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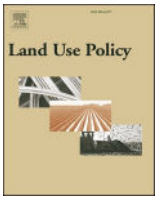

Review of smallholder palm oil sustainability reveals limited positive impacts and identifies key implementation and knowledge gaps

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ABSTRACT

'Sustainable palm oil' aims to eliminate deforestation, greenhouse gas emissions, land conflicts and labour abuses from palm oil global value chains while maintaining palm oil production as a vehicle for development in tropical countries. However, smallholder palm oil growers are a small minority of those who are certified as sustainable and persistently face multiple socio-economic challenges. We analysed 100 journal articles that address smallholders, oil palm and issues related to sustainability in order to critically examine the current state of evidence for sustainability upgrading in smallholder palm oil global value chains. We identify a focus on sustainability certification in the academic research agenda that has left key implementation and knowledge gaps on meeting smallholders' needs outside of a certification framework. An implication of this is that buyers, policy-makers, and consumers do not recognise both the challenges and advantages of small-scale agriculture for sustainable palm oil. We found that certification standards struggle to resolve persistent smallholder challenges, such as low incomes, low yields and insecure land tenure. Certification appears to be a flawed method to conceptualize and measure the sustainability of smallholders. We, therefore, advocate broadening approaches to studying sustainability and smallholder palm oil production, particularly to target issues that are of immediate concern for smallholder farmers as opposed to prioritising productivity. Future research should take inspiration from diverse established fields of research in defining sustainable practices, such as agroecology or agroforestry.

1. Introduction

Oil palm production is an important component of development strategies for Southeast Asian countries and interest in the industry is growing in other countries with tropical forests, especially Thailand, Nigeria and Colombia (Castellanos-Navarrete et al., 2021; FAO, 2020). Palm oil production has increased sharply as a commercial crop for vegetable oil and biofuel in the last decade, reaching 73.03 million metric tons of palm oil in 2019/20 from 46.39 million metric tons in 2009/10 (Boons and Mendoza, 2010; Tan et al., 2009; US Department of Agriculture, 2022), p. 28). Palm oil is highly efficient and versatile, meaning that it is more productive per hectare that any other oil crop and it can grow on a wide range of soils in tropical climates. Palm oil is sold in well-established global markets, and thus contributes to the economies of low and middle income countries in tropical climatic zones (Butler et al., 2009; Pye and Bhattacharya, 2012).

Yet palm oil production is a driver of deforestation (Abood et al., 2015; Busch et al., 2015; Carlson et al., 2013), with its attendant greenhouse gas emissions (Harris et al., 2012), as well as air pollution from the use of fire for land conversion (Carlson et al., 2013), and biodiversity loss (Vijay et al., 2016). Oil palm plantation development can generate negative social impacts, such as the appropriation of land and natural resources from local people (Amnesty International, 2016; Gerber, 2011; Li, 2015; Obidzinski et al., 2012; Rival and Levang, 2014) and exploitative labour practices (Amnesty International, 2016; Li, 2015). In addition, managing solely for oil palm yields can be associated with lower and less reliable incomes and lead to food insecurity for smallholders (Rival and Levang, 2014). Finally, elites benefit disproportionately from oil palm expansion, often at the expense of less fortunate neighbours (Obidzinski et al., 2012; Rival and Levang, 2014).

Given its significant social and environmental externalities, there has been growing concern for the sustainability and desirability of the oil palm sector. Therefore, we conducted a scoping review of the academic literature that incorporates research from various disciplines to explore the concept of sustainable palm oil as it applies to smallholder producers. Certification standards are defined mainly by agro-businesses

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and international NGOs with little input from smallholders (Cheyns, 2014). However, the definition and methods of measuring sustainability hold different meanings across different contexts and scales. A smallholder perspective on sustainable palm oil is highly relevant because smallholders and rural communities are depicted as both beneficiaries who would suffer from a decline in the palm oil industry, as well as people who are critically impacted by environmental and social issues related to palm oil. This scoping review provides a systematic assessment of the evidence that *sustainability management* in the palm oil sector provides material benefit to smallholder palm oil growers and enhances environmental protections through upgrading (Ponte, 2019).

From over 3000 search results (including duplicates), using Web of Science, Scopus and Proquest databases, we selected 100 peer-reviewed journal articles for full-text review that incorporated palm oil, smallholders, and at least one aspect of sustainability as the subject of study. Whilst there are many studies examining aspects of sustainability for smallholders, such as livelihoods or farming practices, it is uncommon to find interdisciplinary reviews that bring together research examining environmental, economic and social issues (Qaim et al., 2020). This is nevertheless necessary as these factors are closely intertwined in the implementation of sustainability-oriented policies.

This paper focuses on small-scale agriculture because of its importance for both palm oil value chains and rural livelihoods. Smallholders produce 30% of palm oil globally but are undervalued in different ways (Chain Reaction Research, 2021, p. 3). For instance, a recent report found that, even though smallholders generate 6% of the value in the global palm oil value chain, their relative share of the profits made across the value chain is almost zero (Chain Reaction Research, 2021). In addition, independent smallholders make up a small fraction of certified palm oil producers, accounting for only 1.3% of the oil palm land certified by the Roundtable on Sustainable Palm Oil (RSPO), which is by far the largest global certification scheme for palm oil (RSPO; Voora et al., 2019). Despite its marginalised position in global value chains, small-scale oil palm production is important for rural livelihoods and poverty alleviation; there are more than 3 million smallholders cultivating palm oil globally (RSPO; The World Bank, 2011).

The paper proceeds with first an overview of the concept of sustainability in global value chains and how sustainability upgrading is conceptualized in regards to palm oil development. This lens informs the literature review methodology, which seeks to understand both current conditions of smallholder palm oil production and initiatives for upgrading to investigate how far sustainability certification initiatives offer socio-economic or environmental additionality. *Additionality* here refers to the improvements achieved by an initiative in comparison to what would have happened if the initiative had never been carried out. The paper further addresses processes of inclusion and exclusion in certified sustainable palm oil value chains, and concludes with a discussion of the implications of the results for further research.

1.1. The palm oil global value chain, sustainability management and upgrading

The term *global value chain* refers to the full range of activities that firms, farmers and workers carry out to bring a product or service from its conception to its end use, recycling or reuse (Ponte et al., 2019). These activities take place globally, and so-called *lead firms* determine how these functions are distributed, and that they meet certain standards, prices and timelines (Ponte et al., 2019). Whilst small and large-scale firms in the palm oil global value chain face many of the same criticisms regarding environmental degradation, they greatly differ in their modes of production, influence and socio-economic conditions. Small-scale agriculture can be distinguished from large-scale by a variety of factors, including farm size, use of family labour, market or subsistence orientation, level of integration into the input and output supply chains, and farming methods, but there is no definitive characterisation. Important issues that affect small-scale palm oil producers include low productivity, low incomes and a lack of access to premium sustainability markets. Smallholders are rarely lead actors in global value chains.

From a general perspective, the major objective of sustainability certification is to independently verify claims that palm oil production has minimal adverse environmental or social impacts. For companies, the objectives of certified sustainable palm oil are to preserve the economic benefits of palm oil production, particularly by using branding to enhance their reputation and to obtain access to specific markets. This can be conceptualised as *sustainability management*, a phrase coined by (Ponte, 2019) to describe "the strategies and practices that corporations put in place to address sustainability issues in ways that facilitate continuous capital accumulation". These strategies may include participating in multi-stakeholder initiatives to address sustainability governance in the sector, sourcing goods from locations that can meet certification standards at low prices, and increasing monitoring along the supply lines (Ponte, 2019). There are concerns, however, that the drive for sustainability in the palm oil sector may be placing greater emphasis on opening and maintaining environmentally-conscious markets than protecting tropical environments and local communities (Pye, 2019). Indeed, sustainability initiatives may harm smallholders by raising the bar for entry to the palm oil sector, and increasing the burden of monitoring and compliance in ways that would reduce profit margins for small-scale actors but increases lead firms' control (Brandi, 2017; Ponte, 2019).

We investigate the claims and impacts of sustainability for smallholders in the palm oil sector through the lens of *sustainability upgrading*. This comprises understanding the current sustainability-related challenges that affect smallholder palm oil growers, and whether sustainability initiatives offer additionality. Within the Global Value Chains (GVC) literature, *economic upgrading* has commonly been understood as the flow of knowledge within value chains that results in acquiring new capabilities, or shedding former activities, to improve one's position in the value chain to gain a greater share of the benefits or access new market segments (Gereffi, 1999; Ponte and Ewert, 2009). This can occur through (1) product upgrading: improving the product to increase unit value; (2) process upgrading: improving the efficiency by which inputs are transformed into outputs; (3) functional upgrading: acquiring or abandoning old functions to improve productive activities; or (4) inter-chain upgrading; applying competences acquired from one part of the chain and using them elsewhere in another chain (Humphrey and Schmitz, 2002; Ponte, 2020; Schmitz, 2006).

Whilst the GVC literature has long focused on the capturing of profits as the main goal of organisations through *economic upgrading*, there has been a recent turn towards *social upgrading*. This is defined as, "the process of improvement in the rights and entitlements of workers as social actors, which enhances the quality of their employment" (Barrientos et al., 2011), p. 324). Studies concerned with *social upgrading* thus typically focus on workers' livelihoods and working conditions. However, with a focus on workers in industrial or manufacturing value chains, the concept of *social upgrading* does not necessarily apply to smallholders. As smallholders are both the firm (capital) and worker (labour) in one entity, economic and social aspects of sustainability will be discussed together as *socio-economic upgrading* in this article (Neilson, 2019).

However, focusing on economic and social benefits can result in a failure to take into account environmental harm or benefits. Thus, there is an emerging literature that aims to mainstream the concept of *environmental upgrading*, focusing on the ways in which GVC actors attempt to improve or minimize their environmental impact (Campling and Havice, 2019; Ponte, 2020). This may occur as a result of internal drivers, for instance lead firms or suppliers may change their practices in order to fulfil strategic choices, or external drivers, which are usually new forms of regulation or pressure from civil society (Lister et al., 2015; Ponte, 2020; Poulsen et al., 2018). Like *economic upgrading*, *environmental upgrading* can be understood as forms of product, process, or

organizational upgrading, for instance using a more energy efficient process (De Marchi et al., 2013). Examples of upgrading activities can be seen in Table 1.

Whilst *economic*, *social* and *environmental upgrading* might together be considered as *sustainability upgrading*, it is important to note that they are not always complementary. Indeed, GVC scholarship already acknowledges the darker sides of 'upgrading'. The concept of *downgrading*, for instance, highlights how lower standards of products or suppliers' conditions are common and profitable strategies for lead firms (Ponte, 2020; Ponte and Ewert, 2009). Higher environmental standards can generate greater burdens on small-scale suppliers resulting in a *sustainability-driven supplier squeeze* (Ponte, 2020). For example, mechanised land clearing has fewer adverse environmental impacts over burning but is more expensive. As noted below, producers usually receive little to no premium for selling certified sustainable palm oil to compensate for such expenses.

Corporate and governmental instruments usually define *sustainable palm oil* as certified by a multi-stakeholder initiative, such as the Roundtable on Sustainable Palm Oil (RSPO). Sustainability promoted through voluntary sustainability standards (VSS) is widely regarded as a policy tool for socio-economic and environmental upgrading for smallholders (De Bakker et al., 2019; Nesadurai, 2019). VSS can be understood as a pathway of upgrading, because lead firms support the transfer of skills and technology to farmers (Neilson, 2019). However, a significant criticism of the emphasis on certification in policy is that it focuses on high-level industry actors, particularly large agribusinesses. Small-scale producers, on the other hand, are usually unable to meet the cost or management requirements of certification. Nevertheless, their negative impacts are relatively small compared to industrial scale palm oil plantations (Brandi et al., 2015). Thus, it is necessary to examine which actors are able to upgrade through certification and those who are not.

2. Literature search

We conducted a scoping review to investigate the issues that are most closely associated with *sustainable palm oil* for smallholders in the academic literature. This study is a scoping review because it aims to delineate the nature and extent of the current research on a topic, with a view to identify parameters and gaps in the body of literature that may lead to further research (Ahmed et al., 2016; Grant and Booth, 2009).

We used a structured literature review protocol; framing the review question, identifying relevant work, assessing study quality, summarizing the evidence, and interpreting findings (Ahmed et al., 2016). As illustrated in Fig. 1, we firstly conducted searches using Web of Science, Scopus, and Proquest Agricultural & Environmental Science Collection databases using the search terms (smallhold* OR small-scale OR "small scale") AND ("palm oil" OR "oil palm") AND (sustainab*). This yielded 502 articles, including duplicates. The titles and abstracts of the search results were screened and duplicates removed, leaving 57 articles that specifically incorporated smallholder palm oil growers as the population of study and self-identified as sustainability-relevant. These articles were saved in a library using Mendeley, and then analyzed using Nvivo 12. These were coded into main 'themes', which were typically the main dependent variable. Where, for example, an article investigated the effect of certification on rates of deforestation, deforestation was chosen as the article's theme.

Because research that has been conducted on issues related to sustainability and smallholder palm oil producers is not necessarily labelled with the key word 'sustainability', we undertook subsequent searches using the themes that were identified in the first search round. These searches are presented in Table 2. As previously, texts were selected for full-text screening based on whether they specifically included smallholder palm oil growers as a population of study.

Only peer-reviewed journal articles written in English were reviewed. Whilst this is the main language of international policy, it is a limitation because both Malaysia and Indonesia are centres of research on palm oil and we recognise that there may be parallel areas of research. It is important to note that much of the English language literature originates in the Global North, where palm oil has a generally negative reputation. One may expect that academic articles from producing countries are more favourable of palm oil. In order to check the geographical spread of the researchers, we listed the first authors' institutions by region, counting those with double affiliations twice. The majority of authors are affiliated with institutions in Europe (37), followed closely by South-east Asia (33), and then North America and Australia (7 each), the rest of Asia and Central and South America (5 each), and African institutions (3). Nevertheless, most articles are collaborations between multiple institutions from both oil palm producing and non-oil oil palm producing regions. We are therefore confident that by using multiple scientific databases to make a systematic review of the international peer-reviewed literature, our search methodology identified the most significant issues related to sustainable palm oil and smallholders.

2.1. Analysis

In total 100 texts were selected for full-text screening, which were coded inductively using NVivo 12 software. NVivo software enabled us to highlight findings from across a large number of research articles and organize them flexibly. From this process, we were able to collect, compare and synthesize findings on the benefits and challenges related specifically to current smallholder production of palm oil and initiatives for upgrading. In a second step, these issues were organised according to environmental, social-economic and certification categories for comparison.

3. Results

3.1. Smallholders and sustainability issues in the literature

Our literature search shows that there has been a steep increase in

Table 1
Examples of product, process, functional and inter-sectoral socio-economic and environmental upgrading activities.

	Product upgrading	Process upgrading	Functional upgrading	Inter-sectoral upgrading
Definitions (Humphrey and Schmitz, 2002; Ponte, 2020; Schmitz, 2006)	Moving into more sophisticated product lines with increased unit values	Transforming inputs into outputs more efficiently by reorganizing production systems or using superior technology	Acquiring new, superior functions in the chain (or abandoning existing low value-added functions) to increase the skill content of activities	Using the competence acquired in a particular chain to move into new sectors
Example of social or economic upgrading activity for smallholder palm oil growers	Receiving a price premium for producing certified sustainable palm oil	Growing oil palm as part of a polyculture system to benefit food security and local biodiversity	Smallholder cooperative ownership of a mill enabling local communities to retain more value locally	Learning how to grow other crops well through sustainability upgrading programs, enabling better food security (Inobu, 2020)
Example of environmental upgrading activity for smallholder palm oil growers	Using a higher yield variety of oil palm as an alternative to expansion into forested areas	Accessing soil analysis services in order to reduce or eliminate agrochemical use	Reducing agrochemical use and local pollution using good agricultural practices (GAP)	Applying good agricultural techniques to other crops

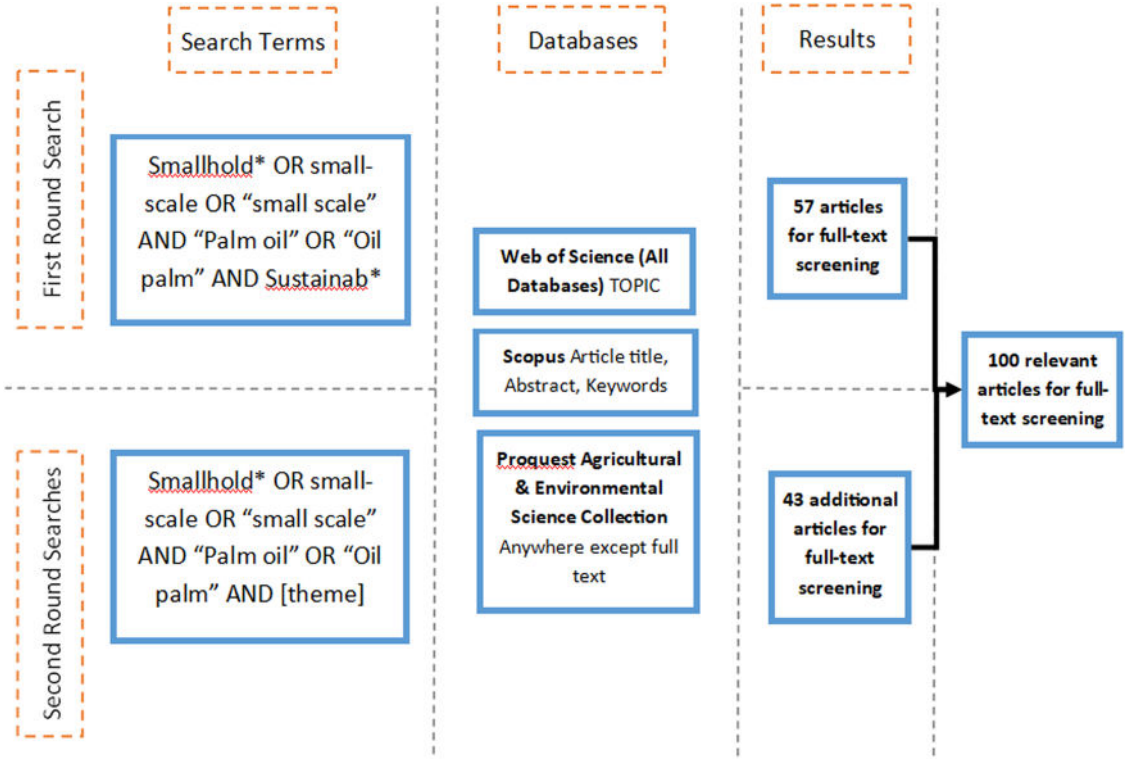

Fig. 1. Overview of literature search strategy.

studies on smallholder palm oil growers since 2018 although interest had been growing in preceding years (Fig. 2). Table 3 displays the main topics of each broad sustainability theme evident in the literature. The largest broad theme is 'socio-economic' (39 articles), although this is dominated by studies on smallholder livelihoods (16) that investigate the impacts of oil palm cultivation on rural development through a development studies lens. This category also includes ten articles on improving yields through good agricultural practices, mostly with an ecological focus. Much less attention is paid to understanding socio-political relations (2). Of the 33 articles with an environmental focus, 13 are related to biodiversity and 13 have land use change or deforestation as the main dependent variable. Eighteen articles examine issues related to smallholders gaining certification, and ten articles examine together interactions between environmental and socio-economic variables. This analysis demonstrates a strong interest in certification, rural livelihoods, biodiversity, and land use change or deforestation.

As expected, the majority (66) of the studies focus geographically on Indonesia and Malaysia (Fig. 3). This is likely because these two countries produce 85% of palm oil globally. Whilst there are some commonalities, it would be a mistake to generalise to all smallholders globally from this sample. For instance, there are regional differences in the environmental impacts of smallholder palm oil production; in Latin America, oil palm has mostly expanded over cattle pastures (56%) and cropland (23%) rather than forests (Castellanos-Navarrete et al., 2021; Furumo et al., 2020). Small-scale palm oil production also differs regionally in social and economic dimensions; as one example, supply chains in African countries are different to those in Southeast Asia as there are mostly independent mills that vary in scale and quality (Khatun et al., 2020; Ordway et al., 2019). One observes different power dynamics in countries and regions where smallholder producers are dominant, which is the case in some central American and African countries (Castellanos-Navarrete, 2021; Glinskis and Gutiérrez-Vélez, 2019).

As well as cross-country differences, within country differences are also evident in the literature. Smallholders can be defined by size, use of family labour, crop diversity, absenteeism, the importance of palm oil in livelihoods, and there is a sliding scale of integration within a larger company from contract (also called scheme, managed or plasma) smallholders to independent smallholders (Baudoin et al., 2015; Jelsma et al., 2017; Schoneveld et al., 2019). A wide variety of palm oil producers are considered smallholders in the academic literature, from those managed by a large company, to mainly subsistence-based farmers, and small-scale landowners who do not farm (Bennett et al., 2019; Jelsma et al., 2017). Nevertheless, 72 of the articles lacked a clear definition of smallholders. Where smallholders were defined by farm size, this varied from under two hectares to under 50 ha. As might be expected, these different smallholder groups operate very differently with diverse outcomes, which ought to be acknowledged by researchers (Baudoin et al., 2015).

3.2. *Economic and social upgrading*

3.2.1. *Smallholder production of palm oil*

Studies from all countries where palm oil is grown support that palm oil is preferred by smallholders because it is more profitable than other crops (Ayompe et al., 2021; Cahyadi and Waibel, 2016; Cramb and Sujang, 2013; Jaza Folefack et al., 2019; Kubitza et al., 2018; Langston et al., 2017; Lee et al., 2014; Meijaard and Sheil, 2019; Naylor et al., 2019; Qaim et al., 2020; Rist et al., 2010; Santika et al., 2019). Palm oil adoption has consequently also been found to support higher consumption in Indonesia with increased expenditures on food, health, education, and durable consumer goods (Euler et al., 2017; Krishna and Kubitza, 2021; Qaim et al., 2020; Rist et al., 2010). As oil palm tolerates many soils and inhospitable conditions, it is sometimes the only possible commercial crop in locations that would otherwise be unsuitable for agriculture (Meijaard et al., 2020; Meijaard and Sheil, 2019).

Smallholders commonly have lower yields than large-scale plantations, but there are vast differences in productivity between regions and some exceptions. In Southeast Asia, smallholders are estimated to produce half the fresh fruits bunches (FFBs) per hectare as large plantations

Table 2
Overview of sustainability-related 'themes' used as search terms.

	Number of search results (peer-reviewed journal articles in English)		
Search Terms	**Web of Science (All Databases)** TOPIC	**Scopus** Article title, Abstract, Keywords	**Proquest Agricultural & Environmental Science Collection** Anywhere except full text
smallhold* OR small-scale OR "small scale" AND "palm oil" OR "oil palm" AND			
sustainab*	182	125	195
intensif* OR yield OR productiv*	178	136	121
livelihood* OR "rural development" OR poverty	140	85	83
"ecosystem services" OR water OR air OR pollution	139	71	98
deforest* OR "forest clearance" OR peat*	123	87	95
biodivers*	113	67	98
"carbon emissions" OR "greenhouse gas" OR GHG	92	60	82
"land use change" OR LUC OR "land cover change" OR "land conversion"	81	74	65
"land tenure" OR tenure OR "land rights" OR indigenous	81	37	31
resilien* OR shocks OR "climate change" OR "food security"	74	46	48
certification	60	44	37
innovation OR finance OR credit	58	30	30
"good agricultural practices" OR GAP OR "best management practices"	37	28	22
cooperative* OR union OR collective OR collab*	33	24	14

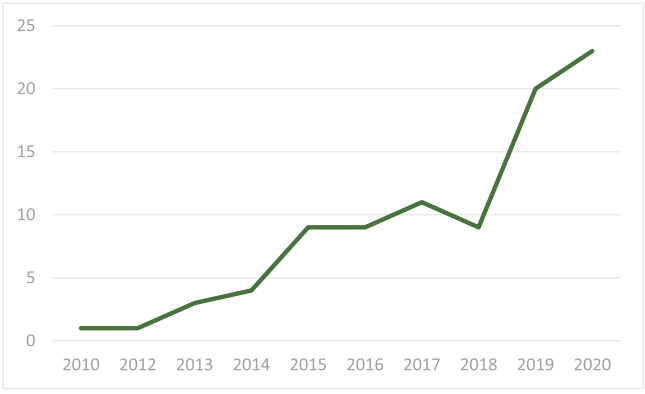

Fig. 2. Number of journal articles per year.

on average, whereas in Africa smallholders produce approximately a third (Euler et al., 2016; Ordway et al., 2017; Rhebergen et al., 2020; Woittiez et al., 2017; Woittiez et al., 2019). However, smallholdings in Papua New Guinea, the Solomon Islands, and parts of West Sumatra in Indonesia produce the same and sometimes more per hectare than large plantations (Razak et al., 2020; Woittiez et al., 2017). In the case of the Ophir smallholder plantation scheme in West Sumatra, this success has

Table 3
Categorization of journal articles as relevant to socio-economic, environmental, environmental and socio-economic, and certification upgrading for smallholders.

Sustainability Area	Key Topics of Research	Articles
Socio-Economic	Smallholders' livelihoods; productivity/ yields/ intensification on smallholdings; good agricultural practices (GAP); poverty alleviation; institutions and governance capacity in rural palm oil areas; structure of rural economy; community goods; food security; resilience to shocks; smallholders' use and access to finance and credit; modes of production (cooperatives; company-farmer contracts); insecure land tenure; conflicts; wellbeing of smallholders and rural communities	(Ayompe et al., 2021; Bennett et al., 2019; Brako et al., 2020; Brandão et al., 2021; Cahyadi and Waibel, 2016; Castellanos-Navarrete and Jansen, 2015; Cheyns, 2014; Cramb and Sujang, 2013; Djouma et al., 2018; Euler et al., 2017; Euler et al., 2016; Futemma et al., 2020; Gatto et al., 2017; Hervas, 2019; Hidayat et al., 2015; Higgins and Richards, 2019; Jelsma et al., 2019; Jelsma et al., 2017; Khaled Saifullah et al., 2018; Koczberski et al., 2018; Krishna et al., 2017; Krishna and Kubitza, 2021; Kubitza et al., 2018; Lee et al., 2014; Majid Cooke, 2012; Martin et al., 2015; Mertz et al., 2013; Naylor et al., 2019; Nchanji et al., 2016; Pye, 2019; Raharja et al., 2020; Rhebergen et al., 2020; Rist et al., 2010; Santika et al., 2020; Santika et al., 2019; Soda et al., 2016; Soliman et al., 2016; Woittiez et al., 2017; Woittiez et al., 2019)
Environmental	Biodiversity on smallholdings and smallholder dominated landscapes; effects of polyculture and monoculture; land use change and deforestation by smallholders; greenhouse gas emissions through peat drainage or forest fires; carbon storage; conservation; agrochemical pollution; water use	(Afriyanti et al., 2019; Alwarritzi et al., 2015; Anggraini and Grundmann, 2013; Atiqah et al., 2019; Azhar et al., 2015; Azhar et al., 2017; Azhar et al., 2014; Azhar et al., 2014; Castellanos-Navarrete, 2021; Clough et al., 2016; Dhandapani et al., 2020; Furumo et al., 2020; Glinskis and Gutiérrez-Vélez, 2019; Jaza Folefack et al., 2019; Kunz et al., 2019; Langston et al., 2017; Meijaard et al., 2020; Nabara et al., 2020; Ordway et al., 2019; Ordway et al., 2017; Purwanto et al., 2020; Rahman et al., 2021; Razak et al., 2020; Rudolf et al., 2020; Schmidt and De Rosa, 2020; Schoneveld et al., 2019; Shuhada et al., 2020; Syafiq et al., 2016; Tapia et al., 2021; Tee et al., 2019; Teuscher et al., 2015; Uckert et al., 2015; Yahya et al., 2017)
Environment and Socio-Economic	Tradeoffs between environmental protection and economic development; land cover changes and social changes in rural communities	(Baudoin et al., 2015; Bennett et al., 2018; Brandi, 2017; Castellanos-Navarrete et al., 2021; Dharmawan et al., 2020; Dislich et al., 2018; Fromm et al., 2020; Meijaard and Sheil, 2019; Purnomo et al., 2020; Qaim et al., 2020)
Certification	Readiness for certification; cost and benefits to smallholders of certification; barriers for smallholders to access certification; impacts of certification on smallholders and rural communities	(Apriani et al., 2020; Brandi et al., 2015; Dharmawan et al., 2021; Ernah and Waibel, 2016; Ernah and Waibel, 2020; Hidayat et al., 2016; Hidayat et al., 2018; Hutabarat et al., 2018; Hutabarat et al., 2019; Jelsma et al., 2017; Khatun et al., 2020; Majid et al., 2021; Martens et al., 2020; Nesadurai, 2019; Rodthong et al., 2020; Saadun et al., 2018; Schoneveld et al., 2019; Sheng Tey et al., 2021)

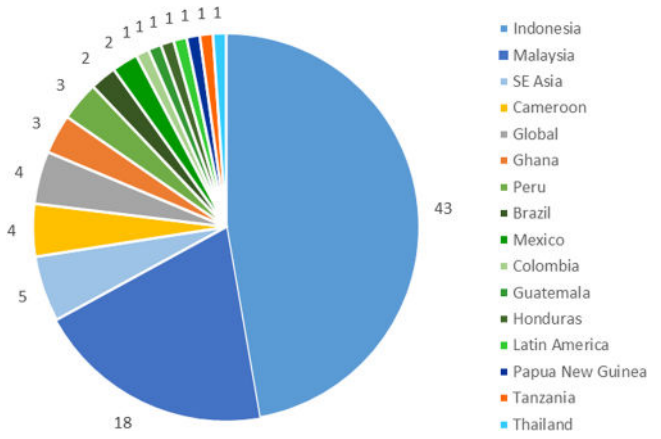

Fig. 3. Journal articles' countries and regions of focus; Blue colours indicate SE Asian countries, orange indicates African countries; green indicates Latin American countries.

been attributed to its well-designed collective action rules that distribute responsibilities and benefits effectively across scheme participants (Jelsma et al., 2017).

The low yields of smallholders are mostly attributed to poor inputs; particularly suboptimal planting materials, inadequate or excessive application of fertilizers, herbicides and insecticides, and poor quality soils (Jaza Folefack et al., 2019; Jelsma et al., 2019; Rhebergen et al., 2020; Soliman et al., 2016; Woittiez et al., 2019). Labour and capital constraints also contribute to low yields, due to suboptimal weeding and harvesting, as well as late replanting (Khatun et al., 2020; Lee et al., 2014; Rhebergen et al., 2018; Soliman et al., 2016; Uckert et al., 2015; Woittiez et al., 2017). Intercropping is suspected to reduce oil palm yields due to competition for light, water and nutrients, but this is under-researched and could in some instances even have positive yield effects (Nchanji et al., 2016; Rudolf et al., 2020). Smallholders are often constrained by limited knowledge about best practices, especially independent smallholders without ties to a company or government program (Apriani et al., 2020; Azhar et al., 2017; Dhandapani et al., 2020; Dharmawan et al., 2021; Euler et al., 2016; Martin et al., 2015). Additionally, smallholders often have poor access to input markets and therefore buy planting materials and agrochemicals from unlicensed local sellers (Euler et al., 2016; Jelsma et al., 2019; Jelsma et al., 2017; Schoneveld et al., 2019). A lack of capital is also a major factor preventing farmers obtaining good input materials consistently (Anggraini and Grundmann, 2013; Cramb and Sujang, 2013; Jelsma et al., 2017; Soliman et al., 2016).

Most studies on socio-economic upgrading for smallholders focus on improving yields, for which providing access to good quality planting materials and training in good agricultural practices are key interventions (Apriani et al., 2020; Brandi et al., 2015; Ernah and Waibel, 2020; Furumo et al., 2020; Hutabarat et al., 2018; Khaled Saifullah et al., 2018; Kunz et al., 2019; Rhebergen et al., 2020; Sheng Tey et al., 2021). Such product and process upgrading can be made possible through private companies (contract smallholders), NGOs, cooperatives, or government-run programmes. Nevertheless, many studies report that training initiatives fail to meet their objectives. This may be due to a lack of communication with the target smallholders, poor investment and design, as well as indifference from smallholder communities who may not be convinced of the benefits of a high-input high-output system (Hidayat et al., 2015; Jelsma et al., 2017; Martin et al., 2015). A low-input low-output system is not problematic from an income perspective, and there are a myriad of structural and cultural factors why smallholders may choose it (Jelsma et al., 2019). Indeed, large-scale plantations are not necessarily more profitable due to the high management costs (Azhar et al., 2017).

3.2.2. *Smallholders in the palm oil value chain*

Even though smallholder palm oil producers have higher incomes, struggles with low incomes remain common. Smallholders are often described as 'price takers rather than price makers' who have low bargaining power relative to suppliers, middlemen and mills (Martin et al., 2015; Raharja et al., 2020). Smallholders with ties to a company, who may be contracted or independent, often receive better prices for fresh fruit bunches and have access to maintained roads but may also be burdened with more debts or other costs depending on the terms of the contract (Bennett et al., 2019; Futemma et al., 2020; Gatto et al., 2017; Lee et al., 2014). Fair prices and contracts are major concerns of smallholders (Martens et al., 2020; Pye, 2019).

The terms of palm oil contracts vary both within countries and globally. This is an issue where power asymmetries between smallholders and large companies become evident. Companies are frequently criticised for exercising power over smallholders by various means, including making contracts that are difficult for smallholders to understand, especially regarding complicated pricing mechanisms (Cahyadi and Waibel, 2016; Hutabarat et al., 2019; Purwanto et al., 2020; Rist et al., 2010). Companies have thus been accused of unequal benefit sharing with smallholders and local communities (Cahyadi and Waibel, 2016; Ernah and Waibel, 2020; Gatto et al., 2017; Rist et al., 2010; Santika et al., 2019). The proliferation of contract farmers is sometimes attributed to the liberalisation of development-oriented partnership projects in favour of industry interests, alongside reductions in economic support from the state for development projects (Bennett et al., 2018; Purwanto et al., 2020; Pye, 2019).

Cooperatives may be a way to address smallholders' low bargaining power in global agricultural value chains (Raharja et al., 2020). Such functional upgrading may help smallholders become more competitive by reducing costs through economies of scale and collective bargaining (Bennett et al., 2019; Raharja et al., 2020). Being part of a cooperative is a requirement of most certification schemes as it helps reduce transaction costs in the sustainable palm oil supply chain. There are important case studies, such as the Ophir and Amanah Associations in Indonesia, that demonstrate that strong institutional frameworks with appropriate principles and capacity building, are required to set up effective cooperatives that deliver social and economic benefits to their members (Bennett et al., 2019; Hutabarat et al., 2018; Jelsma et al., 2017). However, corruption and poor management are frequently cited as major obstacles for smallholder cooperatives to achieve positive outcomes (Castellanos-Navarrete et al., 2021; Fromm et al., 2020). Furthermore, dependence on all others in the group to maintain the certification membership is a challenge within cooperatives (Kunz et al., 2019; Martens et al., 2020).

Whilst it was expected that non-state sustainability standards would disrupt patronage networks and advocate for social and environmental measures that would benefit smallholders, case studies of farmer advocacy suggest that this has not yet been the case (Schoneveld et al., 2019). Within the Roundtable on Sustainable Palm Oil (RSPO), for instance, smallholders have historically been excluded from central committees and struggled to communicate using the required techno-managerial language (Cheyns, 2014; Martens et al., 2020). Independent certified smallholders must use only licensed sellers for both input and output supply chains, which makes them more dependent on large plantations and their demands. When contract smallholders become certified, they are more dependent on the leading company than before, as independent smallholders become more dependent on the companies or NGOs that support them (Hidayat et al., 2015). Such developments suggest that lead firms are able to secure control over the value chain through sustainability management rather than smallholders improve their position. Therefore, smallholder concerns have thus far been insufficiently addressed by certification schemes.

3.2.3. *Socio-economic risks of smallholder palm oil production*

Palm oil production can both decrease and increase smallholders'

livelihood security. The opportunity to diversify and generate off-farm incomes may be an important factor in improved livelihood security and financial benefits from oil palm production (Bennett et al., 2019; Euler et al., 2017; Hidayat et al., 2015; Kubitza et al., 2018; Martens et al., 2020). A major advantage of oil palm is that it gives a higher return on labour than competitor cash crops such as rubber, where labour is often a key constraint for smallholder production (Anggraini and Grundmann, 2013; Clough et al., 2016; Euler et al., 2017; Krishna and Kubitza, 2021; Purwanto et al., 2020; Rist et al., 2010).

Oil palm adoption in general holds many risks for smallholders, however. Firstly, it does not necessarily reduce smallholders' vulnerability to future poverty in the event of a shock (Cahyadi and Waibel, 2016). In some cases it increases vulnerability to poverty due to food insecurity and debts, especially during the first three to four unproductive years of a plantation or during the replanting phase (Castellanos-Navarrete and Jansen, 2015; Pye, 2019). Contract smallholders, who are the majority of certified smallholders, usually have higher debts than other smallholders (Bennett et al., 2019; Cahyadi and Waibel, 2016; Castellanos-Navarrete et al., 2021). Additionally, they are more vulnerable to production or price shocks and food insecurity in cases where they are encouraged to specialize in oil palm (Cahyadi and Waibel, 2016; Dharmawan et al., 2021; Futemma et al., 2020; Hervas, 2019). Smallholders in cooperatives typically have lower debt burdens and better food security (Bennett et al., 2019; Jelsma et al., 2017; Koczberski et al., 2018).

Despite positive impacts on incomes, consumption, and employment, the impacts of palm oil on wellbeing indicators and inequality at village level are often negative (Hervas, 2019; Meijaard and Sheil, 2019; Qaim et al., 2020). Studies conducted in Indonesia have found declines in social and environmental measures of wellbeing associated with palm oil development that has occurred since 2000 (Krishna and Kubitza, 2021; Santika et al., 2020; Santika et al., 2019). Palm oil adoption is often associated with increased inequality at the local scale. Those who already have more land, capital and governmental support benefit the most from palm oil production (Cahyadi and Waibel, 2016; Cramb and Sujang, 2013; Euler et al., 2017; Naylor et al., 2019; Pye, 2019; Qaim et al., 2020; Santika et al., 2019). Whilst palm oil production may contribute to the creation of private wealth, a lack of investment in community goods, including infrastructure and the preservation of ecosystem services, may increase inequalities and leave non-palm oil community members worse off than before (Krishna and Kubitza, 2021; Mertz et al., 2013; Santika et al., 2020).

One of the major challenges for sustainable smallholder production is insecure land tenure. There are marked differences between groups who are able to establish legal land ownership along lines of other markers of inequalities, including personal networks, education, wealth, gender and indigeneity (Jelsma et al., 2017; Khatun et al., 2020; Majid Cooke, 2012; Martin et al., 2015; Nchanji et al., 2016). A lack of documentation can also effect other issues related to livelihoods, such as the ability of smallholders to access credit and technical support or their willingness to invest money and effort in the land. For example, smallholders might increase their investment in order to support a land claim. Conversely, in the case of Sabah, Malaysia, smallholders reportedly fear that if they improve their oil palm plots without a legal title, it will attract land-grabbers or opportunistic fruit-gatherers (Martin et al., 2015).

The profitability of producing palm oil as part of a high-input high-output system is uncertain for smallholders, even though it is regarded as a main benefit of sustainable palm oil. Interventions towards certified sustainable palm oil typically involve increased costs in the form of (a) group management costs, (b) capacity building costs, (c) the costs of legal and impact assessments, (d) internal control costs, (e) certification audit costs, and (f) certification maintenance costs, and (g) production modification costs (Sheng Tey et al., 2021). The increased costs of training and auditing for certification may not be covered by the benefits of a higher productivity through good agricultural practices. With certification, smallholders may have higher incomes resulting from technical assistance or more secure market integration, but price premiums are not guaranteed (Hutabarat et al., 2018; Sheng Tey et al., 2021). In some cases certified sustainable palm oil growers have lower incomes than uncertified counterparts (Brandi, 2017; Hutabarat et al., 2018; Martens et al., 2020). The uncertainty is greater where the costs of certification are covered by NGOs or a company, as this support could be retracted in the future (Hidayat et al., 2016).

3.3. Environmental upgrading

3.3.1. Biodiversity

Smallholdings are generally found to be more biodiversity-friendly than agro-industrial plantations due to their size and farming processes, though they are still much less biodiverse than primary or secondary forests (Azhar et al., 2017; Azhar et al., 2014; Dhandapani et al., 2020; Razak et al., 2020; Syafiq et al., 2016). Greater numbers of birds, mammals, and insects have been found on or near smallholdings than large plantations, likely due to the fact that floristic diversity and stand structural complexity provide more food, shelter and prey (Azhar et al., 2017; Ghazali et al., 2016; Teuscher et al., 2015; Yahya et al., 2017). At farm level, smallholders commonly undertake polyculture, with palm oil part of a broader livelihood portfolio (Furumo et al., 2020; Ghazali et al., 2016; Koczberski et al., 2018; Langston et al., 2017; Nchanji et al., 2016). Smallholders may also have a lesser effect on biodiversity than large plantations due to lower agrochemical use, but the impact of this on biodiversity is under-studied (Jaza Folefack et al., 2019; Razak et al., 2020). At landscape level, smallholdings are usually different shapes and sizes with various boundary plantings, the diversity of which is important for allowing species to move between forest areas in search of food, habitats, and escape from hazards (Azhar et al., 2015; Clough et al., 2016; Tapia et al., 2021).

On the other hand, smallholders' impacts on biodiversity are often negative too. Case studies from Indonesia suggest that smallholders often lack knowledge of proper agrochemical management and cause local pollution through the incorrect storage, application and disposal of agrochemicals and their containers (Brandi et al., 2015). Smallholders are also known to use fires for land clearing, although the precise roles of companies and smallholders in forest fires are unclear (Gaveau et al., 2017). Smallholdings in Malaysia have been found to have higher poaching rates and a study found that independent smallholders took more measures than managed smallholders to control wild or pest animals, including trapping or hunting them (Saadun et al., 2018). These findings highlight that attention must be paid to the tension between supporting diverse wildlife and agricultural production.

There is a general paucity of evidence regarding changes to environmental standards as a result of sustainability-related upgrading. Some studies conclude that more extension activities are needed for smallholders to achieve full compliance with GAP certification standards (Ernah and Waibel, 2016; Hidayat et al., 2018; Rodthong et al., 2020). Training initiatives may have positive additionality for environmental standards through improved knowledge of agrochemicals and integrated pest management, as well as promoting area set aside for conservation (Brandi, 2017; Furumo et al., 2020; Kunz et al., 2019). These interventions may reduce pollution and support biodiversity but their effects are yet to be measured.

3.3.2. Deforestation and greenhouse gas emissions from land use change

The extent to which smallholders engage in forest clearance differs by region and country, and depends on a wide variety of factors including their legal and financial resources. Furthermore, there is disagreement in the literature on the overall contribution of oil palm expansion to deforestation; assessments of deforestation differ widely, depending partly on the assessment scope and methods (Meijaard et al., 2020). Regarding smallholders, even though there are very high rates of deforestation in West Africa, in Ghana, where the majority of palm oil

producers are smallholders (60%), only an estimated 7% of the deforestation in the country is attributed to citrus, oil palm and rubber expansion combined (Khatun et al., 2020). In most of Southeast Asia, industrial plantations have been identified as a leading driver of deforestation (Curtis et al., 2018). It has been estimated that 88.3% of forest loss in Sumatra between 2000 and 2010 was due to private companies, followed by smallholdings at 10.7% (Lee et al., 2014).

Nevertheless, there is a particular concern that smallholders convert fragile ecosystems, including peatlands (Meijaard et al., 2020). This is often attributed to the fact that both corporate zero-deforestation commitments and moratoria on granting industrial concessions in primary forests and peatlands increase competition for land with mineral soils, which is already mostly cultivated by large-scale companies. Smallholders are thus pushed towards marginal lands, including primary forests and peatlands (Afriyanti et al., 2019; Ayompe et al., 2021; Gaveau et al., 2017; Hidayat et al., 2018; Hutabarat et al., 2018; Schoneveld et al., 2019). Being pushed towards marginal land also affects smallholders' struggles with soil erosion, limited water resources and poor water quality, which contributes also to lower oil palm yields (Ernah and Waibel, 2016; Majid Cooke, 2012).

It has been noted that only wealthier smallholders can bear the costs of draining peatlands or maintaining a remote palm oil plot on the forest frontier where there is limited infrastructure (Jelsma et al., 2017; Schoneveld et al., 2019; Schoneveld et al., 2019). Clearance by fire is noted as common in the literature, as it is cheaper than machinery, but is not studied in detail for smallholders (Dharmawan et al., 2021; Schoneveld et al., 2019). Smallholders often make use of agricultural land that is already in use or forests that have already been degraded by timber extraction, as the costs of conversion are lower. In Peru, for instance, a study found that smallholders converted more land between 2010 and 2016 for palm oil production than large-scale enterprises, but overall deforestation by smallholders was about the same magnitude as they utilised more existing agricultural or degraded lands (Dharmawan et al., 2020; Glinskis and Gutiérrez-Vélez, 2019).

Low yields are often cited as a key motivation for smallholder expansion because intensification through better agricultural practices or replanting older stands is more expensive than the costs of expansion (Alwarritzi et al., 2015; Hutabarat et al., 2018; Jaza Folefack et al., 2019; Martens et al., 2020). As before, it is the relatively more affluent farmers who already own larger plots of land that are most likely to expand operations to increase production (Schoneveld et al., 2019). As mentioned earlier, informality and insecure tenure rights are also significant drivers of smallholder driven deforestation. In Peru, Malaysia, and Indonesia many cases of clearing to establish land tenure have been observed. This has occurred where smallholders have planted oil palm in order to assert their ownership of the land, as well as to prove to the local government that the land is not available to be allocated to private companies (Anggraini and Grundmann, 2013; Cramb and Sujang, 2013; Glinskis and Gutiérrez-Vélez, 2019; Naylor et al., 2019; Soda et al., 2016).

The impacts of certification on deforestation by smallholders are not well studied. A case study conducted in Indonesia found that RSPO certification did not sufficiently reduce incentives for smallholders to expand farms rather than intensify for both plasma and independent smallholders (Slingerland, 2018). Contract farming in general is often associated with negative outcomes for deforestation, as it is one way in which smallholders are able to secure the capital and technology for forest clearance (Gatto et al., 2017; Glinskis and Gutiérrez-Vélez, 2019).

3.3.3. Environmental risks of smallholder palm oil production

There is a consensus in the literature that globally, even though both smallholder and agro-industrial plantations have negative impacts on the environment, small-scale palm oil production is generally less harmful (Bennett et al., 2018; Glinskis and Gutiérrez-Vélez, 2019; Martens et al., 2020). This takes into account impacts on biodiversity, deforestation, and carbon emissions through land use change. However, the impact of smallholder production might change in the future. In Indonesia and Malaysia, it is becoming increasingly difficult for companies to open up large tracts of land but large companies commonly source from smallholder suppliers (Ayompe et al., 2021; Jelsma et al., 2019).

Rural communities are often presented as the best managers of local conservation as they are able to utilise local knowledge and may have a closer relationship with the local environment. However, one ought to be careful not to fall into the so-called 'local trap' and fail to consider that different rural communities both nationally and globally have different aspirations and goals for the use of natural resources (Castellanos-Navarrete, 2021; Langston et al., 2017; Purwanto et al., 2020). Community forestry management in Indonesia, for instance, has generally lead to good outcomes in terms of avoided deforestation, but in some contexts it lead to increased deforestation (Santika et al., 2017; Santika et al., 2019). It has been observed that imposed discourses of conservation, typically from the Global North, often have very little resonance with small-scale farmers (Castellanos-Navarrete, 2021; Martin et al., 2015; Saadun et al., 2018). To a great extent, smallholders' smaller ecological footprint is attributed to using less intensive agricultural methods, such as incorporating polyculture or using fewer agrochemical inputs, and having more limited resources for forest clearance. Less intensive methods of production may not be a choice, but used because the farmers lack the financial or technical capability to farm more intensively. There is a concern that if smallholders' capabilities increase without incentives to conserve natural forests, it would enable further deforestation (Brandi, 2017).

3.4. Processes of inclusion and exclusion for certified sustainable palm oil

Only 13.8% of certified RSPO land is managed by smallholders and only 1.3% is managed by independent smallholders, despite the fact that smallholders produce 30–40% of all palm oil (Amsterdam Declaration Partnerships, 2021; Apriani et al., 2020; Chain Reaction Research, 2021). This demonstrates that contract farmers who are already integrated into global palm oil value chains are more likely to access certification. In the literature, low rates of certification for smallholders is attributed to multiple barriers to certification, as well as a lack of incentives. These bottlenecks determine which smallholders are able to upgrade and which are not.

In the first instance, there are barriers to certification stemming from the political and economic constraints at national and local levels. Many smallholders cannot be certified because they cannot obtain the legal documents to prove land tenure or because they are growing on newly cleared land or peat soils (Apriani et al., 2020; Dharmawan et al., 2021; Hutabarat et al., 2018; Jelsma et al., 2017). This has been estimated to affect 5–10% of smallholders in Southeast Asia (Hutabarat et al., 2018; Rietberg and Slingerland, 2016). Studies conducted in Indonesia have also identified local government bureaucracy as an obstacle, especially where authorities are unable or unwilling to carry out the necessary inspections and approvals (Brandi, 2017; Hidayat et al., 2015). The local government may also be unable to supply or ascertain key information, such as which areas are classified as High Conservation Value (HCV) (Brandi, 2017). Furthermore, as described above, smallholders globally often rely on middlemen for both input and output markets, which goes against certification scheme requirements for certified retailers and transparency in the supply chain (Hidayat et al., 2018; Martin et al., 2015; Schoneveld et al., 2019). The exclusion of middlemen sometimes leads to local resistance for certification, as the emphasis on becoming buyers and suppliers for agro-industrial actors may damage local markets (Hidayat et al., 2018; Khatun et al., 2020).

Secondly, smallholder farmers often lack the capabilities required for the certification process. The initial and recurrent fees for trainings, administration, monitoring and auditing are high relative to smallholders' incomes and the future returns uncertain (Hutabarat et al., 2018; Kunz et al., 2019; Saadun et al., 2018; Sheng Tey et al., 2021).

These costs are frequently covered by an NGO or large company to make the certification process possible (Apriani et al., 2020). Independent smallholders who do not have access to extension services often do not have the knowledge to comply with certification standards for good agricultural practices (GAP) or information about certification in general (Dharmawan et al., 2021; Ernah and Waibel, 2016; Furumo et al., 2020; Schoneveld et al., 2019). Organizational and managerial skills are also required to attain certification. Requirements such as keeping records and maintaining smallholder organisations can be substantial additional tasks for many smallholders (Apriani et al., 2020; Brandi et al., 2015; Dharmawan et al., 2021).

Lastly, a lack of consumer demand for sustainable palm oil reduces incentives for smallholders to become certified. Price premiums rarely materialize as certified sustainable palm oil is frequently sold as conventional palm oil (Apriani et al., 2020; Brandi, 2017; Hidayat et al., 2016; Martens et al., 2020). There are theoretical concerns that certification would lead to market exclusion or a bifurcated market for sustainable and unsustainable palm oil, but this is not yet empirically documented. Overall, only 19% of oil palm land is certified sustainable palm oil (Amsterdam Declaration Partnerships, 2021). Key markets for palm oil, specifically China and India, do not yet require sustainable palm oil at a national level. Importantly, domestic consumers of palm oil in low-income countries are unlikely to be able or willing to pay premium prices for sustainable palm oil (Brandão et al., 2021; Hidayat et al., 2015; Higgins and Richards, 2019; Nesadurai, 2019; Ordway et al., 2017).

The few available studies suggest that those who are already more experienced oil palm farmers, with access to extension services, and owning legal documentation, are more likely to comply and adopt certification standards (Rodthong et al., 2020; Schoneveld et al., 2019). These farmers are most likely to be contract farmers or Indonesian settler communities. This trend highlights the importance of development interventions alongside certification so as to avoid contributing to increasing inequality, whether from private or public sources.

4. Discussion

The literature on smallholder palm oil growers is diverse, encompassing perspectives from across the social and natural sciences. These studies are often disconnected and reveal only a partial picture of sustainability for smallholders, for instance focusing on the economic development of smallholders without exploring the impacts on the local environment or non-palm oil households. Whilst it is impossible for every research project to focus on every socio-economic or environmental aspect, it is necessary to bring this knowledge together to understand the feasibility and effectiveness of sustainability policies.

Given the emphasis on market-based instruments for sustainability governance in the palm oil sector, it is not surprising that there has been a plethora of research that focuses on certification and it has widely been assumed that sustainability certification enables palm oil smallholders to upgrade. Through collating findings on both certification and topics relevant to sustainability in smallholder palm oil production, we demonstrate that certification standards do not respond to many key challenges, nor build upon smallholder advantages for both socio-economic and environmental benefits. There is currently limited and mixed evidence of environmental upgrading from certification for biodiversity or deforestation. However, there are increased socio-economic risks for smallholders due to increased costs and uncertain returns. Sustainability certification for palm oil thus raises the bar of entry to premium markets and causes a sustainability-driven supplier squeeze, unless costs for smallholders continue to be covered by NGOs or large companies. This conclusion corresponds with other authors who also find that the conceptualization of 'sustainability' used for certified sustainable palm oil reflects the needs and interests of large-scale actors preparing palm oil for export in global value chains (Azhar et al., 2017; Cheyns, 2014; Khatun et al., 2020). Conversely, local markets can be important for small-scale farmers (Khatun et al., 2020). Thus, the results of our scoping review indicate that academic research should move away from certification as way to conceptualize and measure sustainability for smallholder palm oil growers.

Smallholders have historically had little input into developing certification standards and consequently smallholder challenges and preferences have remained underrepresented in the literature. As a starting point in deciding what to measure, researchers could investigate what meanings *sustainability* hold for smallholders themselves. Challenges that require further exploration in this context include insecure land tenure, opaque pricing mechanisms, debt, and potential pathways for functional upgrading that would increase smallholders' share of the benefits in palm oil value chains, through cooperatives or other means (Dallas et al., 2019). These may be more fruitful subjects to investigate socio-economic upgrading alongside environmental upgrading (Pye, 2019). A broader understanding of sustainability in the palm oil sector as socio-economic and environmental upgrading highlights alternative areas for additionalities. For example, there are indications in the literature that practices that are common in smallholder landscapes, such as polyculture, are better for local biodiversity and food security. In general, even though the cultivation of palm oil has largely coincided with the rise of sustainability discourse, many areas for research on smallholder palm oil growers do not differ from traditional topics within agricultural and development studies on finding ways to enhance smallholder support services (Brandi, 2017). Future research could incorporate knowledge from diverse established fields of research, such as agroecology or agroforestry, on providing support to smallholders using environmentally sensitive methods.

Recent developments in promoting sustainability attempt to address some of the main criticisms of certification cited in this review. For example, the 2019 RSPO Independent Smallholder Standard recognises the need to lower the costs of the certification process to promote greater inclusivity (RSPO, 2019). Jurisdictional Approaches are another recent strategy that has been implemented since 2015, whereby certification is obtained stepwise for the production and processing of palm oil at the scale of government administrative areas (RSPO, 2021a). This strategy also aims to increase the participation of smallholders. Additionally, it encourages collaboration with local government, who have the authority to implement measures such as living wages, secure land tenure or the protection of forests at the landscape level (RSPO, 2021a). These new approaches must be evaluated on their own or as part of a policy mix analysis to assess if they facilitate meaningful sustainability upgrading for smallholders in light of the issues raised in this review.

Finally, this review also urges that greater attention is paid to understanding the distribution of both the benefits and costs of conventional and sustainable palm oil. Despite the fact that multiple articles highlight key differences in the characteristics of farmers who are regarded as smallholders (Baudoin et al., 2015; Jelsma et al., 2017; Schoneveld et al., 2019), these differences are often undefined in the academic literature. For instance, it is known that forest clearance and peat drainage requires financial capital, thus it is only possible for a subset of smallholder palm oil growers. There are also blind spots in the literature regarding emerging palm oil producing countries outside of Southeast Asia, particularly Nigeria and Colombia.

5. Conclusion

Through a scoping review, we assessed the current nature and extent of the literature on sustainability and smallholder palm oil growers. We conducted a literature search that yielded 100 articles that included smallholder palm oil growers and a sustainability-related topic as the subject of study. We firstly examined the extent of the research on sustainability and smallholders, and found that interest has ballooned in recent years with strong emphases on certification and environmental impacts, as well as livelihoods from a development perspective. Turning towards the current evidence of socio-economic and environmental

upgrading for smallholders through sustainability certification, we found that interventions such as training for good agrochemical management and improved input supply chains often result in upgrading for smallholders, although certification itself is risky for smallholders due to increased costs. There are gaps in the literature on meeting smallholders' needs outside of a certification framework and improving their influence and benefits within the global value chain. In addition, more attention ought to be paid to the different impacts of smallholder palm oil production both across and within countries. This review demonstrates the value of considering socio-economic and environmental factors together as they are closely intertwined in the implementation of sustainability-related policy. Future research may also incorporate institutional sustainability. Given the complexity of sustainability in the palm oil sector, future approaches to assessing sustainability may benefit from a broader perspective, for instance the analysis of landscape-level and jurisdictional approaches to transforming agricultural practices. Even though the development of oil palm is widely known to have occurred at the expense of the environment, some research suggests that there are plausible scenarios that reconcile forest conservation with oil palm production and prosperous livelihoods (Brandi, 2017; Castellanos-Navarrete et al., 2021; Purnomo et al., 2020).

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References

Abood, S.A., Lee, J.S.H., Burivalova, Z., Garcia-Ulloa, J., Koh, L.P., 2015. Relative contributions of the logging, fiber, oil palm, and mining industries to forest loss in Indonesia. Conserv. Lett. 8 (1), 58–67. https://doi.org/10.1111/conl.12103.

Afriyanti, D., Hein, L., Kroeze, C., Zuhdi, M., Saad, A., 2019. Scenarios for withdrawal of oil palm plantations from peatlands in Jambi Province, Sumatra, Indonesia. Reg. Environ. Change 19, 1201–1215. https://doi.org/10.1007/s10113-018-1452-1.

Ahmed, S., Vaska, M., Turin, T., 2016. Conducting a literature review in health research: basics of the approach. Typology Methodol. Corresp. Author JNHFB 5 (September 2019), 44–51. ⟨http://www.equator-network.org/reporting-guidelines/⟩.

Alwarritzi, W., Nanseki, T., Chomei, Y., 2015. Factors determining Household level farmers' decisions to expand oil palm farmland in Indonesia. J. Fac. Agric., Kyushu Univ. 60 (2), 563–568.

Amnesty International, 2016. The great palm oil scandal. Amnesty Int. 1–148. ⟨https://www.amnesty.org/download/Documents/ASA2151842016ENGLISH.PDF⟩.

Amsterdam Declaration Partnerships. (2021). About. https://ad-partnership.org/about/.

Anggraini, E., Grundmann, P., 2013. Transactions in the supply chain of oil palm fruits and their relevance for land conversion in smallholdings in Indonesia. J. Environ. Dev. 22 (4), 391–410. https://doi.org/10.1177/1070496513506225.

Apriani, E., Kim, Y.-S., Fisher, L.A., Baral, H., 2020. Non-state certification of smallholders for sustainable palm oil in Sumatra, Indonesia. Land Use Policy 99, 105112. https://doi.org/10.1016/j.landusepol.2020.105112.

Atiqah, N., Yahya, M.S., Aisyah, S., Ashton-Butt, A., Azhar, B., 2019. Birds associated with different tree species and structures in oil palm agroforestry landscapes in Malaysia. Emu 119 (4), 397–401. https://doi.org/10.1080/01584197.2019.1621680.

Ayompe, L.M., Schaafsma, M., Egoh, B.N., 2021. Towards sustainable palm oil production: the positive and negative impacts on ecosystem services and human wellbeing. J. Clean. Prod. 278, 123914 https://doi.org/10.1016/j.jclepro.2020.123914.

Azhar, B., Puan, C., Zakaria, M., Hassan, N., Arif, M., 2014. Effects of monoculture and polyculture practices in oil palm smallholdings on tropical farmland birds. Basic Appl. Ecol. 15 (4), 336–346. https://doi.org/10.1016/j.baae.2014.06.001.

Azhar, B., Lindenmayer, D.B., Wood, J., Fischer, J., Zakaria, M., 2014. Ecological impacts of oil palm agriculture on forest mammals in plantation estates and smallholdings. Biodivers. Conserv. 23 (5), 1175–1191. https://doi.org/10.1007/s10531-014-0656-z.

Azhar, B., Saadun, N., Puan, C.L., Kamarudin, N., Aziz, N., Nurhidayu, S., Fischer, J., 2015. Promoting landscape heterogeneity to improve the biodiversity benefits of certified palm oil production: Evidence from Peninsular Malaysia. Glob. Ecol. Conserv. 3, 553–561. https://doi.org/10.1016/j.gecco.2015.02.009.

Azhar, B., Saadun, N., Prideaux, M., Lindenmayer, D.B., 2017. The global palm oil sector must change to save biodiversity and improve food security in the tropics. J. Environ. Manag. 203, 457–466. https://doi.org/10.1016/j.jenvman.2017.08.021.

Barrientos, S., Gereffi, G., Rossi, A., 2011. Economic and social upgrading in global production networks: a new paradigm for a changing world. Int. Labour Rev. 150 (3–4), 319–340. https://doi.org/10.1111/j.1564-913X.2011.00119.x.

Baudoin, A., Bosc, P.-M., Moulin, M., Wohlfahrt, J., Marichal, R., Caliman, J.-P., Bessou, C., 2015. Linking the transformation of production structures to a multidimensional sustainability assessment grid of smallholders oil palm plantations. Int. J. Sustain. Dev. World Ecol. 22 (6), 520–532. https://doi.org/10.1080/13504509.2015.1090497.

Bennett, A., Ravikumar, A., Paltán, H., 2018. The political ecology of oil palm company-community partnerships in the Peruvian Amazon: deforestation consequences of the privatization of rural development. World Dev. 109, 29–41. https://doi.org/10.1016/j.worlddev.2018.04.001.

Bennett, A., Ravikumar, A., McDermott, C., Malhi, Y., 2019. Smallholder oil palm production in the peruvian amazon: rethinking the promise of associations and partnerships for economically sustainable livelihoods. Front. For. Glob. Change 2. https://doi.org/10.3389/ffgc.2019.00014.

Boons, F., Mendoza, A., 2010. Constructing sustainable palm oil: how actors define sustainability. J. Clean. Prod. 18 (16–17), 1686–1695. https://doi.org/10.1016/j.jclepro.2010.07.003.

Brako, D.E.D.E., Richard, A., Alexandros, G., 2020. Do voluntary certification standards improve yields and wellbeing? Evidence from oil palm and cocoa smallholders in Ghana. Int. J. Agric. Sustain. 1–24. https://doi.org/10.1080/14735903.2020.1807893.

Brandão, F., Schoneveld, G., Pacheco, P., Vieira, I., Piraux, M., Mota, D., 2021. The challenge of reconciling conservation and development in the tropics: lessons from Brazil's oil palm governance model. World Dev. 139, 105268 https://doi.org/10.1016/j.worlddev.2020.105268.

Brandi, C.A., 2017. Sustainability standards and sustainable development - synergies and trade-offs of transnational governance. *Sustainable Development*, 25 (1), 25–34. https://doi.org/10.1002/sd.1639.

Brandi, C.A., Cabani, T., Hosang, C., Schirmbeck, S., Westermann, L., Wiese, H., 2015. Sustainability standards for palm oil: challenges for smallholder certification under the RSPO. J. Environ. Dev. 24 (3), 292–314. https://doi.org/10.1177/1070496515593775.

Busch, J., Ferretti-Gallon, K., Engelmann, J., Wright, M., Austin, K.G., Stolle, F., Turubanova, S., Potapov, P.V., Margono, B., Hansen, M.C., Baccini, A., 2015. Reductions in emissions from deforestation from Indonesia's moratorium on new oil palm, timber, and logging concessions. Proc. Natl. Acad. Sci. USA 112 (5), 1328–1333. https://doi.org/10.1073/PNAS.1412514112.

Butler, R.A., Koh, L.P., Ghazoul, J., 2009. REDD in the red: palm oil could undermine carbon payment schemes. Conserv. Lett. 2 (2), 67–73. https://doi.org/10.1111/j.1755-263x.2009.00047.x.

Cahyadi, E.R., Waibel, H., 2016. Contract farming and vulnerability to poverty among oil palm smallholders in Indonesia. J. Dev. Stud. 52 (5), 681–695. https://doi.org/10.1080/00220388.2015.1098627.

Campling, L., Havice, E., 2019. Bringing the environment into GVC analysis: antecedents and advances. In: Ponte, S., Gereffi, G., Raj-Reichert, G. (Eds.), Handb. Glob. Value Chains. Edward Elgar Publishing, pp. 214–227. https://doi.org/10.4337/9781788113779.00019.

Carlson, K.M., Curran, L.M., Asner, G.P., Pittman, A.M.D., Trigg, S.N., Marion Adeney, J., 2013. Carbon emissions from forest conversion by Kalimantan oil palm plantations. Nat. Clim. Change 3 (3), 283–287. https://doi.org/10.1038/nclimate1702.

Castellanos-Navarrete, A., 2021. Oil palm dispersal into protected wetlands: Human–environment dichotomies and the limits to governance in southern Mexico. Land Use Policy 103 (September 2020), 105304. https://doi.org/10.1016/j.landusepol.2021.105304.

Castellanos-Navarrete, A., Jansen, K., 2015. Oil palm expansion without enclosure: smallholders and environmental narratives. J. Peasant Stud. 42 (3–4), 791–816. https://doi.org/10.1080/03066150.2015.1016920.

Castellanos-Navarrete, A., de Castro, F., Pacheco, P., 2021. The impact of oil palm on rural livelihoods and tropical forest landscapes in Latin America. J. Rural Stud. 81, 294–304. https://doi.org/10.1016/j.jrurstud.2020.10.047.

Chain Reaction Research, 2021. FMCGs, Retail Earn. 66% Gross Profits Palm. Oil Value Chain (Issue June).

Cheyns, E., 2014. Making "minority voices" heard in transnational roundtables: The role of local NGOs in reintroducing justice and attachments. Agric. Hum. Values 31 (3), 439–453. https://doi.org/10.1007/s10460-014-9505-7.

Clough, Y., Krishna, V.V., Corre, M.D., Darras, K., Denmead, L.H., Meijide, A., Moser, S., Musshoff, O., Steinebach, S., Veldkamp, E., Allen, K., Barnes, A.D., Breidenbach, N., Brose, U., Buchori, D., Daniel, R., Finkeldey, R., Harahap, I., Hertel, D., Scheu, S., 2016. Land-use choices follow profitability at the expense of ecological functions in Indonesian smallholder landscapes. Nat. Commun. 7. https://doi.org/10.1038/ncomms13137.

Cramb, R.A., Sujang, P.S., 2013. The mouse deer and the crocodile: oil palm smallholders and livelihood strategies in Sarawak, Malaysia. J. Peasant Stud. 40 (1), 129–154. https://doi.org/10.1080/03066150.2012.750241.

Curtis, P.G., Slay, C.M., Harris, N.L., Tyukavina, A., Hansen, M.C., 2018. Classifying drivers of global forest loss. Science 361 (6407), 1108–1111. https://doi.org/10.1126/science.aau3445.

Dallas, M.P., Ponte, S., Sturgeon, T.J., 2019. Power in global value chains. Rev. Int. Political Econ. 26 (4), 666–694. https://doi.org/10.1080/09692290.2019.1608284.

De Bakker, F.G.A., Rasche, A., Ponte, S., 2019. Multi-stakeholder initiatives on sustainability: a cross-disciplinary review and research agenda for business ethics. Bus. Ethics Q. 29 (3), 343–383. https://doi.org/10.1017/beq.2019.10.
De Marchi, V., Di Maria, E., Micelli, S., 2013. Environmental strategies, upgrading and competitive advantage in global value chains. Bus. Strategy Environ. 22 (1), 62–72. https://doi.org/10.1002/bse.1738.
Dhandapani, S., Girkin, N.T., Evers, S., Ritz, K., Sjögersten, S., 2020. Is intercropping an environmentally-wise alternative to established oil palm monoculture in tropical peatlands? Front. For. Glob. Change 3. https://doi.org/10.3389/ffgc.2020.00070.
Dharmawan, A.H., Mardiyaningsih, D.I., Komarudin, H., Ghazoul, J., Pacheco, P., Rahmadian, F., 2020. Dynamics of rural economy: a socio-economic understanding of oil palm expansion and landscape changes in east Kalimantan. Indones. Land 9 (7). https://doi.org/10.3390/land9070213.
Dharmawan, A.H., Mardiyaningsih, D.I., Rahmadian, F., Yulian, B.E., Komarudin, H., Pacheco, P., Ghazoul, J., Amalia, R., 2021. The agrarian, structural and cultural constraints of smallholders' readiness for sustainability standards implementation: the case of Indonesian sustainable palm oil in east Kalimantan. Sustain. (Switz.) 13 (5), 1–20. https://doi.org/10.3390/su13052611.
Dislich, C., Hettig, E., Salecker, J., Heinonen, J., Lay, J., Meyer, K.M., Wiegand, K., Tarigan, S., 2018. Land-use change in oil palm dominated tropical landscapes—An agent-based model to explore ecological and socio-economic trade-offs. PLoS ONE 13 (1), 1–20. https://doi.org/10.1371/journal.pone.0190506.
Djouma, S.H., Feintrenie, L., Levang, P., Nji, A., 2018. Co-designing win-win partnerships between agro-industries and smallholders in the palm oil sector in Cameroon. Biotechnol., Agron. Soc. Environ. 22 (3), 136–151. https://doi.org/10.25518/1780-4507.16522.
Ernah, P.P., Waibel, H., 2016. Adoption of sustainable palm oil practices by Indonesian smallholder farmers. J. Southeast Asian Econ. 33 (3), 291–316.
Ernah, P.P., Waibel, H., 2020. Will teaching sustainability standards to oil palm smallholders in Indonesia pay off. Int. J. Agric. Sustain. 18 (2), 196–211. https://doi.org/10.1080/14735903.2020.1744899.
Euler, M., Hoffmann, M.P., Fathoni, Z., Schwarze, S., 2016. Exploring yield gaps in smallholder oil palm production systems in eastern Sumatra, Indonesia. Agric. Syst. 146, 111–119. https://doi.org/10.1016/j.agsy.2016.04.007.
Euler, M., Krishna, V., Schwarze, S., Siregar, H., Qaim, M., 2017. Oil palm adoption, household welfare, and nutrition among smallholder farmers in Indonesia. World Dev. 93, 219–235. https://doi.org/10.1016/j.worlddev.2016.12.019.
FAO, 2020. FAOSTAT Stat. Database. ⟨http://www.fao.org/faostat/en/#home⟩.
Fromm, I., Feurer, M., Mengel, S., 2020. Sustainable palm oil production in Honduras: Myth or reality? Int. Rev. Mod. Sociol. 46 (1–2), 82–106.
Furumo, P.R., Rueda, X., Rodríguez, J.S., Parés Ramos, I.K., 2020. Field evidence for positive certification outcomes on oil palm smallholder management practices in Colombia. J. Clean. Prod. 245. https://doi.org/10.1016/j.jclepro.2019.118891.
Futemma, C., De Castro, F., Brondizio, E.S., 2020. Farmers and social innovations in rural development: collaborative arrangements in Eastern Brazilian Amazon. Land Use Policy 99 (August), 104999. https://doi.org/10.1016/j.landusepol.2020.104999.
Gatto, M., Wollni, M., Asnawi, R., Qaim, M., 2017. Oil palm boom, contract farming, and rural economic development: village-level evidence from Indonesia. World Dev. 95, 127–140. https://doi.org/10.1016/j.worlddev.2017.02.013.
Gaveau, D.L.A., Pirard, R., Salim, M.A., Tonoto, P., Yaen, H., Parks, S.A., Carmenta, R., 2017. Overlapping land claims limit the use of satellites to monitor no-deforestation commitments and no-burning compliance. Conserv. Lett. 10 (2), 257–264. https://doi.org/10.1111/conl.12256.
Gerber, J.F., 2011. Conflicts over industrial tree plantations in the South: Who, how and why. Glob. Environ. Change 21 (1), 165–176. https://doi.org/10.1016/j.gloenvcha.2010.09.005.
Gereffi, G., 1999. International trade and industrial upgrading in the apparel commodity chain. J. Int. Econ. 48 (1), 37–70. https://doi.org/10.1016/S0022-1996(98)00075-0.
Ghazali, A., Asmah, S., Syafiq, M., Yahya, M.S., Aziz, N., Tan, L.P., Norhisham, A.R., Puan, C.L., Turner, E.C., Azhar, B., 2016. Effects of monoculture and polyculture farming in oil palm smallholdings on terrestrial arthropod diversity. J. Asia-Pac. Entomol. 19 (2), 415–421. https://doi.org/10.1016/j.aspen.2016.04.016.
Glinskis, E.A., Gutiérrez-Vélez, V.H., 2019. Quantifying and understanding land cover changes by large and small oil palm expansion regimes in the Peruvian Amazon. Land Use Policy 80, 95–106. https://doi.org/10.1016/j.landusepol.2018.09.032.
Grant, Maria J., Booth, Andrew, 2009. A typology of reviews: an analysis of 14 review types and associated methodologies. Health Information and Libraries Journal 26 (2), 91–108. https://doi.org/10.1111/j.1471-1842.2009.00848.x.
Harris, N.L., Brown, S., Hagen, S.C., Saatchi, S.S., Petrova, S., Salas, W., Hansen, M.C., Potapov, P.V., Lotsch, A., 2012. Baseline map of carbon emissions from deforestation in tropical regions. Science 336 (6088), 1573–1576. https://doi.org/10.1126/science.1217962.
Hervas, A., 2019. Land, development and contract farming on the Guatemalan oil palm frontier. J. Peasant Stud. 46 (1), 115–141. https://doi.org/10.1080/03066150.2017.1351435.
Hidayat, N.K., Glasbergen, P., Offermans, A., 2015. Sustainability certification and palm oil smallholders' livelihood: a comparison between scheme smallholders and independent smallholders in Indonesia. Int. Food Agribus. Manag. Rev. 18 (3), 25–48. https://doi.org/10.22004/ag.econ.208400.
Hidayat, N.K., Offermans, A., Glasbergen, P., 2016. On the profitability of sustainability certification. Journal of Economics and Sustainable Development, 7, 18.
Hidayat, N.K., Offermans, A., Glasbergen, P., 2018. Sustainable palm oil as a public responsibility? On the governance capacity of Indonesian Standard for Sustainable Palm Oil (ISPO). Agric. Hum. Values 35 (1), 223–242. https://doi.org/10.1007/s10460-017-9816-6.
Higgins, V., Richards, C., 2019. Framing sustainability: alternative standards schemes for sustainable palm oil and South-South trade. J. Rural Stud. 65, 126–134. https://doi.org/10.1016/j.jrurstud.2018.11.001.
Humphrey, J., Schmitz, H., 2002. How does insertion in global value chains affect upgrading in industrial clusters? Reg. Stud. 36 (9), 1017–1027.
Hutabarat, S., Slingerland, M., Rietberg, P., Dries, L., 2018. Costs and benefits of certification of independent oil palm smallholders in Indonesia. Int. Food Agribus. Manag. Rev. 21 (6), 681–700. https://doi.org/10.22434/IFAMR2016.0162.
Hutabarat, S., Slingerland, M., Dries, L., 2019. Explaining the "Certification Gap" for Different Types of Oil Palm Smallholders in Riau Province, Indonesia. J. Environ. Dev. 28 (3), 253–281. https://doi.org/10.1177/1070496519854505.
Inobu, 2020. Sumarni: Reaping Man. Benefits RSPO Certif. ⟨https://inobu.org/sumarni-reaping-the-many-benefits-of-rspo-certification⟩.
Jaza Folefack, A.J., Ngo Njiki, M.G., Darr, D., 2019. Safeguarding forests from smallholder oil palm expansion by more intensive production? The case of Ngwei forest (Cameroon). For. Policy Econ. 101 (September 2018), 45–61. https://doi.org/10.1016/j.forpol.2019.01.016.
Jelsma, I., Slingerland, M., Giller, K.E., Bijman, J., 2017. Collective action in a smallholder oil palm production system in Indonesia: The key to sustainable and inclusive smallholder palm oil. J. Rural Stud. 54 (2017), 198–210. https://doi.org/10.1016/j.jrurstud.2017.06.005.
Jelsma, I., Schoneveld, G.C., Zoomers, A., van Westen, A.C.M., 2017. Unpacking Indonesia's independent oil palm smallholders: an actor-disaggregated approach to identifying environmental and social performance challenges. Land Use Policy 69, 281–297. https://doi.org/10.1016/j.landusepol.2017.08.012.
Jelsma, I., Woittiez, L.S., Ollivier, J., Dharmawan, A.H., 2019. Do wealthy farmers implement better agricultural practices? An assessment of implementation of Good Agricultural Practices among different types of independent oil palm smallholders in Riau, Indonesia. Agric. Syst. 170, 63–76. https://doi.org/10.1016/j.agsy.2018.11.004.
Khaled Saifullah, M., Kari, F.B., Othman, A., 2018. Poverty among the small-scale plantation holders indigenous communities in Peninsular Malaysia. Int. J. Soc. Econ. 45 (2), 230–245. https://doi.org/10.1108/IJSE-10-2016-0296.
Khatun, K., Maguire-Rajpaul, V.A., Asante, E.A., McDermott, C.L., 2020. From agroforestry to agroindustry: smallholder access to benefits from oil palm in Ghana and the implications for sustainability certification. Front. Sustain. Food Syst. 4. https://doi.org/10.3389/fsufs.2020.00029.
Koczberski, G., Curry, G.N., Bue, V., Germis, E., Nake, S., Tilden, G.M., 2018. Diffusing risk and building resilience through innovation: reciprocal exchange relationships, livelihood vulnerability and food security amongst smallholder farmers in Papua New Guinea. Hum. Ecol. 46 (6), 801–814. https://doi.org/10.1007/s10745-018-0032-9.
Krishna, V.V., Kubitza, C., 2021. Impact of oil palm expansion on the provision of private and community goods in rural Indonesia. Ecol. Econ. 179 (July 2020), 106829 https://doi.org/10.1016/j.ecolecon.2020.106829.
Krishna, V.V., Euler, M., Siregar, H., Qaim, M., 2017. Differential livelihood impacts of oil palm expansion in Indonesia. Agric. Econ. (U. Kingd.) 48 (5), 639–653. https://doi.org/10.1111/agec.12363.
Kubitza, C., Krishna, V.V., Alamsyah, Z., Qaim, M., 2018. The economics behind an ecological crisis: livelihood effects of oil palm expansion in Sumatra, Indonesia. Hum. Ecol. 46 (1), 107–116. https://doi.org/10.1007/s10745-017-9965-7.
Kunz, Y., Otten, F., Mardiana, R., Martens, K., Roedel, I., Faust, H., 2019. Smallholder telecoupling and climate governance in Jambi Province, Indonesia. Soc. Sci. 8 (4), 115. https://doi.org/10.3390/socsci8040115.
Langston, J.D., Riggs, R.A., Sururi, Y., Sunderland, T., Munawir, M., 2017. Estate crops more attractive than community forests in West Kalimantan, Indonesia. Land 6 (1). https://doi.org/10.3390/land6010012.
Lee, J.S.H., Abood, S., Ghazoul, J., Barus, B., Obidzinski, K., Koh, L.P., 2014. Environmental impacts of large-scale oil palm enterprises exceed that of smallholdings in Indonesia. Conserv. Lett. 7 (1), 25–33. https://doi.org/10.1111/conl.12039.
Lee, J.S.H., Ghazoul, J., Obidzinski, K., Koh, L.P., 2014. Oil palm smallholder yields and incomes constrained by harvesting practices and type of smallholder management in Indonesia. Agron. Sustain. Dev. 34 (2), 501–513. https://doi.org/10.1007/s13593-013-0159-4.
Li, T.M., 2015. Social impacts of oil palm in Indonesia: a gendered perspective from West Kalimantan. Soc. Impacts oil Palm. Indones.: A Gend. Perspect. West Kalimantan. https://doi.org/10.17528/cifor/005579.
Lister, J., Poulsen, R.T., Ponte, S., 2015. Orchestrating transnational environmental governance in maritime shipping. Glob. Environ. Change 34, 185–195. https://doi.org/10.1016/j.gloenvcha.2015.06.011.
Majid, N.A., Ramli, Z., Sum, S.M., Awang, A.H., 2021. Sustainable palm oil certification scheme frameworks and impacts: a systematic literature review. Sustain. (Switz.) 13 (6). https://doi.org/10.3390/su13063263.
Majid Cooke, F., 2012. In the name of poverty alleviation: experiments with oil palm smallholders and customary land in Sabah, Malaysia. Asia Pac. Viewp. 53 (3), 240–253. https://doi.org/10.1111/j.1467-8373.2012.01490.x.
Martens, K., Kunz, Y., Rosyani, I., Faust, H., 2020. Environmental governance meets reality: a micro-scale perspective on sustainability certification schemes for oil palm smallholders in Jambi, Sumatra. Soc. Nat. Resour. 33 (5), 634–650. https://doi.org/10.1080/08941920.2019.1674436.
Martin, S., Rieple, A., Chang, J., Boniface, B., Ahmed, A., 2015. Small farmers and sustainability: Institutional barriers to investment and innovation in the Malaysian palm oil industry in Sabah. J. Rural Stud. 40, 46–58. https://doi.org/10.1016/j.jrurstud.2015.06.002.

Meijaard, E., Sheil, D., 2019. The moral minefield of ethical oil palm and sustainable development. Front. For. Glob. Change 2. https://doi.org/10.3389/ffgc.2019.00022.
Meijaard, E., Brooks, T.M., Carlson, K.M., Slade, E.M., Garcia-Ulloa, J., Gaveau, D.L.A., Lee, J.S.H., Santika, T., Juffe-Bignoli, D., Struebig, M.J., Wich, S.A., Ancrenaz, M., Koh, L.P., Zamira, N., Abrams, J.F., Prins, H.H.T., Sendashonga, C.N., Murdiyarso, D., Furumo, P.R., Sheil, D., 2020. The environmental impacts of palm oil in context. Nat. Plants 6 (12), 1418–1426. https://doi.org/10.1038/s41477-020-00813-w.
Mertz, O., Egay, K., Bruun, T.B., Colding, T.S., 2013. The last swiddens of Sarawak, Malaysia. Hum. Ecol. 41 (1), 109–118. https://doi.org/10.1007/s10745-012-9559-3.
Nabara, S., Man, N., Kamarulzaman, N.H., Sulaiman, Z., 2020. Smallholder oil palm farmers' pro-adaptation behaviour under climate impact scenario: application of protection motivation theory. Clim. Dev. 0 (0), 1–9. https://doi.org/10.1080/17565529.2020.1801374.
Naylor, R.L., Higgins, M.M., Edwards, R.B., Falcon, W.P., 2019. Decentralization and the environment: assessing smallholder oil palm development in Indonesia. Ambio 48 (10), 1195–1208. https://doi.org/10.1007/s13280-018-1135-7.
Nchanji, Y.K., Nkongho, R.N., Mala, W.A., Levang, P., 2016. Efficacy of oil palm intercropping by smallholders. Case study in South-West Cameroon. Agrofor. Syst. 90 (3), 509–519. https://doi.org/10.1007/s10457-015-9873-z.
Neilson, J., 2019. Livelihood upgrading. In: Ponte, S., Gereffi, G., Raj-Reichert, G. (Eds.), Handbook on Global Value Chains. Edward Elgar Publishing, pp. 296–309.
Nesadurai, H.E.S., 2019. Transnational private governance as a developmental driver in Southeast Asia: the case of sustainable palm oil standards in Indonesia and Malaysia. J. Dev. Stud. 55 (9), 1892–1908. https://doi.org/10.1080/00220388.2018.1536262.
Obidzinski, K., Andriani, R., Komarudin, H., Andrianto, A., 2012. Environmental and social impacts of oil palm plantations and their implications for biofuel production in Indonesia. Ecol. Soc. 17 (1) https://doi.org/10.5751/ES-04775-170125.
Ordway, E.M., Naylor, R.L., Nkongho, R.N., Lambin, E.F., 2017. Oil palm expansion in Cameroon: insights into sustainability opportunities and challenges in Africa. Glob. Environ. Change 47, 190–200. https://doi.org/10.1016/j.gloenvcha.2017.10.009.
Ordway, E.M., Naylor, R.L., Nkongho, R.N., Lambin, E.F., 2019. Oil palm expansion and deforestation in Southwest Cameroon associated with proliferation of informal mills. Nat. Commun. 10 (1), 1–11. https://doi.org/10.1038/s41467-018-07915-2.
Ponte, S., 2019. Sustainability, global value chains and green capital accumulation. Handb. Glob. Value Chains 228–238. https://doi.org/10.4337/9781788113779.00020.
Ponte, S., 2020. The hidden costs of environmental upgrading in global value chains. Rev. Int. Political Econ. 1–26. https://doi.org/10.1080/09692290.2020.1816199.
Ponte, S., Ewert, J., 2009. Which way is "up" in upgrading? Trajectories of change in the value chain for South African wine. World Dev. 37 (10), 1637–1650. https://doi.org/10.1016/j.worlddev.2009.03.008.
Ponte, S., Gereffi, G., Raj-Reichert, G., 2019. Introduction to the Handbook on Global Value Chains. In: Ponte, S., Gereffi, G., Raj-Reichert, G. (Eds.), Handbook on Global Value Chains. Edward Elgar Publishing, pp. 1–27. https://doi.org/10.4337/9781788113779.00005.
Poulsen, R.T., Ponte, S., Sornn-Friese, H., 2018. Environmental upgrading in global value chains: the potential and limitations of ports in the greening of maritime transport. Geoforum 89, 83–95. https://doi.org/10.1016/j.geoforum.2018.01.011.
Purnomo, H., Okarda, B., Dermawan, A., Ilham, Q.P., Pacheco, P., Nurfatriani, F., Suhendang, E., 2020. Reconciling oil palm economic development and environmental conservation in Indonesia: a value chain dynamic approach. For. Policy Econ. 111, 102089 https://doi.org/10.1016/j.forpol.2020.102089.
Purwanto, E., Santoso, H., Jelsma, I., Widayati, A., Nugroho, H.Y.S.H., van Noordwijk, M., 2020. Agroforestry as policy option for forest-zone oil palm production in Indonesia. Land 9 (12), 1–34. https://doi.org/10.3390/land9120531.
Pye, O., 2019. Commodifying sustainability: development, nature and politics in the palm oil industry. World Dev. 121, 218–228. https://doi.org/10.1016/j.worlddev.2018.02.014.
Pye, O., Bhattacharya, J., 2012. The palm oil controversy in Southeast Asia: A transnational perspective. ISEAS Publishing,.
Qaim, M., Sibhatu, K.T., Siregar, H., Grass, I., 2020. Environmental, economic, and social consequences of the oil palm boom. Annu. Rev. Resour. Econ. 12, 321–344. https://doi.org/10.1146/annurev-resource-110119-024922.
Raharja, S., Marimin, Machfud, Papilo, P., Safriyana, Massijaya, M.Y.Y., Asrol, M., Darmawan, M.A.A., 2020. Institutional strengthening model of oil palm independent smallholder in Riau and Jambi Provinces, Indonesia. Heliyon 6 (5). https://doi.org/10.1016/j.heliyon.2020.e03875.
Rahman, N., Giller, K.E., de Neergaard, A., Magid, J., van de Ven, G., Bruun, T.B., 2021. The effects of management practices on soil organic carbon stocks of oil palm plantations in Sumatra, Indonesia. J. Environ. Manag. 278. https://doi.org/10.1016/j.jenvman.2020.111446.
Razak, S.A., Saadun, N., Azhar, B., Lindenmayer, D.B., 2020. Smallholdings with high oil palm yield also support high bird species richness and diverse feeding guilds. Environ. Res. Lett. 15 (9), 094031 https://doi.org/10.1088/1748-9326/aba2a5.
Rhebergen, T., Fairhurst, T., Whitbread, A., Giller, K.E.K.E., Zingore, S., 2018. Yield gap analysis and entry points for improving productivity on large oil palm plantations and smallholder farms in Ghana. Agric. Syst. 165, 14–25. https://doi.org/10.1016/j.agsy.2018.05.012.
Rhebergen, T., Zingore, S., Giller, K.E.K.E.K.E., Frimpong, C.A., Acheampong, K., Ohipeni, F.T.F.T., Panyin, E.K.E.K., Zutah, V., Fairhurst, T., 2020. Closing yield gaps in oil palm production systems in Ghana through best management practices. Eur. J. Agron. 115, 126011 https://doi.org/10.1016/j.eja.2020.126011.
Rietberg, P., Slingerland, M., 2016. Costs and benefits of RSPO certification for independent smallholders. A Sci. –Policy Pap. Rspo. Wagening. Univ.
Rist, L., Feintrenie, L., Levang, P., 2010. The livelihood impacts of oil palm: Smallholders in Indonesia. Biodivers. Conserv. 19 (4), 1009–1024. https://doi.org/10.1007/s10531-010-9815-z.
Rival, A., Levang, P., 2014. Palms of controversies: Oil palm and development challenges. Center for International Forestry Research (CIFOR) https://doi.org/10.17528/cifor/004860.
Rodthong, W., Kuwornu, J.K.M., Datta, A., Anal, A.K., Tsusaka, T.W., 2020. Factors influencing the intensity of adoption of the Roundtable on Sustainable Palm Oil practices by smallholder farmers in Thailand. Environ. Manag. 66 (3), 377–394. https://doi.org/10.1007/s00267-020-01323-3.
RSPO. (2021b). RSPO Website. https://rspo.org/.
RSPO, 2019. RSPO Independent Smallholder Standard for the Production of Sustainable Palm Oil. ⟨https://rspo.org/library/lib_files/preview/1127⟩.
RSPO, 2021a. Jurisd. Approach. ⟨https://www.rspo.org/resources/certification/jurisdictional-approach⟩.
Rudolf, K., Romero, M., Asnawi, R., Irawan, B., Wollni, M., 2020. Effects of information and seedling provision on tree planting and survival in smallholder oil palm plantations. J. Environ. Econ. Manag. 104, 102361 https://doi.org/10.1016/j.jeem.2020.102361.
Saadun, N., Lim, E.A.L., Esa, S.M., Ngu, F., Awang, F., Gimin, A., Johari, I.H., Firdaus, M. A., Wagimin, N.I., Azhar, B., 2018. Socio-ecological perspectives of engaging smallholders in environmental-friendly palm oil certification schemes, 333–3340 Land Use Policy 72 (December 2017). https://doi.org/10.1016/j.landusepol.2017.12.057.
Santika, T., Meijaard, E., Budiharta, S., Law, E.A., Kusworo, A., Hutabarat, J.A., Indrawan, T.P., Struebig, M., Raharjo, S., Huda, I., Sulhani, Ekaputri, A.D., Trison, S., Stigner, M., Wilson, K.A., 2017. Community forest management in Indonesia: Avoided deforestation in the context of anthropogenic and climate complexities. Glob. Environ. Change 46 (August), 60–71. https://doi.org/10.1016/j.gloenvcha.2017.08.002.
Santika, T., Wilson, K.A., Budiharta, S., Kusworo, A., Meijaard, E., Law, E.A., Friedman, R., Hutabarat, J.A., Indrawan St., T.P., John, F.A.V., Struebig, M.J., 2019. Heterogeneous impacts of community forestry on forest conservation and poverty alleviation: Evidence from Indonesia. People Nat. 1 (2), 204–219. https://doi.org/10.1002/pan3.25.
Santika, T., Wilson, K.A., Budiharta, S., Law, E.A., Poh, T.M., Ancrenaz, M., Struebig, M. J., Meijaard, E., 2019. Does oil palm agriculture help alleviate poverty? A multidimensional counterfactual assessment of oil palm development in Indonesia. World Dev. 120, 105–117. https://doi.org/10.1016/j.worlddev.2019.04.012.
Santika, T., Wilson, K.A., Law St, E.A., John, F.A.V., Carlson, K.M., Gibbs, H., Morgans, C. L., Ancrenaz, M., Meijaard, E., Struebig, M.J., 2020. Impact of palm oil sustainability certification on village well-being and poverty in Indonesia. Nat. Sustain. 1, 0–24. https://doi.org/10.1038/s41893-020-00630-1.
Schmidt, J., De Rosa, M., 2020. Certified palm oil reduces greenhouse gas emissions compared to non-certified. J. Clean. Prod. 277, 124045 https://doi.org/10.1016/j.jclepro.2020.124045.
Schmitz, H., 2006. Learning and earning in global garment and footwear chains. Eur. J. Dev. Res. 18 (4), 546–571. https://doi.org/10.1080/09578810601070688.
Schoneveld, G.C., Ekowati, D., Andrianto, A., Van Der Haar, S., 2019. Modeling peat- and forestland conversion by oil palm smallholders in Indonesian Borneo. Environ. Res. Lett. 14 (1) https://doi.org/10.1088/1748-9326/aaf044.
Schoneveld, G.C., van der Haar, S., Ekowati, D., Andrianto, A., Komarudin, H., Okarda, B., Jelsma, I., Pacheco, P., 2019. Certification, good agricultural practice and smallholder heterogeneity: Differentiated pathways for resolving compliance gaps in the Indonesian oil palm sector. Glob. Environ. Change 57 (July), 101933. https://doi.org/10.1016/j.gloenvcha.2019.101933.
Sheng Tey, Y., Brindal, M., Djama, M., Hanis, A., Abdul, I., 2021. A review of the financial costs and benefits of the Roundtable on Sustainable Palm Oil certification: Implications for future research. Sustain. Prod. Consum. 26, 824–837. https://doi.org/10.1016/j.spc.2020.12.040.
Shuhada, S.N., Salim, S., Nobilly, F., Lechner, A.M., Azhar, B., 2020. Conversion of peat swamp forest to oil palm cultivation reduces the diversity and abundance of macrofungi. Glob. Ecol. Conserv. 23, e01122 https://doi.org/10.1016/j.gecco.2020.e01122.
M. Slingerland Is RSPO certification having an impact on smallholders ' decisions to expand or intensify production? 2018. http://www.sensorproject.net/wp-content/uploads/2018/05/SEnSOR-Smallholder-intensification-v-expansion_Final.pdf.
Soda, R., Kato, Y., Hon, J., 2016. The diversity of small-scale oil palm cultivation in Sarawak, Malaysia. Geogr. J. 182 (4), 353–363. https://doi.org/10.1111/geoj.12152.
Soliman, T., Lim, F.K.S.K.S., Lee, J.S.H.S.H., Carrasco, L.R.R., 2016. Closing oil palm yield gaps among Indonesian smallholders through industry schemes, pruning, weeding and improved seeds. R. Soc. Open Sci. 3 (8) https://doi.org/10.1098/rsos.160292.
Syafiq, M., Nur Atiqah, A.R., Ghazali, A., Asmah, S., Yahya, M.S., Aziz, N., Puan, C.L., Azhar, B., 2016. Responses of tropical fruit bats to monoculture and polyculture farming in oil palm smallholdings. Acta Oecologica 74, 11–18. https://doi.org/10.1016/j.actao.2016.06.005.
Tan, K.T., Lee, K.T., Mohamed, A.R., Bhatia, S., 2009. Palm oil: Addressing issues and towards sustainable development. Renew. Sustain. Energy Rev. 13 (2), 420–427. https://doi.org/10.1016/j.rser.2007.10.001.
Tapia, J.F.D., Doliente, S.S., Samsatli, S., 2021. How much land is available for sustainable palm oil. Land Use Policy 102 (November 2020), 105187. https://doi.org/10.1016/j.landusepol.2020.105187.

Tee, S.L., Solihhin, A., Juffiry, S.A., Rinalfi Putra, T., Lechner, A.M., Azhar, B., 2019. The effect of oil palm agricultural expansion on group size of long-tailed macaques (Macaca fascicularis) in Peninsular Malaysia. Mamm. Biol. 94, 48–53. https://doi.org/10.1016/j.mambio.2018.12.006.

Teuscher, M., Vorlaufer, M., Wollni, M., Brose, U., Mulyani, Y., Clough, Y., 2015. Trade-offs between bird diversity and abundance, yields and revenue in smallholder oil palm plantations in Sumatra, Indonesia. Biol. Conserv. 186, 306–318. https://doi.org/10.1016/j.biocon.2015.03.022.

The World Bank Group framework and IFC strategy for engagement in the palm oil sector 2011. https://www.ifc.org/wps/wcm/connect/d876e1ef-6fba-44cc-a1fa-1af450ff3c5c/WBG+Framework+and+IFC+Strategy_FINAL_FOR+WEB.pdf?MOD=AJPERES&CVID=lcUFZxb.

Uckert, G., Hoffmann, H., Graef, F., Grundmann, P., Sieber, S., 2015. Increase without spatial extension: productivity in small-scale palm oil production in Africa—the case of Kigoma, Tanzania. Reg. Environ. Change 15 (7), 1229–1241. https://doi.org/10.1007/s10113-015-0798-x.

US Department of Agriculture. (2022). Oilseeds: World Markets and Trade. April. https://apps.fas.usda.gov/psdonline/circulars/oilseeds.pdf.

Vijay, V., Pimm, S.L., Jenkins, C.N., Smith, S.J., 2016. The impacts of oil palm on recent deforestation and biodiversity loss. PLoS ONE 11 (7). https://doi.org/10.1371/journal.pone.0159668.

Voora, V., Larrea, C., Bermudez, S., & Balino, S. (2019). Global Market Report: Palm Oil. https://www.iisd.org/system/files/publications/ssi-global-market-report-palm-oil.pdf.

Woittiez, L.S., van Wijk, M.T., Slingerland, M., van Noordwijk, M., Giller, K.E., 2017. Yield gaps in oil palm: a quantitative review of contributing factors. Eur. J. Agron. 83, 57–77. https://doi.org/10.1016/j.eja.2016.11.002.

Woittiez, L.S., Turhina, S.R.I., Deccy, D., Slingerland, M., Van Noordwijk, M., Giller, K.E. N.E., 2019. Fertiliser application practices and nutrient deficiencies in smallholder oil palm plantations in Indonesia. Exp. Agric. 55 (4), 543–559. https://doi.org/10.1017/S0014479718000182.

Yahya, M.S., Syafiq, M., Ashton-Butt, A., Ghazali, A., Asmah, S., Azhar, B., 2017. Switching from monoculture to polyculture farming benefits birds in oil palm production landscapes: Evidence from mist netting data. Ecol. Evol. 7 (16), 6314–6325. https://doi.org/10.1002/ece3.3205.