for temporary income until new trees yield, intending to plant new commodity crops throughout their entire fields. Some growers note the synergies in planting cacao and peppercorn together. Intercropping gamal trees as stakes for peppercorn vines reduces the grass growing in the interstices between cacao trees, reducing weed growth. Furthermore, the peppercorn vines provide an additional layer of shade for the chocolate leaves, preventing them from being over-scorched by the sun. Most people however – for reasons articulated above – plan to clear cacao trees as soon as they have access to the income from newly planted commodities, making way for expanded production of more lucrative crops.

8. Conclusions

Dominant narratives to date have largely presented investments as either a win-win-win for corporations, smallholders and their environments, or as a grab for greater corporate control that will further endanger rural livelihoods, leading to debt, dispossession, and/or greater inequities in value capture along agricultural commodity chains. Re-embedding sustainable intensification programs in context, and examining their articulations with complex social and natural realities, reveals certain disconnects between policy narratives and actualities in East Kolaka. By doing so, this work adds to a growing discussion on both the emergence of contemporary public-private investments in sustainability and their implications for smallholders and their agrarian environments.

I have argued that growing public-private partnerships, at least to some extent, aim to facilitate greater corporate access to limited regional cacao supplies and high-quality cacao in the context of ongoing protectionism within Indonesia's domestic cacao economy. This points to the utility of such investments in fostering long-term corporate accumulation and interests, potentially to long-term detriment of smallholders, particularly if/where contractual purchase arrangements between smallholders and end corporate buyers emerge. However, at present, and despite the proliferation of support for cacao production, many if not most households appear to be turning away from the crop. Growers see cacao as a fickle crop ill-suited to degraded local agro-ecologies. Growers also see cacao as a deteriorating economic proposition vis-à-vis emergent markets in peppercorn, clove and oil palm. A handful of growers remain invested in the crop. Most other people manage cacao as a short-term source of income while they wait for new commodity crops to yield. Many growers have fallowed their fields or their trees, or have begun to clear trees from their fields. Certification and other direct purchasing schemes

present as impositions rather than as meaningful support.

Growers' disinterest is not a strategy of resistance to corporate control or engagement. Rather, many growers appear as business-savvy economic actors. Most people perceive recommended growing techniques to be valid. The labor costs however are too high to justify further investment, producing as they do for sub-livelihood wages. My research has shown that if the price were right, more people would invest in proposed management and production practices. More growers would also undertake long-term capital investments in their fields. Rather than infinitely expanding the repertoire of recommended practices (and time and labor-intensive meetings), a far more effective solution would be to increase the share of value smallholders receive for producing cacao. Certification premiums, promising a meager premium above current prices, will not be sufficient to compete with the returns other commodities provide.

These data suggest that an equitable share of the value along cacao commodity chains, one which sufficiently compensates people for their labor in producing this global commodity would provide a strong basis for a sustainable cacao economy in Sulawesi. Instead, in March 2015, the various public and private partners behind SCPP announced that SCPP would be extended through March 2018. The newly dubbed "Green Prosperity Sustainable Cocoa Production Program" (GP-SCPP) like its predecessor SCPP has been financed by US development aid, in this case, through matching investments from the Millennium Challenge Corporation, an organization created by Congress in 2005 to support private sector engagement in development practice.

CONCLUSION

This dissertation is organized around three narratives that have been central to enrolling the diverse array of public and private actors and institutions invested in the sustainable intensification of Sulawesi's smallholder cacao economy. Each is in essence an *historical* argument about the nature of cacao expansion and production though often not treated or assessed as such. The first is the proposition that cacao production, both globally and in Sulawesi, is closely associated with deforestation (and thus, that investments are needed to enable further production on existing lands, preventing a 'mining' of remnant forest resources) (see, e.g., Nieston et al. 2004; Ruf and Schroth, 2004; Clough et al. 2009). The second is the proposition that the Indonesian state was "hands-off" in the course of cacao expansion (and thus, that private sector and civil society engagement is needed to introduce *guided* development where none has existed previously) (see, e.g., Akiyama and Nishio, 1996; Ruf and Yoddang, 2001; Neilson, 2007). The third is the notion that supporting cacao production means supporting smallholder livelihoods in this region. This idea is so pervasive it is nearly taken for granted, exemplified by the vast sums of money invested in Sulawesi's cacao sector in the name of development aid (see, e.g., ACDI/VOCA 2005; Kindornay and Higgins, 2012; Sustainable Cocoa Production Program, 2016).

These assumptions comprise the received wisdoms which make current public-private investments in Sulawesi *make sense* to so many of their constituent participants, even when the reality seems to contradict this logic. Collectively, they allow for current investments to be promoted in ways that obscure the highly asymmetric and uneven ways people and landscapes have been incorporated into cacao markets as well as the highly uneven distribution of benefits and risks associated with contemporary investments. Ultimately, they frame the "cacao problem" and the "cacao solution" in Sulawesi in ways that foreclose other ways of imagining conservation and development policy in this region (Li 2007; Lave, 2012). My dissertation, by critically deconstructing these interlocked assumptions throughout three chapters, aims to supplement the relatively more apolitical ecologies (Robbins, 2011) that have been offered for this region and of public-private interventions in the cacao sector to date. Throughout my three research chapters, I expose the partiality of economic understandings of the sector, providing a more nuanced understanding of the socio-spatial and socio-political dynamics of land use, land cover and livelihood change that have characterized recent transitions and developments. By doing so, I provide a grounded explication of how novel governance arrangements in tropical agricultural landscapes are playing out, and with what implications for both agrarian producers and their environments.

Chapters One and Two assess relationship between cacao and deforestation, drawing on Landsat MSS imagery from the GLS 1975 collection and wall-to-wall land cover change mapping with over 150 Landsat ETM+/TM images within Google Earth Engine. I integrate these data with forty years of provincial-scale data on tree crop production and in-migration, as well as spatial data on soil fertility and elevation. Corroborating existing work, this data reveals strong linkages between cacao expansion and forest cover loss, particularly in alluvial lowland forests (Ruf and Siswanputro 1995; Ruf and Yoddang,

2001; Erasmi et al., 2004; Nieston et al. 2004; Ruf and Schroth, 2004; Steffan-Dewenter et al., 2007; Erasmi and Twele, 2009). However, these data also challenge the essentialized relationship between cacao and forest cover loss often posited. I find that smallholder tree crop plantings, including plantings for cacao, produced rates of tree cover gain which were three times gross rates of forest cover loss from 1972-1995 and which equaled gross loss rates from 1995-2014. The smallholder tree crop economy not only drove forest clearance; it also *revegetated* long-fallowed *Imperata* grasslands.

These data facilitate a more comprehensive understanding of the environmental implications of tree crop production in this region, pointing to the need to expand the baselines used to study carbon and biodiversity change in tree crop production landscapes (i.e. beyond an assessment of forest conversion). They also provide a uniquely historical and multi-directional assessment of the biophysical changes associated with agricultural expansion and production in tropical landscapes. Although the expansion of export-oriented commodities, particularly oil palm, soy and cattle, has been associated with significant forest cover loss (Gibbs et al., 2010; Carlson et al., 2012), significant evidence suggests that dynamics of tree cover gain are more definitive of contemporary land cover changes in certain parts of Latin America and Asia than are dynamics of forest clearance (Rudel et al., 2002; Chazdon, 2014; Hecht, 2014). Despite the diversity of change trajectories underway, however, much work within land systems science has continued to focus on refining estimates of forest cover loss, particularly recent rates of tropical forest cover loss.

Chapter One documents 42 years of land cover change across 78.9%, 88.1% and 99.7% of all of Southeast Sulawesi province for the reference years 1972, 1995 and 2014. This approach demonstrates how recent methodological advancements within land systems science can be used to overcome limitations in historical imagery availability and issues of cloud cover in tropical environments. These advancements are at least four-fold, and include: (i) open access to the entire Landsat archive, (ii) the cultivation of high-quality, pre-processed collections of historical imagery through the Global Land Survey databases; (iii) the development of a novel cloud-based computing platform, Google Earth Engine; and (iv) techniques of multi-date image compositing. **Chapter One** emphasizes the utility of new data sources, tools and techniques in capturing processes of tree cover *gain*; a longer-term process than is tree felling and to date relatively absent from analyses of tropical land cover change.

Chapter Two grounds four decades of land use and land cover change in four lowland villages to critically assess the proposition that the state remained “hands-off” throughout Sulawesi’s cacao boom. Countering this narrative, **Chapter Two** demonstrates a long precedent of state policy interventions which both directly and indirectly contributed to the formation of a smallholder cacao economy in Southeast Sulawesi. From roughly the 1950s through the 1980s, state foresters’ land claims and forced evacuations of indigenous Tolaki swiddeners helped “free” forested land for conversion to cacao production. Colonization programs and forest industries populated rural areas with in-migrants and drove initial encroachments into the forest, deepening market linkages between rural areas and nearby towns. In many areas, support for production and

agricultural development initiatives then provided growers with inputs, information and tenurial security as they planted forested lands in cacao. These policies not only enabled some of the fastest rates of cacao adoption ever observed globally; they also drove forest cover loss and fostered high smallholder livelihood dependence on cacao – key dynamics to which contemporary policies respond.

These data nuance an assessment of the environmental implications of cacao expansion, suggesting that much of the forest that was cleared in the course of cacao expansion was not “primary forest” as others have claimed (e.g., Ruf and Scroth, 2004). It is likely that many cleared patches of land were forcibly abandoned Tolaki swidden fallows or degraded state forests whose most valuable timber and rattan species had already been extracted by concessionaires. This is further suggested by interviews which suggest that forest lands cleared for cacao were often “sold” in ways that protected prior claimants’ rights to planted fruit and palm trees contained within them, including durian, rambutan and, most importantly, sago palm, an important subsistence staple in the region.

These results speak to the role of state development regimes in shaping the formation of commodity frontiers throughout many tropical landscapes, particularly in the post-WWII period (Hecht, 1993; Rudel, 1993; De Koninck, 1996; Angelsen and Kaimowitz, 2001; Lambin and Geist, 2001). I contribute to this work by providing an illustrative case of the “patchwork” nature of state territorialization, exposing the heterogeneity and uneven nature of state territorialization processes even within the same category of land use and control: state forestlands (Peluso and Vandergeest, 1995). These data concretize the notion that history matters. They illustrate how different historical manifestations of political violence and different configurations of state actors and institutions have contributed to divergent scenarios of cacao expansion, smallholder market success, and landscape change in four otherwise broadly similar settlement regions.

The current neoliberal moment is, according to some, marked by the retreat and hollowing out of states throughout the liberalized market economies of the Global South. These data push against this narrative by illustrating how histories of state engagement live on in the various inscriptions of prior state engagements (Bryant and Bailey, 1997; Lukas, 2014): in high levels of rural differentiation along lines of class and ethnicity; in degraded production ecologies; in long-standing conflicts surrounding the ownership and governance of land; and in broadly uneven legacies of frontier development and state formation. My dissertation findings illustrate why histories of state engagement remain relevant, even as corporate and civil society actors come to play a larger role in implementing and designing agricultural development policy.

Finally, **Chapter Three** assesses the proposition that sustainable intensification initiatives are enabling smallholder livelihood security and environmental conservation, understood here to refer to improved production ecologies, broadly script. I begin by describing the programs themselves. I find that despite the diversity of programs that have operated in the region to date, all share common programmatic emphases, including: teaching growers diversified and agro-ecological techniques for managing pest and pathogen regimes; training households to approach “farming as a business” and to

produce high-quality fermented cacao; facilitating the establishment of buying stations controlled by lead multi-national firms such as Cargill; and providing modest price premiums for fermented cacao (and though not yet implemented, eventually for UTZ certified cacao).

I found striking disconnects between these forms of extension and growers' aspirations and capacities in the sector. Most cacao growing households appear to be turning away from the crop. Growers see cacao as a fickle crop ill-suited to degraded local agro-ecologies. Growers also see cacao as a deteriorating economic proposition vis-à-vis emergent markets in peppercorn, clove and oil palm. A handful of growers remain invested in the crop. Most other people manage cacao as a short-term source of income while they wait for new commodity crops to yield. Many growers have fallowed their fields or their trees, or have begun to clear trees from their fields. Certification and other direct purchasing schemes present as impositions rather than as meaningful support.

Growers' disinterest is not a strategy of resistance to corporate control or engagement. Many growers appear as business-savvy economic actors. Most people perceive recommended growing techniques to be valid. The labor costs however are too high to justify further investment, producing as they do sub-livelihood earnings. These findings show that if the price were right, more people would invest in proposed management and production practices. More growers would also undertake long-term capital investments in ecologically repairing their fields. Rather than infinitely expanding the repertoire of recommended practices (and time and labor-intensive meetings), a far more effective solution would be to increase the share of value smallholders receive for producing cacao. Certification premiums, promising a meager premium above current prices, will not be sufficient to compete with the returns other commodities provide. These data suggest that an equitable share of the value along cacao commodity chains, one which sufficiently compensates people for their labor in producing this global commodity (and which redresses the more than 15% decline in smallholders' value share over the past two decades), would provide a strong basis for a sustainable cacao economy in Sulawesi.

These data raise the question of who such investments serve, if not their purportedly core constituency: smallholder producers. It also raises the question of why such investments persist, fifteen years after their onset and in the context of sustained smallholder fatigue with cacao. I conclude, drawing on participant observation at two industry conferences and in-depth interviews with program representatives and financial supporters (**Chapter 3**), that investments continue because they serve corporate interests in chocolate markets in Asia. Indonesia is the only country in Asia to rank within the top ten annual exporters of cacao globally. It is by extension the only production site capable of supplying growing consumer bases in India and China on a just-in-time basis. Further, Indonesia's cacao sector is relatively free from the concerns surrounding child labor and political volatility that plague the other key nodes of global supply in West Africa (Neilson, 2007). Private sector investments in cacao in this region, to important extent, facilitate greater corporate access to limited smallholder cacao supplies in Indonesia. They enable highly consolidated multinationals greater competitive capacity to scramble for first-footing in the quickly growing chocolate markets of India and China.

Private sector engagement in current public-private initiatives thus does not only result from growing demand for sustainable agriculture among consumer bases in the Global North. It also emerges out of and in response to broader competitive dynamics along highly consolidated agri-food commodity chains. Private sector actors may be committed to greater smallholder livelihood security and lower rates of deforestation in smallholder cacao commodity frontiers. This would, at minimum, protect companies from the sometimes explosive consumer campaigns that have come to shape contemporary environmental politics. Such campaigns, such as the Greenpeace campaign which depicted Kit-Kats made of Orangutan fingers and fur¹¹, can place considerable pressure on companies, particularly “big brand” companies whose profits are predicated on a good reputation in sated consumer markets.

Framing these investments solely in the language and logic of socio-environmental sustainability, however, obfuscates other important geopolitical questions and sites of analysis. Re-casting them in terms of these competitive dynamics, in turn, sheds greater light on new dimensions of capitalist accumulation and territorialization processes in the 21st century. Evaluating policy propositions in the context of broader corporate accumulation strategies also reinforces the constraints of a public development philosophy insistently predicated on private sector engagement. It showcases how policies build on and elaborate not only earlier repertoires of state control in this landscape, but nearly fifteen years of civil society and corporate investment. Prior policy regimes centered a monotypic and input-intensive production ideal. Sustainable intensification initiatives advance an agro-ecological and ideal. Much like earlier policy regimes, however, contemporary policies reach only a narrow subset of agrarian society, potentially exacerbating resource inequities.

Taken collectively, then, this dissertation helps to re-politicize de-politicized notions of the prospective *win-wins* and *win-win-wins* under contemporary investments in sustainable intensification in Sulawesi and elsewhere. In doing so, my dissertation research can be seen as paying homage to some of the earliest works in political ecology. These works, often explicitly historical, drew upon theoretical toolkits from neo-Marxist development theory and peasant studies to challenge then-mainstream narratives of human-environment change (e.g. tropical deforestation and soil erosion), placing global flows of capital, deepening market integration and states back into the analytical framework (e.g. Dove, 1983; Watts, 1983; Blaikie and Brookfield, 1987; Peluso, 1992). Using these toolkits, the earliest foundational political ecologies provided a political corrective: they overturned then-common emphasis on the local-level drivers (e.g., poverty or population) to recover the broader webs of relations shaping human-environment change. By doing so, they overturned apolitical and overly technocratic policy solutions, offering insight into the historical origins of contemporary marginalization. They showed how understanding the multi-faceted origins of socio-environmental problems could help to critically interrogate how the problem was defined (and by whom) while simultaneously exposing potential sites of more progressive intervention.

¹¹ <https://www.youtube.com/watch?v=VaJjPRwExO8>

My dissertation is inspired by the richly *socio-environmental* orientation of these works, and of subsequent work in similar vein (Turner, 1999; Arce-Nazario, 2007; Robbins 2001, 2003; Lave, 2012; Simon, 2016; Sayre, 2017). I channel this inspiration by adopting what Lave and others have referred to as a *Critical Physical Geographical* approach: one which pays attention to uneven power relations and the politics of environmental science while simultaneously promoting the capacity of biophysical inquiry to advance socio-environmental justice (Lave et al., 2014). In my case, integrating remotely sensed analyses and land use surveys with more ethnographic and social data, including oral histories, in-depth interviews and household surveys, informed my analyses in at least three ways.

First, a mixed-methods approach provided me with multiple lines of evidence to analyze particular claims. For example, remotely sensed analyses and secondary data, household surveys and oral histories provide three means of assessing linkages between crop adoption and forest cover loss. Each method, however, pulls slightly different components of longer-term landscape change into focus. Remotely sensed data clarified the extent of total landscape change in particular settlement areas, both inside and outside the smallholder agricultural sector, and allow me to situate village case studies in broader geographical and historical context. These data also generated potential sites for ethnographic research: Why, for example, had dynamics of forest clearance accelerated so quickly in the late 1990s? Were patterns of tree cover gain inside the state forest boundaries a byproduct of time or had trees been deliberately planted? Household surveys let me work around the limitations of historical Landsat imagery at low resolution and reconstruct specific moments in the late 1980s and early 1990s when households had stopped planting cacao in grasslands and begun to plant it in the forest. Oral histories showed me processes usually invisible to pixels and surveys: the forcible eviction of most Tolaki people from the forest throughout the 1960s; small ‘encroachments’ into state forest to hunt game and wild cassava in the 1970s as people endured famine in small, rain-fed lowland plots; and the regional trade networks in logging and rattan which operated in and through state-claimed forests. I triangulated across all these disparate vantage points when I conclude that state territorialization – rather than cacao production, *per se* – produced much of the forest cover loss commonly attributed to smallholder tree crop plantings.

Second, in my case, an integrated socio-environmental analysis contributed to the counter-argument I posed to counter dominant development narratives. Despite their limitations, their obfuscations, and their inherently vague referents, “win-win” arguments are difficult to dismantle. Their fixity as discourse derives from multiple dynamics. Their capacity to wrangle a broad array of socio-environmental challenges into panacea approaches (Ostrom and Cox 2010: 452). The concentrations of power and financial resource that “monocrop” the development landscape with these utopian visions, even where they largely serve corporate interests. At least one dimension of their fixity, however, are the institutional structures that shape policy analysis within academia. There is a tendency to compartmentalize and analyze different social, ecological and political processes and effects within different disciplinary analyses and research initiatives. An integrated socio-environmental analysis in this case shored my capacity to critique

sustainable intensification policies by allowing me to engage in a multi-faceted analysis of both their broader logics and grounded implications.

Finally, I believe that incorporating an analysis of the environment into a socio-political assessment of agricultural expansion and development policy and politics helped me to further explicate and demonstrate how the environment itself must be seen as an agent of change. The environment intervenes in this account in diverse ways to shape the limits of capital accumulation and the dynamics of agrarian change. In this case, in the intractable pest and pathogen regimes that confront both growers and corporations alike; in the disease management techniques that must be undertaken at particular moments following the increasingly unpredictable onset of the wet season; and in the depletion of local forest reserves which has led many land-poor individuals to migrate to logging camps in the north of the province. These data make it clear that the environment is not only a by-product of recent history. It has also been a contributor to it.

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