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# PUBLIC ENGAGEMENT PROMOTES CONSUMER CHOICE IN FAVOUR OF SUSTAINABLE PALM OIL

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**ABSTRACT**

*Despite the superior productivity, utility and economic benefits of palm oil compared with other oil crops, the palm oil industry often receives negative publicity for its environmental impact and there is widespread confusion over the perception of palm oil. The fact is that it is difficult to avoid palm oil consumption, and consumer boycotts will do little to resolve the social and environmental issues associated with oil palm agriculture. Instead, greater awareness of the importance of certified sustainable palm oil (CSPO) is needed. We used a mixed-methods survey to explore public awareness of palm oil, and understand the factors influencing sustainable consumer choice. Our survey, conducted in the Rainforest Biome of the world-renowned Eden Project in the United Kingdom, a nation with relatively high environmental awareness, revealed that public awareness of palm oil was generally low and that consumers had poor knowledge of CSPO. We identified that the most significant barriers preventing consumer choice for CSPO products were unclear labelling, product availability and cost. We recommend that the palm oil industry focus on enhancing sustainability, promoting the benefits and increasing the visibility of CSPO in supply chains and final products, rather than waiting for consumer choice alone to drive change.*

**Keywords:** consumer habits, oil palm, public awareness, public perception, sustainability.

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## INTRODUCTION

We are living through the sixth mass extinction and human activities are destroying biodiversity at a rate significant enough for the Anthropocene to have been named after us (Pievani, 2014). Highly respected global institutions such as the United Nations (UN) and the European Parliament have declared a Climate and Ecological Emergency (European Parliament, 2019; UN Environment Programme, 2021), with public belief in the climate emergency at 81% in the United Kingdom (UK) (Flynn *et al.*, 2021). The rapid expansion of the palm oil industry has had major negative consequences for the environment, yet the industry supports the livelihoods of millions of people globally (Padfield *et al.*, 2019). To resolve this palm oil paradox, the industry must adopt and develop sustainable practices underpinning the protection of land for biodiversity, ecosystem function, carbon capture and future crop production (Corciolani *et al.*, 2019; Meijaard *et al.*, 2018).

For more than two decades academic research has considered the impact and opportunities of the palm oil industry (Padfield *et al.*, 2019), yet the

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public's perception of palm oil has been influenced largely by the media (Jackson *et al.*, 2019; Yan, 2017). In 2018, the Christmas advertisement of a UK-based supermarket chain was not approved for broadcast by the non-governmental organisation (NGO) Clearcast because it was deemed too political. The advertisement, originally produced by Greenpeace, featured an animated orangutan (*Pongo* spp.) named 'Rang-tan' and the impact of oil palm expansion on its rainforest habitat. The supermarket chain had intended to use the advertisement to promote their decision to remove palm oil and its derivatives from their own-brand products. The embargo generated major publicity and discussion on social media, as well as a petition against Clearcast's decision (Mundy, 2018a). The negative response was such that Clearcast took steps to protect its staff from the backlash, including permanent removal of some social media presence (Mundy, 2018b). Celebrities and politicians used their social media platforms to call attention to palm oil and the retailer's boycott of its use (Sweney, 2018). In the week following the release of the controversial 'Rang-tan' advert (11-17 November 2018) input of the search terms 'palm oil' and 'sustainable palm oil' into the Google Search engine peaked in the UK. However, for every 100 searches using the term 'palm oil', there were just six for 'sustainable palm oil' (data extracted using Google Trends), suggesting that the spark in media attention did little to raise public awareness of sustainable palm oil, as Greenpeace had originally intended (Greenpeace, 2020).

A major challenge for producers is the perception that palm oil is an 'environmentally damaging' source of vegetable oil (Borrello *et al.*, 2019; Guadalupe *et al.*, 2019; Ostfeld *et al.*, 2019). More than 85% of the world's palm oil is produced in Indonesia and Malaysia; the industry's expansion in these countries has caused irreparable damage to Southeast Asia's primary tropical rainforest through habitat clearance (Murphy, 2014), and has reduced their carbon storage potential (Guillaume *et al.*, 2018). As production continues to expand in regions of Africa and South America we are likely to see further environmental damage (Ocampo-Peñuela *et al.*, 2018), with further loss in forest cover destroying biodiversity and undermining our ability to mitigate climate change (Guillaume *et al.*, 2018).

Oil palm expansion undoubtedly threatens biodiversity, but it has not been the sole driver of biodiversity loss in the tropics (Myzabella *et al.*, 2019; Russell, 2018). For example, fibre plantations for pulp and paper production, illegal logging and hunting have all contributed to habitat and species decline (Abood *et al.*, 2015; Jackson *et al.*, 2019; Meijaard *et al.*, 2011; Sodhi *et al.*, 2004). Similarly, the production of palm oil alternatives, which have lower yields per unit area, can be more environmentally damaging than that of palm oil (Foster *et al.*, 2011; Parsons *et al.*, 2020). Shifts in consumer choice to palm oil alternatives would therefore not necessitate a better outcome for biodiversity (Foster *et al.*, 2011; Jackson *et al.*, 2019; Meijaard *et al.*, 2018). Moreover, consumer boycotts of palm oil can have significant negative socioeconomic impacts in palm oil producing regions including the loss of employment and out-competition of smallholders by larger concessions (Lee *et al.*, 2014).

Communication campaigns and customer purchasing decisions frequently favour products which are branded 'palm oil free', and perceived as healthier, more sustainable options compared with those containing palm oil (Borrello *et al.*, 2019; Guadalupe *et al.*, 2019). However, this is not necessarily the case (Jackson *et al.*, 2019), and puts pressure on the consumer to read product labels in order to detect palm oil and its derivatives. This approach assumes a high level of awareness and time on behalf of the consumer, and also depends on the availability of products. Whilst it is possible for consumers to identify and purchase products containing certified sustainable palm oil (CSPO), cost is likely to be a barrier preventing the purchase of CSPO or palm oil-free products given that they are often more expensive (Ostfeld *et al.*, 2019).

There is evidently some way to go before the palm oil paradox is resolved, but the industry has taken major steps to develop a code of conduct under the Roundtable on Sustainable Palm Oil (RSPO) (Jackson *et al.*, 2019). The RSPO aims to establish a globally sustainable palm oil industry, currently certifying ~20% of annually produced palm oil as sustainable (RSPO, 2018a). Alongside stakeholders in the palm oil industry, the RSPO develops and implements standards for sustainable production based on ethical, transparent and legal operations, respect for human rights, support for smallholders, optimisation of productivity, efficiency, positive impacts and resilience and protection, conservation and enhancement of ecosystems and the environment (RSPO, 2018b). For example, Sime Darby, an RSPO founding-member company, cancelled planned oil palm plantations in Cameroon as establishment would have necessitated destruction of existing forest (Feintrenie, 2014).

While the majority of sustainable palm oil comes from Southeast Asia, RSPO certification is on the rise in both South America and West Africa (RSPO, 2018a). Jackson *et al.* (2019) surmised that palm oil could become the most environmentally, socially and economically sustainable vegetable oil source through adherence to the RSPO principles

and criteria. Given the potential of a globally sustainable palm oil industry, it is essential that we develop our understanding of the impact that palm oil research has on members of the public, particularly in those nations where palm oil is produced and where it is consumed. The reaction to 'Rang-tan' demonstrated how quickly an environmental campaign, intended to raise awareness of unsustainable agro-practices, can be 'hijacked' by misinformation and bias. However, impacts and opportunities for the sustainable production of oil palm vary by biogeographical region, and this requires clear communication to the public. A study by Reardon *et al.* (2019) found that consumer views of palm oil are shaped by location and can be impacted by campaigns and flows of information on palm oil. We therefore set out to establish, by way of introduction, which countries generate the most oil palm publications, before asking which research themes contribute most to those publications. We then ask, what is the level of public knowledge of palm oil in a typical consumer country, and how can consumers be encouraged to embrace sustainable palm oil?

## MATERIALS AND METHODS

### Literature Search, Selection Criteria and Data Acquisition

Google Scholar's global database was searched in November 2019 for original peer-reviewed research, review papers and scientific reports (excluding patents and citations) using the search term ('palm oil' or 'oil palm'). We confined the search dates between 2000, the year in which Myers *et al.* (2000) identified biodiversity 'hotspots' threatened by severe habitat loss and exploitation, and 2018, the last full year of data available at the time of searching. Cited more than 12 000 times, Myers *et al.* (2000) were the first to associate deforestation and biodiversity losses with agricultural expansion in the tropics. Our search returned 17 900 publications and consistent with Padfield *et al.* (2019), we found a near exponential increase in the number of publications per year containing the terms 'palm oil' or 'oil palm'.

To address Question 1, we randomly selected a subset of 200 publications from Google Scholar. This gave a reasonable sample size, whilst providing good resolution for analysis. We assigned each publication to a biogeographical region based on the locality of the research. These regions, all key areas of oil palm cultivation and palm oil production, were Southeast Asia, South America, Africa or Global (where the publication took a global perspective rather than being region specific). To answer Question 2, keywords were extracted from the publications and used to align each publication to one of seven research impact themes: (1) Greenhouse Gas (GHG) Emissions, (2) Biodiversity, (3) Improving Sustainability, (4) Biofuels, (5) Working Conditions and Livelihoods, (6) Production Methods and Global Trends, and (7) Deforestation. Previous work has also identified these as key themes within oil palm literature (Sheil *et al.*, 2009).

### Questionnaires at the Eden Project

To address Questions 3 and 4 we performed a mixed-methods cross-sectional survey at the Eden Project. This visitor attraction, educational charity and social enterprise is located in the Southwest of England (Eden Project, 2019). Over one million people visit the Eden Project annually (Eden Project, 2018), with peak visitor flow in July and August. The visitors include education groups, local residents and tourists; 90% of visitors are from the UK, with 75% visiting while on holiday (Eden Project, 2019). During schooling periods, adult visitors predominate alongside formal education school groups, whereas families with children predominate during school holidays (Elworthy, 2016).

The Eden Project's main attraction is the Rainforest Biome, which houses the world's largest indoor tropical rainforest. It was at the centre of this indoor rainforest that we designed and built an exhibit on the story of oil palm and palm oil. Our exhibit comprises several full-size oil palms with information displaying the story of the production, impact, opportunities and sustainability of palm oil (*Figure 1*). The exhibit, which also features the RSPO logo, is in the tropical crops section of the Rainforest Biome and all visitors have to pass this section of the visitor attraction (although they do not have to read the exhibition materials). Using a convenience sampling approach, we handed questionnaires to members of the public as they passed the palm oil exhibition. A researcher handed out the paper questionnaires to consenting participants in July and August 2018. Due to high temperatures in the Rainforest Biome, the questionnaire was designed to take a maximum of 5 min to complete. As no personal data were collected, participation and the return of a completed questionnaire indicated consent for data collection. The questionnaire included open and closed questions about self-rated knowledge of palm oil, awareness of the RSPO logo, awareness of products containing palm oil, and attitudes towards sustainable palm oil consumption. Critically, we collected our data before the surge of negative attention engulfed palm oil in November 2018 following the UK supermarket chain advertisement (Sweney, 2018).

*Figure 1. Collage of images from the oil palm exhibit (image credit: Eden Project).*

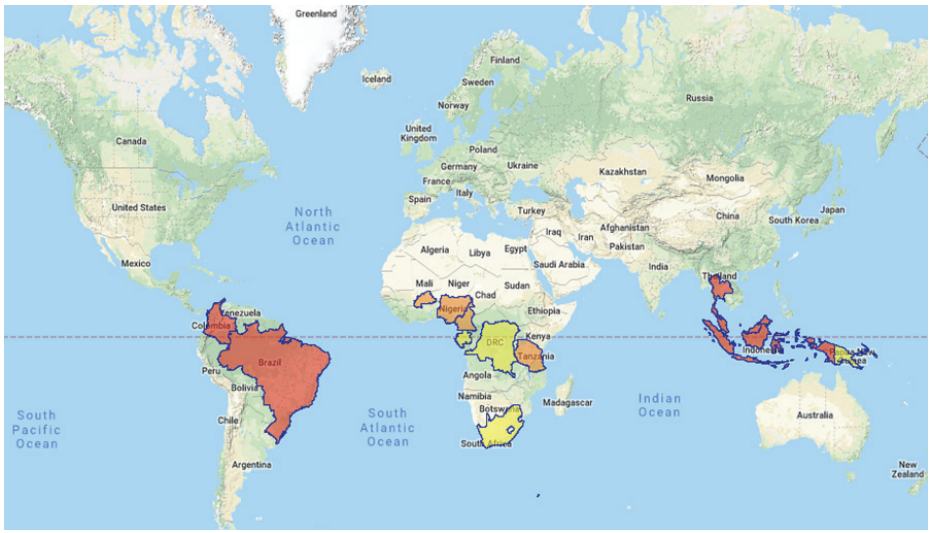


*Figure 2. Map of publications by region. Red > 15 publications; Amber 5-15 publications; Green < 5 publications of our subset of 200 publications.*

### Statistical Analysis

After testing data for normality, we used one sample Chi-Square ($\chi^2$) tests to assess the distribution of (a) the total number of publications by region ($n$=200 for all samples across Southeast Asia, South America, Africa or Global), and (b) publications by research theme. To assess the distribution of research themes within each of the different equatorial regions we used Chi-Square tests of independence ($\chi^2$). All data collected from the Eden Project were transcribed from the questionnaire into Excel v10. A Wilcoxon signed rank test ($Z$) was used to compare pre- and post-exhibition self-rated knowledge of palm oil. A Spearman correlation ($r_s$) was used to quantify the relationship between self-rated knowledge and awareness of palm oil's use in consumable products, and a Mann-Whitney $U$ test was used to assess awareness of the RSPO logo based on self-rated knowledge. Content analysis based on qualitative responses was used to identify the key factors that would encourage consumers to purchase CSPO products. All statistical analyses were performed in IBM SPSS Statistics for Windows, Version 25.0 (IBM Corp. Armonk, New York, USA).

## RESULTS

### Question 1. Which Countries Generate the Most Oil Palm Publications?

Within the randomly selected subset of publications ($n$=200), oil palm was the subject of a significantly higher number of publications in Southeast Asia ($n$=88) and Global ($n$=75) than in South America ($n$=19) and Africa ($n$=18) ($\chi^2$=81.1, df=3, $p$<0.01, *Figure 2*).

**Question 2. Which Research Themes Contribute Most to Those Publications?**

Key research themes were not distributed equally, with significantly more publications falling into 'Production methods and global trends' ($n$=49) and 'Working conditions and livelihood' ($n$=46) than would be expected for an equal distribution (25-30 publications per theme) ($\chi^2$=46.12, df=6, $p$<0.01; *Figure 3*). Conversely, 'GHG emissions' ($n$=14) and 'Deforestation' ($n$=10) had significantly fewer (*Figure 3*). The under-representation of these themes was also apparent in the distribution of publications by research theme within the four geographical regions, where distribution was also significantly uneven ($\chi^2$=0.008, df=18, $p$<0.05).

**Question 3. What is the Level of Knowledge of Palm Oil in a Typical Consumer Country?**

We collected data from 397 respondents (89% between the ages of 25-64 years old) in July and August 2018. The respondents assigned quantitative values to their knowledge of palm oil from a pre- ($n$=395) and post-exhibition ($n$=375) perspective (no knowledge = 0, some knowledge = 1, good knowledge =2, expert knowledge =3). Respondents generally rated their pre-exhibition knowledge of palm oil as poor, with a mean 'knowledge value' of 0.95 ± 0.03. However, visiting the palm oil exhibition increased this to 1.83 ± 0.02, a significant positive impact ($Z$=-16.13, $p$<0.001). *Figure 4* highlights this increase in cohort knowledge and shows that all respondents felt they had at least some knowledge of palm oil after visiting the exhibition. Complementary to this assessment, we asked respondents to indicate, from a list of commercially available products, which items they were unaware contained palm oil prior to their visit. The greatest 'unknowns' were toothpaste, bread, detergent and shampoo (*Figure 5*). When asked if they were aware of RSPO certification before their visit to the Eden Project, more than 90% ($n$=387) of respondents reported that they were not (*Figure 6*). Even after passing through the exhibit containing the RSPO logo, more than 80% of respondents ($n$=361) were unable to name the RSPO when their logo's identifying text was removed (*Figure 6*).

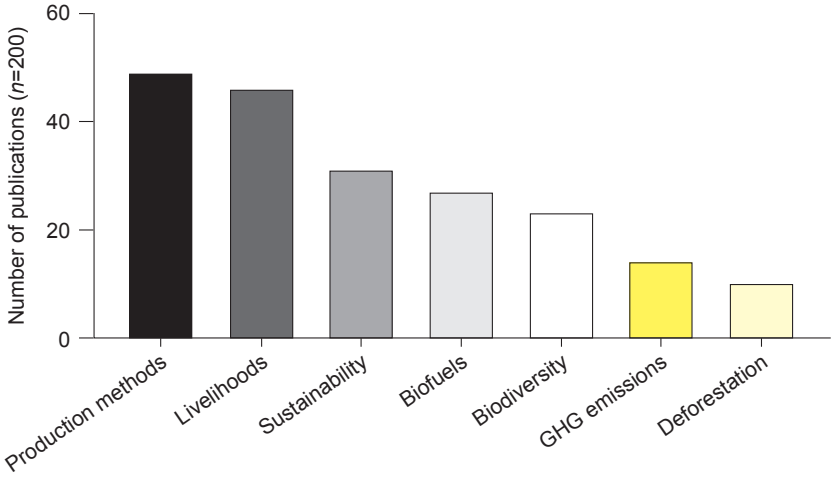


*Figure 3. Distribution of publications across key research themes.*

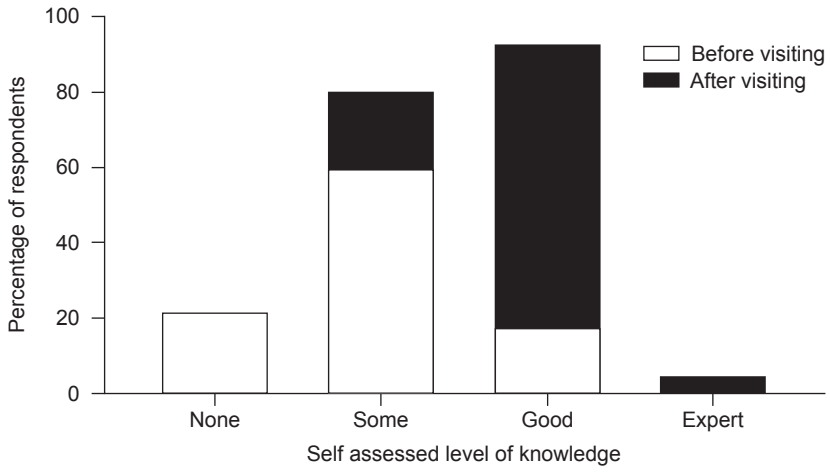


*Figure 4. Change in knowledge of respondents by visiting palm oil exhibit.*


*Figure 5. Percentage of participants that were unaware that the product shown contained palm oil.*

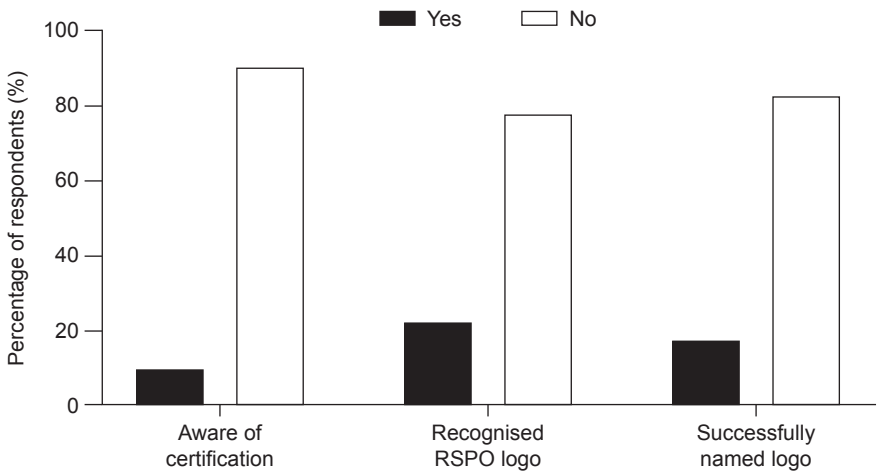


*Figure 6. Percentage of participants that (a) were aware of oil palm certification, (b) claimed to recognise the RSPO logo with its text removed, and (c) successfully named the RSPO logo.*

To gauge the accuracy of the respondents' self-assessment of their knowledge of palm oil, we compared their self-rated pre-exhibition knowledge with their pre-exhibition awareness of products containing palm oil. If their self-assessed knowledge was reasonably accurate, we would expect to see a negative correlation between their self-rated knowledge level, on a scale of 0-3, and the number of products that they were unaware contained palm oil. Indeed, we found a significant negative correlation ($r_s$=-0.371, $p$<0.01), indicating reasonable efficacy of respondents' self-assessment of their pre-visit knowledge levels. Similarly, respondents who rated their pre-visit knowledge as 'good' were found to be significantly more aware of the RSPO logo than those with 'some' knowledge ($U$=6854, $p$=0.002, *Figure 7*).

However, respondents' pre-visit knowledge of palm oil did not clearly align with pre-visit awareness of RSPO certification. One respondent, who reported 'expert' level pre-visit knowledge of palm oil, was not aware of RSPO certification,

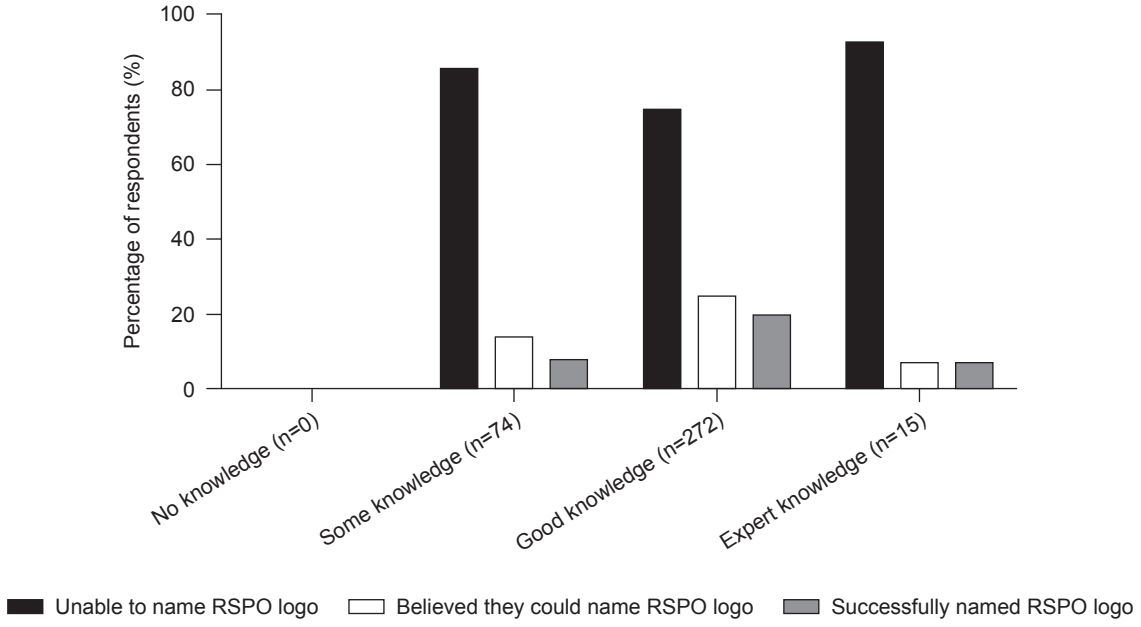


*Figure 7. Percentage of participants and response to logo after engagement with the palm oil exhibit.*

while ~4% of respondents who claimed to have 'no knowledge' of palm oil, reported that they were aware of RSPO certification. Generally, respondents performed poorly when asked to identify the RSPO logo (*Figure 7*). Only 21% and 7% of respondents who rated their post-visit knowledge as 'good' and 'expert' respectively were able to correctly name the RSPO logo, despite having some pre-existing awareness of CSPO and having just visited an exhibition that featured the RSPO logo.

**Question 4. How Can Consumers Be Encouraged to Embrace Sustainable Palm Oil?**

After visiting the Eden Project's palm oil exhibition, 78% of respondents reported that they were more likely or much more likely to buy CSPO products. Respondents identified that the most important factors that would encourage them to buy products containing CSPO were: (1) protection of primary rainforest (65.0%); (2) ensuring workers get a fair price for the palm oil they sell (25.0%); and (3) improving biodiversity on plantations (9.0%). Less than 1% of respondents stated that they 'would not buy a product containing CSPO' (0.3%) ($n$=312). We also assessed what factors may be preventing respondents from purchasing CSPO products and found: (1) unclear labelling (33%), (2) availability of products (24%), and (3) cost (23%) to be the most significant barriers ($n$=312). Upon completion of the survey, respondents were asked to 'tell us one fact about palm oil that you learnt from your visit today'. Content analysis of the responses ($n$=332) produced 409 individual items which were assigned across five categories: (1) the pervasiveness of palm oil ($n$=125, 31.0%); (2) purchasing/consumption and awareness of sustainable palm oil ($n$=122, 30.0%); (3) biodiversity/environmental issues ($n$=86, 21.0%); (4) production and yield ($n$=74, 18.0%) and (5) other ($n$=2, 0.5%).

## DISCUSSION

Our aim was to explore public awareness of palm oil and RSPO certification and to understand how the palm oil industry can assist consumers in making informed and sustainable choices. This is important, as gaining a better understanding of how to harness consumer purchasing power will be key to driving sustainability further up the global agenda. In line with Padfield *et al*. (2019), we found that the number of peer-reviewed palm oil related publications has increased almost exponentially since the year 2000. With the majority of these publications focussed on Southeast Asia, comparatively few focused on oil palm agriculture in Africa and South America. This is perhaps not surprising given that Southeast Asia's commercial oil palm cultivation boom began shortly after Malaysia's independence more than 60 years ago (Murphy, 2014), whereas oil palm expansion in other regions has largely taken place since 2000 (Carrere, 2013; Pardo Vargas *et al*., 2015). Thus, the disparity in the number of palm oil publications across production regions that we observed was likely a fair representation of the distribution of global palm oil research within the academic literature. While research conducted in Southeast Asia has been largely reactive to oil palm expansion and its impacts, the likely gaps in

knowledge arising from the gap in research from other growing regions present an opportunity for proactive research and clear communication of the benefits of sustainable palm oil. By applying knowledge gained through oil palm development in Southeast Asia to other growing regions in West Africa and South America, the global palm oil industry could vastly improve its sustainability. The reaction to the 'Rang-tan' campaign demonstrates how public outrage at unsustainable agro-practices can spur consumer boycotting, but it also highlights the power of campaigning through storytelling. For example, in order to address the negative association between palm oil and the decline of the orangutan, there is an urgent need to deliver positive stories from Southeast Asia. Furthermore, communication of positive and innovative research in areas of new development, where there is still significant opportunity to develop truly sustainable palm oil practices, is of the utmost importance. For example, a recent study in Colombia showed that where oil palm plantations replaced pasture, carbon losses were reduced by 99.7 ± 9.6% when compared to rainforest conversion (Quezada *et al.*, 2019), thereby increasing the carbon sequestration potential of the landscape and sparing endemic-species-rich forest ecosystems (Ocampo-Peñuela *et al.*, 2018; Prescott *et al.*, 2016).

Publications were assigned to research categories using a 'best-fit' method; much of the research categorised showed some overlap between definitive themes. These overlaps were most common for ecological and environmental categories where, for example, it would have been feasible to assign a publication to either the Deforestation or Biodiversity category. Nevertheless, we found ecological and environmental research (*i.e.*, Biodiversity, Deforestation and GHG emissions) to be under-represented in the literature compared with publications that considered the social (*i.e.*, working conditions and livelihoods) and economic (*i.e.*, production methods and global trends) impacts and opportunities of oil palm. This suggests that more oil palm research has been conducted from an anthropocentric, rather than an ecocentric perspective. Padfield *et al.* (2019) made similar observations, and noted that peer-reviewed articles containing the terms 'palm oil' or 'oil palm' were heavily weighted towards engineering and biofuel topics. Topics such as land use change and biodiversity were far less common. Although landmark publications such as Myers *et al.* (2000) have highlighted the ecological consequences of intense anthropogenic activity, oil palm expansion has continued to drive deforestation and losses to biodiversity (Wilcove *et al.*, 2013). Disparities in the distribution of publications by research theme may indicate that the ecological and environmental impacts of the palm oil industry are less of a research priority than social and economic impacts. However, given that research is underpinned by funding availability, this could also suggest that funding, and especially industrial funding, favours socio-economic (*i.e.*, anthropocentric) over ecological and environmental (*i.e.*, ecocentric) research. This is concerning because as production expands in South America and Africa, where much of the population lives below the poverty line (World Bank, 2019), socio-economic research and development is likely to be prioritised over that of conservation (Billé *et al.*, 2012).

Our study, in line with previous work by Padfield *et al.* (2019), revealed a substantial volume of research into palm oil sustainability. Whilst this may highlight an historical disregard of sustainability (Morgans *et al.*, 2018), it is potentially indicative of a shift in the industry's priorities in favour of sustainable development (Padfield *et al.*, 2019). This is evidenced by the fact that a non-trivial component (~20%) of palm oil produced globally is now certified by the RSPO (Roundtable on Sustainable Palm Oil, 2018a). However, negative media attention and product boycotting have often drawn attention away from the benefits of CSPO and efforts to promote its production (Jackson *et al.* 2019; Laurance *et al.*, 2010). For this reason, we designed the palm oil exhibition in the Rainforest Biome at the Eden Project to provide the public with a balanced narrative of the scientific evidence on oil palm agriculture.

Our survey at the Eden Project provided a good insight into the public's awareness of palm oil before the 'Rang-tan' advertising campaign went viral, and an opportunity to understand the effectiveness of the exhibition as a platform for public engagement of a complex socio-economic and environmental issue. Our results indicated that engagement with the exhibit content had a significant and positive impact on respondents' knowledge of palm oil and its products. Participants generally had poor knowledge of palm oil and its use in consumer products, with less than 20% of respondents reporting to have had a 'good knowledge' of palm oil before visiting the exhibition (*Figure* 4). This demonstrates that despite an exponential increase in palm oil research, a disconnect remains between academic research and public awareness of palm oil. Thus, exhibitions such as ours at the Eden Project will become an increasingly important tool for addressing the challenge of convincing consumers to buy CSPO (Laurance *et al.*, 2010). Awareness of palm oil in consumer products varied by product type, and we found that respondents were most likely to be unaware that personal care and household products such as toothpaste (70% unaware) and laundry detergent (53% unaware) contained palm oil. Consumers were far less likely to be unaware of palm oil's prevalence in food products such

as margarine (18% unaware) and biscuits (27% unaware), and this is likely to be a response to palm oil's portrayal in the media which has frequently focused on demand from the food industry (Jackson *et al.*, 2019). After visiting the exhibit, none of the respondents reported 'no knowledge' of palm oil. Thus, our results provide further evidence of the effectiveness of scientific exhibits for engaging consumers and improving awareness of complex environmental issues.

A study by Ostfeld *et al.* (2019) revealed that recognition of the RSPO's logo was effectively zero, and thus, recommended that government policies should be amended to require companies to source 100% CSPO instead of relying on consumers to demand and purchase products containing CSPO. We similarly observed a near complete inability of participants to name the RSPO logo, even after visiting the exhibition, which clearly displays the RSPO logo. This suggests that simply displaying the RSPO 'ecologo' is not enough and will not be sufficient to encourage a change in the buying habits of consumers. This can be remedied, as other ecolabels are widely recognised; for example the Fairtrade logo was recognised by 82% of shoppers in the UK (Ostfeld *et al.*, 2019). Though Fairtrade was established over 25 years ago, its reputability has been underpinned by extensive outreach work, advertising and marketing in the mainstream media (Fairtrade Foundation, 2019). At present, the RSPO logo is rarely used as a consumer-facing label, thus, may not be considered an immediately applicable tool for engaging consumers (Ostfeld *et al.*, 2019). Therefore, efforts from the RSPO and its member companies to increase visibility within the mainstream media in countries that are major consumers of palm oil would likely pay dividends in terms of public understanding, RSPO logo recognition and willingness to support CSPO.

Indeed, we found that the Eden Project's palm oil exhibit had a major and positive impact on the willingness of visitors to support CSPO, with 78% of respondents reporting that they were more likely or much more likely to buy CSPO products after visiting the exhibit. This clearly evidences the positive role that tourism attractions and botanical gardens can play in raising awareness and changing attitudes towards environmental issues. There is much evidence that tourists value the environment and with targeted, relevant communications, could be encouraged towards more sustainable consumption behaviour (Font and McCabe, 2017). While visitors to attractions such as the Eden Project could be considered a key audience for CSPO products, efforts must also be made to ensure that learning opportunities for improved awareness of CSPO as well as access to products are available to audiences beyond those who would visit an educational charity and visitor destination.

Despite finding that palm oil publications regarding 'Biodiversity' and 'Deforestation' were under-represented in comparison with other themes in the literature, when we asked visitors at the Eden Project what would encourage them to purchase CSPO, 'protection of primary rainforest' was found to be of the highest priority (65%). When respondents were asked to relay one fact about palm oil that they had learnt from their visit, the 'pervasiveness of palm oil' (31%) as well as 'awareness of sustainable palm oil' (30%) were most common responses. This contrasts with the broad unawareness of the presence of palm oil in different product groups that respondents reported before visiting the exhibition. Reported barriers to purchasing CSPO did not indicate a lack of interest in or willingness to support CSPO; we identified that unclear labelling, lack of product availability and cost were the key factors inhibiting consumer choice. The responses provided in our survey of consumers were generally consistent with those reported from palm oil industry stakeholders by Padfield *et al.* (2019). Though our respondents did not explicitly state that protecting biodiversity was the most important factor that would encourage consumers to purchase CSPO products, the protection of rainforest will certainly serve to protect biodiversity. Together, this suggests that while consumers are concerned with the prevalence of palm oil in products, the use of positive messages such as the protection of rainforest or fair prices for workers will be key to encouraging consumers to make sustainable purchasing decisions rather than boycotting palm oil altogether. This should alleviate fears from manufacturers and retailers over drawing attention to the fact that they are using palm oil (Chaudhari and Purkayastha, 2011; Ostfeld *et al.*, 2019), and provide direction for future marketing and campaigning decisions. In addition, this finding can inform improvement of the RSPO's operations. The roundtable has attracted criticism for ineffective monitoring and its failure to halt the destruction of primary rainforest and provide beneficial ecological outcomes for its approved members (Morgans *et al.*, 2018; Schouten and Glasbergen, 2011). Thus, prioritisation of rainforest conservation, paired with effective communication of this through campaigns and exhibitions, may increase support and demand for certified palm oil.

Awareness in botanical gardens and other relevant settings can have a measurable impact on awareness and knowledge of palm oil and the issues surrounding it, but this is not the only form of communication that is needed to effect change. Environmentalism is a fast-moving field, with foci often changing with each new 'crisis' reported (Goldsmith and Goldsmith, 2011). Longer-term engagement with relevant information is needed, particularly in a time when 'fake news' and viral

online content can rapidly disseminate facts and information which may have a negative impact on the environment and wildlife, however unintended (Clarke *et al.*, 2019). The role of scientists should be dualistic in nature, working towards engaging the public in discussion while supporting the development and implementation of sustainable practices. In the UK, the success of a collaborative approach is demonstrated by Chester Zoo's 'Sustainable Palm Oil City' initiative, which has led to Chester becoming the first sustainable palm oil city in the world. The campaign, alongside increasing consumer awareness, assisted more than 50 organisations including manufacturers, restaurants, cafes, and educational institutions to audit their supply chains and make a time-bound commitment to using 100% RSPO certified palm oil (Chester Zoo, 2019a). Through providing a toolkit, educational resources, and an incentive for local businesses, Chester Zoo expanded its reach to new audiences (Ancrenaz *et al.*, 2018; Chester Zoo, 2019b). They also addressed some of the key barriers to sustainable palm oil consumption identified by our study, such as unclear labelling and lack of availability. Similar initiatives are now under development in Bristol, Newquay, and Oxford (Bristol Zoo, 2018; Chester Zoo, 2019c). Increasing public awareness is key to improving the reputation of sustainable palm oil, and cross-organisational collaboration will allow stakeholders throughout the supply chain to feel confident in promoting what has become an essential ingredient to 21st century life.

## CONCLUSION

Consumer awareness of palm oil and its prevalence in products remains low in the UK, as does knowledge of CSPO, and the RSPO. However, consumers will support rather than boycott products which protect rainforests, which should encourage manufacturers to promote their use of CSPO. This will be important in driving change, but the palm oil industry needs to do more to increase awareness of CSPO. Visitor attractions and educational charities such as the Eden Project represent an effective opportunity to support public engagement and raise awareness of the complex underlying issues and the viability of CSPO as a solution. Public perception of the palm oil industry could be improved through further outreach work and positive storytelling led by un-biased parties.

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