German, L., G. C. Schoneveld, and P. Pacheco 2011. The social and environmental impacts of biofuel feedstock cultivation: evidence from multi-site research in the forest frontier. *Ecology and Society* **16**(3): 24.
http://dx.doi.org/10.5751/ES-04309-160324

Guest Editorial, part of a Special Feature on Local, Social, and Environmental Impacts of Biofuels

The Social and Environmental Impacts of Biofuel Feedstock Cultivation: Evidence from Multi-Site Research in the Forest Frontier

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ABSTRACT. Preoccupation with global energy supplies and climate change in the global North, and a desire to improve the balance of trade and capture value in the emerging carbon market by developing countries, together place biofuels firmly on the map of global land use change. Much of this recent land use change is occurring in developing countries where large agro-ecologically suitable tracts of land may be accessed at lower economic and opportunity cost. This is leading to the gradual penetration of commercial crops that provide suitable biofuel feedstocks (e.g., sugarcane, soybean, oil palm, jatropha) into rural communities and forested landscapes throughout many areas of the global South. Expansion of biofuel feedstock cultivation in developing countries is widely embraced by producer country governments as a means to achieve energy security and stimulate rural economic development through employment and smallholder market integration. It is also expected that foreign and domestic investments in biofuel feedstock cultivation will lead to positive economic spillovers from knowledge transfer and investor contributions to social and physical infrastructure. While biofuel feedstocks are expanding through large industrial-scale plantations and smallholder production alike, the expansion of industrial-scale production systems has been countered by a critical response by civil society actors concerned about the implications for rural livelihoods, customary land rights, and the environmental effects of biofuel feedstock cultivation. To date, however, limited data exist to demonstrate the conditions under which widely anticipated economic and climate change mitigation benefits accrue in practice, and the implications of these developments for forests, local livelihoods, and the climate change mitigation potential of biofuels. In such a situation, debates are easily polarized into those for and against biofuels. This special issue seeks to nuance this debate by shedding light on the local social and environmental impacts accruing to date from the expansion of biofuel feedstock cultivation through in-depth case studies in 6 countries in Asia, Africa, and Latin America. Findings provide a more nuanced picture of costs and benefits, and point to a host of risks that need to be proactively managed to leverage the potential of the industry as an engine of national social and economic development.

Key Words: *Africa; biofuels; environmental impacts; forest frontier; Latin America; social impacts; Southeast Asia*

THE LOCAL, SOCIAL, AND ENVIRONMENTAL IMPACTS OF BIOFUELS: NARRATIVES AND COUNTER-NARRATIVES

The recent surge in biofuel investments and production volumes is driven by the promise of multiple social, economic, ecological, and geopolitical benefits which have driven key producer and consumer countries alike to establish policies to incentivize the industry (Timilsina and Shrestha 2010). While industry stakeholders and some analysts continue to declare the social and ecological benefits of biofuels (Goldemberg et al. 2008, Goldemberg and Guardabassi 2009), an increasing number of reports from civil society and research organizations has begun to question these benefits (Civil Society Biofuels Forum 2010, Forest Peoples Programme and Sawit Watch 2010, Friends of the Earth 2010, Plevin et al. 2010). It is noteworthy that the benefits and costs tend to vary across commodities, business models, and landscapes, making findings from industrial-scale bioethanol production in Brazil, for example, different from the impacts associated with oil palm in Indonesia or Jatropha cultivation in sub-Saharan

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Africa, each of which is expanding through both smallholder and industrial-scale production models. Such differences are often obscured in the polemics that have characterized this emerging industry. We will review the key arguments made for and against biofuel feedstock expansion, with a focus on the local social and environmental impacts that are the core theme of this special issue.

Ecological benefits and costs

One of the primary justifications for a shift to biofuels as an alternative energy source has to do with the climatic benefits that are anticipated to occur from the substitution of fossil fuels, whose combustion results in large net CO_2 emissions, to fuels whose combustion releases gases sequestered through cultivation and which are therefore considered greenhouse gas (GHG) neutral (Macedo 2005, Peters and Thielmann 2008). This promise of greener energy for transport has led to the inclusion of biofuels in alternative energy targets in many industrialized countries, notably the USA and the EU, and a growing number of developing countries, notably Brazil (Ministério da Agricultura, Pecuária e Abastecimento 2006, Amatayakul and Berndes 2007, US Congress 2007, Petroworld 2008, EU 2009). Recent publications quantifying the climate effects of biofuel feedstock cultivation suggest, however, that these benefits cannot be assumed due to the potentially significant GHG emissions associated with land use change, fossil fuel usage in cropping and processing, and marketing (Reijnders and Huijbregts 2008). Some studies suggest that the emissions associated with direct and indirect land use change alone may negate estimated climatic benefits, particularly when biofuels displace carbon-rich ecosystems and displace food production (Searchinger et al. 2008, Romijn 2009, Lapola et al. 2010, Plevin et al. 2010). Yet the net climate impacts of oil palm cultivation even on carbon-rich peatlands continue to be disputed by industry (World Growth undated). Within scientific and policy circles, it is increasingly recognized that adequate accounting of the climatic effects of biofuels must consider the full life cycle of the bioenergy production, distribution, and consumption chain, as well as direct and indirect land use changes associated with biofuel feedstock cultivation (Pena et al. 2010, Fritsche et al. 2011). While the uncertainties associated with indirect land use changes pose very real challenges to the measurement of these effects, they are anticipated to be significant and should not be left out of life cycle calculations (Plevin et al. 2010).

While the environmental debate centers largely around climate change issues, other environmental effects of biofuels are also the subject of debate. Many claim that the ability to cultivate biofuel feedstocks such as oil palm and jatropha on marginal land can lead to the reclamation of degraded lands, making these areas productive again and thereby avoiding forest conversion (Borras et al. 2010, Villela 2009, cited by Teixeira de Andrade and Miccolis 2010, Wilkinson and Herrera undated). Despite lack of comprehensive data, in the early 1990s it was estimated that approximately 500 million hectares of degraded land were available for cultivation in the world, 100 million hectares of which were located in Latin America, 100 million hectares in Asia, and 300 million hectares in Africa (Field et al. 2007). In Indonesia alone, 27 million hectares of degraded and “unproductive” forestlands have been identified for palm oil plantations (Cotula et al. 2008). However, many recent reports dispute whether investors can be induced to target such lands, suggesting that many are more inclined to convert forested lands for the rents they may receive from the same, or actively seek productive farmland for profit maximization (Casson 1999, Gaia Foundation et al. 2008, Borras et al. 2010). In Indonesia, for instance, timber, plywood, and pulp and paper companies have obtained permission to clear millions of hectares of forest under the guise of oil palm plantation establishment. While some of these companies utilized timber revenues to finance the development of oil palm estates (Manurung 2002, cited by World Bank 2010), much of this deforestation occurred without ever resulting in any plantation investments or rural livelihood benefits (Casson 1999, Holmes 2002, Sandker 2007, Valentino 2011).

Some analysts have attempted to quantify the effects of biofuel feedstock expansion on forests. Koh and Wilcove (2008) suggest that between 1990 and 2005, an estimated 55% to 59% of oil palm expansion in Malaysia and at least 56% of that in Indonesia occurred at the expense of natural forest cover. It is not surprising that the few biodiversity impact studies done on oil palm in this region point to significant reductions in species richness and in the prevalence of species of high conservation value relative to both primary and disturbed forests (Fitzherbert et al. 2008, Danielsen et al. 2008). In the Brazilian Amazon, only a small portion of total deforestation is linked to cropland expansion, since about 70% is related to the expansion of cattle ranching (Margulis 2004). In the state of Mato Grosso, 17% of total deforestation during the 2001-2004 period was attributed to cropland expansion, notably for soy (Morton et al. 2006). In southern Brazil, the direct impacts of sugarcane expansion on forestlands are limited since expansion was found to occur largely on previously converted and actively used areas (cropland, pasture) (Meloni Nassar et al. 2008). Incorporation of indirect effects would undoubtedly increase these effects. A simulation study conducted by Lapola et al. (2010) estimated that for Brazil to meet its 2020 biodiesel consumption target, an additional 10.8 million ha of land would be required for soy cultivation. While some of this expansion is expected to be directly at the expense of forest, it is projected that the most profound impact on forests will occur through displaced cattle ranching, illustrating the potential significance of indirect land use change. While evidence from Africa is limited and largely anecdotal, some studies document commercial operators targeting forested landscapes for plantation development (ABN 2007, Gordon-Maclean et al. 2009, Nhantumbo and Salomao 2010, Mortimer 2011, Valentino 2011).

Social and economic benefits and costs

The debate over the local social and economic impacts of biofuels is also contentious, and focuses on a few key issues: the ability of biofuels to serve as a stimulus to rural economies, effects on land access and control, and food security. Any look at the arguments for and against biofuels must be explicit about the business model for biofuel feedstock cultivation under consideration since socioeconomic benefits are likely to be strongly shaped by the mode of production. Industrial-scale plantations, smallholders growing independently for market, and diverse arrangements under which companies contract smallholders to produce feedstock on their behalf, will each have their own unique set of impacts, despite the inherent diversity within each.

Biofuels as a stimulus to rural economies

Rural economic benefits are a key rationale behind the expansion targets and biofuel policies and incentives established by producer country governments around the world (Energy Sector Management Assistance Program 2005, Energy Commission of Ghana 2006, Timnas BBN 2006, Ministry of Energy and Water Development of Zambia 2008, Republic of Mozambique 2009, Andrade and Miccolis 2010, World Bank 2010), and a number of multi-purpose feedstocks have historically been used as engines of rural economic development (Potter and Lee 1998, Government of Brazil 2005). Under the right conditions, for example, oil palm can yield positive socioeconomic benefits to rural communities through employment, infrastructure improvements, increases in land value, and income from smallholder cultivation (World Bank 2010). Soybean production has brought significant income to land owners and produced important economic multipliers in the downstream food industry (Goldsmith and Hirsch 2006), although anecdotal evidence suggests that benefits are concentrated in larger landholdings.

One of the primary benefits purported to come with large-scale plantations is formal employment (Peters and Thielmann 2008). In the few cases in which employment figures are cited, benefits are highly variable. The oil palm industry in Indonesia and Malaysia employs anywhere from 0.08 to 0.5 people per ha, with higher employment rates associated with smallholder-based production, followed by operations of lesser scale and sophistication (World Bank 2010). Companies exhibit a bias toward workers with backgrounds in sedentary agriculture in their hiring practices, and in the process deprive indigenous communities of potential benefits (Colchester 2010, World Bank 2010). Although in Brazil sugarcane and ethanol production have generated significant direct employment, the number of workers employed in sugarcane production has decreased by 62 percent as a result of mechanization (Ortiz and Rodrigues 2006, Dufey 2008). Similar trends characterize the soy sector, in which mechanized cultivation generates on average only 0.05 to 0.06 jobs per ha (Bickel and Dros 2003), although this takes place in areas of relatively low population density where off-farm income helps to bolster rural livelihoods. In addition to the limited labor intensity of some feedstocks, plantation employment tends to be unskilled and highly insecure as a result of temporary employment; benefits to poverty alleviation are, therefore, often limited (Macedo 2005; Marti 2008, World Bank 2010).

Although the net local economic benefits from plantation agriculture remain a topic of debate, evidence from independent, smallholder-based feedstock production is relatively promising. In some cases, feedstocks such as oil palm have provided greater net returns to land and labor than smallholders are able to obtain from other cash crops (Feintrenie et al. 2010, Rist et al. 2010, World Bank 2010). However, such benefits depend on the profitability of the crop relative to other options and on market access. Rist et al. (2010) found that smallholder cooperatives are essential to the realization of such benefits when operating in the interests of members, as a result of their roles in negotiating better prices and in holding companies accountable to contractual agreements. Positive experiences from countries such as India and Mali suggest that with adequate financial and technical support, jatropha cultivation can be successfully incorporated into traditional farming systems while providing complementary sources of income and promoting the local uptake of modern energy (United Nations Department of Economic and Social Affairs 2007, Wijgerse 2008, Practical Action Consulting 2009).

Findings from smallholder–company partnerships are more mixed. For Indonesia's Nucleus Estate Smallholder (NES) scheme, for example, where local farmers give up an average of 10 ha of land in exchange for 2 ha of cultivated oil palm (so-called "plasma"), impacts on livelihoods have been highly variable depending on the nature of the contract and market prices for oil palm (World Bank 2010). While significant gains have been reported for some households, others have greater difficulty paying off loans and face a risk of perpetual indebtedness (Colchester and Jiwan 2006, Marti 2008). Furthermore, the large investments needed for processing facilities for feedstock such as oil palm and sugarcane favor situations of monopsony in which smallholders are limited to a single buyer and less able to shape the terms of payment (World Bank 2010). Farmers operating under sugarcane settlement schemes in countries such as Malawi, Swaziland and Zambia, in which the principal provides irrigated land, inputs, and extension services to smallholders in exchange for exclusive cultivation of their crop of choice, have managed to achieve high levels of productivity and relatively high incomes. However, such schemes have been criticized for reducing smallholder capacity to grow food crops as result of strict output requirements, and for undermining household food security (FAO 2008*a*, Tyler 2008). The tendency for households to forego food crop production for profitable cash crops can alter intra-household dynamics to the detriment of women and increase household exposure to shocks (Porter and Phillips-Howard 1997, Zen et al. 2008). Findings from incipient jatropha schemes in Tanzania found household economic impacts to be negative in the short-term and raise questions as to the competitiveness of smallholder jatropha cultivation in relation to other crops (Messemaker 2008, Loos 2009). The literature on the Social Fuel Seal under Brazil's National Biodiesel Production Program is also deeply divided regarding the effectiveness of efforts to engage family farms in biodiesel feedstock production (Hall et al. 2009, Hospes and Clancy 2011). Difficulties faced by smallholders to negotiate fair contracts with more powerful companies are suggested to underlie high levels of non-participation in the program (Garcez and de Souza Vianna 2009, Hospes and Clancy 2011). For both industrial-scale plantations and smallholder production models involving formal agreements with companies, conflicts over the terms of agreement are common. Lack of clarity over debt repayment terms and land ownership, failure of companies to deliver on verbal promises, and the tendency of middlemen (government or community leaders) to act in their own interest are common complaints (Porter and Phillips-Howard 1997, World Bank 2010, German et al. 2011).

Effects of biofuels on land ownership and control

One of the main concerns about the expanding biofuel industry, linked to the prominent role of industrial-scale plantations, is its effects on local land rights. A synthesis by Cotula et al. (2008) points to growing evidence for the negative effects of large-scale commercial biofuel production due to reduced access to land and water and involuntary land seizures. In Indonesia, the NGO SawitWatch identified 630 land disputes between palm oil companies and local communities, while the national land bureau identified 3,500 disputes related to oil palm in the country (Forest Peoples Programme and Sawit Watch 2010). The majority of these conflicts are related to land and related compensation, and derive from the absence of clear land rights, lack of transparency, the absence of free, prior, and informed consent, and inequitable benefit sharing arrangements (Marti 2008, Rist et al. 2010). Indigenous people with traditional claims to land are particularly disadvantaged by oil palm expansion, as formal recognition of their claims is limited (World Bank 2010). Findings are similar in

Africa (Cotula et al. 2008). In Latin America, commercial pressures on land occur through different processes, with diverse implications in terms of local tenure rights. There are cases, such as in Bolivia, in hich soybean expansion has taken over lands occupied by indigenous populations, thus affecting local livelihoods (Cronkleton et al. 2009). Yet the most widespread dynamic is that of voluntary market transactions through which smallholders sell their lands to larger operators as an attractive opportunity in the short term. The latter has led to a process of consolidation of landholdings in prime agricultural areas and in land reform settlements alike (Fearnside 1999, Ludewigs et al. 2009; Pacheco 2009).

Effects of biofuels on food security

The third debate relates to the effect of biofuels on food security. The expansion of biofuels can have two primary effects on food security. On the one hand, direct effects may occur through this tendency for industrial-scale feedstock production to displace customary land uses. On the other hand, the effects of these land use changes and diverted end uses of multi-purpose feedstock on food prices can undermine food access by the poor. According to the FAO (2008*b*), rapid growth of biofuel production has the potential to undermine both household food security and national level food self-sufficiency through its impact on food prices. As the poor spend disproportionately high percentages of household income on food, they are particularly vulnerable to food price increases (FAO 2008*a*). The diversion of the US corn and soybean crop and the Brazilian sugar crop to biofuels is generally considered to have contributed to the 2007/2008 food price crisis (Mitchell 2008, Baier et al. 2009, Department for Environment, Food and Rural Affairs 2010), though there appears to be little consensus as to the degree of influence. Several recent studies predict that the rising demand for biofuels will over time increasingly influence world food prices (International Food Policy Research Institute 2006, OECD-FAO 2007, Fischer et al. 2009). Yet the more relevant effects for this special issue are those induced by changes in land tenure, occupation, and use. The issue of marginal lands is as relevant to this debate as it is to the environmental impact debate. The so-called “marginal” lands are typically assumed to be abandoned or unproductive, thus eliminating any negative effects on local household food security. Yet as several recent publications point out (Rossi and Lambrou 2008, Borras et al. 2010), these lands almost inevitably support crucial livelihood functions, particularly for the most vulnerable (landless, cash-poor) who rely on these areas for subsistence or to sustain them in times of need. Thus, in addition to inducing landlessness, replacing diverse land uses (controlled by local communities) with monocultures (controlled by companies) through the spread of commercial biofuel production can have adverse effects on local livelihoods, household food security, and the economic, social, and cultural dimensions of land use (Cotula et al. 2008, Zen et al. 2008). The question of whether the benefits from formal employment, social infrastructure, and economic spillovers that accompany commercial biofuel production can offset such losses has yet to be systematically addressed in much of the literature.

ABOUT THE SPECIAL ISSUE

Scope

The papers in this special issue seek to gather evidence on the local social and environmental impacts of biofuel feedstock production in select countries of Africa, Asia, and Latin America, and the extent to which the growing biofuels industry is yielding benefits to local livelihoods and climate mitigation. The research is part of a larger collaborative research initiative financed by the European Commission entitled, “Bioenergy, sustainability and trade-offs: Can we avoid deforestation while promoting bioenergy?” The wider project focus on the conditions under which biofuel expansion does and does not lead to loss of forest cover led us to focus on biofuel expansion in dry and tropical forest ecoregions and landscapes. Building on case studies from Africa (Ghana and Zambia), Asia (Indonesia and Malaysia) and Latin America (Brazil and Mexico), we explore how impacts on different social groups and environmental variables vary and try to distill the conditions under which positive and negative impacts become manifest.

Research questions

The primary question guiding this research is, “What are the social, economic, and environmental impacts of biofuel feedstock production in forest-rich biomes, and how are costs and benefits distributed among local stakeholders?" Secondary questions helping to operationalize the research include the following:

1. What are the major feedstocks in the landscapes of interest, and what are the predominant business models (e.g., industrial-scale plantations, outgrower schemes, independent smallholders) employed in their cultivation?

2. What ecological impacts may be observed from different feedstocks and business models? What major land use changes are observed, and what are the implications for the climate change mitigation potential of biofuels?

3. What local social and economic impacts may be observed from different feedstocks and business models for households affected in different ways by biofuel expansion (e.g., outgrowers, land losing households, employees)? Where major land use changes are observed, what livelihood impacts may be observed from resulting changes in forest products and services?

Methodology

Methodological framework

An effort was made to standardize the methodology to be employed in each focal country and case study site by elaborating key steps in the methodology and developing generic research instruments to be adjusted and refined based on local realities. Key steps in the generic methodology included the following:

1. Identify major business models for the selected commodity and location. Examples include industrial-scale plantations, smallholder biofuel feedstock production linked to industry (e.g., via outgrower schemes), and/or independent smallholder cultivation with no formal linkages to industry.

2. Identify local stakeholders affected in different ways by biofuel feedstock expansion under each business model. For industrial-scale plantations, examples included employees and households selling, leasing or losing land to the company and other actors affected indirectly. For smallholder-based cultivation, examples included growers and other households affected indirectly by conversion of existing land uses to biofuel feedstock.

3. Conduct focus group discussions or key informant interviews (in the case of individuals) with each identified stakeholder group to identify locally relevant types of impacts and trade-offs using a generic checklist. For select groups (e.g., former land owners and users), focus group discussions were to be gender-disaggregated. The aim with this step was to identify a broad range of issues of local importance or salience, with a focus on locally important types of impacts. Key issues to be captured included: changes in household livelihood portfolios and strategies for using available resources (i.e., land, forest, labor, capital) as a direct consequence of the emerging biofuel market; observed impacts from bioenergy expansion, both positive and negative, including economic, social, and environmental dimensions; impacts on customary practices related to natural resource access or management; gendered impacts; impacts on social relationships (cooperation or conflict); environmental impacts; effect of biofuel expansion on local power relations and related impacts; processes used to acquire land, and livelihood activities displaced; types of households getting involved as growers and barriers to participation.

4. Carry out household surveys. A generic household survey instrument was developed, to be updated based on focus group discussions (e.g., to incorporate locally salient impact variables) and adjusted to field realities. Surveys focused on biofuel-induced changes in local livelihood portfolios and customary land/forest access and management, and the socio-economic and environmental impacts of the same.

5. Assess environmental impacts and climate change mitigation effects. In addition to employing household surveys to evaluate the percentage of households perceiving different

types of environmental impacts, independent analyses of land cover change were envisioned where feasible and likely to add value to existing analyses. Observed or reported land use changes were employed to calculate carbon debts created from the conversion of different land use types. The time needed for each biofuel production system to pay back its carbon debt was further calculated based on a life cycle analysis of the GHG reduction potentials of the system.

Given the diversity in case study countries and sites, this methodology was implemented as is or significantly adapted to the local context. These modifications were driven by the diversity of business models (shaping which stakeholder groups were relevant) and local land use systems (rendering some questions irrelevant), as well as by the scale of research chosen by the select partner (e.g., ecoregional research rather than specific investments, as in the Brazilian case). This diversity will be explored further in the presentation of case studies.

Case study selection

The next step was to identify case study sites in each country where the above methodology would be carried out. The following criteria were employed in the selection of cases:

1. Presence of biofuel feedstock cultivation in dry or tropical forest ecosystems.

2. Presence of a diversity of business models, in case study countries where multiple business models could be found in a single field site.

3. Established linkages to the biofuel market, in cases where biofuel feedstock have multiple end uses, both fuel and food, and end uses are uncertain.

The application of these criteria resulted in the selection of 12 sites in the six focal countries (Table 1). Only in the more mature industries was it possible to find industrial-scale plantations and smallholder-based feedstock production in tandem, resulting in significant variations in the business models and stakeholder groups targeted for data collection in the different research sites.

Introduction to the papers in this issue

The first six papers in this issue present the results of social scientific methods employed to assess local social and environmental impacts in the six focal countries. The first two papers are from Southeast Asia. The paper by Krystof Obidzinski, Rubeta Andriani, Agus Andrianto and Heru Komarudin explores the social and environmental impacts of palm-based biodiesel in Indonesia based on case studies in West Kalimantan and Papua. The second paper, by A.A.B. Dayang Norwana, Lesley Potter, R. Kunjappan and Melissa Chin, presents a case on palm-based biodiesel in Sabah State, Malaysia. This is followed by two case studies on jatropha-based biodiesel from Africa: a paper by George Schoneveld, Laura German and Eric Nukator profiling an industrial-scale plantation in Ghana and a paper by Laura German, George Schoneveld and Davison Gumbo on a large outgrower scheme in Zambia. The final two case studies are from Latin America. The first paper by Mendelson Lima, Margaret Skutsch and G. de Madeiros Costa is an exploratory look at the widely researched Brazilian soy industry, with a focus on impacts attributable to biofuels in the Amazon and *cerrado* biomes. The final case study, by Margaret Skutsch, Emilio de los Rios, S. Solis, Enrique Riegelhaupt, D. Hinojosa, S. Gerfert, Yan Gao and Omar Masera, explores the impacts of industrial-scale and smallholder-based jatropha production in three Mexican states.

In the next chapter, Wouter Achten and Lou Verchot employ land use change data from the twelve case studies in the six focal countries, as well as different direct and indirect land use change scenarios where such data is absent, to explore the implications of biofuel-induced land cover change for the climate change mitigation potential of biofuels. The special issue closes with a synthesis paper by the editors reflecting on the key patterns emerging from these case studies, and exploring implications for sector governance.

Table 1. Overview of research sites

Country	Site	Vegetation Type	Business Model(s)	Stakeholder Groups Consulted
Brazil	Guarantã do Norte and Alta Floresta	Humid tropical forest (Amazon biome)	Industrial-scale plantations Independent growers	Employees Independent growers Other affected households
	Santarém	Humid tropical forest (Amazon biome)	Industrial-scale plantations Independent growers	Employees Independent growers Other affected households
	Sorriso	Dry forest (Cerrado biome)	Industrial-scale plantations Independent growers	Employees Independent growers Other affected households
Ghana	Pru District, Brong Ahafo	Forest-savannah transition zone	Industrial-scale plantations	Employees Land losing households (customary rights holders and recent migrants)
Indonesia	Boven Digoel, Papua	Humid tropical forest (mineral soils)	Hybrid (industrial-scale plantation + outgrowers)	Employees, Land losing households, Other affected households
	Manokwari, Papua	Humid tropical forest (mineral soils)	Hybrid (industrial-scale plantation + outgrowers)	All groups
	West Kalimantan	Humid tropical forest (peat swamp)	Hybrid (industrial-scale plantation + outgrowers)	All groups
Malaysia	Beluran District, Sabah	Humid tropical forest	Industrial-scale plantation Independent growers	Employees Independent growers Affected neighbors
Mexico	Chiapas	Secondary dry forest (*acahual*)	Outgrower scheme	Outgrowers
	Michoacán		Outgrower scheme	Outgrowers
	Yucatán		Industrial-scale plantation	N/A (environmental impact focus)
Zambia	Northern Province	Miombo woodland	Outgrower scheme	Outgrowers (with and without NGO support)

Responses to this article can be read online at:
http://www.ecologyandsociety.org/vol16/iss3/art24/responses/

Acknowledgments:

This special feature has been produced with the financial assistance of the European Union, under a project entitled, "Bioenergy, sustainability and trade-offs: Can we avoid deforestation while promoting bioenergy?" The objective of the project is to contribute to sustainable bioenergy development that benefits local people in developing countries, minimizes negative impacts on local environments and rural livelihoods, and contributes to global climate change mitigation. The project is managed by the Center for International Forestry Research and implemented in collaboration with the Council on Scientific and Industrial Research (South Africa), Joanneum Research (Austria), the Universidad Autónoma de México, and the Stockholm Environment Institute. The views expressed herein can in no way be taken to reflect the official opinion of the European Union.

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