

POLICY PERSPECTIVES

Taking the Bitter with the Sweet: Sugarcane's Return as a Driver of Tropical Deforestation

Krystof Obidzinski¹, Koen Kusters², & Sophia Gnych³¹ Center for International Forestry Research, GOV² WiW - Global Research and Reporting³ Center for International Forestry Research, GOV**Keywords**

Agricultural expansion; deforestation; food security; REDD; Indonesia.

CorrespondenceKrystof Obidzinski, Jln CIFOR Situ Gede West Bogor, Bogor, Indonesia, 16115.
Tel: +62-251-862-2622; fax: +62-251-862-2100.
E-mail: k.obidzinski@cgiar.org**Received**

28 August 2014

Accepted

20 March 2015

doi: 10.1111/conl.12172

Abstract

Over more than 400 years, large areas of tropical forest in Brazil, the Caribbean, the Philippines, Australia, and other parts of the world were cleared to make way for sugarcane plantations. There is a general consensus in the scientific community that since the 1950s, the frontier expansion of sugarcane has stabilized and direct pressure on tropical forests from sugarcane expansion has diminished. Here, we show, however, that sugarcane plantations are on the cusp of returning as a major driver of deforestation in Indonesia. The Indonesian government has developed preferential policies designed to boost sugar production in the name of national food security, and is seeking to convert more than 1 million hectares of tropical forest into sugarcane plantations. If fully developed, the plantation expansion program will undermine Indonesia's goal of reducing greenhouse gas emissions. The scale of the expansion program is such that it will radically alter the global environmental impact of sugarcane.

Introduction

Throughout its long history of commercial cultivation, sugarcane has demanded large areas of land. From the early 16th century until the 1950s, the expansion of sugarcane resulted in large-scale deforestation on the Atlantic coast of Brazil and in the Caribbean (McNeill 1986; Fitzpatrick & Keegan 2007; Funes Monzote 2013). In other parts of the world too, such as the state of Queensland in Australia and the Philippines, cultivating sugarcane became synonymous with deforestation as forests gave way to plantations and further land-use change due to improved infrastructure and increased migration (Honda 1996; Griggs 2007).

In Brazil, there is some debate about whether sugarcane production persisted as an indirect driver of deforestation, by displacing commercial crops and cattle ranching in established agricultural zones and forcing them into the frontier areas in the Amazon region (Sparovek *et al.* 2009; Lapola *et al.* 2010). There is also some evidence of additional negative environmental

impacts from sugarcane agriculture, including soil degradation, deterioration of aquatic systems, nitrogen pollution, and the destruction of riparian zones (Martinelli & Filoso 2008). Today, however, sugarcane agriculture is no longer a direct driver of deforestation in the Amazon (Sparovek *et al.* 2009; Gao *et al.* 2011). This is true not only for Brazil, but also for other areas of sugarcane production. In the Caribbean, sugar is no longer the focus of national economies, as they have diversified through growth in sectors such as tourism and services (Funes Monzote 2013). The economy of Queensland has shifted toward mining and Great Barrier Reef tourism (Costigan n.d.), while the Philippines' sugarcane sector never recovered from its stagnation following changes in import agreements with the United States and declining prices on the world market in the 1980s (Nelson 1988; Honda 1996). In Indonesia, by contrast, the sugarcane sector is on the brink of a government-engineered boom – and our analyses indicate that this growth will see a concomitant increase in deforestation.

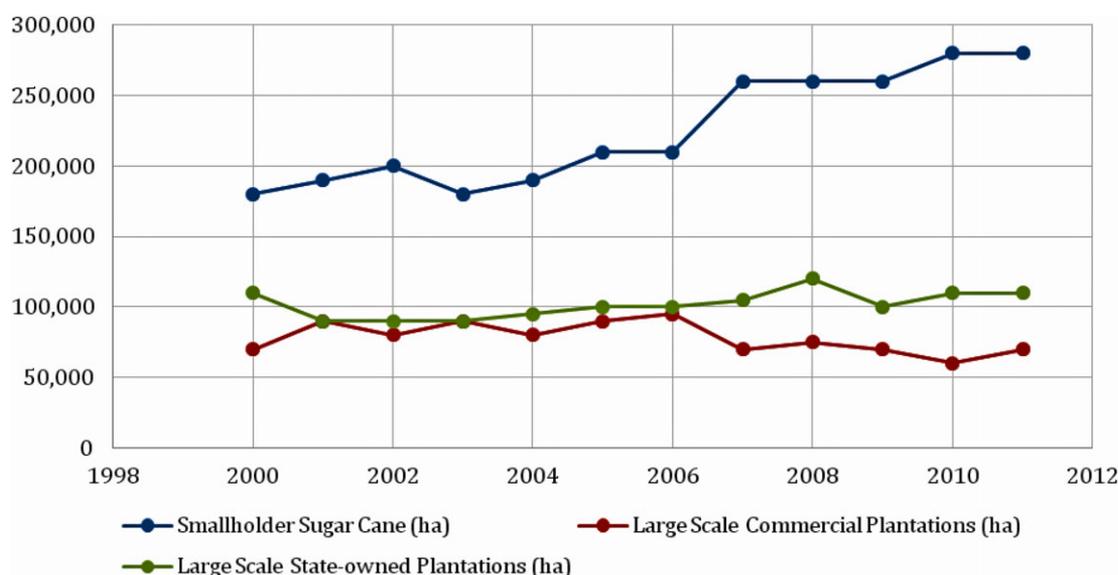


Figure 1 Sugarcane cultivation in Indonesia.

Source: Pusat Data dan Sistem Informasi Pertanian 2013.

Indonesia's sugarcane sector

Commercial cultivation of sugarcane in Indonesia began around 1830, initially as part of the forced cultivation system instituted by the Dutch colonial administration. Sugarcane plantations were established on existing smallholder agricultural lands, mostly in Central and Eastern Java (Nelson & Panggabean 1991). Today, these provinces still account for about 60% of Indonesia's total sugarcane plantation area (Directorate General of Estates 2013).

As of 2011, Indonesia had 457,000 ha of sugarcane plantations. The vast majority of these plantations are smallholder sugarcane farms, which cover 280,000 ha. About 70,000 ha are large-scale commercial plantations, while the remaining 110,000 ha are large-scale state-owned enterprises (Figure 1).

While smallholder sugarcane farming predominates at the national level in Indonesia, it is even more pronounced in particular parts of the country, especially East and Central Java. These two provinces are the hubs of smallholder sugarcane growing, accounting for nearly 90% of smallholder sugar cultivation in Indonesia (Figure 2). In terms of business models for sugarcane growing in Indonesia, there are three predominant schemes, that is: (1) *Inti*, (2) *Plasma*, and (3) independent farming (Maulidiah 2013; Wibowo 2013). The *Inti* arrangement is where a commercial enterprise manages all plantation operations and smallholders' main means to gain benefits are either waged labor or through profit

sharing in cases where smallholder land has been leased or transferred to corporate use. *Plasma* is an outgrower scheme whereby farmers grow sugarcane and deliver it to the company mill at an agreed upon price. Finally, independent farming denotes sugarcane farms without pre-existing sale or labor arrangements. The independent farmers are the largest group by far, but their holdings are extremely fragmented, as up to 70% of the smallholder sugarcane plots are less than 1 ha (Maulidiah 2013).

By the 1930s, Indonesia had become the world's second largest producer of sugar and a net exporter. Until around 1990, the country managed to produce enough sugar for domestic consumption (Nelson & Panggabean 1991). In the late 1990s, as part of an IMF rescue package ratified in the wake of the 1998 economic crisis, the Indonesian government liberalized sugar production and trade policies, and removed support programs for smallholder sugarcane production. This quickly translated into a sharp increase in the import of raw and refined sugar. Fearing an adverse effect on over 2 million farmers and seasonal sugarcane farmers and workers, since 2002 the government has tried to bolster the domestic sector by increasing the tax on the import of sugar, limiting the number of import licenses, and by providing incentives to improve the efficiency of sugar mills. The government also tried to increase the productivity of existing plantations by providing better genetic material (Rusastra *et al.* 2008).

Yet, none of the government's measures has resulted in significantly higher sugar production. Even though the

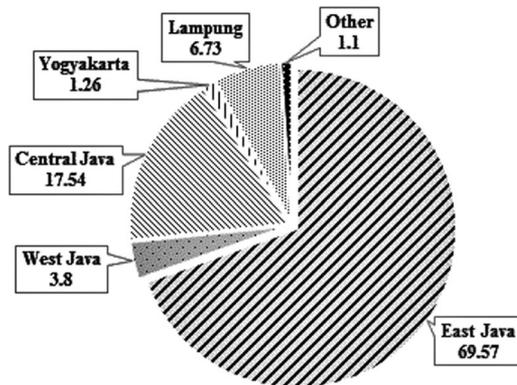


Figure 2 Distribution of small-holder sugar cane cultivation in Indonesia (%)

planted area showed a marginal increase, productivity of sugarcane per hectare remained constant at 5–6 tons of cane per hectare while demand for sugar continued to rise (Pusat Data dan Sistem Informasi Pertanian 2013). Investments in new mills remain limited, and old sugarcane varieties have not been replaced with new, higher-yield varieties. Causes of this policy failure include concerns among the private sector and government agencies about the high fragmentation of sugarcane holdings in Java, the high costs involved in upgrading their productivity, and the risks associated with the often unclear legal status of smallholder properties. Indonesia now has a deficit of 3 million metric tons of sugar per year (Wijianti 2014), with most of the imported sugar originating from Thailand (USDA Foreign Agricultural Service 2013).

Expansion of large-scale plantations in the name of food security

Sugar production is again featuring in Indonesian government policies, this time as one of four key commodities at the heart of the country's food self-sufficiency program, launched in 2008. The program, which aims to expand the cultivation of rice, corn, beef, and sugar (Ministry of Agriculture 2009), was prompted by concerns over food security, which arose in response to increased demand for biofuels, the global financial crisis, and fluctuations in food prices. The government plans to increase sugar production by developing large-scale commercial sugarcane plantations outside of Java. To support this goal, Government Regulation No. 10/2010 permits each sugarcane company to hold up to 150,000 ha of land, which is more than three times the maximum area allowed for other commodities. For the province of Papua, the maximum area of sugarcane plantations is even set at 300,000 ha. After issuing this regulation, the

government announced that at least 500,000 ha of land outside of Java would be planted with sugarcane, and up to 25 new sugar mills would be constructed with a total investment value of \$2.6 billion (Jakarta Post 2010).

The process of large-scale expansion received further support when Presidential Decision No. 10/2011 exempted sugarcane plantations from the Forest Conversion Moratorium. This moratorium had been signed into law earlier that year as part of the \$1 billion agreement between Norway and Indonesia, designed to reduce Indonesia's land-based greenhouse gas emissions by establishing institutional infrastructure and capacity for the program known as Reducing Emissions from Deforestation and Forest Degradation (REDD+; Murdiyarso *et al.* 2011). With the exemption of sugarcane from the moratorium, plans were made to convert more than 1 million hectares of Indonesian forestland to sugarcane, an area roughly the size of Jamaica (Table 1). The main areas targeted in the plans are the southern part of Papua Province and the Aru Islands covered largely with lowland rainforest and monsoon forest (Figures 3). Of the land proposed for sugarcane in the lowlands of southern Papua, 27% (130,000 ha) is covered with primary tropical forest, while the remaining 73% (355,000 ha) is covered with secondary forest formations and savannah. On the Aru Islands, not less than 92% (200,000 ha) of the proposed plantation sites are covered with primary tropical forest. Also, we found major contradictions between currently existing land-use zones and the proposed sugarcane plantations. In the southern part of Papua, for example, about 40% of the proposed concessions overlap with protected areas (Game Reserves and Nature Reserves). Converting these areas would threaten the unique biodiversity of this part of the world, including species listed as vulnerable in the IUCN Red List, such as the Southern Cassowary (*Casuarius casuarius*), near-threatened species, such as the Brown-headed Crow (*Corvus fuscicapillus*), Gurney's Eagle (*Aquila gurneyi*) and Forest Bittern (*Zonerodius heliosylus*), and the critically endangered Aru Flying Fox (*Pteropus aruensis*). The latter is thought to be restricted to the Aru Islands, but there are no recent records of this species, so there is a possibility it is already extinct. The planned conversion does not only threaten biodiversity, but also negates indigenous claims to the forest areas, and would negatively affect local people's access to forest resources (Forest Watch Indonesia 2014).

Indonesia is currently considered to have one of the highest rates of deforestation in the world, with the loss of primary forest totaling over 6.02 million hectares from 2000 to 2012 according to a recent analysis by Margono *et al.* (2014). Consequently, it is the world's fifth largest emitter of greenhouse gases, and the largest contributor of emissions from land-use change and forestry (WRI,

Table 1 Area of forest in Indonesia designated for conversion to sugarcane

Stage of development	Number of concessions	Area (hectares)
Forest area currently being converted to sugar cane	12	246,213
Forest area approved for conversion	22	333,370
Plantation concessions under consideration by the government	16	448,142
Total	50	1,027,725

Source: Ministry of Forestry 2013.

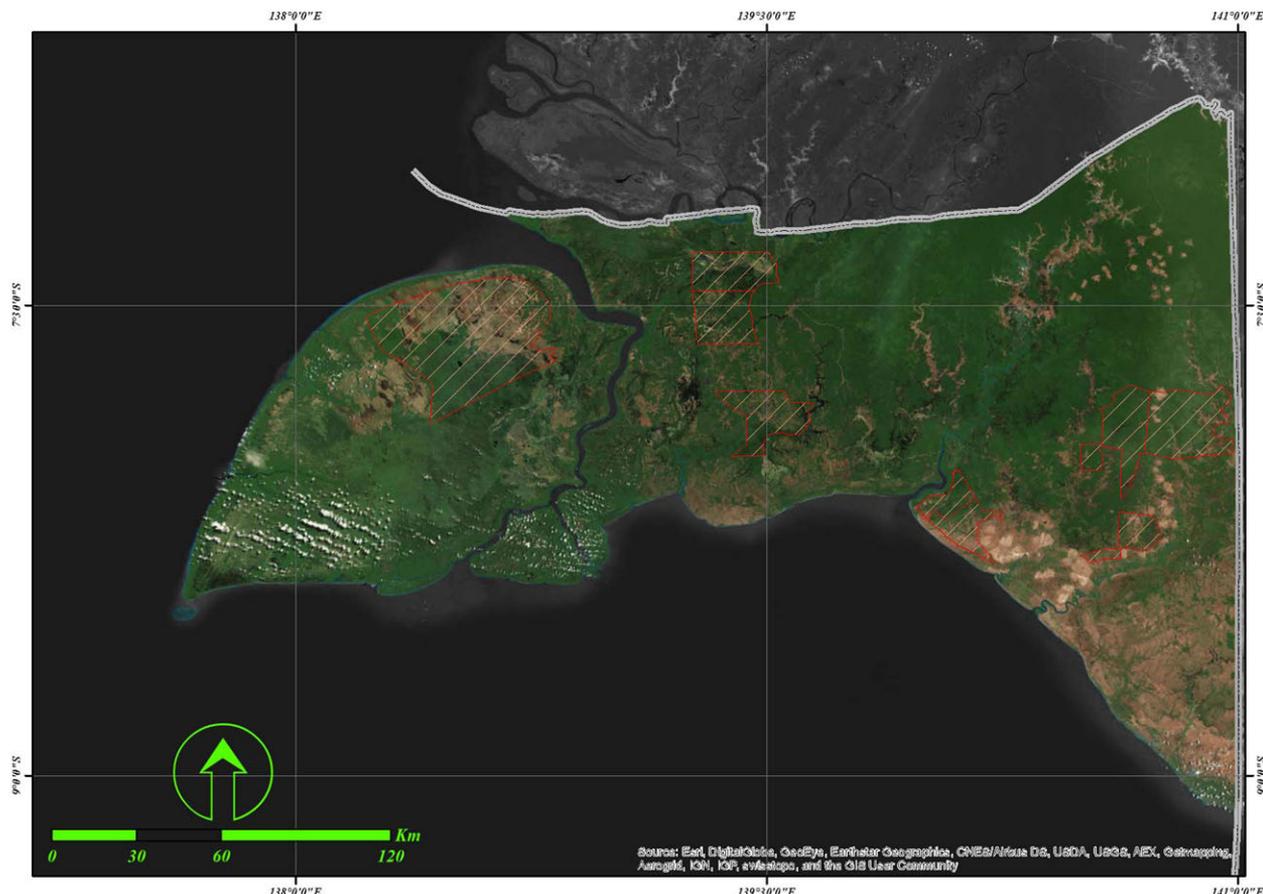


Figure 3 Land concessions allocated for sugar cane plantation in Papua Province.

CAIT 2.0. 2014). Should the planned conversion of forest areas into sugarcane plantations go ahead, Indonesia’s deforestation and emission figures will increase significantly. We used IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 2006) to estimate the carbon stocks in these concession areas. The guide provides carbon stock estimates for 22 different land cover types in Indonesia. Assuming that all natural vegetation in the proposed plantation area is replaced with sugarcane, and the latter captures 8 tons of CO₂ equivalent per hectare per crop cycle (Papua Governor Regulation. 2013), sugarcane development in Aru Islands may result

in the release of 106,274,212 tons of CO₂ into the atmosphere, while in Papua the volume of net carbon loss may be 19,217,775 tons of CO₂. Cumulatively, the development of sugarcane plantation in these areas would increase Indonesian GHG emissions from land-use change and forestry by 20%, effectively negating the efforts and progress with REDD+ in other parts of the country.

In early 2014, bowing to increasing pressure from civil society organizations, the Ministry of Forestry withdrew its support for sugar plantation estates on the state forest land in Eastern Indonesia (Satari 2014). However, it is not clear what this means in practice as concession

licenses have already been issued and state forest areas excised for plantation development have legal standing. Attempts to withdraw permits or change the status of these lands are likely to be met with strong resistance from powerful commercial interests, and therefore requires strong political will at district, provincial, and national levels, and the backing from the Parliament, Bureaucracy, and the general public (*cf.*, Luttrell *et al.* 2014). The newly installed cabinet of President Joko Widodo has recently reaffirmed the target of 500,000 ha of land for sugarcane plantations outside of Java (Kompas 2015).

Making the most of existing smallholder farms

There are ample opportunities to increase sugar production without significantly expanding the area under plantations. Indonesia ranks only 31st in the world for its sugarcane productivity, and its recovery rate of sugar per ton of sugarcane is half of that in Thailand (OECD/FAO 2012). The Indonesian Industry Sugarcane Plantation Research Centre (P3GI) has developed sugarcane varieties that have yields up to 50% higher than the varieties used on Indonesian plantations, but to date, hardly any plantation owners have adopted these varieties (Jakarta Post 2013). The government could support the replanting of sugarcane farms with these high-yield varieties through subsidized, targeted loans for sugarcane smallholders or smallholder associations. The combination of these measures with investments in transportation infrastructure and new mills would likely result in significant gains in sugar production from existing estates (Arjchariyartong Wuttipong 2006). Additional support to strengthen the legal status of sugarcane farms is required, as currently many smallholder farms are located on lands that are not registered with the national land agency. Lack of legal clarity of smallholder sugarcane farms is one of the key reasons behind limited investment in the small-scale sector and difficulties with accessing bank credit. Government efforts to encourage and facilitate land registration would improve smallholders' tenure security and enable better access to credit facilities.

Two notes of caution are required. First, it should be ensured that intensification does not compromise the resilience of farming systems or increase the vulnerability of farmers. This implies, among others, managing the spill-over effects of agrochemicals, maintaining diversity and environmental services at the landscape level, and avoiding farmer dependency on agricultural input providers and financiers. Second, improving smallholder productivity – by introducing higher yielding varieties, providing loans, investments in infrastructure, and the promotion of tenure security – will not automatically reduce pres-

sure on natural areas. It may even result in the opposite; when farming becomes more profitable, it can act as a stimulus for further expansion at the cost of forested areas (Angelsen & Kaimowitz 1999; Byerlee *et al.* 2014). Efforts to increase yields per hectare should therefore be combined with better land-use planning to prevent further conversion of forested areas. At the very least, this requires that all legal procedures are followed in the permit allocation process. This has reportedly not been the case in the Aru islands, where permits for sugarcane plantations were obtained without the required environmental permit letter, which is in violation of the Indonesian environmental and spatial planning laws (Forest Watch Indonesia 2014).

Although global attention has turned to oil palm, fiber plantations and logging as the major drivers of deforestation in Indonesia (Abood *et al.* 2014), our analysis shows that sugarcane is set to re-emerge as a primary cause of forest loss, due to policies aimed at securing national food security. It could result in the loss of at least 1 million hectares of forest with a major negative environmental impact, defying Indonesia's own ambitions to lower greenhouse gas emissions from deforestation and forest degradation. This could be averted through a revision of existing plantation permits and spatial plans, and should be combined with investments in sustainable intensification of existing smallholder sugarcane farms.

Acknowledgments

Data collection and analysis for this paper were carried out with support from CORDAID of the Netherlands, USAID RDMA project "Economic choices and tradeoffs to REDD in Asia" and the DFID project "Emerging countries in transition to green economy: will it make a difference for forests and people?" We would like to express our gratitude for the financial support received. Special thanks are due to Age Kridalaksana for assistance with GIS and carbon stock analyses as well as to Imogen Badgery-Parker for review and editing of the manuscript.

References

- Abood, S.A., Lee, J.S.H., Burivalova, Z., Garcia-Ulloa, J. & Koh, L.P. (2014). Relative contributions of the logging, fiber, oil palm, and mining industries to forest loss in Indonesia. *Conserv. Lett.*, doi: 10.1111/conl.12103
- Angelsen, A. & Kaimowitz, D. (1999). Rethinking the causes of deforestation: lessons from economic models. *World Bank Res. Obs.*, **14**, 73–98.
- Arjchariyartong Wuttipong (2006). *The competitiveness of the sugar industry in Thailand*. PhD thesis, University of

- Hohenheim, Germany. <http://d-nb.info/983905916/34> (visited). Accessed August 1, 2014.
- Byerlee, D., Stevenson, J. & Villoria, N. (2014). Does intensification slow crop land expansion or encourage deforestation? *Global Food Security*, **3**, 92–98.
- Costigan, J. (n.d.). Queensland: Australia's strongest economy. www.forbescustom.com/EconomicDevelopmentPgs/QueenslandP1.html (visited Aug. 19, 2014).
- Directorate General of Estates (2013). *Index of IP_ASEM_BUN_2013*. Ministry of Agriculture of Republic of Indonesia. http://www.pertanian.go.id/IP_ASEM.BUN_2013 (visited Aug. 19, 2014).
- Fitzpatrick, S.M & Keegan, W.F. (2007). Human impacts and adaptations in the Caribbean Islands: an historical ecology approach. *T. Roy. Soc. Edin.-Earth.*, **98**, 29–45.
- Forest Watch Indonesia. (2014). The last rainforest in Aru Island under threat. Bogor, 11 March 2014. <http://fwi.or.id/publikasi/the-last-rainforest-in-arui-island-under-threat> (visited Nov. 13, 2014).
- Funes Monzote, R. (2013). The Greater Caribbean: from plantations to tourism. Pages 17–23 in C. Leal, J.A. Pádua, J. Soluri, editors. *New environmental histories of Latin America and the Caribbean*. RCC Perspectives, Munich.
- Gao, Y., Skutsch, M., Masera, O. & Pacheco, P. (2011). *A global analysis of deforestation due to biofuel development*. CIFOR, Bogor.
- Griggs, P. (2007). Deforestation and sugar cane growing in Eastern Australia, 1860–1995. *Environ. Hist.*, **13**: 255–283.
- Honda, Y. (1996). *Sugar production, trade, economy, environment and the Philippines*. <http://www1.american.edu/TED/philsug.htm> (visited Aug. 19, 2014).
- IPCC. (2006). *2006 IPCC guidelines for national greenhouse gas inventories*. Institute for Global Environmental Strategies (IGES), Hayama.
- Jakarta Post. (2010). *32 investors to put Rp 24.3t into sugar plantations*. <http://www.thejakartapost.com/news/2010/01/29/32-investors-put-rp-243t-sugar-plantations.html>. Accessed (visited 19 August Aug. 19, 2014).
- Jakarta Post. (2013). *Govt blames low sugar output on the rain and cane*. <http://www.thejakartapost.com/news/2013/10/19/govt-blames-low-sugar-output-rain-and-cane.html> (visited Aug. 19, 2014).
- Kompas. (2015). 9 million hectares of land immediately shared (agriculture). [http://prnt.kompas.com/baca/2015/02/28-\(1\)/Lahan-9-Juta-Hektar-Segera-Dibagikan](http://prnt.kompas.com/baca/2015/02/28-(1)/Lahan-9-Juta-Hektar-Segera-Dibagikan) (visited Mar. 2, 2015).
- Lapola, D.M., Schaldach, R., Alcamo, J., et al. (2010). Indirect land-use changes can overcome carbon savings from biofuels in Brazil. *PNAS*, **107**, 3388–3393.
- Luttrell, C., Resosudarmo, I.A.P., Muharrom, E., Brockhaus, M. & Seymour, F. (2014). The political context of REDD+ in Indonesia: constituencies for change. *Environ. Sci. Policy.*, doi: <http://dx.doi.org/10.1016/j.envsci.2012.10.001>
- Margono, B.A., Potapov, P.V., Turubanova, S., Stoll F. & Hansen, M.C. (2014). Primary forest cover loss in Indonesia over 2000–2012. *Nature Clim. Change*, doi:10.1038/nclimate2277
- Martinelli, L.A. & Filoso, S. (2008). Expansion of sugarcane ethanol production in Brazil: environmental and social challenges. *Ecol. Appl.*, **18**, 885–898.
- Maulidiah, F. (2013). *Perkembangan Kemitraan antara Petani Tebu dengan PG. Krebet Baru: Perilaku Ekonomi Petani Tebu Desa Krebet 1998–2011*. Master Thesis, Faculty of Social Sciences, Malang University, Indonesia.
- McNeill, J.R. (1986). Forests and ecological history: Brazil, 1500–1984. *Environ. Rev.*, **10**, 122–133.
- Ministry of Agriculture. (2009). *Rancangan Rencana Strategis Kementerian Pertanian 2010–2014* (Strategic plan of the Ministry of Agriculture 2010–2014). <http://depan.go.id/sakip/admin/file/renstra-setjen-2010-2014.pdf> (visited Aug. 19, 2014).
- Ministry of Forestry. (2013). *Kebijakan Pelepasan Kawasan Hutan Produksi Yang Dapat Dikonversi (HPK) Untuk Pembangunan Pabrik Gula* (Policy on the use of conversion forest for sugar industry). <http://www.peragi.org/wp-content/uploads/2013/11/Kebijakan-Pelepasan-Kawasan-Hutan-Produksi-yang-Dapat-Dikonversi-untuk-Pembangunan-Pabrik-Gula.pdf> (visited Aug. 19, 2014).
- Murdiyarsa, D., Dewi, S., Lawrence, D. & Seymour, F. (2011). *Indonesia's forest moratorium: a stepping stone to better forest governance?* CIFOR, Bogor.
- Nelson, G.C. (1988). Sugar in the Philippines: policy responses to a distorted world market. *Food Policy*, **13**, 283–292.
- Nelson, G.C. & Panggabean, M. (1991). The costs of Indonesian sugar policy: a policy analysis matrix approach. *Am. J. Agr. Econ.*, **73**, 703–712.
- OECD/FAO. (2012). *OECD-FAO agricultural outlook 2012–2021*. OECD Publishing and FAO. <http://dx.doi.org/10.1787/agr.outlook-2012-en> (visited Aug. 19, 2014).
- Papua Governor Regulation. (2013). *Peraturan Gubernur Papua No. 9 Tahun 2013 tentang Rencana Aksi Daerah Penurunan Emisi Gas Rumah Kaca (RAD-GRK) Provinsi Papua Tahun 2012–2020* (Papua Governor Regulation No. 9 2013 concerning the provincial action plan to reduce greenhouse gas emissions 2012–2020). Jayapura, Indonesia.
- Pusat Data dan Sistem Informasi Pertanian. (2013). *Informasi Ringkas Komoditas Perkebunan, Tebu*. No. 02/01/I, 14 January 2013, Jakarta.
- Rusastra, I.W., Napitupulu, T.A. & Bourgeois, R. (2008). *The impact of support for imports on food security in Indonesia*.

- Economic and Social Commission for Asia and the Pacific, UNESCAP-CAPSA, Bogor.
- Saturi, S. (2014). *Kebun Tebu Batal, Hutan Kepulauan Aru Sementara Aman* (Plantations cancelled, forest on Aru Islands safe for the time being). April 14, 2014. <http://www.mongabay.co.id/2014/04/14/kebun-tebu-batal-hutan-kepulauan-arus-mentara-aman/> (visited Aug. 19, 2014).
- Sparovek, G., Barretto, A., Berndes, G., Martins, S. & Maule, R. (2009). Environmental, land-use and economic implications of Brazilian sugarcane expansion 1996–2006. *Mitig. Adapt. Strat. Glob. Change*, **14**, 285–298.
- USDA Foreign Agricultural Service. (2013). Indonesia sugar annual report 2013. GAIN report number: ID1314. http://agriexchange.apeda.gov.in/marketreport/Reports/Sugar_Annual_Jakarta_Indonesia.3-1-2013.pdf (visited Nov. 20, 2014).
- Wibowo, E. (2013). Pola Kemitraan Antara Petani Tebu Rakyat Kredit (TRK) Dan Mandiri (TRM) Dengan Pabrik Gula Modjopanggung Tulungagung. *Agribisnis* **1**(1), University Islam Kalimantan, Indonesia.
- Wijianti E.Y. (2014). Produksi Gula Hanya 2,5 Juta Ton (Sugar production only 2.5 million tons). *AgroIndonesia* (23 July, 2014).
- WRI, CAIT 2.0. (2014). *Climate analysis indicators tool: WRI's climate data explorer*. World Resources Institute, Washington, DC. <http://cait2.wri.org> (visited Aug. 20, 2014).