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The local social and environmental impacts of biofuel feedstock expansion

A synthesis of case studies from Asia, Africa and Latin America

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Key points

Six case studies were conducted in southeast Asia, sub-Saharan Africa and Latin America representing different eco-regions, business models and local stakeholder groups. Findings suggest:

1. Many of the purported ecological and rural livelihood benefits of the biofuel industry have not materialised.
    - Widespread deforestation, the failure of many companies to deliver on promises, heavy reliance by companies on short-term employees, barriers to market entry, and risks borne by outgrowers have undermined the industry's promise.
    - For the biofuel sector to deliver on its promise of mitigating climate change, government policies explicitly channelling biofuels towards the forest frontier must give way to regulated expansion of industrial-scale plantations to avoid conversion of carbon-rich forest lands. Expansion of smallholder production models should also be accompanied by services to improve yields of both seed and oil.
2. Uneven local livelihood impacts are the norm.
    - The winners tend to be those who can most afford upfront investments in feedstock cultivation and plantation employees. The losers tend to be customary land users whose livelihoods are undermined by plantation expansion and who face the greatest difficulty in capturing benefits.
    - Action is needed to protect both customary land users and smallholders, who bear a disproportionate cost of the emerging industries. This includes strengthening the voice of customary land users in land negotiations. It also means ensuring they are able to capture employment and other benefits and do not have to give up traditional livelihoods for the sake of formal employment. The government should also restrict outgrower contracting until the production system is proven to be viable, ensure contracts are mutually beneficial to growers and investors, and support poorer households to overcome barriers to market entry.

Introduction

A strong interest in biofuels has arisen out of a preoccupation with the security of energy supply and global climate change in industrialised countries, and from an unfavourable balance of trade and interest in capturing value in the global carbon market by developing countries (Energy Commission 2006; MEWD 2008; República de Moçambique 2009). These factors have placed biofuels firmly on the map of global land use change. Much of this change is occurring in developing countries where larger tracts of land may be accessed at lower economic and opportunity costs (Mathews 2007). This has led to the penetration of biofuel feedstocks into rural communities and forested landscapes in many poor countries. Expansion of biofuel feedstock production in developing countries is widely embraced by government as a means to develop the rural economy—through the engagement of outgrowers and through the stimulus provided by foreign direct investment to rural infrastructure and employment generation (Andrade and Miccolis 2010; MEWD 2008; República de Moçambique 2009; Timnas BBN 2006).

The environmental costs of biofuel feedstock expansion are generally viewed by its proponents as either insignificant—due to the limited economic and ecological value of existing vegetation and land uses—or worth bearing due to the anticipated future benefits (MAPA 2006). Yet, limited data exists to demonstrate the extent to which anticipated benefits are likely to accrue. In such a situation, debates are easily polarised into those 'for' and those 'against' biofuels. While the biofuel sector is still in its early stages in some case-study countries and these findings are preliminary, it is clear that biofuel feedstock production can bring both concrete benefits to local livelihoods and significant costs (see also McCarthy 2010). The result will depend on the production models employed (smallholder or industrial scale), the governance conditions in place, and which 'local stakeholder group' you belong to (employees or customary land users).

Building on case studies from Africa (Ghana, Zambia), Asia (Indonesia, Malaysia) and Latin America (Brazil, Mexico), this brief explores how impacts on different social groups and environmental variables vary and tries to distil the conditions under which positive and negative impacts become manifest.

Overview of case studies

The research sought to capture the impacts of biofuel development in diverse contexts and from a range of perspectives. Case study analyses were therefore conducted in different eco-regions for a range of business models (industrial feedstock plantations, outgrower schemes, hybrids and independent growers). They also sought to capture differentiated impacts of biofuel development on plantation employees, small-scale feedstock growers (those cultivating independently and those on contract), households losing land to plantation development, and other actors affected indirectly by feedstock expansion. The case study locations, business models, and stakeholder groups surveyed are summarised in Table 1.

Environmental impacts

Direct and indirect deforestation

Given that the main impetus of biofuel expansion is the potential to mitigate climate change, it is important to look at the extent to which biofuel expansion is contributing to deforestation and whether the purported climate benefits are in fact achieved. This is particularly important as one of the underlying motivations of biofuel programmes in

Table 1. Summary of case study countries, business models and stakeholder groups

Country	Business model	Local stakeholders
Brazil	Industrial-scale plantation + independent growers	Sorriso site (cerrado biome): independent growers (large- and small-scale, land reform settlements) Northern Mato Grosso site (Amazon transition zone): independent growers (medium scale) Santarem site (Amazon biome): independent growers (medium scale)
Ghana	Industrial-scale plantation	Pru District site: customary land owners and users (differentiated into indigenous and migrant families); employees
Indonesia	Hybrid (industrial-scale plantation + outgrowers)	Manokwari, Papua, site: all Boven Digoel, Papua, site: all except for independent growers West Kalimantan site: all
Malaysia	Industrial-scale plantation + independent growers	Sabah site: employees; independent growers; affected neighbours
Mexico	Outgrower (social impacts) + industrial-scale plantation (ecological impacts)	Chiapas site: employees (on smallholder farms); outgrowers Michoacán site: employees; outgrowers Yucatán site: none (focus on environmental impacts of industrial scale plantation)
Zambia	Outgrower	Chinsali site: outgrowers contracted to company, without NGO[a]-supported market linkages Mungwi site: outgrowers contracted to company, with NGO support for alternative markets

a. NGO = nongovernmental organisation

case-study countries is the reduction of carbon emissions by providing a 'green' alternative to fossil diesel fuel (Chin in press; German and Schoneveld in press; Skutsch *et al.* in press).

Industrial-scale plantations. The expansion of industrial-scale feedstock plantations was found to be directly associated with deforestation. In the dry forests of the *cerrado* biome in Brazil, there has been large-scale deforestation from soya expansion since the 1980s as a direct consequence of government policy (Lima and Skutsch in press). In Mato Grosso, cropping, largely for soya, is responsible for 16–20% of deforestation (Morton *et al*. 2006), although most soya is destined for food and fodder. Using national blending targets and diverse methods for allocating the burden of direct deforestation to biodiesel (relative value and weight of primary products, and area figures), the sector's contribution to deforestation in Mato Grosso is estimated to be 1.5–6.4% (Skutsch *et al*. in press).

In the Santarem site, only a small percentage of the 28 000 ha of soya expansion occurring from 1996 to 2008 came at the expense of primary forest; much of the remainder was opened in secondary forest or fallow areas (Skutsch *et al*. in press). In the West Kalimantan site, 94% of the 5266 ha of oil palm expansion has occurred at the expense of peat swamp forest. In Ghana, 46% of plantation expansion has occurred at the expense of dry forest and 31% at the expense of fallow vegetation.

Data on indirect deforestation are largely qualitative. In Indonesia, oil palm plantations were found to cause degradation in adjacent forest areas by displacing timber extraction activities (e.g. for construction, fire wood) and concentrating these activities in remaining forests. In Malaysia, the only forest remaining is found within forest reserves, which are partially degraded due to small-scale logging, hunting, land clearing for agriculture and periodic fires (Dayang Norwana *et al*. in press). One of these reserves remains in relatively good condition, however, with sightings of orang-utan, sun bears, wild boar, mouse deer and barking deer. Yet even here, an aerial survey conducted between 2002 and 2003 showed a 90% decline in orang-utan numbers based on population estimates in the early 1980s (SFD 2005). In Ghana, displacement of prime cropland (yam, groundnuts and minor cash crops), high-value forest products (shea nut, locust bean or *dawa dawa*, charcoal, medicinal plants, mushrooms, game) and fallow land essential to the continuity of the bush-fallow agricultural system were also beginning to place increased pressure on surrounding forest areas. Charcoal burning is also expected to intensify as households turn to alternative livelihood activities following land loss (Schoneveld *et al*. in press). Loss of fallow land is also likely to shorten cropping cycles, thus undermining soil fertility.

In all sites, plantations are also due to expand—with corresponding effects on forests and livelihoods as much of the area within concessions is either mature forest (as in Indonesia) or mixed land uses consisting of agricultural plots, forest and fallow (as in Ghana).

Smallholder biofuel production. Zambia was the one country case study where land use change associated with

Table 2. Summary of direct land use changes for industrial-scale plantations

Site[a]	Year operations initiated	Concession area (ha)	Area developed (ha)	Area deforested[b] (ha)	Forest type
Mato Grosso, Brazil	Various	Various	5 075 079 (2007)	540 000 (2001–2004)	Dry forest (cerrado)
Pru District, Ghana	2008	14 500	800 (by 2009)	368 forest + 248 fallow (by 2009)	Dry forest (forest–savannah transition zone)
West Kalimantan, Indonesia	1994	13 605	5266[c] (by 2009)	4949 (by 2009)	Secondary peat swamp forest
Boven Digoel, Papua, Indonesia	1998	34 000	17 000 (by 2010)	11 300 (by 2008)	Primary humid tropical rain forest
Yucatán, Mexico	2007	12 000 at time of research; approx. 20 000 by end of 2010	2500 at time of research; approx. 5000 by end of 2010	Most of the area planted, but density of the cleared forest varied greatly	Secondary dry forest (acahual)

a. Deforestation analyses for Indonesia's Manokwari site and the Malaysian site are not yet final. b. With the exception of Ghana, only a portion of this area is from the biofuel industry because much of the production of oil palm and soya is destined for the food market. c. The figure in the 2004 environmental impact assessment is 5713 ha; however, we used analyses of satellite imagery to match the dates of the two estimates (ha developed, ha deforested).

smallholder systems was assessed. Significant deforestation was found to occur—with 22% of respondents claiming direct deforestation of mature forest due to biofuel expansion and 20% indirect deforestation from the relocation of displaced food crops (German *et al*. in press). Informant recall data suggests that for every 1000 ha of jatropha grown on smallholders' fields in the study site, an estimated 310 ha of mature forest and 196 ha of fallow land was cleared. While land use changes associated with smallholder-based production were not quantified in Indonesia, oil palm was also found to displace former cropland (rubber plantations, pineapple groves, maize), secondary forest and fallow land. In the Mexican state of Michoacán there was evidence that woody vegetation (secondary forest) was being cleared and taken out of the shifting agricultural system for jatropha cultivation. It is interesting to note that for jatropha cultivated in dry forest, net negative carbon balances can be observed—depending on the age of cleared vegetation.

Carbon impacts

Whether biofuels have a net positive or negative effect on carbon stocks will depend on the below- and above-ground carbon stocks in the existing vegetation, land clearing practices (e.g. whether all vegetation is cleared, whether vegetation is burnt) and carbon stocks in biofuel plantations that replace it. The observed land use change of greatest concern to global climate change mitigation is the conversion of peat swamp forest to oil palm, which has been estimated to result in a carbon debt of 1294–3452 mg CO_2 per ha (Fargione *et al.* 2008). Estimates for the time required to return to levels of carbon in the original ecosystem (the so-called 'carbon payback time') for these forests range from 423 to 692 years (Danielsen *et al.* 2008; Fargione *et al.* 2008)—something which will never occur in practice due to the declining productivity of aging oil palm plantations. Even the carbon debt induced through tropical rainforest conversion in southeast Asia would take longer to repay (an estimated 86 years) than the useful life of oil palm.

For soya in Brazil, carbon debts range from an estimated 737 mg CO_2 per ha for the Amazon biome to 85 mg for the *cerrado*, with payback times of 319–37 years, respectively (Fargione *et al.* 2008). It is interesting to note that even for jatropha cultivated in dry forest, net negative carbon balances can be observed—depending on the age of cleared vegetation. Carbon balances assessed in the Yucatán site in Mexico suggest carbon payback times of 8–53 years, depending on the age of the dry forest or *acahual* cleared (Skutsch *et al.* in press). If jatropha replaces mature *acahual*, a positive carbon balance is never likely to be achieved because the useful life of jatropha is around 20 years, after which it would be cut and replaced. If a complete life cycle analysis were to be conducted, including other greenhouse gas emissions, the climate mitigation potential of jatropha would be further undermined by N_2O emissions associated with fertiliser use (Skutsch *et al.* in press).

The ´carbon footprint´ of any biofuel feedstock is significantly dependent on yield. This is of particular concern for jatropha, which exhibits highly variable yields of both seed (agronomic productivity) and oil (percentage of oil yield during crushing)—depending on the genetic material used, the business model (smallholder or industrial-scale), the presence and quality of extension services and harvesting practices (German *et al.* in press). Higher yielding production is much more efficient from a carbon point of view, even though it requires higher carbon inputs (Skutsch *et al.* in press). These differences have a significant effect on the yield of crude jatropha oil per hectare and (for jatropha produced at the expense of forest cover) on the deforestation 'cost' of any unit of fuel produced. Given the differences in yield between small-scale and industrial-scale plantations in Zambia, German *et al.* (in press) show the ecological importance of more stringent environmental controls on industrial-scale forest conversion and providing technical services to smallholders. For local ecological and land use conditions, the least amount of forest clearance per tonne of biofuel can be obtained from large-scale plantations where forest clearance is kept to a minimum—due in large part to the higher yields. If on the other hand primary *miombo* woodland continues to be cleared for industrial-scale feedstock production, the deforestation effects of biofuel production can be less for smallholders—provided mid-range yields of around 1.6 tonnes per hectare can be guaranteed.

Other localised environmental impacts

Diverse local stakeholder groups also highlighted a number of other environmental impacts associated with industrial-scale plantations. Residents in all sites in Indonesia and Malaysia expressed concern over air pollution from plantations and mills and declining water quality in natural waterways or swamps (Andriani *et al.* in press; Dayang Norwana *et al.* in press). Declining water quality results from increased erosion and siltation, heavy use of pesticides, discharge of effluent from the mills and (in the West Kalimantan site) from the increased incidence of flooding resulting from the destruction of natural drainage in peatlands. Only in Sabah did local residents recognise factors other than oil palm expansion, such as upstream logging. Yet in this site residents also had the most detailed accounts of pollution of waterways, stating that the river water is no longer potable and has to be filtered before use, the river water 'turns blackish when effluent is discharged from mills' and the river surface 'looks oily'. They also cited incidences of dead fish floating in the river. In several sites, residents link these changes to oil palm-induced deforestation. In Boven Digoel, Papua, residents also blamed plantation expansion for the expansion of waterlogged areas, which they believe are responsible for observed increases in malaria and yellow fever.

Local social and economic impacts

Processes of land transfer for industrial-scale plantations

Latin American experiences. The processes of large-scale land transfer to investors vary considerably across research sites. In Brazil and Mexico, the processes observed involved mostly voluntary transactions between land 'sellers' and 'buyers', and must be contrasted with land acquisition processes in the other countries. In the case study sites in Mexico, jatropha is expanding either through its adoption by smallholders or by large-scale estates. In the Yucatán, where the only industrial-scale plantation model was observed, jatropha is being grown by companies on large private ranches previously used by absentee landlords for low intensity and low-profit grazing, and therefore is not resulting in the displacement of smallholder producers or production. In Brazil, the establishment of large-scale soya farms is largely occurring through voluntary sale of land, although this has led in some cases to the consolidation of landholdings and displacement of smaller-scale ranching (Lima and Skutsch in press).

Experience in sub-Saharan Africa. In Ghana and Zambia, processes of large-scale land transfer are subject to a number of problems due to both the formal procedures of land transfer and irregularities in practice. By law, customary rights are recognised in both countries and chiefs may concede or decline large-scale land leases or permanent transfer of ownership. Yet in practice, chiefs are unskilled in such 'high-stake' negotiations, are easily swayed by promises of 'development', and often lack the political savvy and legal literacy to negotiate favourable terms. In both countries, land ministries and investment promotion agencies play a role in facilitating investor access to land by negotiating with chiefs on their behalf (and establishing land banks), but only in Zambia were these processes observed to be directly involved in facilitating land transfers. In Ghana, where chiefs are given discretionary powers on matters pertaining to land, investors were largely negotiating directly with chiefs and formalising agreements with the assistance of independently hired lawyers.

Irregularities in land transfers involved both customary authorities and the State. In Ghana, for example, many plantations operate outside government purview, precluding the government's ability to regulate investor practices so as to leverage more sustainable and equitable outcomes. Only a small minority of foreign companies in Ghana were found to have registered at the appropriate government agencies and to have obtained the mandatory environmental permits. Furthermore, while customary land users and recent migrants were forced to relinquish farmland, fallow and communal forestland to investors, in most plantations the affected households were neither consulted nor informed ahead of time. Chiefs were instead found to enter into long-term lease agreements of 25–50 years, on terms which were largely unknown to customary land users. Deference to chiefly authority has meant that such actions largely go unchallenged by land losing households.

In contrast to the Ghana case, in Zambia the principle of free, prior and informed consent was more often compromised by government agencies than private investors. Government officials from the Ministry of Lands or investment promotion agencies were proactively involved in negotiating large-scale land transfers with chiefs. Unlike Ghana, most of these transfers involved permanent transfer of land from customary to statutory tenure, whereby the State becomes the land owner and the party allocating land to investors on a leasehold basis—often for a period of 99 years. While some chiefs reported having been coerced, others seem to have bowed to State authority with the belief that the State knows best and would operate in the interest of the people.[1] In addition to customary land users foregoing the opportunity to negotiate terms of agreement with companies, this process also leads to the permanent loss of customary land to the government. No cases of compensation for land

Table 3. Examples of compensation payments to customary leaders in Papua, Indonesia

Site	Area of select land deals (ha)	Compensation (US$)
Manokwari, Papua	14 800	300 000
	5 500	0
Boven Digoel, Papua	14 000	100 000
	8 000	Compensation for sago (US$ 0.5 per tree) and timber (US$ 1 per m^3) only[a]

a. While it is unclear how much was actually paid in compensation, the equivalent value—based on yield estimates—was about US$ 300 000 for timber and sago alone (Andriani *et al.* in press).

1 In Ghana, one company was found to have hired 'agronomic consultants' from the district office of the Ministry of Agriculture, thereby lending legitimacy to the process in the eyes of affected households.

loss were identified, as land allocation to investors was negotiated 'for the purposes of development'.

Southeast Asian experience. In Indonesia and Malaysia, plantation establishment has also led to the displacement of customary land uses and users. While customary land rights are in theory recognised in both countries, they are only recognised with formal title. In Malaysia, all land that is not privately owned or awarded as 'native land' belongs to the State, requiring formal land titles for native claims to be legally recognised (Dayang Norwana *et al.* in press). Of respondents, 77% indicated that their families were not consulted in advance of land transfers. Those who were aware in advance were only notified through a letter from the village head. Others were consulted by the company on issues related to security and road access but not about land transfers.

In Indonesia, land transfer was observed to occur either through government intervention or through direct negotiations between companies and customary land users. More often than not, land transfers involved some form of formal compensation (Andriani *et al.* in press). Forms of compensation included cash payments for land, displaced forest products or labour, and establishment of 'plasma' schemes in which households are paid for the harvest of fresh fruit bunches on land managed by the company.

In both sites in Papua, compensation, when paid, was given to tribal chiefs. Yet the scale of compensation varied according to the negotiating skills of customary leaders (Table 3). This also led to subsequent dissatisfaction with compensation levels, with some customary leaders pushing for additional compensation. Problems also ensued from the governance of compensation by customary leaders. Several cases of internal conflict associated with the lack of transparency in the distribution of these funds were reported by affected households. In one site, 92% of respondents reported not receiving any compensation, despite reported land compensation payments.

Sites vary in terms of how customary land users and migrant communities are differently affected by these developments. In Indonesia, migrant households were less affected by industrial-scale biofuel expansion as they had received formal land titles through government-financed 'transmigration' schemes and were less dependent on forests for their livelihoods than customary land users. In Ghana, on the other hand, migrant households were far less likely to receive replacement land than native inhabitants, and this land was three times smaller on average (Schoneveld *et al.* in press).

Impacts on employees

In order to explore whether the biofuel sector is delivering on its stated aims of stimulating rural development through employment generation, it is important to look at both job creation and job quality. It is also important to understand the benefits of employment relative to the activities displaced by industrial-scale plantations and other employment opportunities.

In most cases, concrete livelihood benefits were observed from employment. In Brazil, where the industry is most advanced, job quality is relatively good—with a daily wage of US$ 20 for temporary labourers, and salary plus commission following the harvest for permanent employees. In Malaysia, 77% of respondents felt that employment had improved their incomes and livelihood conditions, with many employees provided with free housing and access to better social services. In Indonesia, experiences of employees were more mixed. In the West Kalimantan site, the majority of employees claimed a net positive impact on their livelihoods. However, almost half the respondents in Boven Digoel claimed to have been negatively affected by employment. Employees stated that during recruitment, they were promised higher salaries and better facilities. Many now have no choice but to continue to work on plantations as they have relocated their families to plantation sites (Andriani *et al.* in press). In Ghana, 67% of respondents considered plantation employment to have had a net positive impact on their livelihoods despite very recent employment. In Mexico, the only place where employment benefits from small-scale feedstock production were assessed, jatropha cultivation has reportedly driven up local wage rates. At US$ 7.70 a day, this is nearly double the national minimum wage. Employees particularly appreciated the fact that the work is more constant than with food crops (e.g. requiring regular weeding), providing steady income flows. This group of respondents rated their livelihood gains more highly than any other group, even small-scale feedstock growers (Skutsch *et al.* in press).

In most sites where respondents claimed livelihood improvements from employment, increased income was stated as a key reason. In Malaysia, they also included improved education for their children. In Ghana, however, incomes were not reported to have improved; rather, it was more regular income flows that employee households cited as the key benefit relative to pre-employment livelihood activities. Regularity of income flows was a cited benefit to employees in Indonesia and Malaysia as well.

In addition to looking at the quality of employment, it is important to look at employment levels relative to displaced land uses. In the Brazilian *cerrado*, employment levels on soya estates are very low due to the high degree of mechanisation. A typical 5000 ha farm was found to employ as few as 10 permanent (skilled) and 15 temporary workers (1 full-time and 1.5 temporary per 500 ha) (Lima and Skutsch in press). While the market chain generates additional employment, with the exception of Brazil (where ranching employs fewer people per area than soya), employment levels were found to be far less than those associated with displaced land uses. In Ghana, greater returns to land are also acquired from displaced land uses than from formal employment. Employment levels were approximately one employee per 6.7 ha of plantation area. Yams were found to generate around 110% the per hectare value of employment. Employment would compare far less favourably if the value of other displaced crops and forest products were considered (Schoneveld *et al.* in press).

With countries leasing large tracts of land in the name of employment, it is important that anticipated employment levels be critically reassessed.

Impacts on small-scale feedstock producers

Another key aim of policy makers has been to enhance rural incomes through smallholder participation in biofuel feedstock production. This type of production was observed in Indonesia, Malaysia, Mexico and Brazil.

In cases where smallholders are engaged in feedstock production in well-established biofuel industries, concrete benefits are generally observed. In Indonesia, small-scale feedstock farmers—present in the Manokwari and West Kalimantan sites—mostly reported positive livelihood impacts from oil palm cultivation (Andriani *et al.* in press; see also Feintrenie 2010; Rist *et al.* 2010). This was attributed to higher incomes and related improvements in housing, to an expansion of social networks and to road construction (largely associated with industrial-scale operations). A larger number of farmers engaged in plasma schemes reported positive impacts on livelihoods. Some respondents said these benefits resulted from the company sharing part of the labour burden associated with oil palm cultivation.

In Manokwari, Indonesia, 2 ha out of every 2.5 ha received from the government through the transmigration scheme were used as collateral for loans to establish oil palm plantations. After 10 to 15 years, more than 85% of these farmers were able to repay their loans and have their ownership certificates to land and plantations (used as collateral) returned to them. Also, oil palm ownership certificates can be used as guarantees to secure loans for additional business ventures.

In Malaysia, livelihood improvements for small-scale growers were associated with increased income, a shift away from traditional revenue streams and more flexible working hours (Dayang Norwana *et al.* in press).[2]

In Brazil, farmers producing feedstock for industrial-scale operations under the 'Social Fuel Seal' programme are clearly benefiting from a policy which provides biodiesel producers with incentives to source their raw materials from smallholders and 'family farms' (defined as farms of less than 100 ha). However, the high cost of providing technical support to small farms means that settlements in which individual landholdings are much less than 100 hectares are not of interest to companies, who therefore pick and choose which land reform settlement they ´adopt´. The economies of scale associated with large-scale production have also led to considerable consolidation of land holdings in these resettlement areas (Lima and Skutsch in press).

In the Amazon transition zone, high transport costs and restricted access to credit (for which land titles are required) have limited the expansion of soya. In Santarem, credit is the major barrier to expansion, since both land titles and a certificate showing that no deforestation has occurred are needed. In the *cerrado* zone, many of the smaller landholdings distributed under the agrarian reform programme are too small to compete in the soya market, even in a protected market created by government support programmes.

In cases where smallholders are engaged in feedstock production in emerging biofuel industries, no real benefits have materialised. This is the case in the emerging jatropha industry in Mexico and Zambia. Findings from both countries suggest very low profit margins for jatropha farmers (German *et al.* in press; Skutsch *et al.* in press). In Mexico, economic returns per ha from jatropha were found to be attractive partially due to a government subsidy to offset establishment costs in the first two years. However, if the costs of labour are factored in, the sales price would scarcely cover input costs, even taking the subsidy into account.

In Zambia, one company had reportedly abandoned farmers entirely, delivering only seed and technical support out of many promised benefits. Efforts to provide an alternative market to farmers, supported by nongovernmental organisations, while too new to evaluate, had contributed about US$ 15 per annum to average household incomes. When factoring in labour, costs were found to be considerably higher than benefits.

In both sites, early payments (government subsidies in Mexico, and the promise of loans and payments by processing companies in Zambia) were found to be key factors motivating farmers to invest in jatropha. As the industry is very new in both countries, it still remains to be seen whether farmers will find jatropha cultivation a

2 Once plantations are established, work on oil palm is reportedly more flexible than traditional livelihood activities, alleviating the work load for men. Furthermore, better established growers can afford to hire daily labourers to carry out plantation work, leaving time for small-scale business ventures.

worthwhile economic pursuit. Barriers to market entry were also found in these sites. In Chiapas, jatropha farmers were found to have larger average landholdings and in Michoacán, 81% of farmers were identified as being of average income or wealthy (Lima and Skutsch in press). Given the newness of the programme, relative wealth is a driver rather than a consequence of involvement. Land, labour and lack of land title were found to limit involvement by some households.

It is important to note that small-scale farmers were found to be bearing much of the risk associated with an emerging and largely untested jatropha industry. In Mexico and Zambia, farmers contracted to private companies had signed agreements committing to sell only to these companies, yet the purchase price and the basis for calculating this price were never established (German *et al.* in press; Skutsch *et al.* in press). In Mexico, while farmers had to commit to selling only to the contracting company there was no counter-clause guaranteeing the company requirement to purchase seed. In Zambia, such a counter-clause did exist, but informally contracted technical agents were found to have signed on the company's behalf, with associated commitments by the company unlikely to be upheld in courts of law. In Michoacán and the two Zambian sites, technicians employed by the government programme and companies contracting outgrowers were quick to persuade farmers of the high yield and economic benefits of jatropha cultivation, yet in neither country have they actually purchased any of the product despite several seasons of production.

Responses have been mixed, with select farmers in both countries pulling up or neglecting their plantations because the company had not come to collect seeds and others continuing to invest with the hope of future returns. The financial instability of jatropha outgrower companies and the market thus poses a risk to farmers. In Michoacán one company acting as an intermediary in the government-sponsored programme pulled out, and in both countries financial problems left some companies unable to uphold their commitments to outgrowers.

Food security concerns

In most sites where smallholders adopted biofuel feedstocks, some food crops were displaced. In Chiapas, two thirds of jatropha farmers interviewed had converted maize or other food crops, while almost a third had converted pasture land. In Michoacán, small-scale jatropha cultivation was found to displace both permanent fields and shifting agricultural plots (both in use and under fallow) where maize had been grown. In Indonesia, jatropha was found to displace cash crops such as rubber and pineapple. In Zambia, where food security effects were looked at in greater detail, 58% of respondents were found to have integrated jatropha into permanent agricultural plots. Another 39% of households had opened fallow and forest areas, taking these out of the shifting agricultural system. Yet despite these changes, due to the practice of intercropping jatropha with existing food crops, only 39% of respondents indicated that food crops such as millet, cassava, maize and groundnuts were displaced from by jatropha. Many households established new plots for these crops elsewhere, some of them on more fertile land. However, disaggregating the data showed that some households had experienced a decline in food production due to land use changes or labour shortages. It is also important to consider that negative effects on food crop production may increase over time in intercropped fields as jatropha begins to crowd out food crops. Based on our research, food security seems to be a more significant concern in areas dominated by industrial-scale plantations and where land consolidation is occurring.

Impacts on customary land owners and users

Displacement of customary land uses. The most negative impacts of biofuel feedstock expansion have been those associated with the displacement of customary livelihoods resulting from large-scale land transfer to investors. This has not occurred in the Brazilian and Mexican sites. Economic losses stem from the loss of both agricultural and forest incomes.

In the Malaysian site, all land has now been converted to oil palm except for areas set aside as forest reserves (Dayang Norwana *et al.* in press). In addition to loss of land for rice farming, deforestation has led to the widespread abandonment of forest-based livelihood activities such as hunting and extraction of non-timber forest products. Those who continue to hunt have to travel further and deeper into the forest to find game. Furthermore, as many customary land users no longer own land, they are more dependent on hunting, gathering and fishing than before, making deforestation and declines in water quality more keenly felt. Most households who lost land to the company continue to fish as a key component of their livelihood portfolio. However, water pollution has led to a decline in landings and related incomes. The reduced fish catch and inability to continue planting rice has resulted in the need to purchase much of their food, undermining household food security.

Results are similar in Indonesia, where decreased forest cover has resulted in a reduction in access to forest products and in the practice of shifting agriculture (Andriani *et al.* in press). Households have either abandoned these activities altogether and shifted to other livelihood activities, or suffered the increased labour burden of having to walk longer distances to collect forest products or to open new fields for shifting cultivation. Those involved in logging and sawmill employment have had to abandon their former livelihood activities entirely due to dwindling forest resources. All respondent groups reliant on forest products and services have had to shift to on-farm activities (for those who still owned land) or to off-farm work. They also have to purchase forest products they once sourced for free (e.g. wood for construction, fruit).

In Ghana, significant livelihood declines were observed within two years of plantation establishment due to the loss of agricultural land and displacement of forest-based livelihoods (Schoneveld *et al.* in press). The average household lost more than three quarters of their landholdings by the end of 2009. Furthermore, only 26% of households had been able to acquire replacement land at the time of research. The replacement land constituted only 12.6% of initial landholdings, resulting in severely compromised agricultural incomes (Schoneveld *et al.* in press). An estimated 50% of households acquiring new land found the replacement land to be of poorer quality.

Barriers to land replacement were both cultural and biophysical, with migrant households experiencing greater difficulty securing new land from chiefs. Much remaining land was waterlogged, rocky or far from settlements. Due to the loss of access to land, the vast majority of respondents reported declining contributions of forest and agricultural activities to household livelihood portfolios (98% and 73%, respectively). Significant losses in women's income streams were also observed through the destruction of 'minor' crops during plantation establishment and marked declines in the availability of *dawadawa* and shea butter. Of respondents, 73% perceived net declines in their standard of living as a result of plantation expansion.

In Brazil, the only reported effect on customary land uses was the progressive displacement of the timber industry to the *cerrado*, and the gradual demise of cattle ranches in the soya frontier (Lima and Skutsch in press).

In some sites, such losses are countered with significant livelihood benefits. However, only in select sites is this believed to have resulted in net livelihood improvements. In Malaysia, customary land users noted significant benefits from the establishment of oil palm plantations in the area. These included improved road access and increased job opportunities, with at least 30% of respondents having household members working as unskilled labourers at the plantations. The greatest concern therefore lies with those who have not been ensured formal employment or other economic opportunities to compensate for their losses.

In sites where biofuel expansion has occurred through smallholder-based production models, negative impacts from the displacement of customary land uses were not considered to be significant.

Benefit flows to affected households. In Ghana, while employees welcome the company and the more regular income streams derived from employment, only 4% of land losing households had secured employment at the time of research, despite their declared interest in formal employment (Schoneveld *et al.* in press). In the three villages affected by the early phase of plantation expansion, only 1 in 11 households were found to have a household member employed by the company. This represents only 13% of the plantation labour force at the time of research, despite a verbal agreement between the paramount chief and the company to provide preferential employment to all affected households.

In Indonesia and Malaysia alike, the majority of jobs on plantations were also found to go to migrants from outside affected communities, from other provinces[3] or—as in the case of Sabah—other countries (Andriani *et al.* in press; Dayang Norwana *et al.* in press). In the case of Indonesia, local residents tend to be given low-paid jobs as unskilled labourers. Their skills base and work ethic are often considered inadequate by managers, and most of them were found to be unable to secure or retain jobs on plantations. Those with positive employment experience were found to be largely transmigrants. In Boven Digoel, those with adequate capital or high positions in traditional communities were found to be better able to capture the opportunities presented by oil palm.

Prevalence of social conflict

With the notable exception of Malaysia, where plantations are certified by the Roundtable on Sustainable Palm Oil, cases of social conflict associated with oil palm expansion were common. The most prevalent and significant sources of conflict or concern (in cases where deference to authority precludes conflict) were related to land transfers and the distribution of benefits (land compensation, employment).

Conflicts over land transfers resulted from either disagreement over the decision to sell or transfer land, or over the management of revenues derived from land transfers. In Indonesia, one of the most contentious issues has been differential compensation payments among customary authorities and land users (Andriani *et al.* in press). This has led to unresolved social tension in all sites. The other conflict derives from government allocation of customary land to transmigrants. Conflict was mostly observed in plasma areas near the nucleus estate, where former land owners have demanded the return of their land. While repeated mediation attempts by local government agencies have been largely unsuccessful, one case was observed in Manokwari where a profit sharing mechanism had been put into place as a form of compensation to customary land

3 In one site in Indonesia, Manokwari, only 8% of employees were found to be of the indigenous Arfak ethnic group (Andriani *et al.* 2010).

owners. In addition to conflict between native and migrant communities, discontent is also oriented towards the government, whom native Papuans perceive as being biased towards transmigrants. Tensions between native and migrant communities over land transfer were also observed in Ghana, where recent migrants perceived their land to have been specifically targeted for plantation development.

A number of conflicts surrounding benefit distribution mechanisms were also observed. The main issue related to employee–company relations, notably inequitable or non-preferential hiring practices (Andriani *et al.* in press; Skutsch *et al.* in press). This is common where companies provide equal or greater employment opportunities to workers from outside affected communities, whom displaced communities feel are less entitled. In West Kalimantan, a conflict between community members and the company over employment policies was successfully resolved through dialogue, leading to a reduction in the number of migrant workers employed and greater employment opportunities for long-time residents.

In Indonesia, conflict has also arisen over the distribution of opportunities to participate in the plasma scheme. In West Kalimantan, this form of conflict was found to affect relations between those receiving and those not receiving plasma as compensation for land loss (Andriani *et al.* in press). Finally, conflicts can also emerge in relation to the impacts of formal employment on social obligations and the burden that must be borne by others. In Ghana, for instance, conflict ensued when plantation employees failed to participate in communal works. This conflict escalated to such an extent that police intervention was required (Schoneveld *et al.* in press).

A number of conflicts were also observed within smallholder-based production schemes. In Zambia, a conflict was observed between growers and local technical agents hired by outgrower companies. Being the only company 'representatives' left behind, these agents bore most of the social burden of company withdrawal (German *et al.* in press). In one case, growers threatened to take the technical agent to court for failing to deliver on company promises. A second set of issues, observed in Mexico, involved shifts in customary natural resource management practices—such as the diversion of water from cattle to nurseries, and the destruction of jatropha by freely grazing cattle (Skutsch *et al.* in press). These appear to be exceptions, rather than the rule. Interestingly in Sabah, where a company has made considerable effort to protect its global reputation (e.g. through compliance with RSPO standards), there was no mention of conflict among community members or between local residents and the company.

Conclusions

This synthesis points to two key sets of findings. First, many of the purported benefits of the biofuel industry have not materialised in the cases researched. Widespread forest conversion during biofuel expansion has reduced the climate mitigation benefits of the industry while undermining customary livelihoods. The rural development benefits associated with formal employment and small-scale feedstock production have also been disappointing in many sites. Reasons include the failure of companies to live up to their promises (or poorly communicated promises), high levels of temporary employment, barriers to market entry, and—as in the cases of Mexico and Zambia—widespread mobilisation of outgrowers to bear the risks of an unproven industry.

The second set of findings relates to the uneven local livelihood impacts. A socially disaggregated analysis clearly points to mature industries having both winners and losers. In several cases, but most notably in Brazil, the winners are those actors who can afford to bear the up-front costs of investment that enable them to break into the market. In other cases, such as Malaysia and West Kalimantan, the winners are the employees. In most cases, the losers are customary land owners.

Land losers can also experience net benefits if compensation meets or exceeds the value of displaced land uses, benefits are governed to the advantage of all land losing households, and losses are compensated with preferential employment and services. However, these conditions are rarely observed in practice. In the absence of preferential policies or support services by companies or government, households which lose the most from such developments will continue to have the most difficulty capturing opportunities associated with them.

A number of lessons may be derived from these early findings, to enable the emerging biofuels industry to better deliver on its promises. The first set of findings relates to governing the environmental impacts of biofuels. For the biofuel sector to deliver on its promise to mitigate climate change, it is essential that the expansion of industrial-scale plantations does not occur at the expense of mature forest. Furthermore, to minimise the negative environmental footprint of smallholder-based feedstock production, it will also be important to ensure adequate services are provided to enhance yields of both seed (in the field) and oil (in the factory). It will also be important to raise awareness on the role of environmental standards in buyer markets, and the conditions under which net climate benefits have been achieved.

A number of actions are also needed to protect both customary land users and smallholders from exploitation. The poor are bearing a disproportionate cost of the emerging biofuel industry, either through land loss or through uncertain returns on investment. To protect customary land users, it is essential to strengthen their voice in land negotiations, ensure they are able to effectively capture opportunities associated with this growing industry and reconcile them with formal employment. Strengthening their voice may or may not mean formalising customary rights, given the administrative barriers to formalisation, the difficulty of unitary normative frameworks in capturing the nuanced (e.g. non-exclusive) and socially embedded nature of customary rights, and the lack of any guarantee that formalisation will restore the rights of the rightful owners (de Soto 2000; Lavigne-Delville 2006; Lund 2008). However, it does mean ensuring recognition of the rights of customary land owners and users, and ensuring the downward accountability of those negotiating on their behalf (and of the negotiation process itself). It also requires levelling the playing field by enhancing local awareness of the risks and the uncertainties associated with future benefits, and ensuring clarity (and legal backing) on what they can expect to gain in return.

Ensuring emerging opportunities can be captured by those who most need them means ensuring preferential employment or feedstock sourcing policies for land losing households, and a stronger government role in supporting quality and equity in corporate social responsibility practices. To reconcile customary land uses with formal employment, it is important to look into the conditions under which this may be possible in different locations.

To protect small-scale growers from exploitation, governments must also play a greater role in regulating the expansion of the biofuels industry. This might entail placing upper limits on the number of outgrowers that can be contracted until the production system and business model are proven to work, ensuring contractual terms are mutually beneficial to growers and investors, and ensuring poorer households have the means or support services required to break into the market.

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