

and 2014. The number of SKTM letters in villages with borders overlapping concessions was compiled and attributed to each concession for comparative analysis. Given the purported economic and social benefits industrial oil palm development provides World Growth Institute (2011), a decline in the number of SKTM letters was expected, reflecting an overall improvement in social well-being.

Provision of healthcare facilities

In addition to employment opportunities, the development of sustainable large-scale palm oil plantations is thought to deliver benefits to neighbouring communities through the increased provision of community services and social infrastructure. Indeed, to cope with an influx of workers, many palm oil companies provide housing, healthcare and education facilities for their employees and members of the surrounding communities as part of their Corporate Social Responsibility (CSR) commitments (Sime Darby 2014, Wilmar 2015) and as a requirement of RSPO P&C 6.5. The provision of healthcare facilities is seen as a particularly important factor to help address the inequitable access to health care services across districts (Efendi 2012). Subsequently, we would expect an increase in the number of healthcare facilities per capita provided in villages neighbouring both certified and non-certified concessions over time, and for villages neighbouring certified concessions to have greater access to facilities than those neighbouring non-certified concessions. For the current analysis, we focused on the type and number of rural health facilities available in villages bordering palm oil concessions and included facilities such as clinics and maternity services. Data on these facilities was obtained through Indonesian population and housing census (PODES) for the years 2000 and 2014 (BPS (Statistics Indonesia)). Attributes were assigned to concessions by overlaying village level data with concession maps.

Economic

Profit

In principle, RSPO certification should facilitate improved profitability for participating businesses through access to global markets, more effective plantation management, and higher price premiums. As certification is costly to obtain though, and principles and criteria can be challenging to enforce depending on the scale of operations Levin *et al* (2012), the profitability of RSPO certification remains a key concern for palm oil producers (Laurance *et al* 2010, Brandi *et al* 2015). We would, therefore, expect the profitability of certified concessions to be the same or increase relative to the counterfactual. Building upon methodology employed by the Zoological Society of London Sustainable Palm Oil Transparency Toolkit (ZSL SPOTT), we analysed share values of publically registered palm oil companies. Of the hundreds of palm

oil companies operating in Kalimantan, only 29 are publicly listed, 14 of which had been publicly listed prior to the implementation of RSPO in 2005. Nine of the 14 companies are active members in RSPO and have actively certified at least a portion of their land holdings. In assessing profitability we, therefore, focus on these companies for which data is available and compare the 9 RSPO certified companies with the 5 non-certified companies. Pre-certification share prices were calculated on the company's closing price on the 1st of July 2005, and current prices calculated on the closing price on the 30th of June 2016. All share prices were converted into Singapore Dollar (SGD) at the average value for 2016.

Yields

RSPO certification involves numerous criteria to facilitate the adoption and continual improvement of best management strategies (RSPO P&C 2013). It can, therefore, be expected that effective program implementation will result in improved yields for plantations implementing these 'best practices' compared to the counterfactual. We assessed plantation yields through calculations of Fresh Fruit Bunch production (FFB) in metric tonnes for plantations with comparably ages crops as reported in organizational annual reports (see supplementary material) for the years 2005 and 2014. Where applicable, the proportion of RSPO certified area was also recorded with data obtained from RSPO ACOP reports.

Results

Environment

Orangutan

There was no evidence to support the sustainability of certified plantations with respect to orangutans. Orangutan populations declined in both certified and non-certified concessions between 2009–2014. Prior to certification, concessions that were to become RSPO certified held fewer orangutans than non-certified concessions, with a mean population per concession of 18 and 22 respectively. Certified concessions also experienced a faster, albeit non-significant rate of decline than non-certified concessions (figures 2 and 3(a) and table 2). When matched on initial density (number of orangutan/ha), certified and non-certified concessions showed a similar rate of decline (supplementary figure 3.1).

Fire

There was no evidence to support the sustainability of certified plantations with respect to fire incidence. Fire outbreaks in certified and non-certified concessions have increased between 1999–2015. No significant difference was found between treatments (figures 2 and 3(b) and table 2).