UNIVERSITY OF CALIFORNIA

Los Angeles

From certification outcomes to certification processes: Demand, supply and adoption of eco-certification along the natural rubber supply chain

A thesis submitted in partial satisfaction

of the requirements for the degree Master of Urban and Regional Planning

by

Sean Francis Kennedy

2014

ABSTRACT OF THESIS

From certification outcomes to certification processes: Demand, supply and adoption of eco-certification along the natural rubber supply chain

by

Sean Francis Kennedy

Master of Urban and Regional Planning

University of California, Los Angeles, 2014

Professor Susanna B. Hecht, Chair

The intensification and expansion of natural rubber cultivation over the 20th century has had a profound impact on landscapes and livelihood strategies in South and Southeast Asia. Rubber cultivation continues to generate wealth for many smallholders and land owners, but has come at the cost of forest conversion, habitat and biodiversity loss, disruption of watershed functions, increased livelihood vulnerabilities – and in some cases – dispossession of land. Eco-certification, a form of market-based environmental regulation intended to promote less harmful production practices by securing premium prices for commodities produced in accordance with ecologically and socially responsible private standards, has been proposed by a number of researchers and NGOs as a means of addressing some of the negative impacts of rubber production. However, the highly fragmented nature of the rubber industry and a general lack of consumer awareness of rubber production processes and impacts have resulted in lower levels of

support for this approach compared to other agricultural commodities such as coffee and timber products. Somewhat counter-intuitively, the near ubiquity of natural rubber as an industrial input renders it largely invisible to end-users and makes it difficult for consumers to identify clear connections between products and their environmental or social footprint.

In recent years, issues associated with rubber production have gained visibility and a number of industry stakeholders across a range of rubber submarkets have started to adopt forms of eco-certification and labeling in response to a growing market for certified rubber products. While encouraging, the disparate nature of rubber certification efforts across an already highly fragmented industry makes it difficult to determine the alignment between claims to address environmental and social concerns and actual performance. This thesis contrasts the environmental and social impacts of natural rubber production with the range of emerging natural rubber certification efforts to assess the alignment between certification needs and certification outcomes. In addition, this thesis seeks to understand the processes that give rise to particular forms of eco-certification that may or may not serve to address actual issues associated with current production practices. By examining the nature and contexts of the relationships between certification stakeholders along the rubber commodity chain, this paper illuminates the ecological and social processes that have given rise to the demand, supply and adoption of natural rubber eco-certification as a particular form of private environmental regulation.

Following a review of the literature on eco-certification and the emergence of private regulation more broadly, I provide an overview of the global rubber industry and the range of environmental and social impacts – both positive and negative – that characterize the natural rubber product lifecycle. In Part 3 I present an overview of current mandatory and voluntary standards promoted as having the potential to overcome environmental and social concerns, and assess the extent to which these standards align with the broader negative impacts identified in Part 2. In Part 4, I examine the processes that have given rise to particular forms of eco-certification by examining the motivations of a set of actors along the rubber commodity chain who are currently involved in the production, consumption or certification of certified latex products. Using the case of the recently developed Global Organic Latex Standard, or GOLS, I follow the process of certification from the environmental and social concerns that give rise to *demand* for certification, to the *supply* of certification efforts in response to these demands, to the eventual adoption and *consumption* of particular certification programs by distributors, manufacturers, retailers and consumers.

The findings indicate that despite increased interest in eco-certification of natural rubber in recent years, these emerging certification efforts fail to address many of the more serious impacts associated with natural rubber production such as deforestation, habitat loss and disruption of watershed function. Overall, concerns raised by environmental NGOs appear to have a lower influence over manufacturer and retailer decisions to opt-in to certification programs than concerns expressed by consumers. Personal health impacts such as avoiding contact with dust mites and toxic carcinogens are the primary motivations behind manufacturer, retailer and consumer adoption and consumption of organic latex labeling. In addition, commercial concerns over loss of proprietary information lead to secrecy and make it difficult for consumers to identify the source and potential impacts generated along the commodity chain.

In sum, the current misalignment between the negative environmental and social impacts of natural rubber production and emerging eco-certification efforts points to the limitations of consumer-driven environmental regulation. The case of GOLS presented in this paper suggests a powerful role for the end consumer in emerging certification programs, as well as serious challenges private regulation presents in terms of reshaping existing notions of governance and sovereignty. No longer is democratically invested authority consummate with legitimacy to control and make decisions over the use of a country's natural capital. As such, countries may no longer seek legitimacy from their own citizens when making decisions over resource use and control, but will increasingly derive legitimacy from consumers in the global North. Growing consumer and producer awareness of the impacts associated with rubber cultivation and production is encouraging, but there is much more work to be done.

The thesis of Sean Kennedy is approved.

Susanna B. Hecht, Committee Chair

Edward W. Soja

Nick Menzies

Stephen Commins

University of California, Los Angeles

2014

Table of Contents

ACKNOWLEDGEMENTS

I would like to express my gratitude to my academic advisor and committee chair Susanna Hecht for her particular brand of inspiration, remarks and engagement through the process of this master thesis. Furthermore I would like to thank my committee members Nick Menzies, Ed Soja and Steve Commins for their valuable comments and guidance along the way. I also wish to thank the participants in my survey, who willingly shared their precious time during the process of interviewing. I would like to thank the World Agroforestry Centre, UCLA Luskin School of Public Affairs, the W.K. Kellogg Foundation, the Ralph and Goldy Lewis Center and Luskin Center for Innovation for their generous support. My final thanks are reserved for my wife, Jessica, whose willingness to endure my ill-timed absences and constant ramblings made this accomplishment possible.

From certification outcomes to certification processes: Demand, supply and adoption of eco-certification along the natural rubber supply chain

Introduction

Rubber plantations have expanded rapidly across Southeast Asia, southern China and South Asia since the introduction of the Pará rubber tree (*Hevea brasiliensis*) in the late 19th century (Fox and Castella 2013). Rubber cultivation has generated wealth for many smallholders and land owners, but also resulted in forest conversion, habitat and biodiversity loss, disruption of watershed functions, increased livelihood vulnerabilities – and in some cases – dispossession of land. Many of these ecological and socio-economic impacts, however, are not unique to rubber production. For example, oil palm has been identified by some environmental NGOs as the single biggest threat to rainforests and a major contributor to greenhouse gas emissions (Greenpeace 2007). Widespread public awareness of the impacts of oil palm expansion has contributed to the formation of the Roundtable on Sustainable Palm Oil (RSPO) and the development of the first global standards for the sustainable production of palm oil. In comparison, public awareness of the impacts associated with rubber cultivation has received limited attention.

In recent years, issues surrounding rubber production have gained visibility and a number of industry stakeholders across a range of rubber submarkets have started to adopt forms of eco-certification and labeling in response to a growing market for certified rubber products. Eco-certification – a form of market-based environmental regulation – aims to promote socially and ecologically sustainable production practices by securing premium prices for commodities that are produced in accordance with ecologically and socially responsible standards. Certification depends on the feasibility of market differentiation within the production of a particular commodity, and in particular, the ability of consumers to identify and differentiate between best and worst case production practices. While encouraging, the disparate nature of rubber certification efforts across an already highly fragmented industry makes it difficult to determine the alignment between claims to address environmental and social concerns and actual performance. Overall, a general lack of consumer awareness has resulted in lower levels of support for this approach compared to other agricultural commodities such as coffee and timber products. In addition, the near ubiquity of natural rubber as an industrial input renders it largely invisible to end-users, making it difficult for consumers to identify clear connections between products and their environmental or social footprint.

While significant attention has been directed at the environmental and economic outcomes of eco-certification, limited holistic analysis has been directed at the ways certification efforts are conceived, mobilized and mutated along commodity chains and across industries. This thesis contrasts the environmental and social impacts of natural rubber production with the range of emerging natural rubber certification efforts to assess the alignment between certification needs and certification outcomes. In addition, this thesis seeks to understand the processes that give rise to particular forms of eco-certification that may or may not serve to address actual issues associated with current production practices. By examining the nature and contexts of the relationships between certification stakeholders along the rubber commodity chain, this paper illuminates the ecological and social processes that have given rise to the demand, supply and adoption of natural rubber eco-certification as a particular form of private environmental regulation. Following a review of the literature on eco-certification and the emergence of private regulation more broadly, I provide an overview of the global rubber industry and the range of environmental and social impacts – both positive and negative – that characterize the natural rubber product lifecycle. In Part 3 I present an overview of current mandatory and voluntary standards promoted as having the potential to overcome particular environmental and social concerns, and assess the extent to which these standards align with the broader negative impacts identified in Part 2. In Part 4, I examine the processes that have given rise to particular forms of eco-certification by examining the motivations of a set of actors along the rubber commodity chain who are currently involved in the production, consumption or certification of certified latex products. Using the case of the recently developed Global Organic Latex Standard, or GOLS, I follow the process of certification from the environmental and social concerns that give rise to *demand* for certification, to the *supply* of certification efforts in response to these demands, to the eventual adoption and *consumption* of particular certification programs by distributors, manufacturers, retailers and consumers in California. The paper concludes with some preliminary questions regarding the effectiveness of emerging certification efforts, limitations of market-based environmental regulation, and the need for future research and collaboration across competing and overlapping certification programs.

PART I: LITERATURE REVIEW AND METHODOLOGY

Private environmental regulation, payments for ecosystem services, and the emergence of eco-certification

The use of market-based mechanisms to address perceived state-based environmental regulatory inadequacies is representative of a broader shift toward increased delegation of government regulatory authority to private bodies. Notable examples include the emergence of private prisons, reliance on the private sector in the disaster response to Hurricane Katrina, and the use of private contractors to provide military security in Iraq (Verkuil 2007). In recent years the delegation of authority to private bodies has taken an ever more international character in the form of private regulation of financial and commodity markets (Büthe and Mattli 2011; Büthe 2010a). According to the 2014 State of Sustainability Initiatives – an international consortium that includes the International Institute for Environment and Development and the International Institute for Sustainable Development (IISD) and the Sustainable Trade Initiative (IDH) – the recent growth in the number and use of voluntary sustainability standards can be traced to a growing recognition of the failure of public action in addressing a host of sustainability issues (State of Sustainability Initiatives 2014). Within this context a range of private environmental regulations have emerged, from individual efforts by companies to manage their supply chains to industry-wide codes of conduct and efforts by multi-stakeholder organizations to regulate and monitor using third-party verification (Auld and Gulbrandsen 2013).

Payments for environmental services (PES) programs is one form of private environmental governance that has emerged as a major component of sustainable development policies, representing an alternative to command-and-control environmental policy measures (Stringer et al. 2009). PES operates on the principle that by providing environmental service providers with a payment in excess of the cost incurred by not engaging activities that contribute to land degradation, land-users will be incentivized to adopt sustainable land-use practices.

Buyers of environmental services may be motivated by either direct or indirect needs for the environmental service, such as reduced river sedimentation for the effective operation of a hydropower station or reduced deforestation in order to offset carbon liabilities. PES refers to a wide range of potential incentives made to environmental service providers, ranging from one-off direct payments by service beneficiaries to service providers to more complex ‘market’ mechanisms involving offset credits traded among many buyers and sellers (Leimona, Joshi, and Noordwijk 2009). PES can take the form of both monetary and non-monetary benefits for environmental service providers including direct financial payments, improved forest services and improvements in physical, social, and human capital. The benefits that flow to the environmental service provider is ultimately a function of the benefits of the project relative to the costs, with costs comprised of opportunity costs and transaction costs. Opportunity costs refer to the value of the benefit forgone by not engaging in existing land-use practices, whereas transaction costs result from the exchanges between actors that are necessary to design, implement, monitor and distribute the services and associated benefits (Leimona, Joshi, and Noordwijk 2009). The attribution of costs and distribution of benefits is a major challenge in PES design, particularly given the wide variety of tenurial regimes operating in developing countries (Stringer et al. 2009).

Within the PES literature, a distinction has arisen between the term *payments* for environmental services and *rewards* for environmental services (RES), the former focusing primarily on effectiveness and efficiency and the latter concerned more with equity and fairness (Leimona, Joshi, and Noordwijk 2009). Van Noordwijk et al. (2007) develop a set of principles and criteria for RES, which have been demonstrated to generate pro-poor benefits at the regional scale. Under the criteria, to be effective, efficient and equitable, a RES program must be: (1)

realistic, in that environmental improvements are feasible and will generate benefits for buyers and sellers; (2) conditional, in that payment is dependent upon performance; (3) voluntary, in that involvement in the program is a result of free choice; and (4) pro-poor, in that the project considers equitable impacts on all actors, and design of RES mechanisms is positively biased towards poor stakeholders.

Eco-certification can be viewed as a subset of PES, in that the objective of certification is to generate a price premium for a commodity that is produced in accordance with ecologically and socially responsible standards. Notable programs include Fair Trade coffee, which guarantees producers a living wage for their commodity, and certified organic foods, which emphasizes responsible use of chemicals and protection of natural resources in agriculture. Over the past 25 years, eco-certification and eco-labeling have witnessed rapid expansion. Ecolabel Index, "the largest global directory of eco-labels", currently tracks 437 eco-labels in 197 countries, and 25 industry sectors (Ecolabel Index 2013). Since its inception in 1992, the Europe-wide voluntary environmental program EU Ecolabel has awarded more than 1,300 licenses and can now be found on more than 17,000 products (European Commission 2013). By the end of 2011, 7 percent of wild landings of seafood for human consumption, 9 percent of the world's productive forests, and 17 percent of coffee produced globally were certified (Steering Committee of the State-of-Knowledge Assessment of Standards and Certification 2012). Despite the increasing prevalence of eco-certification, the extent of consumer awareness and producer adoption varies considerably across geographic and political-economic commodity contexts. Two extreme examples are coffee, which under the Fairtrade label is considered one of the forerunners of the eco-certification movement, and natural rubber, which despite widespread concerns over harmful cultivation practices in the scientific community, has only recently received attention from certification advocates and consumers.

A number of studies have sought to analyze and synthesize existing knowledge regarding the effectiveness of current mandatory and voluntary certification programs (Searle, Colby, and Milway 2004; Steering Committee of the State-of-Knowledge Assessment of Standards and Certification 2012). In general, indirect impacts of certification have been found to be both positive and negative, with reasonable evidence to suggest significant though not universal positive changes in near-term ecological, social, and economic well-being resulting from standards-compliant practices (Steering Committee of the State-of-Knowledge Assessment of Standards and Certification 2012). From a more critical perspective, a growing literature has directed attention at equity implications of eco-certification. Some argue that while certification programs may be designed to support livelihoods, the way in which this support is provided may actually serve to unfairly distribute environmental bads or environmental responsibility, fail to recognize and encourage participation by local communities, or by placing externally determined rules and regulations on environmental use, serve to severely limit the potential for future opportunities for livelihood enhancement (Schlosberg 2008). Others contend that attempts at global environmental regulation under the banner of ‘green developmentalism’ – such as eco-certification – merely serve to revive longstanding tensions around class and notions of development (McAfee 1999).

The related issues of equity and environmental and ecological justice point to a need to move beyond an analysis of certification outcomes toward an understanding of the political processes that have given rise to these emerging forms of environmental regulation. In this vein, Büthe (2010b) employs a threefold distinction among stakeholders of the private regulation process: the political actors who demand private regulation, the non-state rule-makers who supply such governance for the global economy, and the actors who adopt private regulations who opt (although not always voluntarily) to behave according to these private rules. Büthe argues that this model leads to an improved understanding of private regulation as a political phenomenon, and allows for the identification of key stakeholders and the incentives and constraints that they face in becoming meaningful actors in private regulation (Büthe 2010b). Whether environmental standards and certification emerge in a particular industry and the particular form those standards take, therefore, is to a large extent a product of the political processes – specifically the relative levels of influence actors are able to exert over others – that manifest within the commodity chain.

Büthe (2010b) posits that private regulation has emerged to fill a void created by the inability of national governments to adequately regulate the rapidly increasing range of transnational commodity flows and transactions that characterize the global economy. By adopting the ‘global economy’ as the primary unit of analysis, however, he fails to consider the specificities of place that may shape the nature and substance of the relationships between stakeholders of private regulation across local, regional and national scales. Also, by presupposing the existence of these groups of actors as distinct entities, the relationships between these actors are viewed as secondary concerns. An alternative conception of commodity chain politics can be derived from the relational comparative approach advocated by Ward (2010). Ward employs the relational comparative approach to the study of cities in an effort to understand cities differently from the way they have been theorized in past comparative urban studies. He argues that an emphasis on ‘interconnected trajectories’ and a focus on how different cities are implicated in each other’s past, present and future, moves comparative analysis of cities beyond the search for similarities and differences between two mutually exclusive contexts (Ward 2010). A model of the certification process that merely distinguishes between those who demand, supply or adopt certification as separate and/or independent entities (i.e. Büthe 2010b) focuses more on the outcomes that arise through the actions of individual actors than it does on the social processes and power-infused relations between these groups have had on their formation. In contrast, the relational comparative approach – if applied to the politics of eco-certification – gives primacy to relationships and the places and scales at which they occur over the presupposed existence of independent units of analysis, or in this case, certification actors. The relational comparative approach as presented here forms the basis of the methodology used in this paper, and will be discussed in greater detail toward the end of this chapter.

The politics of eco-certification

Eco-certification raises a number of political issues due to the differing motivations driving the continuing expansion of private regulation. Consumers, for example, play an important role in certification as they are the ones who ultimately provide the price premium that allows the system to function. Consumers may be driven by altruism, concern for the environment, health benefits, or a desire to know exactly what it is they are buying (Searle, Colby, and Milway 2004). Yet while consumers play an important role in promoting certification uptake, consumer concern generally comes about in response to initial campaigning by environmental nongovernmental organizations, at times driven by their own political agendas (Gouyon 2003). Manufacturers and retailers who adopt certification programs may be driven by their own 'green' agendas, or possibly looking to take advantage of potentially lucrative niche markets. In some cases, organizations excluded from one form of certification (i.e. a producer that fails to meet the standards embodied in a particular certification program) may preempt the perceived threat through the creation of a rival private governance network (Smith and Fischlein 2010). In each case, who develops the certification program and the political-economic conditions under which the program is developed has serious implications for the stringency and effectiveness of the standards embodied in the program.

In his summary of a special issue of *Business and Politics* dedicated to private regulation in the global economy, Büthe (2010a) raises a number of issues relating to the supply of private regulation. The supply of private regulation involves the tasks of standard design and implementation, monitoring and verifying compliance, as well as aspects of public relations in order to generate adequate support. Given the substantial costs involved in these processes, the motivations of private regulation suppliers raise a number of questions. In many cases, the costs of delivering private regulation are offset by efficiency gains or the provision of public goods (Büthe 2010a). Rarely does this occur, however, without some form of political-economic gain for the private body, be it increased market-share, secure links in the supply chain, or to preempt government regulation in order to create their own standards before stricter and less-flexible regulations are enforced (Searle, Colby, and Milway 2004). In this way, firms set standards in order to create the standards that incur the least private cost: a goal that by no means guarantees maximum social benefit (McCluskey and Winfree 2009).

Büthe suggests that the need for providers of private regulation to generate some level of private benefit jeopardizes the viability of the approach in the long-term. For example, not all actors can enjoy increased market-share simultaneously (Büthe 2010a), and to date, there are no examples of self-funding certification schemes (Searle, Colby, and Milway 2004). The majority of certification schemes are dependent on grant aid and thus donor-driven, which subjects program design to the political motivations of funders and potentially limits the community's capacity to undertake sustainable commercial decision-making of their own accord (Colchester et al. 2003). For example, donor demands for "return-on-investment" may lead to an overemphasis on short-term projects with predetermined outcomes and measureable results, that do little to benefit the community in the long term. As such, while the long-term viability of eco-certification may be a concern, a more pressing issue is the way that private interests exercise political power through the funding of these programs in the short-term.

The shift from purely domestic to transnational forms of private regulation also gives rise to a range of new geopolitical dynamics that potentially serve to alter traditional notions of sovereignty and associated concepts of territorial authority and accountability. Cashore et al. (2006) go as far as to argue that markets have the ability to sidestep inadequate governments and gridlocked international negotiations. Concern over implications for the role of the state in terms of control over natural resources has led to considerable attention directed at the perceived threat posed by private regulation to traditional state-based forms of regulation. In his *Outsourcing Sovereignty*, Verkuil (2007) addresses the issue of what he sees as national and global privatization gone too far. To Verkuil, the privatization of government functions relating to decision-making and oversight represents a direct threat to sovereignty, which he defines from a 'traditional perspective' as the 'exercise of power by the state' (p.14). Verkuil presupposes the existence of a once-clear boundary between public and private sectors of society, arguing that it is the increasing ambiguity of this distinction that poses the greatest risk to sovereignty, as he defines it. Of particular concern to Verkuil are the inherent differences between the motivations of public and private actors. Verkuil assigns a certain nobility to the motivations of public actors, whereas as private actors are viewed as likely to respond to the perverse incentives that arise from outsourced government functions to act solely in their own interest, with little regard for the consequences for society. In this way, he cautions against the rampant outsourcing of government functions, which in the case of eco-certification has been made possible through the emergence of a new industry of certification professionals who specialize in the development and management of certification programs (Steering Committee of the State-of-Knowledge Assessment of Standards and Certification 2012). For Verkuil, governments should limit the potential for situations where the efficiency gains from outsourcing government functions to specialists in order to tap into economies of scale are offset by a loss of oversight and responsibility, and in this way, emphasizes the need for public authorities to retain core decision-making capability to ensure legitimacy and accountability (Verkuil 2007).

Critics of this view caution against confusing the reality of private regulation with the ideal of public regulation when discussing issues around private regulation. In defense of private regulation, Büthe (2010a) notes that there is no need to think of public and private as in opposition to one another, but rather, that there exists significant scope for co-regulation, with private and public actors engaged in a symbiotic relationship. This theme is echoed through much of the literature on the networked governance aspects of private regulation. Smith and Fischlein (2010) suggest that "the establishment of private sustainability governance can be understood as the emergence of a hybrid form of organizational field, where network actors draw on reputational and legitimacy resources from existing fields and collectivize in an effort to gain control of, and authority over, the emerging rules of sustainability governance" (513). Cashore et al. (2006) argue that in some cases certification has actually forced disparate stakeholders to come together. For example, LEI – a certification program operated by the Indonesian Ecolabel Institute – has contributed significantly to public awareness and engaged the interest of certifying bodies, companies under assessment and assessors, NGOs, local communities around the forest area under certification assessment, and other individuals involved in the assessment process and sustainable forest management issues (Cashore et al. 2006). In this way, larger, more inclusive networks comprised of public and private actors are seen to help disparate actors to appreciate other's perspectives and work towards compromise, especially when efforts are made to integrate all actors into the process (Cashore et al. 2006).

According to Büthe (2010a) private regulation is least likely to pose a threat to public authority when authority is clearly and explicitly delegated, and when the state has adequate capacity from the outset. As such, the forms of public authority most likely to be threatened by the emergence of private regulation are the ones located in countries characterized by weak political and regulatory institutions. At the risk of gross generalization, it could be argued therefore that there is a much greater risk posed to public authority in developing countries than developed countries. This issue is magnified when taking note of the geography of certification efforts. Returning to Büthe's (2010b) distinction between those who demand private regulation, those who supply private regulation, and those who are the targets of private regulation, it appears that the first two groups are overwhelmingly concentrated in the global North, while the targets of eco-certification tend to be located in the global South (Büthe 2010a). Certification is driven to a large degree by the demands of Northern consumers for ecologically or socially responsible products, the majority of which originate in developing countries such as Indonesia. In this way, certification creates considerable potential to shift power from public institutions in developing countries to the hands of consumers in the global North (Taylor 2005).

A final point concerns the notion of legitimacy. Private governance networks organize across multiple heterogeneous organizational fields whereby participation and consensus serves as a substitute for traditional democratic legality (Smith and Fischlein 2010). As such, the conditions of emerging private environmental governance require actors to access legitimacy and reputation resources beyond a single organization, industry, or advocacy domain (Smith and Fischlein 2010). The process of accessing legitimacy across a range of sources stands in stark contrast to traditional sources of state-based legitimacy, which has historically (at least in a democratic settings) been derived from the collective support of a relatively homogeneous population. In this way, networked private global governance has the potential to change the rules in the game of legitimacy.

Research approach and research questions

This proposal draws on two related theoretical frameworks. First, the proposal will employ the relational comparative approach as advocated by Ward (2010) in order to illuminate the nature and contextual specificities of the relationships that have informed the emergence of natural rubber certification. A key feature of this approach is that rather than taking units of analysis as pre-given, the relational comparative approach begins by questioning how the units to be studied are formed in relation one another, thereby using the different units to pose questions of each other. Specifically, I will be looking at the environmental and political-economic nature and contexts of the relationships between consumers, manufacturers and primary producers that have led to the emergence of a body tasked with the design and implementation of a particular form of natural rubber certification. While no by means revolutionary, this approach allows for an analysis of the processes that give rise to a particular form of certification, rather than simply measuring the effectiveness of a certification program or the impacts on particular stakeholders. Second, global commodity chain (GCC) analysis, which focuses on the sets of inter-organizational networks clustered around a particular commodity or product, will be employed to ground the relational approach while also serving as a tool to identify potential interview subjects (Taylor 2005).

While significant attention has been directed at assessing the *outcomes* of certification, limited holistic analysis has been directed at the ways in which these efforts are conceived, mobilized and mutated along commodity chains and across industries. I will examine the roles and influence of rubber producers, rubber consumers and certification intermediaries in the promotion, facilitation and in some cases, resistance, to certification. By 'studying through' the certification policy process (Ward 2010), the intention is to illuminate the particular relationships that inform certification as a *process*. In order to allow for a meaningful depth of analysis, the scope of the study is restricted to certified natural rubber products – specifically, mattresses – that are either manufactured or distributed in California. Restricting the scope of the study in this way limits the number of products and associated certification programs to be analyzed (of which there are many), as well defining which actors to include in the study and which to omit. More than identifying relative influence of particular groups of actors, the objective is to identify the forms of relationships between actors – such as between consumers and retailers or between manufacturers and primary producers – that have served to either aid or inhibit the emergence of natural rubber certification.

This paper draws on primary sources in the form of interviews with key informants identified through the GCC analysis, and secondary sources including existing studies on the viability of natural rubber certification and eco-certification of other commodities such as coffee and timber. Part II which focuses on the global rubber industry and the environmental and social impacts that occur through the product lifecycle was conducted through a wide-ranging literature review, with particular emphasis on Southeast Asia due to the region's prominence as a site of rubber production. Part III combines an additional literature review with a general internet search for any form of certified natural rubber or latex products. Based on a review of existing latex certification programs presented in Part III, the recently developed Global Organic Latex Standard – or GOLS – was chosen as a means to study through the process of certification demand, supply and adoption, which is presented in Part IV. Using GOLS as a ‘certification umbrella’ (Figure 7), manufacturers specializing in products under the GOLS label were identified, with Sacramento-based Organic Mattresses, Inc. (OMI) chosen as a focal point of the study based on its position as one of the first two US-based manufacturers to be awarded GOLS certification (Bedroom 2014). OMI then served as an anchor to follow the certified rubber commodity chain backward from the latex distributor through to the primary source, and forward to certified mattress retailers in Southern California, which were identified using the OMI website. This process of ‘studying through’ the certification process is represented by the smaller dark arrows in Figure 7, while the direction of the commodity chain is represented by the larger

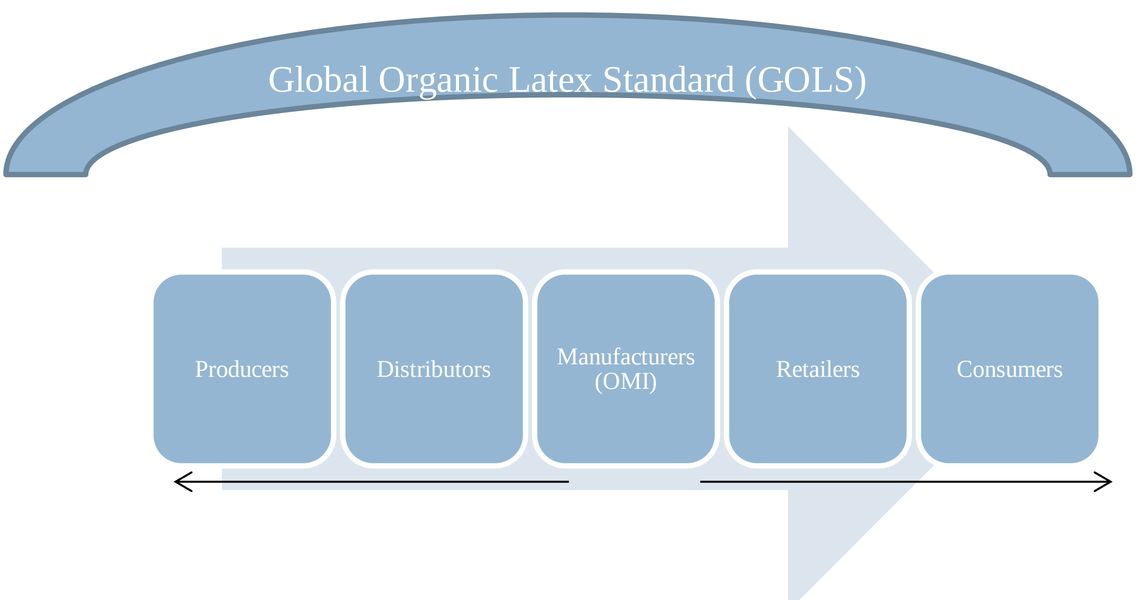

Figure 1: The natural rubber commodity chain and research process under the umbrella of GOLS

arrow in the background. Of the businesses listed on the OMI website as retailers of GOLS certified OMI products, 20 were identified for interview in order to explore the businesses motivations for carrying GOLS certified products, and to provide insight into their customers' motivations for choosing those products over non-certified competitor products.

Research questions:

- What are the current environmental and social impacts that occur through the natural rubber lifecycle? To what extent is there variation in the magnitude of these environmental and social impacts across contexts?
- What and where have been the major obstacles and challenges in the adoption of natural rubber certification?
- To what extent do emerging natural rubber certification efforts align with the environmental and social impacts occurring through the natural rubber lifecycle? To what extent is this (mis)alignment a factor of the conditions under which a particular form of certification emerged (i.e. particular stakeholder motivations, industry characteristics, etc.)?
- How have the relationships/interactions/alliances that characterize the natural rubber industry given rise to differing levels of certification awareness and adoption? How has the nature and context of specific relationships informed the definition and stringency of the standards that form the basis for certification?

PART II: DEMAND FOR NATURAL RUBBER CERTIFICATION – INDUSTRY CHARACTERISTICS AND ENVIRONMENTAL AND SOCIAL IMPACTS OF PRODUCTION

Natural rubber: a global industrial commodity

Rubber latex, a white liquid obtained through the tapping of the Pará rubber tree *Hevea brasiliensis*, is the primary input for various forms of industrial rubber used in the production of tires, tubing, medical gloves, shoe-soles, condoms and rubber bands (Gouyon 2003; Tekasakul and Tekasakul 2006). Of these products, the tire industry is the predominant user, accounting for approximately two-thirds of global demand (The Freedonia Group 2012). Natural rubber comprises approximately 47% of global rubber demand, the remainder consisting of synthetic rubber (Fox and Castella 2013). Unlike synthetic rubber, natural rubber is unique in its ability to withstand extremes of heat and cold, and as such, is the preferred input for range of high-stress uses such as jet and truck tires and medical instruments (Gouyon 2003).

Hevea brasiliensis is native to the humid equatorial regions of Amazonia between 10°N and 10° S, and traditionally grows best at temperatures of 20–28°C with an average annual rainfall of 1800–2000 mm (Arokiaraj 2000; Gouyon 2003). After initial efforts to increase the scale of rubber production in Amazon were thwarted by outbreaks of leaf blight, the center of global rubber production shifted to Southeast Asia around the turn of the 20th century (Hecht and Cockburn 2010). Since its introduction in the region, production has expanded and intensified at rapid pace. Between 1960 and 2000 the area dedicated to intensified rubber monoculture plantations in Southeast Asia approximately doubled, replacing vast areas of forests, swidden cultivation, rubber agroforests and other forms of subsistence agriculture (Aratrakorn, Thunhikorn, and Donald 2006).

Rapid economic growth in China and India has fuelled a concomitant increase in demand for cars, resulting in a direct flow-on effect on demand for natural rubber (Figure 1). Asia currently accounts for almost 70% of global demand, driven largely by China (33.5%), India (8.7%), Japan (6.6%), and Malaysia (4.6%). Demand from Europe and North America represents a significantly lower share, at 13.5% and 10.7%, respectively (FTP Securities 2013). Asia accounted for over 90% of the 11.4 million tonnes produced globally in 2012 – almost a 4% increase from 2011 – followed by Africa (4-5%) and Latin America (2.5-3%) (FTP Securities 2013). Production is concentrated in Thailand, Indonesia, Malaysia, and Vietnam, which combined are responsible for 82% of global production and about 87% of global natural rubber export volume. The majority of natural rubber is produced by smallholders, who are responsible for 93% of rubber production in Malaysia, 90% in Thailand, 89% in India and 85% in Indonesia (Fox and Castella 2013). Projected increasing demand has triggered significant interest from Chinese, Vietnamese and Thai investors to increase in rubber planting in non-traditional rubber regions such as Laos and Cambodia, whose governments have welcomed such investments as a win-win solution to alleviate poverty in rural areas and generate income from export commodities (Fox and Castella 2013; Vannarin and Lewis 2013). In Laos, more than 140,000 ha of rubber have been planted in the last decade, a figure that will potentially reach 300,000 ha during the next decade (Fox and Castella 2013).

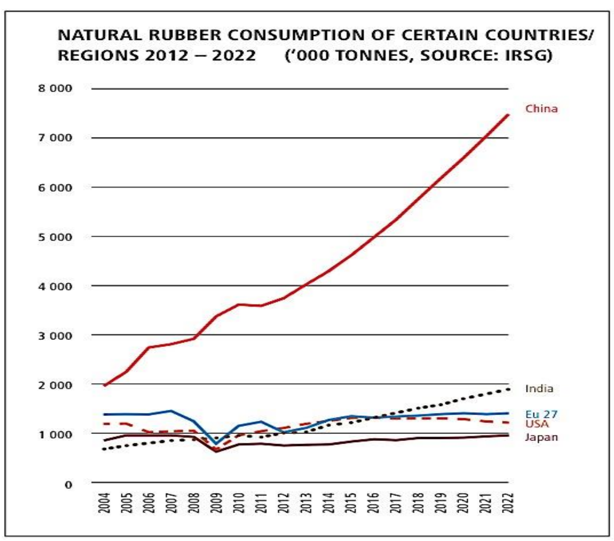

Figure 2: Natural rubber consumption 2004-2012. Source (ETRMA 2012)

In recent years, supply has outpaced demand, leading to downward pressure on prices. In 2012, total natural rubber production increased by 3.97% from the previous year to 11.4 million tonnes, while global natural rubber consumption in 2012 rose only 0.23% from 2011 to 10.9 million tonnes (IRSG 2014). In January 2014, a slowing Chinese economy saw Chinese stockpiles of natural rubber reach a 9-year high (TireBusiness.com 2014). Future demand is likely to be shaped by the uncertain combination of domestic political dynamics in producing countries and global economic trends, such as the magnitude and duration of China's economic slowdown and the extent to which the US and EU are able to recover and prosper in the wake of the Global Financial Crisis (Tiyo 2014). Also on the supply-side, the rubber market is subject to a range of fluctuations owing to the labor-intensity of cultivation, long maturity period of the *Hevea* tree, and the influence of weather and climatic events (ETRMA 2012). The long gestation and maturity period of the rubber tree, for example, makes it difficult for producers to adjust output in response to changes in demand. Each of these factors has the potential to significantly impact supply, resulting in further price variability.

Environmental impacts through the rubber lifecycle

Land use trends

Many environmental impacts associated with natural rubber production – habitat and biodiversity loss, disruption of watershed functions and reduction in soil quality – arise as a result of land use conversion from forest or rubber agroforests to monoculture plantations. Agroforestry was the most is largely considered a favorable alternative to monoculture plantations as it combines agricultural and forestry technologies to create more diverse, productive, profitable, healthy, and sustainable land-use systems. Advantages of this cropping system include income diversification, biodiversity conservation and high return to labor as well as limited investment during the immature period (Penot and Wibawa 1997). In contrast to monoculture plantations, rubber agroforests maintain a forested landscape, protect the soil of the steeply sloping river banks, provide an incentive for controlling fire, and provide additional habitat for wildlife (Schroth and Maria do Socorro 2013). Agroforestry can also help address the limited agricultural productivity of staple crops by minimizing soil fertility depletion, avoid the loss of biodiversity and minimize anthropogenic climate change impacts that occur through forest cutting and degradation, as well as improving dietary intake in poor communities (Powell et al. 2013). Depending on the planting cycle, agroforests can remain productive for up to 70 years, compared with around 25-30 years for monoculture planation's (Lehébel-Péron, Feintrenie, and Levang 2011).

Over the course of the last century, increasing rubber prices and rising demand linked to the expanding market for automobiles have contributed to a shift from complex rubber agroforestry systems to intensive rubber monoculture plantations throughout much of Southeast Asia (Feintrenie and Levang 2011). Although initially forming part of complex rubber agroforests, in Thailand and Malaysia rubber agroforestry has almost disappeared in favor of monoculture plantations (Gouyon 2003). In Phatthalung watershed in southern Thailand, rubber plantations have replaced vast areas of rice paddy, with rubber increasing from 44% to 61% of total land cover between 1976 and 2006, while paddy decreased from 36% to 24% over the same period (Pensuk and Shrestha 2008). In Bungo district on the island of Sumatra, forest cover decreased from 75% to 30% between 1973 and 2005 while rubber monoculture increased from 0% to 30% (Ekadinata and Vincent 2011). Rubber agroforestry also decreased, from 15% to 11% over the same period (Ekadinata and Vincent 2011).

National agricultural and land use policies continue to play a significant role in the geography of rubber expansion and intensification. For decades the Chinese government has actively promoted smallholder rubber production as a scientific alternative to traditional farming practices, and a means of attaining a modern consumer lifestyle (Xu 2006). Rubber is officially regarded as forest in China, a designation that has resulted in conversion from shifting cultivation to rubber plantations which are somewhat inaccurately perceived be an environmentally favorable land-use alternative, despite considerable variation in the environmental impacts of both land uses (Xu 2006). In Thailand, a Forest Encroachment Law passed in 1989 resulted in between 2-5% of rubber area being converted to forest or paddy, but due to the desire of farmers to maintain coverage of rubber, the policy had the unintended consequence of encouraging farmers to convert rice paddies to rubber as an alternative to forest clearing (Pensuk and Shrestha 2008).

Declining world rubber prices during late the 1990s saw many private companies convert their rubber plantations into more profitable oil palm plantations (P.T. Data Consult, Inc. 2010). The Thai government, for example, has invested considerable effort establishing rubber plantations in the country's northeast to make way for oil palm production in the traditional rubber growing region of the country's southeast (Fox and Castella 2013). In Sumatra, provincial governments have exercised their newly gained autonomy and control over land and natural resources by granting concessions to large private oil palm companies, often encroaching on state forest land or agroforest smallholdings. In the five-year period between the implementation of regional autonomy in 2000 and 2005, the governor of Jamb Province, Sumatra announced plans to develop 1 M ha of oil palm in the province (Feintrenie and Levang 2009). Interestingly, some conservationists are also pushing for conversion of rubber to oil palm, as they perceive the conversion of rubber plantations – an already degraded landscape – as preferable to expansion into forested areas rich in biodiversity (Koh and Wilcove 2008).

A recent revival in rubber prices spurred by demand from India and China has resulted in renewed interest in rubber cultivation. Over the last decade, Chinese, Vietnamese and Thai investors have triggered a rapid increase in rubber planting in non-traditional rubber regions such as Laos and Cambodia. Governments in Laos and Cambodia have embraced this investment, promoting large-scale rubber cultivation as a win-win solution to alleviate poverty in remote rural areas and generate income from export commodities. In Laos, more than 140,000 ha of rubber have been planted in the last decade, a figure that will potentially reach 300,000 ha during the next decade (Fox and Castella 2013). In all, more than 1,000,000 ha have been converted in the last several decades in non-traditional rubber growing areas of China, Laos, Thailand, Vietnam, Cambodia, and Myanmar (Fox and Castella 2013).

Greenhouse gas emissions

Rubber cultivation results in greenhouse gas emissions from initial clearing and soil disruption, as well as energy use during processing. Conversion of dense forests to agriculture in the humid tropics leads to a considerable reduction in ecosystem carbon storage as a result of the removal of above-ground biomass and the subsequent reduction in soil organic carbon (Jawjit, Kroeze, and Rattanapan 2010). Rubber trees represent some degree of biomass restoration, although old forests sequester much more carbon than rubber plantations both above and below the ground (Xu, Grumbine, and Beckschafer 2012). Annual carbon emissions due to land use change in Xishuangbanna have been estimated at approximately 370,000 tonnes of carbon per year between 1976 and 1988 and 130,000 tonnes of carbon per year from 1988 to 2003 (Li et al., 2008).

When rubber plantations replace forested land, carbon loss from ecosystems accounts for up to 97% of total emissions (Jawjit, Kroeze, and Rattanapan 2010). Lifecycle emissions associated with the production of concentrated latex, STR 20 (block rubber), and RSS (ribbed smoked sheet) from existing plantations in Thailand amount to 0.49, 0.64, and 0.58 CO_2-eq/tonne of product, respectively, when produced from existing rubber plantations (Jawjit, Kroeze, and Rattanapan 2010). In cases where forest is converted to rubber plantations, emissions from the production of concentrated latex, STR 20 and RSS are estimated to increase to approximately 12, 12, and 19 CO_2-eq/tonne of product. However, when rubber is established on land with modest carbon content such degraded forest or agricultural land as opposed to land with old-growth forest, rubber plantations have a carbon sequestration potential of up to 214 tonnes of carbon per hectare, almost five times higher than the sequestration potential of oil palm at 45 tonnes of carbon per hectare (Kongsager, Napier, and Mertz 2013).

Soil quality and soil carbon

Intensification of rubber plantations has been found to have an adverse impact on soil quality. In general, conversion of shifting agriculture or '*swidden'* to continuous annual cropping systems generates losses of aboveground carbon stocks, reductions of soil organic carbon (SOC) stocks and an overall decline in soil quality (Bruun et al. 2009). While unfertilized rubber gardens have been found to exhibit soil quality similar to that of secondary forests used for swidden, topsoil removal and mechanical terracing associated with intensified systems in Malaysia and China has resulted in a deterioration of physical soil properties and soil compaction (Bruun et al. 2009). Comparisons of soil quality between tropical rainforests and rubber plantations in Xishuangbanna found plantation soil to be slightly more acidic, more compact, higher in ammonia and lower in nitrate than undisturbed areas (Li et al. 2012).

Biodiversity

Conversion of forest or agroforest to intensive agriculture results in habitat fragmentation and a subsequent reduction in biodiversity richness. The geography of rubber production – concentrated in tropical regions associated with high levels of biodiversity – in many cases leads to direct competition between habitats and plantations. For instance, Xishuangbanna covers only 0.2% of China's total land area, yet contains some 25% of all plant species in the entire country (Xu et al. 2005). Between 1976 to 2003, expanding rubber cultivation contributed to a loss of over 370,000 ha of forest in the region (Li et al. 2008). Land under rubber cultivation tripled between 2002 and 2010, and now covers than a fifth of the total area and creating serious implications for regional biodiversity (Horton 2013; Li et al. 2008).

Conversion of forest to plantations in Thailand has be found to have reduced species richness by at least 60%, with insect- and fruit-eating species suffering greater losses than more omnivorous species (Aratrakorn, Thunhikorn, and Donald 2006). In Thailand, species occurring in plantations are significantly more widespread than species recorded only in forests and tend to have smaller body sizes. A high proportion of bird species formerly present in converted forests are unable to adapt to rubber plantations. This results in large losses of bird species and family richness and the replacement of species with restricted ranges and high conservation status by those with extensive ranges and low conservation status (Aratrakorn, Thunhikorn, and Donald 2006). Bat species diversity and activity has been found to be much lower in rubber plantations than in forested areas, and mean insect biomass found to be more than twice as high in forested areas than in plantations (Phommexay et al., 2011).

Rubber agroforestry is generally recognized as a means of rubber production that preserves biodiversity and other ecosystem services (Bennett et al., 2007; Ekadinata& Vincent, 2011; Therville, Feintrenie, &Levang, 2011). Levels of biodiversity in Sumatran rubber agroforests are around 50% lower than natural forests, but still significantly higher than monoculture plantations (Therville, Feintrenie, and Levang 2011). A study on changes in bird communities following conversion of lowland forest to oil palm and rubber plantations in southern Thailand, for example, found that species richness in plantations in which a layer of undergrowth was allowed to develop was significantly higher than in plantations with no undergrowth (Aratrakorn, Thunhikorn, and Donald 2006). In addition, comparisons of rubber agroforests and natural rubber forest have found that although species richness of the tree stratum is higher in forest than in rubber agroforests, species richness of seedlings and saplings is similar between the two land uses (Tata et al. 2008).

Watershed function

The hydrological impact of rubber cultivation depends on the water use of rubber compared to that of the original displaced vegetation and the level of rainwater infiltration (Ziegler, Fox, and Xu 2009). When planted as part of a landscape mosaic on river slopes, rubber agroforests protect soil, prevent erosion and provide habitat for wildlife by maintaining a forested landscape (Schroth and Maria do Socorro 2013). However, repetitive cultivation performed without appropriate conservation methods on steep slopes can accelerate erosion and stream sediment loads, and permanent conversion of hill slopes and road building increases the risk of landslides (Ziegler, Fox, and Xu 2009). On the island of Hainan in southern China, monoculture rubber plantations of steep slopes have resulted in increased soil erosion, soil nutrient loss, reduced stream volume and led to runoff becoming more seasonal (Yi et al. 2013).

In Yunnan, rubber plantations have caused serious hydrological damage as the trees soak up water from the ground to replenish water lost as a result of tapping, in effect draining the water table (Mann 2009). Streams also become desiccated when used as a source of irrigation for cash crops during the dry season (Ziegler, Fox, and Xu 2009). Plantations require the production and use of nitrogen and phosphorus fertilizer and diesel which is used in tillage and fresh latex transportation, and the use of pesticides and fertilizers to sustain commercial rubber plantations reduces water quality (Jawjit, Kroeze, and Rattanapan 2010; Ziegler, Fox, and Xu 2009). In

Laos, conversion of grazing lands to rubber plantations has led to the indirect death of neighboring livestock as a result of herbicide poisoning (Baird 2010).

Genetic modification

The use of clonal varieties to increase latex output and reduce production heterogeneity dates back to the late 19th and early 20th centuries. Bud grafting is a cloning technique used to ensure that genetically identical trees can be produced in unlimited numbers. The process involves the replacement of the shoot system of a plant with that of another more desirable plant, forming a two-part tree comprising a root system belonging to the stock plant and a shoot system contributed by the donor of the bud (India Rubber Board 2002)**.** The development and application of clonal varieties able to withstand greater extremes of cold and limited water availability facilitated the expansion of *Hevea brasiliensis* well beyond traditional growing areas, and today the majority of large-scale plantations employ some form of clonal variety. The Malaysian Rubber Board alone has produced over 2,000 clones.

Clones, however, are not suitable for all soil types, and the improper planting of some clones can lead to branch snapping, and in some cases, trunk snapping (Rubber Journal Asia 2012). Certain clonal varieties used in Malaysia, Indonesia, Sri Lanka, Thailand and India have been found to highly susceptible to diseases such as Corynespora leaf fall, which retards the growth of new branches during refoliation (Benong 2013). The pathogen affects both young and old leaves and causes leaves to fall all year round, which may lead to a delay in maturation of young rubber trees, yield reduction of mature rubber trees and even plant death on susceptible clones (Pu et al. 2007). Although the wider ecological implications of widespread use of clonal varieties has not been documented, many smallholders have resisted the new technology on the basis that the externally produced improved seed is considered high maintenance, high cost and susceptible to pests disease and wind (World Agroforestry Center (ICRAF) 2011).

Energy and waste

Rubber processing is energy intensive, and requires the production and use of electricity, diesel, LPG, ammonia and wood (Jawjit, Pavasant, and Kroeze 2013). The overall environmental impact of concentrated latex production (excluding forest conversion) in Thailand is mainly caused by electricity (49%), followed by ammonia (22%), and diesel use for heating and transportation (10% each)(Jawjit, Pavasant, and Kroeze 2013). In Thailand, the use of formic acid in the coagulation process generates highly acidic wastewater that also contains extremely high values of ammoniacal nitrogen and sulfate. This wastewater is often stored in ponds which have been known to flood during heavy rains, polluting nearby agricultural land (Tekasakul and Tekasakul 2006). Hydroxylamine neutral sulfate (NH2OH) is used as a pre-treatment to prevent hardening of rubber in storage and transit, yet is considered extremely harmful to humans (Cecil and Mitchell 2005).

Another issue concerns the end of the rubber lifecycle, which generates a whole new set of environmental and public health issues. In Europe alone, where demand is dwarfed in comparison to Asia, around 3.3 million tonnes of used tires are generated annually, 2.7 million tonnes of which end up in landfill (ETRMA 2012). In the United States, 275 million tires were in stockpiles in 2003, and approximately 290 million new scrap tires were generated. In addition to occupying vast areas of landfill, tire stockpiles are breeding grounds for mosquitoes and other vectors, resulting in the spread of dengue fever, yellow fever, encephalitis, West Nile virus, and malaria (EPA 2010). Improperly managed stockpiles pose significant environmental problems as a result of the leaching process, fires hazards, and water contamination. According to the US Environmental Protection Agency, toxic emissions from tire fires, such as sulfuric acid and gaseous nitric acid, can irritate the skin, eyes, respiratory and central nervous systems, cause depression, and, in extreme cases, cause mutations and cancer (EPA 2010).

While technical limitations prevent the use of recycled materials in new tires, a growing number of uses for recycled rubber including fuel, flooring and footwear are gaining prominence (Table 3). While the environmental impact of repurposed rubber varies considerably from product to product, such uses do reduce waste and the associated health impacts of waste rubber storage.

No.	Product name	No.	Product name	No.	Product name
1	Mat	15	Shoe core	29	Detent of car
2	Mat base for road	16	Carpet materials	30	Car tire
3	Animal mat	17	Foamed sponge	31	Solid tire
4	Sidewalk surface of golf-course	18	Indoor decorative floor materials	32	Arrester rubber
5	Excising mat for golf-course	19	Wall materials	33	Bottom rubber
6	Mat block for road	20	Floor rising materials	34	Adhesion band
7	Elastic brick	21	(Blending in concrete)	35	Industrial filler
8	Rubber brick	22	Paving materials	36	Transfer band
9	Rubber floor materials	23	(Blending in asphalt)	37	Cheap soft band
10	Rubber plate	24	External pants of car	38	Half-rubber wood product
11	Tennis court	25	Foot mat block of car	39	(Pedal)
12	Man-made lawn materials	26	Splash board of car	40	Insulative bakelite modification
13	Inferior shoes bottom	27	Dust proof of car	41	Protection block
14	Shoe heel	28	Brake band	42	Blending rubber materials

Table 1: Products using recycled tire rubber. Source (Fang, Zhan, and Wang 2001)

Social and economic impacts

Income vulnerability

While the transformation of swidden landscapes into more intensive land uses has generally increased household incomes, increased rubber production has also led to negative effects on the social and human capital of local communities (van Vliet et al. 2012). The promotion of rubber in Yunnan province, for example, has been overwhelmingly successful, with rubber farmers in Xishuangbanna reporting earnings as high as $30,000 per year (Sturgeon 2012). A study examining livelihood impacts in Xishuangbanna, found that income per capita has increased from US$128.3 in 1998 to US$561.7 in 2004 because of an increase of income from rubber from US$75.8 to US$451.4 over the same period (Fu et al. 2009).

Many researchers express concern, however, over the vulnerability smallholders are exposed to by shifting from a diversified to a single income stream. In areas of Xishuangbanna, some households that have traditionally derived income from a mix of rice, tea and fruit, now derive over 80% of their income from rubber production (Fu et al. 2009). The global nature of the natural rubber industry means that prices are influenced by more than simple dynamics of supply and demand. The strength of the rubber market is subject to factors as wide-ranging as global economic trends, exchange rate fluctuations, futures trading, domestic political stability in producing countries, gestation and maturation periods of the *Hevea* tree, the predominance of smallholder producers, as well as climactic and weather variability (ETRMA 2012; Krishnakumar 2013; TireBusiness.com 2014; Tiyo 2014). An increased reliance on a single cash crop drastically increases vulnerability to fluctuations in any one of these factors. Xishuangbanna – a climatically marginal area for rubber production to begin with – is susceptible to weather variations that pose serious consequences for production. In 1999, a cold snap resulted in a 25% loss of production in some areas with serious implications for the food and income security of smallholders now largely reliant on a single crop (Fu et al. 2009). Conversely, too much good weather can lead to overproduction and downward pressure on global prices. A lower number of rainy days – as occurred in Thailand in 2013 – increases the number of days in which latex can be harvested thus boosting production (Phoonphongphiphat 2013). The highly variable nature of the rubber market has led some national producer organizations, such the Indonesian Rubber Association GAPKINDO, to limit production in order to avoid oversupply and downward pressure on prices, adding an additional layer of complexity (Rubber Journal Asia 2013).

Despite the highly variable nature of rubber prices, in some cases rubber production has formed the basis of successful community development efforts. A comparison of the benefits experienced by producers of smallholder rubber plantations in Bangladesh, India and Sri Lanka found rubber plantations contributed more than 50% of total household income and provided employment opportunities for participants and local people (Nath, Inoue, and De Zoysa 2013). It should be noted, however, that the success of these programs hinged more on a number of contextual political and social factors than on the utility of rubber production as a driver of development. Reliance on rubber plantations as a livelihood strategy was successful in India and Sri Lanka due to the presence of stable government support, a factor that was absent in the less-successful Bangladesh experience. Secondly, Indian and Sri Lankan participants benefited from access to land, whereas in Bangladesh only 40% of participants received legal land certificates. Finally, smallholders in India and Sri Lanka formed cooperatives that appear to have contributed to the success of the projects by serving as the means through which subsidies, training and fertilizer and seedlings were provided (Nath, Inoue, and De Zoysa 2013). Overall, these factors highlight the importance of strong political and social structure in conducting development projects, more so than the viability of rubber production as a one-size-fits-all development tool.

Box 1: Motivations and drivers of land use change

Rising natural rubber prices, a high return to land and relatively easy commercialization have been identified as primary motivations for farmers to convert agroforests and other forms of subsistence agriculture into clonal rubber plantations (Feintrenie, Schwarze, and Levang 2010; Pensuk and Shrestha 2008; Therville, Feintrenie, and Levang 2011). Conversion has been aided by improvements in transportation infrastructure that facilitate access to local, national and international markets (Jawjit, Kroeze, and Rattanapan 2010; Miyamoto 2006; Therville, Feintrenie, and Levang 2011). An analysis of land use trajectories in Bungo, Sumatra, for example, found a mere 1% of rubber agroforest remained intact between 1973 and 2005, and that this area only remained intact as it remained inaccessible (Ekadinata and Vincent 2011).

Despite the apparent economic benefits of intensified monoculture plantations, some farmers continue to resist conversion. Monoculture plantations require capital and intensive management techniques, both of which are out of reach for many smallholders (Feintrenie, Schwarze, and Levang 2010). In addition, agroforestry has a number of technical advantages over monocultures including resistance to pests, low labor requirements, wide variety of products, no seasonality, tree cover that protects workers against sun and rain, protection of soil fertility and erosion prevention, and the ability to operate a staggered planting cycle (Feintrenie, Schwarze, and Levang 2010). Secondary income from fruits has been identified as another, although less prominent, reason for resisting agroforest conversion to monoculture. Non-economic factors for retaining agroforestry systems include cultural and sentimental aspects such as inheritance from grandparents, staple food production and daily domestic consumption products, attractive scenery and site of usual daily work (Feintrenie, Schwarze, and Levang 2010).

Conservation is generally treated as a lower priority than immediate economic gain or food security. A study on transition dynamics from agroforests to monoculture plantations in Indonesia found the majority of community members who supported forest conservation lived in areas that had already been converted, indicating a low preference for conservation among agroforest-based smallholders (Feintrenie, Schwarze, and Levang 2010).

Food security

Land use change is a direct driver of change in diets, nutrition and food security, particularly for rural communities (Powell et al. 2013). Forests and trees support food security and nutrition through the provision of nutritionally important foods such as fruits, vegetables, bush meat, fish and insects, the supply of fuel wood, and the sale of forest products can generate income for food purchases. Forests products also serve as livelihood safety nets by providing food sources in times of relative food scarcity.

Land use change associated with the expansion and intensification of rubber cultivation therefore has a direct impact on food security. When rubber production is expanded and intensified, the benefits stemming from the diverse food and income base that forests and agroforestry provide are diminished. Additional income may allow households to purchase food they have traditionally grown themselves, but reliance on a single income stream means that household food security becomes acutely dependent on a stable international rubber price, something that has not been seen historically. This exposure to risk and food insecurity is amplified when cultivation expands into areas not suitable for production. As result, existing land uses such as rice paddy, forest or wetland, are reduced without generating a necessary increase in rubber production and profits to offset these losses.

The beacon of short-term economic gain has driven the expansion of land under rubber cultivation in Xishuangbanna to nearly triple between 2002 and 2010, and to account for more than a fifth of the area's total land (Horton 2013). Increases in monoculture rubber cultivation in the area have led to a decrease in the number of cultivated upland rice varieties and overall level of upland rice production, as well as replacing food sourced through swiddening (Fu et al. 2009). In parts of southern Thailand, the area under rubber cultivation expanded almost 40% between 1990 and 2006, replacing vast areas of rice paddy (Pensuk and Shrestha 2008). In contrast, the diversity and abundance of products and services provided from agroforests provides substantial resilience for local farmers**.** In Indonesia diverse rubber agroforests, though less profitable than mono-specific plantations under normal circumstances, provided livelihood security when the prices of rubber decreased in the international market in late 2008 by offering an alternative source of income from secondary products, such as fruit (Powell et al. 2013).

Land tenure and human rights

The level of prosperity enjoyed in Xishuangbanna has not occurred in all regions where rubber has expanded its reach. Over the last decade, Chinese, Vietnamese and Thai investors have turned their attention to non-traditional rubber regions such as Laos and Cambodia. In Laos alone, more than 140,000 ha of rubber have been planted in the last decade, a figure that will potentially reach 300,000 ha during the next decade (Fox and Castella 2013). Large-scale investments in rubber production through joint ventures between private foreign investors and private Lao investors, or as investments with 100% foreign ownership, are promoted by host governments as a means to bring benefits to the local level through infrastructure development and wage employment (Baird 2010).

A number of reports have shown the social and ecological impacts of these concessions to be devastating, due to polluted environments, scarce employment opportunities and lost access to essential land and resources (Kenney-Lazar 2012). In Laos, Cambodia, Vietnam and Myanmar the transformation of landscapes into more intensive land uses has led to negative effects such as intensified inequities, conflict over land, increased out-migration and loss of cultural identity (Fox and Castella 2013; van Vliet et al. 2012). Peasants have been forcibly relocated to make way for rubber plantations, employed by armed groups to establish tracts of rubber, and forced into planting rubber due to land-use restrictions (Fox and Castella 2013). Foreign investors have been acquiring land with rich soils for low state rents, often without having to ensure that local people are compensated appropriately. Rubber concessions in southern Laos have been found to compete with agricultural and forest lands of importance to local people, replacing them and thus dramatically affecting agrarian livelihoods (Baird 2010). The use of rubber expansion to promote neoliberal development objectives has also eroded traditional institutions and diminished the capacity of smallholders to tolerate fluctuations in land quality, market stability and climate (Xu et al. 2005). As a result, rubber development occurring in southern Laos and other sites of large concessions may be operating to benefit foreign investors and local elites at the expense of most villagers.

Labor conditions

Rubber cultivation and production poses a number of health and wage-related issues for rubber tappers and processors. Health issues include the use of herbicides and chemicals during cultivation and processing, as well as the physically-demanding nature of tapping. In Laos workers are exposed to herbicides and other chemicals, and rarely provided any form of protective clothing (Baird 2011). Fumes from the extensive use of ammonia during the processing of rubber latex have been linked to respiratory illness in factory workers (Tekasakul and Tekasakul 2006), while agricultural workers on rubber plantations are at increased risk for malaria and other vector-borne diseases (Bhumiratana et al., 2013). A study in Kerala, India, found that the repetitive movement and awkward positioning associated with tapping lead to neck pain and other musculoskeletal trauma (Reddy, Kumar, and Uzma 2012).

The emergence of large-scale concessions in Laos has also led to new exploitative forms of wage labor. As peasant livelihood strategies are transformed through land loss, villagers are forced to transition from land users to land laborers on what were in many cases once their own lands. Although there have been significant employment opportunities due the rapid expansion of plantations, this may change once production advances into later stages and the work of weeding and tree maintenance is less labor intensive (Kenney-Lazar 2012). Wages are paid to supervisors who then distribute monies to workers, but in many cases wages are reduced or withheld on the grounds of underperformance or outright corruption. In some cases in Laos, workers have been promised USD 3.55 per day, but had their pay reduced to between USD 2.36 to USD 2.96 at their supervisor's discretion (Kenney-Lazar 2012).

Summary

Projected increases in the demand for natural rubber pose serious risks in terms of the negative environmental and social impacts associated with current production practices. Rubber cultivation has generated wealth for many smallholders and land owners, but also resulted in forest conversion, habitat and biodiversity loss, disruption of watershed functions, increased livelihood vulnerabilities – and in some cases – dispossession of land. The complexity of these risks is magnified by their high variability across contexts. The next section examines some of the certification and alternative measures that have been developed to address these concerns.

PART III: THE SUPPLY OF NATURAL RUBBER CERTIFCATION – THE CURRENT STATE OF NATURAL RUBBER CERTIFICATION EFFORTS

Many of the environmental and socioeconomic impacts covered in this report are not unique to rubber, and have also been attributed to the production of a wide range of other agricultural commodities. In the case of timber, coffee – and more recently, palm oil – concern over environmental and socioeconomic impacts has seen coalitions of environmental nongovernment organizations, industry bodies, corporations and consumers emerge to develop novel solutions outside the realm of traditional state-based regulation. In contrast to public environmental regulation, these emerging private forms of environmental regulation emphasize the power of the market to generate improved social and environmental outcomes. Examples of private environmental regulation range from individual efforts by companies to manage their supply chains, through to industry-wide codes of conduct and efforts by multi-stakeholder organizations to regulate and monitor using third-party verification (Auld and Gulbrandsen 2013). Fair Trade coffee, which guarantees producers a living wage for their commodity, and the Forest Stewardship Council (FSC), which certifies wood products that meet 'socially beneficial and economically prosperous management' standards, are two notable examples of this rapidly expanding approach to environmental regulation and governance.

Previous studies have indicated the potential for existing environmental standards such as FSC, Rainforest Alliance, Organic (such as IFOAM), Lembaga Ekolabel Indonesia (LEI) and the Analog Forestry Network (IAFN) to address the negative impacts of rubber cultivation and production (van den Beemt 2011; Gouyon 2003). Despite considerable research on the topic, industry-level interest in environmental standards for natural rubber is a relatively recent development. What has emerged up until now is a somewhat disparate array of certification efforts applied to niche products. While a growing number of companies claim to have a lower environmental or social impact than competitors, few companies employ clearly defined and monitored standards to support their claims. These *submarkets* – that is, attempts to differentiate products on the basis of less environmentally or socially harmful production practices – typically adopt one of the following four objectives:

1. improve the sustainability of existing production practices
2. certification of rubber by-products (such as rubberwood)
3. promote the use of recycled rubber
4. switch to alternative sources of rubber

In this section, I examine the key players involved in these submarkets and the extent to which public discourse or consumer concerns influence the stringency of these standards and create market incentives that recognize top performers.

Improving the sustainability of existing production practices

Despite the lack of industry-wide environmental standards or certification, increasing producer and consumer awareness of the issues associated with rubber production has given rise to the emergence of a number of niche products claiming to embody environmentally or socially sustainable production practices. Products bearing some of form of rubber eco-labeling now include shoes, clothing and sports equipment, latex gloves, condoms, pillows, mattresses, and even tires.

While the absence of an industry-wide standard makes the validity of sustainability claims such as 'natural' or 'eco-friendly' difficult to verify, increasingly producers are employing third-party verification to legitimize their claims. Of all natural rubber submarkets to emerge, latex products – such as gloves, mattresses and pillows – have attracted the most attention. A 2010 consumer research study by the US-based Specialty Sleep Association found 15% of consumers want "emissions-free" mattresses and that 79 % of consumers surveyed would choose a mattress backed by an understandable and trustworthy environmental claim (SSA

2013). In addition to environmental benefits, environment-friendly products are perceived by consumers to reduce the risk of allergies and other contaminant-related diseases for end-users (Infiniti Research Limited 2014). The growing demand for environment-friendly products is now considered one of the major drivers in the global latex mattress market (Infiniti Research Limited 2014).

Consumer demand for environmentally friendly latex products has led to an increase in the number of suppliers offering certified latex. Environmentally friendly household products supplier ‘If You Care’ offers household rubber gloves made from Forest Stewardship Council (FSC) certified latex, which is tapped by rubber tappers who receive a fair trade premium administered by the Fair Rubber Association (If You Care 2014). While this may appear encouraging, haste to meet growing consumer demand has also resulted in a landscape of disparate labels claiming varying degrees of social and environmental benefits. The California-based premium bedding and furniture supplier Global Latex, for example, boasts no fewer than six eco-labels for the latex component of its products (Figure 3).

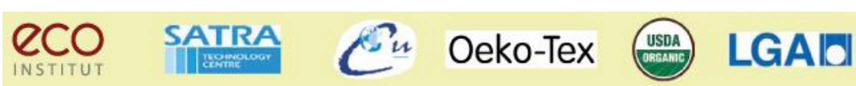

Figure 3: Labels and certification promoted by Latex Global

These labels differ widely in both the objectives and stringency of the standards they embody. Eco-Institut certification concerns the use of chemicals, forests, material use, natural resources, pesticides/herbicides/fungicides and toxics. USDA Organic certification encompasses many of the same criteria as Eco-Institut, but extend their criteria to include animal welfare, biodiversity, GMOs, soil and water quality (Ecolabel Index 2013). Eco-Institut verification is conducted in-house, whereas USDA Organic involves third-party verification, arguably increasing the legitimacy of the label. Rather than generating environmental or social improvements, the proliferation of certification in this way may confuse consumers who might wish to reward the “best performers” but cannot easily determine which standards are most stringent. In addition, these concerns may act as a disincentive for some companies to participate in certification programs, who may be unwilling to absorb the costs of certification compliance without a clear indication of consumer support (Steering Committee of the State-of-Knowledge Assessment of Standards and Certification 2012).

Recently, efforts have been made to address the complexity of the latex certification landscape. In an effort to improve consumer education, retailer training and promote truth in "green" marketing, the US Specialty Sleep Association has developed an ‘Environmental & Safety Program’. The program provides a three-step seal and label program intended to help consumers understand the environmental and safety attributes of participating manufacturers’ products (Figure 4). The seals and tags appear on mattresses from manufacturers who join the program and seek to inform the consumer about the minimum environmental and safety compliance levels to which the particular product adheres. In addition, the disclosure label lists material content by percentage for other components in the mattress such as cotton and timber (SSA 2013).

Figure 4: SSA Environmental & Safety Program labeling

Another important development has been the introduction of the Global Organic Latex Standard (GOLS). Developed by the international certification body Control Union in 2012, GOLS is a newly introduced standard for sustainable processing methods of latex products from organic raw materials. In addition to the use of organic raw material, GOLS addresses aspects such as human health, safety and welfare, and environment in the manufacturing process of latex products. The ambitious standard also seeks to address issues all along the supply chain by including criteria relating to the processing, manufacturing, packing, labeling, trading and distribution of latex products (Control Union Certifications 2012a).

Compared to the latex goods sector, which comprises a mere 10% of total natural rubber consumption, the tire industry has been slower to embrace certification and labeling. Some of the leading brands have incorporated environmental concerns in their communication and management strategies by focusing on reduced energy consumption, limiting the negative environmental impact of the manufacturing process, reducing waste by increasing tire lifespan, or increasing the re-use, recycling and recovery of tires (Gouyon 2003). The EU Tyre Labelling Regulation (EC/1222/2009) introduced compulsory labeling for fuel efficiency, wet grip and rolling noise (ETRMA 2012). The expectation is that consumers are now able to effectively compare tires on the basis of objective information on performances that were otherwise little known (ETRMA 2012). Although this labeling does not include environmental impacts beyond fuel efficiency, it may represent an opportunity for more stringent environmental or social criteria to be incorporated under the label in the future.

In May 2013, the International Rubber Study Group (IRSG) – an inter-governmental organization composed of the world's major rubber producing and consuming stakeholders – made moves to extend the reach of certification along the full length and breadth of the supply chain. The IRSG's 'Sustainable Natural Rubber Action Plan' aims to define and promote a common set of voluntary rubber sustainability standards in what has been up until now a highly fragmented industry (IRSG 2013). The plan is intended to complement existing domestic economic, social and environmental programs in natural rubber-producing countries and aims at improving the production mechanisms in both new and traditional producing countries, and will be based on multi-stakeholder commitment and participation. (ETRMA 2012). The current phase of the plan – being developed with the assistance of the international testing, inspection and certification services company Bureau Veritas – involves the definition of relevant voluntary sustainability guidelines and examination of policy and potential mechanisms for implementation of these guidelines through consultation with the natural rubber producer governments and other international forums on voluntary sustainability standards (IRSG 2013).

While recent efforts of the IRSG suggest a positive direction for industry-wide certification, there will be a number of hurdles to overcome if the plan is to be successful. One issue concerns the level of smallholder involvement in the development and implementation of any standards. At present, the project appears to emphasize sustainability of *supply* more than sustainability in a strict environmental or social sense. In addition, previous studies on the viability of rubber eco-certification have pointed to the lack of market demand for certified rubber products as the primary barrier to the successful implementation of any market-based regulation (Gouyon 2003; van den Beemt 2011). While the emergence of niche products indicates growing consumer interest in 'green rubber', until tire manufacturers and other large rubber consumers feel sufficient market pressure to address sustainability issues along the full extent of the supply chain, certification efforts are likely to remain relegated to the fringe.

Box 2: Agroforestry as a potential 'best practice'

A major issue concerning expanding rubber production – particularly on the Indonesian island of Sumatra – is the conversion from traditional rubber 'agroforestry' to rubber monoculture plantations. Conversion driven by government and smallholder motivations to improve profitability and industry demands for consistent high-quality supply comes at the cost of many valuable benefits a diverse approach to cultivation such as agroforestry provides.

As previously noted, agroforestry combines agricultural and forestry technologies to create more diverse, productive, profitable, healthy, and sustainable land-use systems. Advantages of this cropping system include income diversification, biodiversity conservation and high return to labor as well as limited investment during the immature period (Penot and Wibawa 1997). In contrast to monoculture plantations, rubber agroforests maintain a forested landscape, protect the soil of the steeply sloping river banks, provide an incentive for controlling fire, and provide additional habitat for wildlife (Schroth and Maria do Socorro 2013). Agroforestry can also help address the limited agricultural productivity of staple crops by minimizing soil fertility depletion, avoid the loss of biodiversity and minimize anthropogenic climate change impacts that occur through forest cutting and degradation, as well as improving dietary intake in poor communities (Powell et al. 2013). When compared to slash-and-burn agriculture, net present value and return to labor are significantly improved in rubber agroforestry systems (Penot and Wibawa 1997). Depending on the planting cycle, agroforests can remain productive for up to 70 years, compared with around 25-30 years for monoculture planation's (Lehébel-Péron, Feintrenie, and Levang 2011).

One point of contention concerns the economic viability of rubber agroforestry relative to rubber monocrops. A profitability study of rubber agroforests found the net present value of rubber agroforest to be less than half that of monoculture rubber plantation, even accounting for the sale of secondary agroforest products (Lehébel-Péron, Feintrenie, and Levang 2011). Although rubber agroforestry is considered well suited to local environmental and social conditions, traditionally agroforestry has produced a lower output and lower quality rubber when compared to monoculture plantations, which also affects profitability (World Agroforestry Center (ICRAF) 2011).

Perceived profitability discrepancies and variable quality raise a number of issues for potential eco-certification of agroforest rubber. Agroforestry's reputation of producing a heterogeneous product high in impurities makes it less attractive to the leading tire manufacturers, who generate almost 90% of demand in Indonesia (Gouyon 2003). In addition, strong competition amongst tire manufacturers and the competition of synthetic rubber (although by no means a perfect substitute for natural rubber) puts pressure on natural rubber prices, leading to a situation not favorable to the payment of premium prices for eco-friendly natural rubber in the tire industry, which generates almost 90% of demand for Indonesian rubber. As such, improved quality and profitability can be considered essential criteria if eco-certified agroforest rubber is to become a viable alternative to environmentally- and socially-damaging monoculture practices.

Certification of rubberwood

In addition to rubber and latex certification, other efforts claim to reduce the negative impacts of rubber production through the certification and labeling of rubber by-products. Rubber trees that reach the end of their productive life have traditionally been regarded as waste to be used as fuel wood in drying and smoking sheet-rubber, curing tobacco, brick making or as charcoal for steel production (Ratnasingam, Ioraş, and Lu Wenming 2011). Beginning in the 1980s, however, rubberwood found widespread utilization as an input for furniture, particularly in Malaysia and Sri Lanka. Rubberwood – misleadingly marketed as Malaysian Oak or white teak despite lacking qualities and appearance of either oak or teak – accounts for around 80% of the total export value of Malaysian wooden furniture (Zakaria et al. 2012).

Similar to other industries reliant on agricultural inputs, the global timber market is adapting to new market conditions. According to the Sri Lankan Economic Development Board, meeting environmental standards in the rubberwood industry is becoming a ‘global prerequisite’ (SLEDB). Evolving expectations of international buyers are influencing corporate and plantation decisions to obtain forest management and chain-of-custody certification such as Forest Stewardship Council (FSC), Rainforest Alliance (RA) and Programme for the Endorsement of Forest Certification (PEFC). EU Regulation 995/2010 – also known as the (Illegal) Timber Regulation – prohibits the sale of illegally harvested timber and products derived from such timber within the EU, and requires EU traders who place timber products on the EU market for the first time to exercise 'due diligence' by actively managing and minimizing the risk of placing illegally harvested timber or timber products containing illegally harvested timber on the EU market (European Commission 2014). In addition to EU-wide regulations, many European countries have begun developing their own Public Procurement Policies to ensure that materials used for public projects are sourced from sustainable sources (Malaysian Timber Council 2011).

Until recently, Malaysia had been slow to embrace wood products certification. A lack of price premiums, limited market potential and high cost have been cited as the primary reasons deterring furniture manufacturers from adopting chain of custody certification (Ratnasingam et al. 2008). To ensure that Malaysian legal and sustainable timber would not be excluded from any country’s procurement policy, the Malaysian Timber Council has engaged in ongoing efforts to meet the requirements of Public Procurement Policies in individual countries. Such efforts include collaboration with the Malaysian Furniture Promotion Council (MFPC) to investigate the certification of rubberwood as sustainable wood through a pilot study on Group Certification of Rubber Smallholders under the Malaysian Timber Certification Scheme. This program aims to facilitate greater entry of Malaysian rubberwood products such as furniture into the EU market. In addition, Forest Sustainability (Malaysia) Sdn Bhd is working to develop a nationally-adapted FSC certification standard for use by certification bodies in the country.

At the time of writing, only eight Malaysian timber and timber product companies hold FSC certification for *Hevea brasiliensis* products, compared to over 90 companies in Sri Lanka (Forest Stewardship Council 2014). A major issue around rubberwood certification is that while demand comes from the timber producers and industry, the burden of certification compliance falls on the rubber planters whose core business is producing natural rubber or latex (Zakaria et al. 2012). A related issue is the long-term sustainability of supply. As the area under rubber cultivation in Malaysia and Sri Lanka has declined over the last decade, reserves of rubber trees have also dwindled (Ratnasingam, Ioraş, and Lu Wenming 2011). Threats to supply have led to research to clone rubber solely for timber purposes. The goal is to produce trees with a shorter maturation period that may not necessarily produce latex, and can be cultivated in large-scale monocultures (Zakaria et al. 2012). Such an approach may circumvent conflicting interests of rubberwood and rubber latex producers, but would do little to address the concerns over rubber cultivation raised in this paper.

Recycled rubber

Whereas rubber products and rubberwood emphasize the negative impacts associated with the initial production phase, recycled rubber has emerged in response to the waste generated at the end of the rubber lifecycle. Discarded tires occupy vast areas of landfill worldwide, and due to their chemical composition do not readily breakdown over time. When stockpiled improperly, used tires pose a range of human health and environmental hazards in terms of mosquito-borne disease, water contamination and fire risks (EPA 2010).

The waste management issue has led to a number of efforts to find alternative uses for discarded tires. The majority of processed recycled tires are used as an industrial fuel source, but alternative uses such as fill in construction projects, flooring for athletic facilities and playgrounds, and footwear are gaining prominence (Figure 5). In the United States, using products made from recycled tires fulfills Green Building requirements and qualifies for LEED (Leadership in Energy and Environmental Design) certification credits. The Californian Tire Recycling Act (1989) has dramatically decreased the number of waste tires destined for landfill by awarding grants and loans to businesses and public entities for activities that could expand markets for used tires. Emerging recycled rubber uses and markets include polymer treatment, crumb rubber production, re-treading, shredding, and the manufacture of such products as rubber asphalt, playground equipment, crash barriers, erosion control, floor and track surfacing, oil spill recovery, roofing, and other environmentally safe applications (CalRecycle 2013).

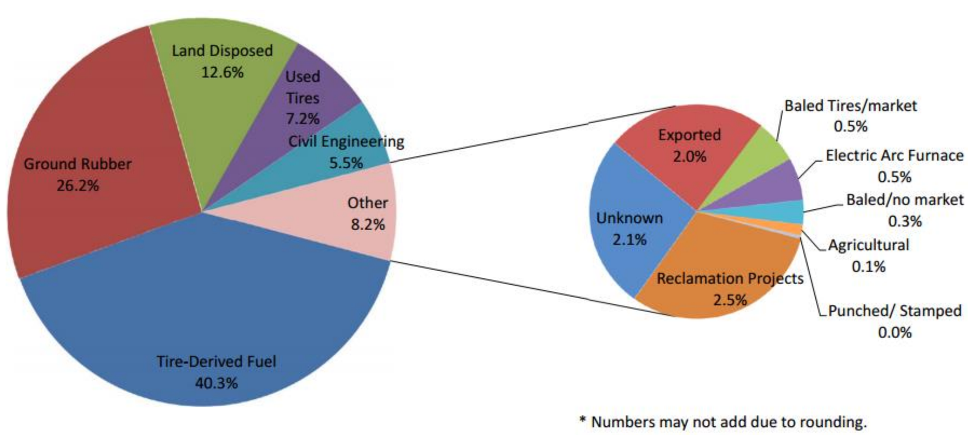

Figure 5: 2009 US scrap tire disposition (% total tons generated annually). Source (Rubber Manufacturers Association 2013)

Recycled rubber is often marketed as environmentally friendly on the basis that its use reduces waste while curbing demand for virgin rubber. While this may be true, the reclamation process presents its own set of environmental concerns. Converting used rubber into a usable form generates between 87 and 341 kg CO_2-eq per ton recycled, depending on the size of the facility (IERE 2009). Energy from recycled rubber (1,072 g CO_2-eq/kWh) has a lower overall carbon footprint than coal (1,300 g CO_2-eq/kWh), but higher than all other fuel resources such as gas and nuclear (IERE 2009). Recycled rubber is also often marketed for its non-environmental benefits. Liberty Tire, the leading producer of recycled rubber products in the United States, claims rubberized asphalt highways ride quieter, last longer, and use significantly less paving material than traditional asphalt, and that rubber mulch is nontoxic and non-staining , minimizes airborne dust and particles, is resistant to wind, water and sunlight, reduces bug and rodent infestation. The promotion of non-environmental benefits appeals to a wider range of consumers than for products marketed based solely on their 'environment-friendly' qualities.

Alternatives to *Hevea brasiliensis*

Hevea brasiliensis has not always dominated the global natural rubber supply. The early Amazon trade comprised four main genera – *Hevea*, *Castilla*, *Manilkara* and *Sapium* – each of which included different a number of species that varied by production method, product handling and the form in which they were sold (Hecht 2013). It was not until *Hevea brasiliensis* was adopted as the cultivar of choice in the British and Dutch colonies of Southeast Asia toward during the late 1800's that the species assumed its current dominance over natural rubber supply. The virtually synonymic relationship between *Hevea* and natural rubber has, however, not gone unchallenged. Over the course of the last century, anticipated increases in natural rubber demand, concerns over threats to supply and recent links between *Hevea*-based latex and allergies have led to significant interest in alternative and diversified production sources.

One alternative to *Hevea brasiliensis* to gain prominence in recent years is Guayule, a desert shrub native to southwest North America. Unlike *Hevea* – which requires temperatures in the range of 20–28°C and average annual rainfall of 1800–2000 mm – guayule is well adapted to semi-arid and Mediterranean areas and grows well under temperatures from -9°C to 40°C and only 350-640 mm of annual rainfall (Palu and Pioch 2013). Guayule has been grown on commercial scale on and off since the 1940's, often in response to apparent threats to supply such as Japanese control of rubber-producing countries during World War II and the energy crisis of the 1970's (Ray 1993). In addition to being less water-intensive than *Hevea*, guayule latex is considered hypoallergenic (hyper sensibility type I) as it contains fewer proteins than allergenic *Hevea* latex (Palu and Pioch 2013). Following an FDA Medical Alert concerning allergies to tropical latex in 1991, the USDA's Agricultural Research Service began researching guayule crop to produce natural rubber. Unlike latex sourced from *Hevea*, guayule latex shows no cross-reactivity with antibodies raised against tropical latex proteins, allowing latex-sensitive individuals to use products derived from guayule latex safely (Yulex 2012). Marketed for its hypoallergenic qualities and substitutability for both synthetic and natural forms of rubber, guayule is expanding its market reach through inclusion in a growing range of traditionally rubber-based products (Figure 6).

Recent interest in Europe and North America has focused on efforts to reduce dependence on traditional rubber producers in the tropics. Arizona State University, Cooper Tire and Rubber, and bio-agriculture company PanAridus have recently been awarded a $6.9 million grant from the USDA and US Department of Energy to research the viability and sustainability of this alternative to tropical rubber (Cooper Tires 2013). According to the PanAridus website '[t]he market for guayule rubber is global, as is the ability to use drought tolerant crops in arid

Figure 6: Guayule applications: Source (Yulex 2012)

regions… [G]uayule rubber could replace up to 30% of our domestic needs, giving rubber manufacturers and tire companies a stable source that neither has to be imported or forces us to compete for global supplies' (PanAridus 2014). The EU-based Production and Exploitation of Alternative Rubber and Latex Sources (EU-PEARLS) has been established to address what it sees as a pending natural rubber shortage driven by a combination of increased demand and record rubber prices, adverse weather attributed to climate change affecting SE Asia, increasing prices for synthetic rubber due to the high oil price and the threat of a fungal disease outbreak affecting Hevea brasiliensis plantations in South-East Asia (Mooibroek and Beilen 2010). Although in its early phases, increasing guayule market share may drastically alter the geography of natural rubber cultivation and associated benefits and costs.

Summary

Table 2 provides a general overview of the alignment between the impacts generated throughout the natural rubber lifecycle and certification and alternative measures claiming to address these impacts. Checked boxes merely indicate whether these measures reference particular impacts: they do not necessarily mean that the implementation of these measures has been or will effective in addressing these concerns. In some cases, such as guayule, the initiative displaces the environmental impact rather than addressing it entirely. Typically, these measures are targeted at specific phases of the rubber lifecycle and to impacts generated in specific contexts. Overall, and while FSC appears to come close, at this time no one certification program or alternative that comprehensively addresses all environmental and social concerns raised in Part II.

Table 2: Alignment between rubber impacts and certification and labeling responses*

	Latex certification programs						**Alternatives to latex certification**		
	GOLS**	FSC	Fairtrade	Eco-Institute	USDA Organic		FSC Rubberwood	Recycling	Guayule
Environmental impacts									
Deforestation		X					X	X	X
GHG emissions		X		X			X	X	X
Soil quality	X	X	X		X		X		
Biodiversity		X			X		X		
Watershed function	X	X	X		X		X		X
Genetic modification	X	X			X		X		
Energy and waste	X***	X	X	X				X	
Social impacts									
Income vulnerability	X	X	X				X		
Food security			X						
Land tenure			X						
Labor conditions	X	X	X				X		

* Details on FSC and Fairtrade based on Potts, Van Der Meer, and Daitchman 2010

**GOLS Version 2.0

*** refers to energy and waste at the source only

PART IV: “DON’T PANIC, IT’S ORGANIC” – ADOPTION AND CONSUMPTION OF CERTIFIED ORGANIC NATURAL LATEX IN CALIFORNIA

Demand for organic products has experienced rapid growth since the initial push for organic production processes in the early 1970s. In the United States alone, from 2004 to 2011 organic food sales more than doubled from $11 billion to $25 billion, accounting for over 3.5 percent of food sales in 2011 (Osteen, Gottlieb, and Vasavada 2012). This section explores the expanding market for certified organic latex products in California within the broader context of growing demand for organic consumer products. Drawing on publicly available information and a series of interviews conducted in early 2014 with organic latex importers/distributors and organic mattress manufacturers and retailers in California, the objective here is to paint a general picture of the varying motivations behind particular stakeholder's recent interest in certified latex.

Based on a review of existing latex certification programs presented in Part III, the recently developed Global Organic Latex Standard – or GOLS – was chosen as a means to study through the process of certification demand, supply and adoption. Using GOLS as a 'certification umbrella' (Figure 7), manufacturers specializing in products under the GOLS label were identified, with Sacramento-based Organic Mattresses, Inc. (OMI) chosen as a focal point of the study based on its position as one of the first two US-based manufacturers to be awarded GOLS certification (Bedroom 2014). OMI then served as an anchor to follow the certified rubber commodity chain backward from the latex distributor through to the primary source, and forward to certified mattress retailers in Southern California, which were identified using the OMI website. This process of 'studying through' the certification process is represented by the smaller dark arrows in Figure 7. Of the businesses listed on the OMI website as retailers of GOLS certified OMI products, 20 were identified for interview in order to explore the businesses' motivations for carrying GOLS certified products, and to provide insight into their customers' motivations for choosing those products over non-certified competitor products.

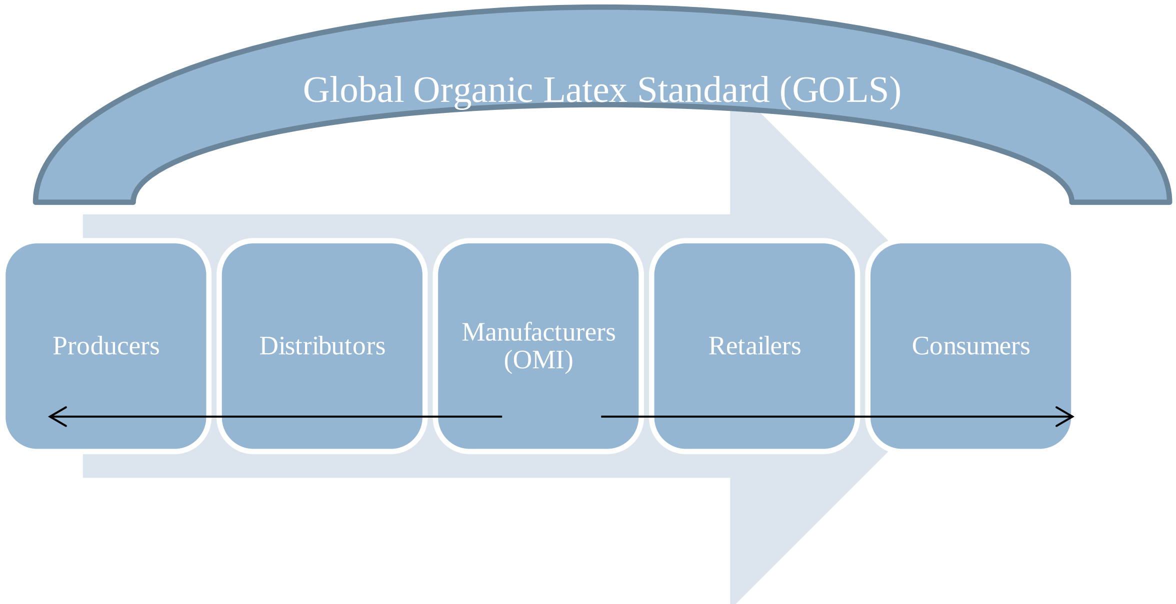

Figure 7: The natural rubber commodity chain and research process under the umbrella of GOLS. The large arrow represents the direction of value chain, while the smaller dark arrows represent the research approach

In total, 13 interviews were conducted via telephone, and respondents included representatives of one manufacturer, one distributor, and 9 retailers[1]. Additional information on GOLS was provided via email correspondence with a Control Union representative – the international inspections and certification organization responsible for developing the standard – closely involved with the development and implantation of the GOLS program. Respondents were asked to explain their business's motivations for entering the certified organic latex market and for their perceptions on industry trends. Interviews consisted of three base questions, which were expanded on as required for purposes of clarification or elaboration. Interview questions included:

[1] With the exception of Organic Mattresses Inc. and Peterson Control Union, respondents and their organizations will not be identified in order to protect confidentiality.

1. What were the primary motivations behind your company's entry into the certified organic latex market?
2. What are customers' typical questions about your products? How would you describe the extent and sophistication of their knowledge on certified latex, in terms of health benefits and production practices?
3. What have been the greatest benefits and challenges your company has faced in the certified organic latex market?

Certification and labeling – Global Organic Latex Standard (GOLS)

The Global Organic Latex Standard, or GOLS, is considered the world's first comprehensive standard for organic latex products. The standard aims to recognize products such as mattresses, gloves, condoms and other products made of organically certified raw rubber latex and to enable manufacturers, exporters, and sellers to promote a product of organic origin that is 'socially justifiable, environmentally friendly and traceable throughout its value chain' (Control Union Certifications 2012a). GOLS contains environmental management provisions including waste and pollution management, waste water treatment and energy and water conservation, as well as social compliance measures relating to safe and hygienic working condition, child labor, forced and compulsory labor, unionization and collective bargaining, living wages, reasonable working hours and harsh or inhumane treatment (Control Union Certifications 2012b). Products carrying the GOLS label must contain no less than 95% organic latex of its total weight. The status of a product carrying the GOLS label is verified through the use of transaction certificates along the supply chain, which are intended to capture the change of ownership of certified products, and are based on the organic standards applied at the field/ farm level (Control Union Certifications 2012b). The GOLS certification process starts with the unprocessed raw rubber latex originating from plant production. Each processing step (centrifugation, molding in to latex core, processing in to mattress) is required to be certified in order to label the final product as GOLS, thereby ensuring the implementation of standards along the entire value chain.

GOLS was developed by Control Union in response to requests from mattress producers, traders and associations for an industry-wide third-party verified organic standard for latex products (Control Union Certifications 2012a). Although there are products with various claims on their organic content (see Part III), prior to GOLS there existed no standard focused on the processing and labeling of latex products. Unlike existing latex standards which focus solely on issues at the source of production, GOLS sets guidelines for the minimum requirements for latex products which are prepared from organic raw material as per sustainable processing methods, and covers the areas of processing, manufacturing, packing, labeling, trading and distribution of natural rubber latex products.

As with many other environmental standards, GOLS also has its limitations. One important limitation stems from the vague language used to describe the specific standards against which natural latex is deemed 'organic'. GOLS relies on a mix of existing organic standards at both the source and final point of sale. Provision 3 – 'Requirements for organic raw material' of the GOLS states:

> "Rubber latex (tree sap) for organic production shall be of organic origin, as per *any recognized national* or *international standard* at the origin and/ or at the point of sale certified by an accredited certification body (as per ISO 65 or IFOAM). Where country specific standards are available at the point of final sale (e.g. NOP in US), the raw material shall comply with the standard applicable at the point of final sale and certified by a certification body accredited as per *a scheme recognized at the point of final sale*" (emphasis added).

Certifying products based on accepted standards at the point of sale allows for variation in the stringency of the standard between different regulatory contexts. The organic standards mentioned in Provision 3 – ISO 65, IFOAM and NOP – each contain explicit provisions regarding the use of certain pesticides, synthetic fertilizers and genetically modified organisms, potentially addressing issues of soil degradation and watershed function. However, these standards are by no means perfect substitutes. The US Department of Agriculture's National Organic Program (NOP) emphasizes responsible use of chemicals, and certified operations must demonstrate that they are protecting natural resources, conserving biodiversity, and using only approved substances. The USDA organic label also verifies that irradiation, sewage sludge, synthetic fertilizers, prohibited pesticides, and genetically modified organisms were not used. However, while conservation of biodiversity is mentioned in the NOP standards, there are no specific provisions that explicitly refer to deforestation, which is arguably the primary cause of biodiversity loss in the case of natural rubber production. In addition, provisions relating to the *conservation* of biodiversity do little to address impacts that have already occurred through historical deforestation. The International Federation of Organic Agriculture Movements (IFOAM), on the other hand, is guided by four high-level principles that reach beyond just the use of chemicals. These principles include (1) Principle of Health; (2) Principle of Ecology; (3) Principle of Fairness, and (4) Principle of Care. In particular, Principle 2 states that '[t]hose who produce, process, trade, or consume organic products should protect and benefit the common environment including landscapes, climate, habitats, biodiversity, air and water', thereby addressing issues of deforestation more explicitly than NOP (IFOAM).

The social compliance measures are also somewhat vague. Provision 7.2.1 states that 'there shall be no new recruitment of child labor, although companies do may have to make some effort to enable any children currently employed to transition to compulsory education'. The form of action companies need to take in order to be shown to be supporting this transition, however, is not specified. Provision 7.5.2 states that 'salary, wages, and benefits paid for a standard working week or month shall meet at a minimum national legal standards or industry benchmark standards, whichever is higher'. While the provision referring to industry benchmark standards may be intended to address cases where national labor policies are either lax or non-existent, the details of the industry standard are not defined in any way. In sum, the provision that "any recognized national or international standard" may be used opens the possibility that some other standard may be used, with the possibility of even lower degrees of stringency when it comes to issues of environmental and social compliance. Ultimately, the way that this clause is interpreted and employed has serious implications for the overall effectiveness of the GOLS program.

Manufacture - Organic Mattresses Inc. (OMI)

GOLS currently applies to a range of finished and semi-finished latex products including centrifuged latex, blocks, cushions, foam mattresses, granules, mattress toppers, mattresses, pillows and sheets, all of which contain a minimum 95% certified organic raw latex material of the total weight (Control Union 2014). In terms of latex mattresses, there are currently seven companies certified under GOLS, located in India, Germany, Sri Lanka and the U.S. (Figure 8).

In 2013, Organic Mattresses Inc. (OMI) became one of the first two US companies to obtain GOLS certification (Appendix 1). OMI has two US factories – located in California and Texas – where GOLS certified latex foam sheets are imported from sources in Sri Lanka and India and manufactured into mattresses, mattress toppers and pillows. The motivation behind OMI's involvement in eco-certification including GOLS stems in part from company founder Walt Bader's personal experience with adverse reactions to certain chemicals (Bader 2011).

Product Details

Latex Mattresses Made with >95% Certified Organic

Find below a list of certified companies for this product.
Note that a single company can appear multiple times when it's certified for multiple certification subprograms.

Certified for	Company Name	Client nr.	Project name	Project country
Global Organic Latex Standard (GOLS)	Cocolatex Exports P Ltd.	815081	Cocolatex Exports P Ltd.	INDIA
Global Organic Latex Standard (GOLS)	Elzacher Matratzen GmbH	829528	Elzacher Matratzen GmbH	GERMANY
Global Organic Latex Standard (GOLS)	Lalan Eco-Latex (Pvt) Ltd.	827360	Lalan Eco-Latex (Pvt) Ltd.	SRI LANKA
Global Organic Latex Standard (GOLS)	Latex Green Private Ltd.	813274	Latex Green Private Ltd.	SRI LANKA
Global Organic Latex Standard (GOLS)	Organic Mattresses, Inc.	823400	Organic Mattresses, Inc.	UNITED STATES
Global Organic Latex Standard (GOLS)	Richard Pieris Natural Foams Ltd.	821802	Richard Pieris Natural Foams Ltd.	SRI LANKA
Global Organic Latex Standard (GOLS)	Safe For Home Products, LLC, dba Naturepedic	816791	Safe For Home Products, LLC, dba Naturepedic	UNITED STATES

Figure 8: GOLS Latex Mattresses Made with >95% Certified Organic. Source www.controlunion.com

According to OMI representatives, the latex mattresses on the market today have evolved from traditional coil spring mattresses, which have been found to provide an environment for a host of bacteria and other life-forms deemed undesirable to sleepers. The links between traditional inner spring mattresses and bacteria and dust mites prompted a shift to memory foam, although the petrochemical basis of the product means this shift failed to address health concerns over chemical sensitivity. In turn, concerns over the use of petrochemicals lead to the development of mattresses made from natural latex. Finally, in an effort to produce the most ‘pure’ mattress money can buy, the company has now pursued organic certification.

One of the major difficulties with adopting organic latex from the perspective of mattress producers is that certification has be slow to keep pace with demand. Customers are willing to pay a price premium for organic rubber provided the organic claim is supported by third-party verification, however the existing landscape of a disparate certification programs characterized by widely varying degrees of stringency made this demand difficult to meet. While not stated explicitly, it is plausible to assume that industry leaders such as OMI would have been behind the push for industry-wide third-party certification such as GOLS. The issue of standard legitimacy appears to be of great concern to OMI, and the company devotes considerable attention to the issue of greenwashing in the latex industry on their website.

Primary production and Distribution

The OMI representatives interviewed for this study were unwilling to provide specific details regarding the sources raw natural latex on the grounds of commercial confidentiality. However, publicly available US shipping records indicate that OMI has sourced its latex from at least two companies since 2011 – Richard Pieris Natural Foams and Cocolatex, based in Sri Lanka and India, respectively (GreatExportImport 2014). Richard Pieris Natural Foams is a subsidiary of Richard Pieris & Company PLC (ARPICO), a Rs.25 billion conglomerate that dominates numerous sectors of the Sri Lankan economy including plantations, rubber, tires, plastics, retail and distribution, financial services, construction and logistics. ARPICO operates a fully integrated production process that incorporates plantation management, research and development, manufacturing to shipping. At present, ARPICO owns and operates the biggest rubber plantations in Sri Lanka – Kegalle Plantations PLC – and the company sources 100% of its natural latex requirement from its own plantations (ARPICO 2014). Kegalle manages a total of 17 estates, and in 2012-13 reported a total production volume of 152,000 MT (ARPICO 2013). Cocolatex is also highly vertically integrated, and – in addition to plantation, manufacturing, and shipping – operates an import and distribution subsidiary in California trading as Latex Global. The scale of Cocolatex’s operations, however, is considerably smaller than ARPICO. In addition, Cocolatex’s plantation activities appear to be restricted to the management of smallholder production systems as opposed to outright ownership of the plantations. At the time of writing, both Richard Pieris Natural Foams and Cocolatex are GOLS certified producers of organic latex mattresses.

The roots of Sri Lankan and Indian rubber production both date back to British colonial interventions in the late 19th and early 20th centuries. While a full exploration of the Indian and Sri Lankan rubber industries is the beyond the scope of this chapter, it should be noted that issues stemming from monoculture production and negative impacts on smallholders are shared between the two contexts. Impacts relating to deforestation and habitat disruption are currently less of an issue, although this owes more to the historical legacy of deforestation in the early 1900s than favorable contemporary practices by global standards (SGS 2007). An important distinction between the two contexts is the mix of smallholder and large-scale commercial production regimes. Smallholders are responsible for almost 90% of Indian production, while in Sri Lanka there is a much more balanced distribution between large-scale commercial and smallholder production (Fox and Castella 2013). In Sri Lanka, corporate ownership of plantations expanded considerably following a 1992 Government policy initiative to privatize much of the state's regional plantation companies (SGS 2007). As a result of the variation in industry ownership between India and Sri Lanka, the socio-economic issues associated with production may vary between contexts. Many of the issues highlighted in Part II – income vulnerability, food insecurity, tenure – are likely to be less of an issue for Sri Lankan commercial interests than for Indian smallholders. Overall, however, the a high degree of vertical integration of the Sri Lankan and Indian operations appears to allow for greater control over all aspects of the value chain, thereby overcoming issues of with chain of custody management that have hindered certification efforts in other sub-sectors of the rubber industry.

From a distributor perspective, certified latex currently suffers two major constraints. The first is a lack of supply, and is attributed to the challenges associated with promoting the uptake of organic production practices among smallholder producers. The promotion of organic farming techniques is difficult as although there are clear long-term benefits in terms of extending the productive life of the tree and improvements in soil quality, the three year conversion period from conventional to organic methods means that smallholders face a serious cash shortfall in the short-term. A second constraint is a general lack of consumer awareness concerning the negative impacts of rubber production. Compared to organic foods – which are directly consumed – the respondent felt that organic latex is much less of a consumer concern. Not only are consumers less concerned with having a choice between organic and conventional latex products, the fact that the products are not ingested further reduces consumer desires to understand the negative environmental and social impacts of production. When asked whether he feels compelled to promote organic latex, the distributor noted that he has limited desire to do so as he is already unable to meet existing demand.

Despite recognizing of a low level awareness of the benefits of organic latex in the broader consumer community, latex distributors in California acknowledged that existing demand for certified latex is driven by a more general consumer demand for 'green' products. This demand falls in line with a broader shift toward healthy and clean living products as noted by OMI. Importantly, the distributor noted that there is considerable variation in the consumer motivations for purchasing 'green' rubber, and that concerns generally relate to consumer health more than to the environmental impacts of rubber production. Overall, the main motivation driving the distributor to engage in organic certification – and to encourage organic production down the value chain – has been more of a response to consumer demand than a desire to 'do good'. From the distributor's perspective, organic agriculture has clear environmental benefits, but the relatively tiny share of the global market compared to tires and the challenges conversion to organic practice entail for smallholders makes it difficult to view the emergence of certification as more than a consumer fad.

Retail and consumer

The growing demand for environmentally-friendly products is now considered one of the major drivers in the global latex mattress market (Infiniti Research Limited 2014). The majority of retailers acknowledged that an important motivation for entering the certified latex industry was in response to consumer demand. In addition, around half of the respondents expressed a level of personal concern over negative environmental impacts associated with latex and production, and expressed that what was good for them (i.e. the respondent) was ultimately good for the consumer. The majority of retailers interviewed exhibited a general understanding of the negative impacts of chemical use on the production landscapes. However – as with the manufacturers – none of the retailers identified deforestation, habitat loss, greenhouse gas emissions or watershed function as issues associated with latex production. One retailer claimed that the latex used in the organic mattresses originates in state-run plantations that generate minimal environmental impact. In addition, the respondent stated that “you don’t have to cut down the tree to make latex, you just milk it”, and on this basis that environmental concern was largely a non-issue.

Echoing statements made by mattress manufacturers and distributors, each of the retailers interviewed stated that health concerns are the primary factors driving consumer interest in organic latex mattresses. Commonly identified benefits compared to conventional coil spring mattresses included:

- Resistance to mold, dust and dust mites (partly due to the structure of the product)
- Springs allow for dust to be trapped whereas the solid nature of latex mattresses prevents dust build up

- Cotton sensitivity issues
- More durable than inner springs which can lose their spring over time
- Concerns over chemical sensitivity and by parents wishing to provide a healthy sleeping environment for their children.

According to a number of retailers, consumer concern over conventional mattresses is driven by an increase in the availability of information concerning issues of toxicity and chemical sensitivity, as well as part of a broader consumer interest in ‘healthy’ and ‘organic’ living. In general, consumers of organic mattresses were considered to be highly educated when it comes to the issues relating to conventional mattresses and the benefits that an organic latex mattress will provide. However, none of the retailers identified specific environmental concerns expressed by their customers. Respondents provided a range of benefits of latex, some but not all of which apply solely to organic latex (i.e. references to comfort). When asked whether consumers exhibit any concern over the environmental impacts of latex production, one retailer argued that health and environmental concerns were but two sides of the same coin, and that by being concerned about their own health, consumers were simultaneously exhibiting concern for the environment.

Summary

GOLS was developed by Control Union in response to requests from mattress producers, traders and associations for an industry-wide third-party verified organic standard for latex products. These industry demands stemmed from consumer demands for ‘organic’ products, which are related to concerns over issues of chemical sensitivity and other pathogens with conventional coil mattresses. Due to a general lack of awareness of latex production processes and a lack of supply chain transparency, consumers have called for a certification system that – in contrast to programs such as FSC – fails to address many of the major concerns with latex production that have been identified throughout the literature.

CONCLUSIONS

Projected increases in the demand for natural rubber pose serious risks in terms of the negative environmental and social impacts associated with current production practices. This paper suggests that despite increased interest in eco-certification of natural rubber in recent years, emerging certification efforts fail to address many of the more serious impacts associated with natural rubber production such as deforestation, habitat loss and disruption of watershed function. In contrast to other certification programs, the influence of environmental NGOs in shaping the form of the certification program has been conspicuously absent. In the case of other forest certification programs – such as Forest Stewardship Council (FSC) – an important part of the mainstreaming strategy involved pressure from environmental activists on retailers (Klooster 2005). In the case of natural rubber, certification has evolved not from pressure from environmental activists or NGOs, but from a broader demand from consumers for 'organic' products. These consumers – due to a general lack of awareness of latex production processes and a lack of supply chain transparency – have called for a certification system that fails to address many of the major concerns with latex production that have been identified throughout the literature. This broad acceptance of the 'don't panic, it's organic' logic fails to recognize and account for the specificities of social and environmental degradation that characterize particular commodities, such as latex. Reflective of this logic, OMI's emphasis on 'purity' conveys a deep concern with impacts on personal health, but fails to capture some of the more serious environmental implications of latex production such as deforestation and issues associated with large-scale monoculture production.

This study – although admittedly of a small and limited scale – also indicates some serious concerns around the transparency of the certification process. Of particular concern are the details of the standards employed on which the organic designation is based, and the requirements for businesses to disclose the structure and geography of their supply chain to end consumers. The omission of explicit provisions on deforestation under GOLS, for example, stands in stark contrast to forest certification programs such as FSC and Rainforest Alliance, which both contain provisions prohibiting land use conversion as critical requirements for certification (Potts, Van Der Meer, and Daitchman 2010). In addition, commercial concerns over loss of proprietary information lead to secrecy and make it difficult for consumers to identify the source and potential impacts generated along the commodity chain. While OMI appears to place a great degree of importance on transparency as a desirable feature of certification programs, the company's unwillingness to identify its sources – apparently in the interests of commercial confidentiality – makes it impossible for consumers to access information about potential issues that may occur along the value chain. While the use of third party verification is intended to address this issue, it could be argued that such a system does little in terms of promoting a broader consumer understanding of the social and environmental impacts that occur along the latex value chain.

When thinking about eco-certification as a policy response, the rubber industry presents serious limitations in terms of both supply and demand. The fragmented and variable nature of the rubber industry points to limited utility in a universally-applicable policy approach. The intricate networks that comprise the rubber industry arguably require policy solutions that adequately address the inter-scalar dimensions of the environmental and social problems they seek to overcome. In some ways, the current emergence of a seemingly fragmented certification landscape may be better equipped to cater to geographically specific concerns. At the same time, such a fragmented approach creates difficulties for producers and consumers to understand certification requirements, while also increasing the costs of adequate monitoring and evaluation.

The disparate nature of rubber certification efforts across an already highly fragmented industry makes it difficult to determine the alignment between claims to address environmental and social concerns and actual performance. To date, limited quantitative research has been conducted on the degrees to which rubber certification programs are effective in generating positive environmental outcomes. Qualitative and quantitative data is also lacking on the degree to which these programs impose unfair burdens on smallholder producers. Flows of benefits need to be assessed to determine whether price premiums flow to smallholders, or are syphoned off by the emerging sector of certification professionals. It also needs be determined whether certification adoption is voluntary, or whether smallholders are being forced to comply due to corporate pressure. All actors involved in the certification process – from smallholders, to manufacturers, to certification bodies, NGOs, governments and consumers – need answers to these questions before certification can be promoted as a socially and environmentally responsible policy response to the negative impacts of rubber cultivation.

Private regulation will continue to draw existing notions of governance and sovereignty into question. No longer is democratically invested authority consummate with legitimacy to control and make decisions over the use of a country's natural capital. The case of GOLS presented in this paper suggests a powerful role of the end consumer in emerging certification programs. As a result, countries may no longer seek legitimacy from their own citizens when making decisions over resource use and control, but will increasingly derive legitimacy from consumers in the global North. In this way, the current misalignment between the negative environmental and social impacts of natural rubber production and emerging eco-certification efforts points to the limitations of consumer-driven environmental regulation. Growing consumer and producer awareness of the impacts associated with rubber cultivation and production is encouraging, but there is much more work to be done.

Appendix 1: Organic Mattresses Inc. (OMI) Global Organic Latex Standard certificate

CERTIFICATE

CERTIFICATE No: C823400GOLS-02.2013
GOLS REGISTRATION No: CU 823400

Field of attention:
Global Organic Latex Standard (GOLS)

Issued to:
Organic Mattresses, Inc.
Yuba City, UNITED STATES
Project in: UNITED STATES

Standard:
Global Organic Latex Standard (GOLS) - Version 2.0

Valid until: 16 December 2013

Control Union Certifications declares to have inspected the unit(s), and/or product(s) of the above mentioned client, and have found them in accordance with the standards mentioned above.

This certificate covers the unit(s), and/or product(s) as mentioned in the authenticated annex of this certificate. This certificate is in force until further notice, provided that the above-mentioned client continues meeting the conditions as laid down in the client contract with Control Union Certifications. Based on the annual inspections that Control Union Certifications performs, this certificate is updated and kept into force.

Date of certification:
12 January 2013
Place and date of issue:
Colombo-07, 24 January 2013

Declared by:

On behalf of the Managing Director

Mr. R.M.C.P Rathnayake

Certifier
Control Union Certifications
Meeuwenlaan 4-6
8011 BZ ZWOLLE
The Netherlands
http://www.controlunion.com
tel.: +31(0)38-4260100

professional inspection and certification

1 of 2

CONTROL UNION CERTIFICATIONS

References

Aratrakorn, Sirirak, Somying Thunhikorn, and Paul F. Donald. 2006. "Changes in Bird Communities Following Conversion of Lowland Forest to Oil Palm and Rubber Plantations in Southern Thailand." *Bird Conservation International* 16 (1): 71–82.

Arokiaraj, P. 2000. "Genetic Transformation of Hevea Brasiliensis (Rubber Tree) and Its Applications towards Crop Improvement and Production of Recombinant Proteins of Commercial Value." In *Molecular Biology of Woody Plants*, edited by S. Mohan Jain and Subhash C. Minocha, 305–25. Forestry Sciences 66. Springer Netherlands. http://link.springer.com/chapter/10.1007/978-94-017-2313-8_14.

ARPICO. 2013. "Annual Report 2012 / 2013". Richard Pieris & Company PLC.

———. 2014. "ARPICO." *ARPICO*. http://www.arpico.com/.

Auld, Graeme, and Lars H. Gulbrandsen. 2013. "Private Regulation in Global Environmental Governance." *The Handbook of Global Climate and Environment Policy*, 394–411.

Bader, Walter. 2011. *Sleep Safe in a Toxic World: Your Guide to Identifying and Removing Hidden Toxins from Your Bedroom*. 2 edition. Topanga, CA: Freedom Press.

Baird, Ian G. 2010. "Land, Rubber and People: Rapid Agrarian Changes and Responses in Southern Laos." *The Journal of Lao Studies* 1 (1): 1–47.

———. 2011. "Turning Land into Capital, Turning People into Labor: Primitive Accumulation and the Arrival of Large-Scale Economic Land Concessions in the Lao People's Democratic Republic." *New Proposals: Journal of Marxism and Interdisciplinary Inquiry* 5 (1): 10–26. Research conducted over many years.

Bedroom. 2014. "OMI and Naturepedic Introduce Certified Organic U.S.-Made Latex Mattresses « Bedroom Magazine." Accessed May 13. http://bedroomretailers.com/mattress-update/omi-and-naturepedic-introduce-certified-organic-u-s-made-latex-mattresses/3868.

Bennett, Mica, Laxman Joshi, Chandra Panjiwibowo, Suseno Budidarsono, Meine van Noordwijk, Hesti Tata, and Endri Martini. 2007. "Eco-Certified Jungle Rubber: A Safety Net for Disappearing Species?" http://www.worldagroforestry.org/sea/Publications/files/poster/PO0115-07.PDF.

Benong, Masahuling. 2013. "Plant Breeding Group." *Plant Breeding Group*. Accessed September 15. http://www.irrdb.com/irrdb/frontpage/index.php?menu=plantbreeders.

Bhumiratana, Adisak, Prapa Sorosjinda-Nunthawarasilp, Wuthichai Kaewwaen, Pannamas Maneekan, and Suntorn Pimnon. 2013. "Malaria-Associated Rubber Plantations in Thailand." *Travel Medicine and Infectious Disease* 11 (1): 37–50. doi:10.1016/j.tmaid.2012.11.002.

Bruun, Thilde Bech, Andreas de Neergaard, Deborah Lawrence, and Alan D. Ziegler. 2009. "Environmental Consequences of the Demise in Swidden Cultivation in Southeast Asia: Carbon Storage and Soil Quality." *Human Ecology* 37 (3): 375–88. doi:10.1007/s10745-009-9257-y.

Büthe, Tim. 2010a. "Global Private Politics: A Research Agenda." *Business and Politics* 12 (3). http://www.degruyter.com/view/j/bap.2010.12.3/bap.2010.12.3.1345/bap.2010.12.3.1345.xml.

———. 2010b. “Private Regulation in the Global Economy: A (P)Review.” *Business and Politics* 12 (3). http://www.degruyter.com/view/j/bap.2010.12.3/bap.2010.12.3.1328/bap.2010.12.3.1328.xml.

CalRecycle. 2013. “Tire Recycling and Market Development.” *CalRecycle*. October 1. http://www.calrecycle.ca.gov/tires/Recycling/.

Cashore, Benjamin, Fred Gale, Errol Meidinger, and Deanna Newsom. 2006. *Confronting Sustainability: Forest Certification in Developing and Transitioning Countries*. Yale University Faculty of Environmental Studies Publication Series. http://eprints.utas.edu.au/2205/.

Cecil, John, and Peter Mitchell. 2005. “FAO.” *Processing of Natural Rubber*. http://ecoport.org/ep?SearchType=earticleView&earticleId=644&page=-2.

Colchester, Marcus, Tejaswini Apte, Michel Laforge, Alois Mandondo, and Neema Pathak. 2003. *Bridging the Gap: Communities, Forests and International Networks*. Cifor. http://www.cifor.org/publications/pdf_files/occPapers/oP-41.pdf.

Control Union. 2014. “Control Union.” *Search Results*. Accessed May 18. http://certification.controlunion.com/SearchResult.aspx?Product_Name=latex.

Control Union Certifications. 2012a. “GLOBAL ORGANIC LATEX STANDARD (GOLS)”. Control Union Certifications.

———. 2012b. “Global Organic Latex Standard (GOLS) Version 2.0.”

Cooper Tires. 2013. “Panaridus To Join Cooper Tire And Other Consortium Partners On $6.9 Million Usda Grant To Develop Guayule Plant-Based Polymer For Tire Applications.” *Cooper Tires*. December 20. http://coopertire.com/News/Corporate-News-Releases/PanAridus-to-join-Cooper-Tire-and-other-Consortium.aspx.

Ecolabel Index. 2013. “Ecolabel Index.” http://www.ecolabelindex.com/.

Ekadinata, Andree, and Grégoire Vincent. 2011. “Rubber Agroforests in a Changing Landscape: Analysis of Land Use/cover Trajectories in Bungo District, Indonesia.” *Forests, Trees and Livelihoods* 20 (1): 3–14.

EPA. 2010. “Scrap Tires: Handbook on Recycling Applications and Management for the U.S. and Mexico”. EPA530-R-10-010. Washington DC: United States Environmental Protection Agency (EPA).

ETRMA. 2012. “Sustainable? ETRMA Annual Report 2012 - 2013”. Annual Report. European Tyre & Rubber Manufacturers Association.

European Commission. 2013. *Facts and Figures*. http://ec.europa.eu/environment/ecolabel/facts-and-figures.html.

———. 2014. “Timber Regulation.” *EU Commission - Environment*. http://ec.europa.eu/environment/forests/timber_regulation.htm#diligence.

Fang, Yi, Maosheng Zhan, and Ying Wang. 2001. “The Status of Recycling of Waste Rubber.” *Materials & Design* 22 (2): 123–28. doi:10.1016/S0261-3069(00)00052-2.

Feintrenie, Laurène, and Patrice Levang. 2009. "Sumatra's Rubber Agroforests: Advent, Rise and Fall of a Sustainable Cropping System." *Small-Scale Forestry* 8 (3): 323–35. doi:10.1007/s11842-009-9086-2.

———. 2011. "Local Voices Call for Economic Development Over Forest Conservation: Trade-Offs and Policy in Bungo, Sumatra." *Forests, Trees and Livelihoods* 20 (1): 35–49. doi:10.1080/14728028.2011.9756696.

Feintrenie, Laurène, Stefan Schwarze, and Patrice Levang. 2010. "Are Local People Conservationists? Analysis of Transition Dynamics from Agroforests to Monoculture Plantations in Indonesia." http://goedoc.uni-goettingen.de/handle/1/7418.

Forest Stewardship Council. 2014. "Public Certificate Search." *Forest Stewardship Council*. http://info.fsc.org/.

Fox, Jefferson, and Jean-Christophe Castella. 2013. "Expansion of Rubber (Hevea Brasiliensis) in Mainland Southeast Asia: What Are the Prospects for Smallholders?" *The Journal of Peasant Studies* 40 (1): 155–70.

FTP Securities. 2013. "Natural Rubber Industry Report 2013". FTP Securities.

Fu, Yongneng, Harold Brookfield, Huijun Guo, Jin Chen, Aiguo Chen, and Jingyun Cui. 2009. "Smallholder Rubber Plantation Expansion and Its Impact on Local Livelihoods, Land Use and Agrobiodiversity, a Case Study from Daka, Xishuangbanna, Southwestern China." *International Journal of Sustainable Development & World Ecology* 16 (1): 22–29. doi:10.1080/13504500902753246.

Gouyon, Anne. 2003. *Eco-Certification as an Incentive to Conserve Biodiversity in Rubber Smallholder Agroforestry Systems: A Preliminary Study*. World Agroforestry Centre Indonesia. http://www.worldagroforestrycentre.org/sea/publications?do=dl&pub_id=67&file=http://www.worldagroforestry.org/sea/Publications/files/workingpaper/WP0003-04.PDF&first_last=ok.

GreatExportImport. 2014. "GreatExportImport." http://www.greatexportimport.com/b-organic_mattresses_inc/954406.

Hecht, Susanna B. 2013. *The Scramble for the Amazon and the "Lost Paradise" of Euclides Da Cunha*. University of Chicago Press.

Hecht, Susanna B., and Alexander Cockburn. 2010. *The Fate of the Forest: Developers, Destroyers, and Defenders of the Amazon, Updated Edition*. University of Chicago Press.

Horton, Chris. 2013. "That Stink Is the Smell of Money: China's New Rubber-Farming Dilemma." *The Atlantic*. May 6. http://www.theatlantic.com/china/archive/2013/05/that-stink-is-the-smell-of-money-chinas-new-rubber-farming-dilemma/275578/.

IERE. 2009. "Carbon Footprint of USA Rubber Tire Recycling 2007". Insitute of Scrap Recycling Industries, Inc.

If You Care. 2014. "If You Care." *If You Care*. http://ifyoucare.com/index.php?home.

IFOAM. "Principles of Organic Agriculture."

India Rubber Board. 2002. “Budding.” *Budding*. http://rubberboard.org.in/ManageCultivation.asp?Id=9.

Infiniti Research Limited. 2014. “Global Latex Mattress Market 2014-2018”. Infiniti Research Limited. http://www.researchandmarkets.com/research/9dk7nn/global_latex.

IRSG. 2013. “Press Release on Sustainable Natural Rubber Project.” http://www.rubberstudy.com/news-article.aspx?id=5057&b=earlier-news.aspx.

———. 2014. “Rubber Statistical Bulletin, January - March 2014 Edition”. International Rubber Study Group.

Jawjit, Warit, Carolien Kroeze, and Suwat Rattanapan. 2010. “Greenhouse Gas Emissions from Rubber Industry in Thailand.” *Journal of Cleaner Production* 18 (5): 403–11.

Jawjit, Warit, Prasert Pavasant, and Carolien Kroeze. 2013. “Evaluating Environmental Performance of Concentrated Latex Production in Thailand.” Accessed July 22. https://gin.confex.com/gin/2012/webprogram/Manuscript/Paper3767/Revised%20Full%20paper%20GIN%202012-Warit%20Jawjit-10%20Sept.pdf.

Kenney-Lazar, Miles. 2012. “Plantation Rubber, Land Grabbing and Social-Property Transformation in Southern Laos.” *Journal of Peasant Studies* 39 (3-4): 1017–37.

Klooster, Dan. 2005. “Environmental Certification of Forests: The Evolution of Environmental Governance in a Commodity Network.” *Journal of Rural Studies* 21 (4). Certifying Rural Spaces: Quality-Certified Products and Rural Governance: 403–17. doi:10.1016/j.jrurstud.2005.08.005.

Koh, Lian Pin, and David S. Wilcove. 2008. “Is Oil Palm Agriculture Really Destroying Tropical Biodiversity?” *Conservation Letters* 1 (2): 60–64. doi:10.1111/j.1755-263X.2008.00011.x.

Kongsager, Rico, Jonas Napier, and Ole Mertz. 2013. “The Carbon Sequestration Potential of Tree Crop Plantations.” *Mitigation and Adaptation Strategies for Global Change* 18 (8): 1197–1213. doi:10.1007/s11027-012-9417-z.

Krishnakumar, PK. 2013. “Global Rubber Prices Jump on Weaker Yen.” *The Economic Times*. January 7. http://economictimes.indiatimes.com//articleshow/17918728.cms.

Lehébel-Péron, Ameline, Laurène Feintrenie, and Patrice Levang. 2011. “Rubber Agroforests’ Profitability, the Importance of Secondary Products.” *Forests, Trees and Livelihoods* 20 (1): 69–84.

Leimona, Beria, Laxman Joshi, and Meine van Noordwijk. 2009. “Can Rewards for Environmental Services Benefit the Poor? Lessons from Asia.” *International Journal of the Commons* 3 (1): 82–107.

Li, Hongmei, Youxin Ma, T. Mitchell Aide, and Wenjun Liu. 2008. “Past, Present and Future Land-Use in Xishuangbanna, China and the Implications for Carbon Dynamics.” *Forest Ecology and Management* 255 (1): 16–24. doi:10.1016/j.foreco.2007.06.051.

Li, Hongmei, Youxin Ma, Wenjie Liu, and Wenjun Liu. 2012. “Soil Changes Induced by Rubber and Tea Plantation Establishment: Comparison with Tropical Rain Forest Soil in Xishuangbanna, SW China.” *Environmental Management* 50 (5): 837–48. doi:10.1007/s00267-012-9942-2.

Malaysian Timber Council. 2011. “Malaysian Timber Council: Annual Report 2011”. Malaysian Timber Council.

Mann, Charles C. 2009. “Addicted to Rubber.” http://lad.nafri.org.la/fulltext/2233-0.pdf.

McCluskey, Jill J., and Jason A. Winfree. 2009. “Pre-Empting Public Regulation with Private Food Quality Standards.” *European Review of Agricultural Economics* 36 (4): 525–39.

Miyamoto, Motoe. 2006. “Forest Conversion to Rubber around Sumatran Villages in Indonesia: Comparing the Impacts of Road Construction, Transmigration Projects and Population.” *Forest Policy and Economics* 9 (1): 1–12.

Mooibroek, H, and J. van Beilen. 2010. “EU-Based Productionand Exploitation of Alternative Rubber and Latex Sources; EU-PEARLS(FP7; P212827)”. presented at the Oud Turnhout : Food & Biobased Research, 2010, Wageningen UR Food & Biobased Research - Biobased Products. http://www.wageningenur.nl/en/Research-Results/Projects-and-programmes/eu-pearls-projects/Publications-EUPEARLS/Show-18.htm?publicationId=publication-way-343032303830.

Nath, Tapan Kumar, Makoto Inoue, and Mangala De Zoysa. 2013. “Small-Scale Rubber Planting for Enhancement of People’s Livelihoods: A Comparative Study in Three South Asian Countries.” *Society & Natural Resources*, no. ahead-of-print: 1–16.

Osteen, Craig, Jessica Gottlieb, and Utpal Vasavada. 2012. “Agricultural Resources and Environmental Indicators, 2012 Edition”. Economic Information Bulletin 98. U.S. Department of Agriculture, Economic Research Service.

P.T. Data Consult, Inc. 2010. “Profile of Rubber Plantations in Indonesia.” *Indonesian Commercial Newsletter*, May 1.

Palu, Serge, and Daniel Pioch. 2013. “European Natural Rubber Production with Guayule as Alternative Source Tohevea Rubber (EUNARS-G)”. Poster, November.

PanAridus. 2014. “PanAridus.” *PanAridus*. Accessed February 24. http://www.panaridus.com/.

Penot, Eric, and Gede Wibawa. 1997. “Complex Rubber Agroforestry Systems in Indonesia: An Alternative to Low Productivity of Jungle Rubber Conserving Agroforestry Practices and Benefits.” In *Proc. Symp. on Farming System Aspects of the Cultivation of Natural Rubber (Hevea Brasiliensis)*, 56–80. http://www.researchgate.net/publication/233886152_An_ICRAFGAPKINDOCIRAD-CP_cooperation_research_programme/file/d912f50c9518223364.pdf.

Pensuk, Anisara, and Rajendra P. Shrestha. 2008. “Changes in Land Use and Rural Livelihoods: A Study of Phatthalung Watershed in Southern Thailand.” *Changes* 18 (2): 143.

Phommexay, Phansamai, Chutamas Satasook, Paul Bates, Malcolm Pearch, and Sara Bumrungsri. 2011. “The Impact of Rubber Plantations on the Diversity and Activity of Understorey Insectivorous Bats in Southern Thailand.” *Biodiversity and Conservation* 20 (7): 1441–56. doi:10.1007/s10531-011-0036-x.

Phoonphongphiphat, Apornrath. 2013. “Asia Rubber-Prices Set To Fall On Rising Supply, Thin Demand.” *Reuters*, July 30. http://www.reuters.com/article/2013/07/30/rubber-physicals-idUSL4N0G01DD20130730.

Potts, Jason, Jessica Van Der Meer, and Jaclyn Daitchman. 2010. *The State of Sustainability Initiatives Review 2010: Sustainability and Transparency*. International Institute for Sustainable Development. http://pubs.iied.org/G03066.

Powell, Bronwen, Amy Ickowitz, Ramni Jamnadass, Christine Padoch, Miguel Pinedo-Vasquez, Terry Sunderland, and Bronwen Powell. 2013. “The Role of Forests, Trees and Wild Biodiversity for Nutrition-Sensitive Food Systems and Landscapes.” http://www.fao.org/fileadmin/user_upload/agn/pdf/Powelletal_ICN21_ForestsandTreesforNutritionSensitive_FINAL_NoEndnote.pdf.

Pu, Jinji, Zhang Xin, Qi Yangxian, Xie Yixian, Zhang Huiqiang, and Zhang He. 2007. “First Record of Corynespora Leaf Fall Disease of Hevea Rubber Tree in China.” *Australasian Plant Disease Notes* 2 (1): 35–36. doi:10.1071/DN07017.

Ratnasingam, Jegatheswaran, Florin Ioraş, and Lu Wenming. 2011. “Sustainability of the Rubberwood Sector in Malaysia.” *Notulae Botanicae Horti Agrobotanici Cluj-Napoca* 39 (2): 305–11.

Ratnasingam, Jegatheswaran, T. H. Macpherson, Florin Ioras, and V. Abrudan. 2008. “Chain of Custody Certification among Malaysian Wooden Furniture Manufacturers: Status and Challenges.” *International Forestry Review* 10 (1): 23–28.

Ray, Dennis T. 1993. “Guayule: A Source of Natural Rubber.” *New Crops*, 338–43.

Reddy, V. Devender, B. Santhosh Kumar, and Nazia Uzma. 2012. “Lung Function Parameters, Neck Pain and Associated Factors among Male Rubber Tapping Workers in Kerala.” *International Journal of Pharma Medicine and Biological Sciences* 1 (2): 43–48.

Rubber Journal Asia. 2012. “The Future of Natural Rubber Hinges on Research.” *The Future of Natural Rubber Hinges on Research*. June 27.

———. 2013. “Gapkindo Bids for Output Reduction by 10%.” http://rubberjournalasia.com/gapkindo-bids-for-output-reduction-by-10/.

Rubber Manufacturers Association. 2013. “U.S. Scrap Tire Management Summary 2005 - 2009”. Washington DC: Rubber Manufacturers Association.

Schroth, Götz, and S. Maria do Socorro. 2013. “Technical and Institutional Innovation in Agroforestry for Protected Areas Management in the Brazilian Amazon: Opportunities and Limitations.” *Environmental Management*, 1–14.

Searle, Robert, Susan Colby, and Katie Smith Milway. 2004. “Moving Eco-Certification Mainstream.” http://www.rainforest-alliance.org/branding/documents/moving_mainstream.pdf.

SGS. 2007. “Forest Management Certification Report - Kegalle Plantations Ltd”. SGS Qualifor Associated Document.

SLEDB. “Wooden Products.” http://www.srilankabusiness.com/find-sri-lankan-suppliers/product-profiles/wooden-furniture.

Smith, Timothy M., and Miriam Fischlein. 2010. “Rival Private Governance Networks: Competing to Define the Rules of Sustainability Performance.” *Global Environmental Change* 20 (3): 511–22.

SSA. 2013. “The Specialty Sleep Association’s Environmental & Safety Program.” *Speciality Sleep Association*. http://www.sleepinformation.org/environmental.html.

State of Sustainability Initiatives. 2014. “The State of Sustainability Initiatives Review 2014: Standards and the Green Economy.”

Steering Committee of the State-of-Knowledge Assessment of Standards and Certification. 2012. *Toward Sustainability: The Roles and Limitations of Certification*. Washington DC: RESOLVE.

Stringer, R, L Lipper, T Sakuyama, and D Zilberman. 2009. “Introduction and Overview.” In *Payment for Environmental Services in Agricultural Landscapes: Economic Policies and Poverty Reduction in Developing Countries*. Springer.

Sturgeon, Janet, C. 2012. “The Cultural Politics of Ethnic Identity in Xishuangbanna, China: Tea and Rubber as Cash Crops Commodities.” *Journal of Current Chinese Affairs* 4: 109–31.

Tata, Hesti L., Saida Rasnovi, Meine van Noordwijk, and Marinus JA Werger. 2008. “Can Rubber Agroforests Conserve Biodiversity in Jambi (Sumatra)?” In *Proceedings of the Indonesian Students’ Scientific Meeting*. http://www.worldagroforestrycentre.org/SEA/PH/publication?do=dl&pub_id=2386&file=http://www.worldagroforestry.org/sea/Publications/files/paper/PP0291-10.PDF&first_last=ok.

Taylor, Peter Leigh. 2005. “In the Market But Not of It: Fair Trade Coffee and Forest Stewardship Council Certification as Market-Based Social Change.” *World Development* 33 (1): 129–47. doi:10.1016/j.worlddev.2004.07.007.

Tekasakul, P., and S. Tekasakul. 2006. “Environmental Problems Related to Natural Rubber Production in Thailand.” *J. Aerosol Res* 21 (2): 122–29.

The Freedonia Group. 2012. “World Rubber: Industry Study with Forecasts for 2015 & 2020”. Cleveland, OH: The Freedonia Group.

Therville, Clara, Laurène Feintrenie, and Patrice Levang. 2011. “Farmers’ Perspectives about Agroforests Conversion to Plantations in Sumatra. Lessons Learnt from Bungo District (Jambi, Indonesia).” *Forests, Trees and Livelihoods* 20 (1): 15–33.

TireBusiness.com. 2014. “NR Prices Reach Lowest Level since 2009.” *Tire Business*. January 9. http://www.tirebusiness.com/20140109/NEWS/140109917/nr-prices-reach-lowest-level-since-2009/.

Tiyo. 2014. “NR Market May Look up on Modest Economic Recovery.” *Rubber Asia*, January-February 2014 edition.

Van den Beemt, Rosa. 2011. “Green Rubber: Potentials and Pitfalls of Upgrading Rubber Agroforests through Eco-Certification.” http://dare.uva.nl/document/220192.

Van Vliet, Nathalie, Ole Mertz, Andreas Heinimann, Tobias Langanke, Unai Pascual, Birgit Schmook, Cristina Adams, et al. 2012. “Trends, Drivers and Impacts of Changes in Swidden Cultivation in Tropical Forest-Agriculture Frontiers: A Global Assessment.” *Global Environmental Change* 22 (2): 418–29. doi:10.1016/j.gloenvcha.2011.10.009.

Vannarin, Neou, and Simon Lewis. 2013. “Hun Sen Shares Vision of Rubber Plantation Boom.” *The Cambodia Daily*. February 22. http://www.cambodiadaily.com/archive/hun-sen-shares-vision-of-rubber-plantation-boom-11253/.

Verkuil, Paul R. 2007. *Outsourcing Sovereignty*. Cambridge University Press. http://www.langtoninfo.com/web_content/9780521867047_frontmatter.pdf.

Ward, Kevin. 2010. “Towards a Relational Comparative Approach to the Study of Cities.” *Progress in Human Geography* 34 (4): 471–87. doi:10.1177/0309132509350239.

World Agroforestry Center (ICRAF). 2011. “Maintaining Agrobiodiversity and Improving Local Livelihood of Smallholder Rubber Farmers in Bungo Distict, Jambi: Assessing Community’s Readiness in Ecocertification of Rubber Agroforestry System.”

Xu, Jianchu. 2006. “The Political, Social, and Ecological Transformation of a Landscape.” *Mountain Research and Development* 26 (3): 254–62. doi:10.1659/0276-4741(2006)26[254:TPSAET]2.0.CO;2.

Xu, Jianchu, Jefferson Fox, John B. Vogler, Zhang Peifang Fu Yongshou, Yang Lixin, Qian Jie, and Stephen Leisz. 2005. “Land-Use and Land-Cover Change and Farmer Vulnerability in Xishuangbanna Prefecture in Southwestern China.” *Environmental Management* 36 (3): 404–13. doi:10.1007/s00267-003-0289-6.

Xu, Jianchu, R. Edward Grumbine, and Philip Beckschafer. 2012. “Landscape Transformation through the Use of Ecological and Socioeconomic Indicators in Xishuangbanna, Southwest China, Mekong Region.” *Ecological Indicators*. http://www.sciencedirect.com/science/article/pii/S1470160X12003147.

Yi, Zhuang-Fang, Charles H. Cannon, Jin Chen, Cheng-Xi Ye, and Ruth D. Swetnam. 2013. “Developing Indicators of Economic Value and Biodiversity Loss for Rubber Plantations in Xishuangbanna, Southwest China: A Case Study from Menglun Township.” *Ecological Indicators*. http://www.sciencedirect.com/science/article/pii/S1470160X13001222.

Yulex. 2012. “Yulex.” *Yulex*. http://www.yulex.com.

Zakaria, Noor Aini, Lim Hin Fui, Ismariah Ahmad, Rohana Abd Rahman, and Norliyana Adnan. 2012. “Is It Time for Rubberwood Certification?” *EAS Strategic Options* 2012 (13): 14–15.

Ziegler, Alan D., Jefferson M. Fox, and Jianchu Xu. 2009. “The Rubber Juggernaut.” *Science* 324 (5930): 1024–25.