

# Social Risk in Palm Oil

## *A quantitative analysis of commercial, social and environmental risk in palm oil supply chains*

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*This research note summarizes the results of an analysis of commercial, social and environmental (CSE) risk in palm oil supply chains. The research applies geospatial data and analytical techniques developed by TMP Systems to examine the risk profiles of suppliers to a dozen multinational companies as well as Roundtable on Sustainable Palm Oil (RSPO) certified mills.*

*We have found that certain companies appear to have greater exposure to CSE risk, because their suppliers operate in quantifiably riskier areas. Secondly, we note that RSPO mills appear to operate in areas with lower risk. We also have some evidence that Astra Agro Lestari (AAL) carries higher risk levels than one might expect from a company operating in Indonesia*

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## Executive Summary

TMP Systems uses localized social and environmental data to inform companies and investors about risks that might impact the performance of real assets (e.g. mills, mines, wind farms, railways). As explained below, this is part of our broader work on commercial, social and environmental (CSE) risk, a term we contrast with the more familiar “environmental, social and governance” (ESG) risk.

In this paper, we share a CSE risk analysis comparing data from over 3,000 palm oil production areas (that is, mills and plantations) with data from 602 assets that have encountered financial, operational or regulatory problems due to conflicts with local populations. Analyzing the supply chains of 12 major palm oil buyers, we arrive at four conclusions of interest to companies and investors with exposure to the sector:

1. For companies, CSE risk analysis using geospatial data may be useful in shaping risk management policies at a company level. We illustrate this point by showing that certain companies – for example, Kellogg’s, Pepsico and General Mills – have a greater proportion of their supplier mills in locations where available social and environmental data correlates with higher CSE risk.
2. For investors, it is also possible to determine if a company’s supply chain might have higher exposure to specific social and environmental conditions (e.g. local poverty, land use patterns) that correlate with higher CSE risk than their competitors. We explain this by showing how all 12 palm oil buyers compare to their peer group.
3. Although many criticize the Roundtable on Sustainable Palm Oil (RSPO) standard, our data suggests that RSPO-certified mills tend to be located in areas with lower risk. While the reader must remember that correlation does not imply causation, we nevertheless believe that it is advisable for companies to favor RSPO certification when considering new suppliers.
4. Some specific suppliers seem to carry higher levels of risk, despite operating a large number of mills that are not concentrated in a single locality. As an example, we share data showing that this appears to be the case with Agro Astra Lestari (AAL), and also show the variation between companies that procure from AAL.

The research note begins with a brief explanation of how CSE risk contrasts with ESG risk, and then explains the specific issue – conflict between mills and local populations – that we have examined. It then enumerates the geospatial datasets used to analyze this risk, with details in support of the three conclusions described above, before concluding with some observations on the financial and operational utility of this novel approach to CSE risk analysis, and how they can be applied by different stakeholders in the palm oil supply chain.

## How our analysis was constructed

### 1. *Rationale: what is different about our approach*

TMP Systems quantifies CSE risk by identifying non-financial factors that create significant financial or operational problems in a business, asset or other similar investment. Unlike ESG risk, it has a strong link to business outcomes, and assesses this link in a more objective, specific and comparable fashion.

ESG has been a helpful way to highlight the importance of things heretofore defined as “externalities”, but ESG risk ratings do not often inform better risk management.<sup>1</sup> This is because they fail a simple test defined in 2013 by Norges Bank Investment Management (NBIM), the managers of Norway’s \$1.113 trillion sovereign wealth fund:

*Objective information related to environmental, social and governance issues should be made available based on a transparent methodology, in a structured manner and be consistent over time. NBIM sees value in external research that investigates any causality between environmental, social and governance risk factors, and economic growth and company profitability.<sup>2</sup>*

Clearly, there are social or environmental factors that have a bearing on financial viability, productivity, regulatory risk and other business issues. This is especially true in palm oil, whose difficulties with social issues are well-documented,<sup>3</sup> and whose dependency on environmental factors is self-evident.

But from a business perspective, we think it more useful to focus on social and environmental factors impacting operational, financial or regulatory outcomes, rather than judging whether a given social or environmental outcome will spark a reaction from advocacy organizations or the press (which ESG risk analysis does quite well). In judging CSE risk, it is therefore important to avoid relying on sensational news reports or small numbers of narrow-bore case studies, compelling and accurate as those may be.

Scenario analysis, resource allocation and other business judgments rely on comparing alternative possibilities, and to use NBIM’s words, it is crucial to assess social and environmental factors in a way that is as objective, structured and consistent as available data

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<sup>1</sup> We are not alone in thinking ESG has fallen short of the mark: examinations by news outlets such as the [Financial Times](#) and advocacy groups like the [American Council for Capital Formation](#) have expressed doubts about the techniques used to quantify these metrics, particularly their subjectivity and relevance in judging company-level risk. See:

Allen, K. 2018. Lies, damned lies and ESG rating methodologies. Alphaville blog. Financial Times. 6 Dec 2018. Online: <https://ftalphaville.ft.com/2018/12/06/1544076001000/Lies--damned-lies-and-ESG-rating-methodologies/>

Doyle, T. 2018. The Big Problem With 'Environmental, Social And Governance' Investment Ratings? They're Subjective. Investors Business Daily. 9 Aug 2018. Online: <https://www.investors.com/politics/commentary/the-big-problem-with-environmental-social-and-governance-investment-ratings-theyre-subjective/>

<sup>2</sup> Norges Bank. 2013. Environmental, social and governance information, Letter to the Rainforest Foundation Norway. Online: <https://www.nbim.no/en/publications/consultations/2013/environmental-social-and-governance-information/>

<sup>3</sup> These issues run the gamut from direct violence between plantations and neighboring land users to infringements of labor rights: the [Zoological Society of London’s SPOTT initiative](#) provides a useful summary.

will allow. We have applied this approach as explained below, first by identifying what data might have a significant correlation with CSE risks.

## 2. *Background: conflicts between palm oil mills and local counterparties*

For the palm oil sector, applying this approach means gathering data about the most crucial link in the supply chain: palm oil mills. This is because evidence suggests that certain forms of CSE risk correlate with interruption in mill operations, or delay in mill expansion or construction. Companies buying from mills have an incentive to examine the risk of non-delivery or lower productivity by mills, and investors in those companies have an incentive to understand whether different companies have different levels of exposure to this form of CSE risk<sup>4</sup>.

To satisfy this, the analysis reviews the potential for significant financial or operational disruption of a palm oil mill due to conflict between the mill operator and local populations<sup>5</sup>. We refer to this type of CSE risk as “tenure risk”<sup>6</sup>, because it is often sparked by a lack of clarity regarding land and resource rights<sup>7</sup>. Tenure risk is common not only in Indonesia, Malaysia and other palm oil producing countries, but in emerging markets generally.

From a business perspective, it is associated with increased compensation payments, new or higher regulatory costs, higher resource costs, higher insurance premiums and/or denial of insurance claims, unplanned capital expenditure, loss of license and inflated legal costs. Existing research undertaken by TMP Systems with the Overseas Development Institute has been able to put some numbers around these downsides, for example, showing that tenure risk can suspend operations for over five years, and cause impairments to the net present value (NPV) of a mill or plantation in the range of 25 to 67 per cent of the original investment<sup>8</sup>.

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<sup>4</sup> There are also strategic reasons for companies and investors to be interested in this topic. In recent weeks, palm oil prices have surged as Malaysia and Indonesia push ahead with biodiesel policies that will increase demand for the commodity, while in parallel, unusually dry weather in southeast Asia has caused some strains on supply. Under these conditions, companies dependent on palm oil may need to review the reliability of their current supply chains, since filling supply gaps may be more costly than usual. This adds to a general appetite for expansion of palm oil production, especially in less-familiar areas outside Malaysia and Indonesia.

<sup>5</sup> This research note on palm oil is the first of a series on CSE risk in sectors that have a significant land footprint. It will be followed by similar papers covering mining (December 2019) and renewable energy (January 2020)

<sup>6</sup> See <https://tmpsystems.net/new-page-1/for> more information.

<sup>7</sup> Tenure risk is often caused by a mismatch between national governments’ promises to concessionaires and local expectations of those concessionaires. Often, land and resources granted through industrial and agricultural concessions are offered to companies and investors as unencumbered opportunities. In reality, they are quite often inhabited by local populations who have significant, unaddressed grievances with local or national government. Rightly or wrongly, those populations tend to view local mills as responsible for remediating these issues. The risk arises when these expectations are not met, and local communities become discontent. Due to slow, corrupt or otherwise untrustworthy legal systems, they do not rely solely on the courts to address their concerns. Instead, they often respond by taking direct action to draw attention to their grievances. That direction action can – and quite frequently does – impede the proper performance of company and investor assets.

<sup>8</sup> ODI, TMP Systems, 2019. Palm Oil Companies Risk Losing Up To \$22.1 Million From Land Tenure Disputes. Online: <https://landportal.org/library/resources/qtr-brief-palm-oil/palm-oil-companies-risk-losing-221-million-land-tenure-disputes>

Additional analysis indicates that just 7% of the tenure disputes were driven primarily by compensation, meaning that these problems are hard to address via a quick financial settlement once they arrive<sup>9</sup>. Instead, the average duration of the disputes – and therefore, impairment of operations – was well over one year, with 44% lasting more than 500 days and 21% lasting more than three years<sup>10</sup>.

### 3. Methodology: quantitative assessments of tenure risk

TMP Systems has constructed a database of blockades, protests, invasions, sabotage, threats to employee safety and arson at project sites, which we use in the geospatial analysis described below. The common theme linking these cases was not reputational damage (although this was sometimes significant), but rather a manifest concern about whether the asset threatened could fulfil its obligations to investors and customers. The database is augmented quarterly, and comprised 602 cases when this analysis was performed in November 2019.

In parallel, we have developed a geospatial analysis technique for quantifying the exposure of a real asset to CSE risk, based on indicator values at the asset’s location. We applied that technique to tenure risk for this analysis. This was done using a replicable, standardized method<sup>11</sup> for scoring underlying indicator values, with 0 representing indicator levels rarely or never associated with social risk, and 100 representing indicator levels associated with social risk, but rarely or never found in places where tenure disputes have not occurred.

The process provides five national-level indicators and nine sub-national-level indicators, weighted according to their statistical association with tenure risk. The table below (Figure 1) sets out the 14 indicators we use to assess exposure to this form of CSE risk, and how they are grouped.

**Figure 1: Indicators and datasets used by TMP to analyze tenure risk<sup>12</sup>**

Category	Indicator (Dataset)
National conditions	Corruption (Corruption Perceptions Index)
	Government Effectiveness (Worldwide Governance Indicators)
	Human Development Index (Human Development Index)
	Political Stability (Worldwide Governance Indicators)
	Voice and Accountability (Worldwide Governance Indicators)
Local Conditions	Access to Electricity (Multidimensional Poverty Index)
	Access to Power (Georeferenced Ethnic Power Relations)

<sup>9</sup> TMP Systems, 2016. IAN: Managing Tenure Risk [http://rightsandresources.org/wp-content/uploads/RRI\\_IAN\\_Managing\\_Tenure-Risk.pdf](http://rightsandresources.org/wp-content/uploads/RRI_IAN_Managing_Tenure-Risk.pdf)

<sup>10</sup> Ibid.

<sup>11</sup> TMP Systems. 2019. Landscape rating system: Methodology for Tenure Risk Similarity Ratings. Online: [https://landscape.info/landscape\\_methodology.pdf](https://landscape.info/landscape_methodology.pdf)

<sup>12</sup> The underlying datasets are available at: <https://landscape.info/sources.php>. Landscape was developed with support from the Rights and Resources Initiative (RRI) via the Interlaken Group - a coalition of leaders from companies, investors, NGOs, government, and international organizations. The Interlaken Group is funded by UK aid from the UK government. However, the views expressed by Landscape and the Interlaken Group do not necessarily reflect the UK government’s official policies.

Category	Indicator (Dataset)
	Territory Covered by Protected Areas (World Database on Protected Areas)
	Relative Poverty of Location v Nation (Multidimensional Poverty Index)
	Vulnerability to Poverty (Multidimensional Poverty Index)
<b>Local Behavior</b>	Asset Ownership (Multidimensional Poverty Index)
	Child School Attendance (Multidimensional Poverty Index)
	Land Use Change (GlobCover)
	Population Change (Gridded Population of the World v4)

We applied this technique based upon data from three sources: World Resource Institute’s Universal Mills List (UML)<sup>13</sup>, which is compiled from multiple sources and is the largest publicly available database of verified palm oil mills; RSPO’s list of certified palm oil mills<sup>14</sup>; and supplier mill lists published by 12 multinational companies with a significant presence of palm oil in their supply chains<sup>15</sup>.

Its main output is an ‘Overall Similarity Rating’ of the area surrounding a point selected by the user, which quantifies how similar that queried location is to places where disputes have occurred between a commercial operator and local counterparties. Since palm oil mills source most of their raw material from producers close by, the 50-kilometer buffer zone which we use to calculate CSE risk ratings provides good coverage of the area in which a dispute at plantation or farm level is likely to impact the operation of the mill and thus disrupt supply.

Each of the mill locations in these lists was analyzed to produce scores for the Overall Similarity Rating, as well as the three Categories and 14 indicators in Figure 2. We then aggregated and averaged the ratings and scores for each group – company supply chains, the RSPO-certified mills and UML – and compared them in a variety of different ways.

We also looked into the subnational variations in the supplier base of each country and region, the ways that risk is concentrated within individual company supply chains, and various other angles to identify patterns and outliers. The following pages summarize what we found.

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<sup>13</sup> The UML draws from multiple publicly available sources including companies, producers, the Roundtable on Sustainable Palm Oil (RSPO) and FoodReg. Available online: <http://data.globalforestwatch.org/datasets/5c026d553ff049a585b90c3b1d53d4f5> 34

<sup>14</sup> Available online: <https://data.globalforestwatch.org/datasets/rspo-palm-oil-mills>

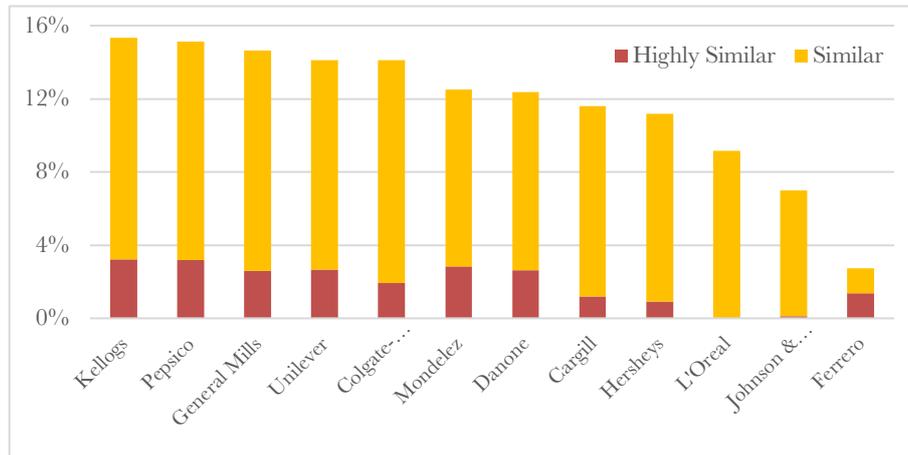
<sup>15</sup> Supplier mill lists were sourced directly from each company’s website. Full sourcing information is set out in the Appendix.

## What our analysis shows

1. *There is significant variation in companies' risk profiles, and CSE risk analysis using geospatial data is useful in developing realistic, targeted risk management policies at a company level.*

The 12 companies we analyzed display a wide range of overall risk ratings within their supply chains. Figure 2 below shows the percentage of each company's supplier mills that fall into the two highest risk categories – Highly Similar and Similar – when analyzed using our technique<sup>16</sup>.

**Figure 2: Percentage of supplier mills rated Highly Similar or Similar for overall CSE risk**



Consider the extremes of this chart: 15% of the mills supplying Kellogg are in the two riskiest categories, whereas Ferrero has only 3% in those groups. The difference between these two in absolute exposure is also marked: there are 1,766 mills in Kellogg's supplier list (57 in the Highly Similar group), where Ferrero has only 73 (3 are Highly Similar).

That implies a magnitude of difference in the effort and resources each company would require to conduct thorough due diligence and consultations with local populations. TMP's experience is that the cost of doing in-person site visits for rudimentary due diligence is absolutely no less than \$5,000-10,000 per mill even if local labor is used<sup>17</sup>, and community engagement requires no less than six months of work for single full-time staff member or consultant.

If these figures roughly match reality, the capital required for this is quite small: a minuscule \$15,000 for Ferrero on the low end, and still just \$570,000 for Kellogg's on the high end. Even if the actual cost were an order of magnitude greater, this would be quite manageable

<sup>16</sup> In our typical use of this analysis, Highly Similar and Similar locations are places where TMP would recommend a more thorough approach to due diligence because they have many of the characteristics of places where there have been disputes in the past. In practical terms, this means due diligence grounded in community engagement for operators, and localized data collection and analysis for buyers and investors. For investors in certain situations – such as private equity funds considering a specific asset – it may also mean rewriting certain terms of the investment agreement in order to ensure measurable performance against social or environmental indicators that associate with CSE risk.

<sup>17</sup> These are conservative estimates based on our qualitative experience rather than empirical data. TMP Systems is currently undertaking research that will aim to fill this gap by quantifying the cost of social diligence and engagement processes.

compared to the downside. We therefore believe that companies should not be concerned about the direct cost of risk management.

Our view of the impact on human resources and time is quite different. If all of Kellogg's risky mills required community engagement support, they would be looking at several years of full-time work for an expert staff member or consultant, which essentially means that it is beyond their likely capacity. As with other forms of risk management, it may therefore make sense for the company to outsource.

In that scenario, the ability to judge risk via localized data may provide companies with a sense of how realistic a given option for CSE risk management may be. In like fashion, companies can use Similarity Ratings to gauge where they stand in comparison to their peers (as can their investors, which may be of particular importance to those with an ethical mandate), and even as a basis for collaboration with those peers on responsible sourcing programs for a given region.

2. *For investors, it is also possible to determine if a company's supply chain might have higher exposure to specific social and environmental conditions than others in the sector.*

A closer investigation of the indicators available within Landscape reveals the detail of how CSE risk is concentrated in individual indicators across each company's supply chain<sup>18</sup>; this is where we begin to get actionable information that can help guide efforts to address and reduce the risk.

The table overleaf (Figure 3) gives a sense of how risk is spread across the 14 factors that we know to be correlated with this specific form of CSE risk. For each company, the table highlights indicators for which the average score is in the top decile. It provides an interesting example of how this information might be useful.

Colgate-Palmolive sits around the middle of the twelve companies in terms of its overall score, CSE risk in its supply chain appears to be somewhat more concentrated in a distinct set of indicators. Half of the 14 average indicator values are in the 9<sup>th</sup> decile of its peer group<sup>19</sup>, and it has the highest score of the group in five of them. They represent a complex mosaic of national and local conditions and behaviors with greater exposure in particular to indicators of poverty and pressure on local land and resources.

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<sup>18</sup> To achieve this, we calculated the mean scores for each company across the 14 indicators which make up the overall CSE similarity score, and then ranked each company's mean indicator score to determine the percentile at which it lies within the overall collection of company palm oil mill supply chain lists.

<sup>19</sup> The indicators are: Asset Ownership; Child School Attendance; Land Use Change; Population Change; Access to Electricity; Access to Power; Protected Areas; Relative Poverty; Vulnerability to Poverty; Corruption; Government Effectiveness; Human Development Index; Political Stability

**Figure 3: Percentile ranking of average indicator values by company vs. total peer group**

	Overall CSE Score	Asset Ownership	Child School Attendance	Land Use Change	Population Change	Access to Electricity	Access to Power	Protected Areas	Relative Poverty	Vulnerability to Poverty	Corruption	Government Effectiveness	Human Development Index	Political Stability	Voice and accountability
<b>Kelloggs</b>	56.5	45%	64%	73%	55%	18%	82%	82%	82%	82%	91%	91%	100%	100%	55%
<b>Pepsico</b>	56.4	91%	91%	55%	73%	82%	91%	73%	100%	73%	100%	73%	73%	82%	36%
<b>General Mills</b>	56.3	82%	55%	64%	64%	64%	73%	45%	73%	91%	73%	82%	91%	91%	27%
<b>Unilever</b>	56.2	64%	73%	36%	45%	27%	64%	36%	64%	55%	82%	100%	82%	73%	45%
<b>Danone</b>	55.1	27%	0%	82%	36%	73%	55%	55%	45%	45%	36%	55%	36%	36%	64%
<b>Hersheys</b>	55.0	55%	18%	45%	91%	45%	27%	27%	27%	36%	55%	27%	64%	55%	0%
<b>Cargill</b>	54.6	73%	9%	100%	27%	91%	9%	18%	36%	27%	64%	36%	45%	64%	18%
<b>Colgate-Palmolive</b>	54.6	100%	82%	91%	0%	100%	36%	100%	91%	100%	18%	45%	18%	18%	100%
<b>L'Oreal</b>	54.4	9%	27%	18%	82%	9%	18%	9%	0%	9%	45%	9%	55%	45%	9%
<b>Mondelez</b>	54.2	18%	36%	27%	18%	55%	45%	91%	55%	64%	27%	18%	27%	27%	82%
<b>Johnson &amp; Johnson</b>	53.5	0%	45%	0%	100%	0%	100%	64%	9%	0%	9%	0%	9%	9%	91%
<b>Fererro</b>	49.5	36%	100%	9%	9%	36%	0%	0%	18%	18%	0%	64%	0%	0%	73%

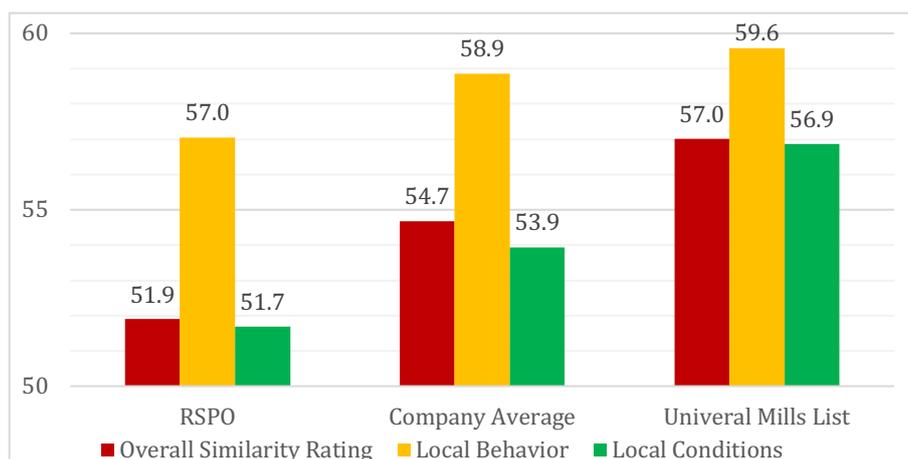
There is no evidence to suggest that Colgate-Palmolive has poor business practices, or to imply that they are choosing to source palm oil from places with vulnerable local populations. Rather, we use this to show that there is a quantitative starting point to guide risk management for companies with highly complex supply chains (and Colgate-Palmolive is one of the largest, with 2,662 mills analyzed for this paper).

It points to issues and places that can be prioritized by the company in allocating resources to risk management and engagement, in this case: poverty and pressure on local land and resources that are more than usually severe in the places from which it sources palm oil. For investors, it is therefore useful in asking detailed questions about the company’s social and environmental risk management strategies.

### 3. RSPO certified mills appear to be in locations with lower CSE risk

Our analysis also produced an unexpected result: RSPO-certified mills seem to be located in areas that associate with a lower CSE risk profile. When compared to the average ratings of the 12 companies we analyzed, and to the Universal Mills List, we see a lower overall similarity rating, and better scores in the subnational indicator groups.

**Figure 4: average CSE risk in RSPO- certified mills, company supplier lists and the Universal Mills List**



The chart above (Figure 4) compares the average risk exposure of mills certified by RSPO with the supplier lists of the twelve multinational buyers, and the Universal Mills List compiled by WRI. The RSPO-certified mills appear to have a less risky profile – the Overall Similarity Rating is 9% lower than the Universal Mills List average – driven by lower exposure to the indicators of Local Conditions and Local Behavior that correlate with CSE risk.

We are examining whether this data indicates some special social diligence internal to the RSPO process, or to a location bias in those mills which were able to meet RSPO standards, or something else. However, we believe that this is already relevant for companies that lack the resources and internal expertise to do specialized social due diligence, insofar as longlisting suppliers with RSPO certification serves as an efficient first step in eliminating the riskiest mills from selection process. Moreover, since certification focuses on improved practice, certified mills in locations with lower CSE risk might be expected to have doubly-improved risk profiles from a sourcing perspective.

It is also worth noting that the 12 multinational buyers we analyzed also have somewhat lower average CSE risk exposure than the Universal Mills List. This suggests to us that existing due diligence in procurement processes and/or standards imposed on suppliers do have some positive effect on the level of social risk in the supply chain. Further assessment of the ability or capacity of milling companies to manage CSE risks in their area would therefore be a useful complement to the results we present here.

#### *4. Agro Astra Lestari appears to be operating in locations with above average CSE risk*

Readers may be familiar with recent controversies caused by Agro Astra Lestari's (AAL) operations in Indonesia and Golden Veroleum's operations Liberia<sup>20</sup>, and the reports on Rabobank and ABN Amro's connections with these companies. Local and international NGOs have put pressure on both banks and financial regulators in Europe, primarily through negative coverage of the issue in the international press.

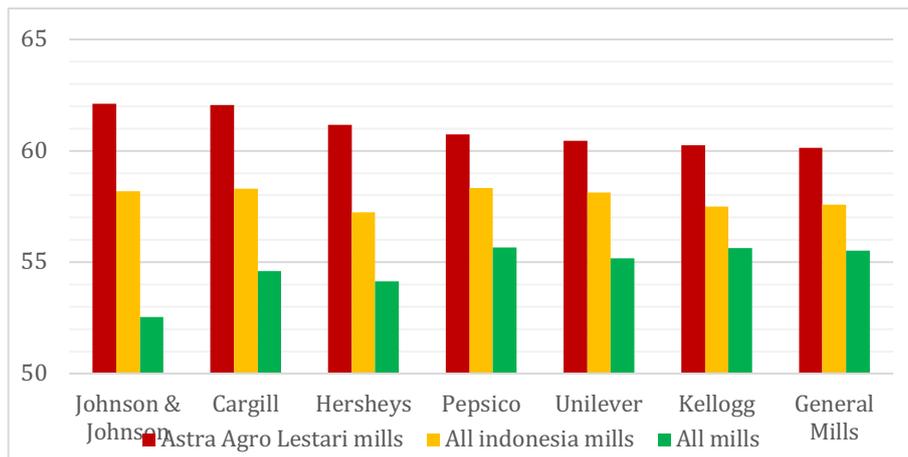
We used the same self-reported supplier lists and CSE data to analyze AAL's Indonesian operations, and their exposure to locations that seem to be at higher risk for disputes. We also assessed the relative exposure of selected companies<sup>21</sup> to these locations. As shown in the chart below (Figure 5), we found that the AAL mills are consistently located in places with a higher CSE risk rating, both relative to the overall supply chain and when compared to the average scores for Indonesian mills in each company's supplier lists.

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<sup>20</sup> Jong, H.J. (2019), 'Seeking justice against palm oil firms, victims call out banks behind them'. Mongabay. Online: <https://news.mongabay.com/2019/10/palm-oil-banks-dutch-indonesia-liberia-astra-agro-gvl/>

<sup>21</sup> This analysis includes companies which provided data on the owners of their supplier mills. Seven appear to have exposure to Agro Astra Lestari in Indonesia: Cargill, General Mills, Hersheys, Johnson & Johnson, Kellogg, Unilever and Pepsico.

**Figure 5: Average CSE risk ratings: Agro Astra Lestari Indonesia vs. all Indonesia and all mills**



In the case of Johnson & Johnson, the AAL mills have a CSE risk rating 7% above the average of its Indonesian suppliers, and 18% higher than the average across the whole supplier base.

Given the heightened risk in these locations, we should not wonder when Astra Agro Lestari's Indonesian mills and plantations come into dispute with neighboring communities. And it is likely that the company knows its business well enough to be aware of how the local context tends towards a higher risk of opposition.

## Conclusion

Companies that procure large quantities of palm oil have difficulty in addressing CSE risk because their supply chains are so complex, involving hundreds or thousands of different producers. A highly qualitative approach led by expert individuals cannot hope to deal with such a problem comprehensively.

Quantitative methods of the sort used to produce this research note provide a means of reducing the complexity by identifying patterns in the data, such as the concentration of risk in certain indicators for Colgate-Palmolive; introducing shortcuts to reducing risk, as seen in the RSPO-certified mills' lower risk profile; and exposing high-risk outliers in the supply chain, like Agro Astra Lestari.

The statistical evidence of the indicators that correlate with heightened CSE risk apply at both the macro and micro level. We can therefore employ these techniques to assess risk across whole supply chains of thousands of mills, but they also allow us to drill right down to the individual mill level, using the exact same methodology and datasets.

The point is not to replace in-depth due diligence and qualitative efforts led by experts. Rather, it is to make it easier to identify the ways in which those scarcer and more expensive resources can be used to the greatest effect.

If you are interested in more information about this approach, please contact [sophia.murday@tmpsystems.net](mailto:sophia.murday@tmpsystems.net).

## Appendix: data sources

We have used the most recently published list of supplier mills, as provided by each company. The quality of the data varies: for example, in some cases there appears to be significant duplication in the listings. We have taken no action to clean up the data in these lists, beyond removing obviously duplicate entries – meaning mills that are listed with identical names and coordinates. Otherwise we have used the information as presented.

### 1. Palm oil mill lists

Company	Mills listed	Mills analyzed	Year	List downloaded from
Cargill	1176	1162	2019	<a href="https://www.cargill.com/doc/1432150938058/cargill-palm-mill-list-q2-2019.pdf">https://www.cargill.com/doc/1432150938058/cargill-palm-mill-list-q2-2019.pdf</a>
Colgate-Palmolive	5687	2662	2018	<a href="https://www.colgatepalmolive.com/content/dam/cp-sites/corporate/corporate/en_us/corp/locale-assets/pdf/Colgate-Palmolive-List-of-Mills-2018H1.pdf">https://www.colgatepalmolive.com/content/dam/cp-sites/corporate/corporate/en_us/corp/locale-assets/pdf/Colgate-Palmolive-List-of-Mills-2018H1.pdf</a>
Danone	3530	3473	2019	<a href="https://www.danone.com/content/dam/danone-corp/danone-com/about-us-impact/policies-and-commitments/en/2019/Danone_Palm_Oil_(Update_2019).pdf">https://www.danone.com/content/dam/danone-corp/danone-com/about-us-impact/policies-and-commitments/en/2019/Danone_Palm_Oil_(Update_2019).pdf</a>
Ferrero	77	73	2018	<a href="https://s3-eu-west-1.amazonaws.com/ferrero-static/globalcms/documenti/3706.pdf">https://s3-eu-west-1.amazonaws.com/ferrero-static/globalcms/documenti/3706.pdf</a>
General Mills	1774	1743	2019	<a href="https://www.generalmills.com/~media/GeneralMills_Mill%20List_2018_June_2019.pdf?la=en">https://www.generalmills.com/~media/GeneralMills_Mill%20List_2018_June_2019.pdf?la=en</a>
Hersheys	1328	1298	2018	<a href="https://www.thehersheycompany.com/content/dam/corporate-us/documents/pdf/Hershey%202018%20H2%20Summary%20Report.pdf">https://www.thehersheycompany.com/content/dam/corporate-us/documents/pdf/Hershey%202018%20H2%20Summary%20Report.pdf</a>
Johnson & Johnson	1207	1028	2017	<a href="https://www.jnj.com/document?id=00000164-ed97-d1a7-a9e7-f9f7d0f0001">https://www.jnj.com/document?id=00000164-ed97-d1a7-a9e7-f9f7d0f0001</a>
Kellogg's	1801	1766	2018	<a href="http://crreport.kelloggcompany.com/download/Kellogg+Mill+List+2018.pdf">http://crreport.kelloggcompany.com/download/Kellogg+Mill+List+2018.pdf</a>
L'Oreal	1356	1243	2018	<a href="https://loreal-dam-front-corp-en-cdn.damdy.com/ressources/afile/181335-46081-resource_pdf-sbwa-l-oreal-mills-list-2018.pdf">https://loreal-dam-front-corp-en-cdn.damdy.com/ressources/afile/181335-46081-resource_pdf-sbwa-l-oreal-mills-list-2018.pdf</a>
Mondelez	3159	3003	2019	<a href="https://www.mondelezinternational.com/impact/sustainable-resources-and-agriculture/agricultural-supply-chain/~media/mondelezcorporate/uploads/downloads/Mills_Data_2019.pdf?la=en">https://www.mondelezinternational.com/impact/sustainable-resources-and-agriculture/agricultural-supply-chain/~media/mondelezcorporate/uploads/downloads/Mills_Data_2019.pdf?la=en</a>
Pepsico	1727	1662	2018	<a href="https://www.pepsico.com/docs/album/esg-topics-policies/pepsico-2018-palm-oil-mill-list.pdf?sfvrsn=d4305aa6_8">https://www.pepsico.com/docs/album/esg-topics-policies/pepsico-2018-palm-oil-mill-list.pdf?sfvrsn=d4305aa6_8</a>
Unilever	1665	1642	2018	<a href="https://www.unilever.com/Images/-unilever-s-universal-palm-oil-mill-list_h1-2018_final_tcm244-530097_1_en.pdf">https://www.unilever.com/Images/-unilever-s-universal-palm-oil-mill-list_h1-2018_final_tcm244-530097_1_en.pdf</a>
RSPO Certified Mills	264	251	2019	<a href="https://data.globalforestwatch.org/datasets/rspo-palm-oil-mills">https://data.globalforestwatch.org/datasets/rspo-palm-oil-mills</a>
Universal Mills List	1875	1869	2019	<a href="http://data.globalforestwatch.org/datasets/universal-mill-list">http://data.globalforestwatch.org/datasets/universal-mill-list</a>

### 2. Landscape ratings database

All data used for CSE risk ratings is taken from the Landscape database, whose sources are listed in full at <https://landscape.info/sources.php>