IMPROVING BUSINESS DECISION MAKING:

VALUING THE HIDDEN COSTS OF PRODUCTION IN THE PALM OIL SECTOR

CITATION

Raynaud, J., Fobelets, V., Georgieva, A., Joshi, S., Kristanto, L., de Groot Ruiz, A., Bullock, S., Hardwicke, R., (2016). Improving Business Decision Making: Valuing the Hidden Costs of Production in the Palm Oil Sector. A study for The Economics of Ecosystems and Biodiversity for Agriculture and Food (TEEBAgriFood) Program.

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A special thank you to the project contributors The Economics of Ecosystems and Biodiversity (TEEB), LEI Wageningen UR, Zoological Society of London (ZSL), Roundtable on Sustainable Palm Oil (RSPO), World Resources Institute (WRI), Sawit Watch.

DISCLAIMER

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GLOSSARY

TERM	DEFINITION
Natural capital	The stock of renewable and nonrenewable natural resources (e.g., plants, animals, air, water, soils, minerals) that combine to yield a flow of benefits to people, both directly and indirectly (Natural Capital Coalition, 2016). Natural capital is frequently valued in terms of impacts on society, such as human health
Social capital	Social capital refers to the value inherent in relationships and networks amongst people and institutions that enables society to function more effectively. An example of an impact on social capital is land dispossession and associated land conflicts
Human capital	Human capital refers to people and their ability to be economically productive. Education, training and health care can help increase human capital. In this study, human capital impacts have a direct effect on the health and welfare of people working in the product's value chain, such as underpayment and occupational health & safety. Polluting air emissions, while valued by their impact on human health, are considered an impact on natural capital
Visible benefits	Economically visible positive flows/impacts such as employment wages
Visible costs	Economically visible negative flows/impacts such as carbon markets which put a monetary price on greenhouse gas (GHG) pollution
Hidden benefits	Economically invisible flows/impacts of agriculture and food system, both positive and negative, include those on water quality, air emissions, and food safety. Hidden costs and benefits are rarely captured by conventional economic analyses that usually value goods and services that have a market price (also referred to as positive externalities). Examples of hidden benefits include aesthetic appreciation of a managed agricultural landscape, leisure and recreation within such landscapes in the form of agro-tourism, or cultural identity arising from the cultivation of and consumption of local farming produce (TEEB, 2015)
Hidden costs	Economically invisible flows/impacts of agriculture and food system, both positive and negative, include those on water quality, air emissions, and food safety. These hidden costs and benefits are rarely captured by conventional economic analyses that usually value goods and services that have a market price (also referred to as negative externalities). Examples of hidden costs include health impacts arising from agro-chemicals and nutrient run-off from farmland affecting the quality of

	bathing water, which in turn impacts on the leisure and recreation opportunities (TEEB, 2015)
Environmental costs/benefits	Environmental costs/benefits is a term used for visible or hidden costs/benefits when referring to the effect they have on natural capital
Social costs/benefits	Social costs/benefits is a term used for visible or hidden costs/benefits when referring to the direct or indirect effect they have on society. This includes all direct and indirect effects of human and social capital impacts and most indirect effects of natural capital impacts
Externalities	An externality arises when the actions of one economic agent in society impose costs or benefits on other agent(s) in society, and these costs or benefits are not fully compensated for and thus do not factor into that agent's decision-making (TEEB, 2015). External costs and benefits are called respectively negative and positive externalities
Internalization of externalities	A range of drivers that can lead to privatization of the external cost to the creator e.g. carbon taxes leading to additional cost to companies releasing greenhouse gases (GHGs)
Ecosystem	A dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit (TEEB, 2015)
Ecosystem services	The direct and indirect contributions of ecosystems to human well-being: • 'Provisioning' ecosystem services - all nutritional, material and energetic outputs from living systems • 'Regulating and Maintenance' ecosystem services - all the ways in which living organisms can mediate or moderate the ambient environment that affects human performance • 'Cultural' ecosystem services - all the non-material, and normally non-consumptive, outputs of ecosystems that affect people's physical and mental states
Eco-agri-food systems complex	A collective term encompassing the vast and interacting complex of ecosystems, agricultural lands, pastures, fisheries, labour, infrastructure, technology, policies, culture, traditions, and institutions (including markets) that are variously involved in growing, processing, distributing and consuming food (TEEB, 2015)
Valuation, economic	The process of estimating a value for a particular good or service in a certain context (in monetary or non-monetary terms) (TEEB, 2015)
Natural/human/social capital accounting	A process of translating physical measures in terms of metric tons of air pollutants emitted, or cubic meters of water used, into a monetary figure

	expressing the damage caused to the environment and society. Also known as monetary valuation, or monetization
Human capital return on investment	The human capital return on investment (HCROI) measures the human capital benefits created (or human capital costs reduced) relative to the financial resources invested. It is defined as the difference between the financial investment of an intervention and the increase in human capital benefits (or reduction in human capital costs) caused by the intervention, divided by the financial investment of the intervention

SUMMARY FOR DECISION MAKERS

EXECUTIVE SUMMARY

This report demonstrates how natural and human capital accounting can be used to understand and reduce the environmental and human impact costs of palm oil production. It was commissioned by TEEB as part of a series of studies for its agriculture and food (TEEBAgriFood) project.

Palm oil is the world's most popular vegetable oil, widely used in the food, personal care, chemicals and energy sectors. Over 56 million tonnes of palm oil was consumed in 2013 and this is expected to double by 2050. Its popularity is due to palm oil's high productivity, low market price, and versatility compared to other vegetable oils. Two types of palm oil are produced – crude palm oil from the fruit of the plant and palm kernel oil from its seed – which are used differently. While palm oil is naturally very stable and suitable for cooking, palm kernel oil contains almost double the amount of saturated fats and lower levels of carotenoids which makes it useful for making soaps, cosmetics and detergents.

However, the rapid growth of palm oil production in some countries is having serious environmental and social impact costs due to carbon dioxide emissions and air pollution from using fire to clear rainforest and peatland for new plantations, water pollution and harm to health from applying fertilizers and pesticides to crops, methane released from palm oil mill effluent processing facilities, land property rights violations during land expansion and substandard wages and working conditions.

The root cause of these problems is that the agriculture sector is too often considered in isolation from the society that it feeds, and the environment that supports it. Instead, business and society need to shift their thinking towards a systems-based approach which recognizes the reality that agriculture, society and the environment are all connected. Natural and human capital accounting are used to reveal these mutual inter-dependencies. In so doing, it is possible to highlight outcomes that both improve human livelihoods and also reduce impacts and dependencies on ecosystems and biodiversity.

Natural capital refers to the resources and services provided by nature such as clean air and water, healthy soil and a stable climate. Human capital refers to people and their ability to be economically productive. Companies, including farmers, in the agricultural sector depend on natural and human capital to support their business activities, so that they can grow crops and raise livestock. However, natural and human capital are often undervalued in the market, leading to their unsustainable use and increasing degradation. Natural and human capital accounting can put a monetary value on these resources and services, as well as on the damage done to them, so that policymakers and businesses can integrate the "true" natural and human capital costs and benefits into decision

making[1].

In this way, companies and investors can use natural and human capital accounting to better understand the risks they face as a result of environmental and social impact costs. These risks stem from stricter regulation driving higher compliance costs, changing consumer demand leading to a loss of market share, and reputational damage reducing share prices. For example, public concern over deforestation could cause customers to switch to certified sustainable palm oil or palm oil-free products. Tougher regulation of burning to clear land for new plantations or requiring legal minimum wages could lead to large fines.

By incorporating natural and human capital accounting into their businesses, companies and investors can reduce these risks, as well as take advantage of opportunities from more sustainable products and production processes. Policymakers too can use natural and human capital accounting when designing regulations or economic instruments to stress test the effect of those on the environment and social well-being.

This research is organized in two parts. First, a materiality assessment quantifies and monetizes a selection of material natural capital impacts of palm oil across the 11 leading producer countries. This is followed by a case study that quantifies and monetizes natural capital impacts in more detail in Indonesia, the largest palm oil producer, and also quantifies and monetizes a selection of human capital impacts. A scenario analysis illustrates how natural and human capital accounting can be used in Indonesia to compare a selection of alternative techniques for growing palm oil which may lower impact costs.

The scope of the research is limited to palm oil production and its supply chain for inputs such as fertilizers and pesticides. This approach was chosen rather than a full value chain assessment because this is where most natural capital impact costs occur. It does not include downstream activities such as transportation, product manufacturing, consumption and end of use. For the same reason, the study also focuses on assessing the natural and human capital costs of palm oil production. The natural and human capital benefits of palm oil production do not fall within the scope of this study. TEEBAgriFood's universal Valuation Framework helps place this scope in context by illustrating a full value chain from production to disposal assessing the cost as well as the benefit side of the equation (TEEBAgriFood, 2016).

FIGURE 0.1: TEEBAGRIFOOD VALUATION FRAMEWORK

[1] In environmental economics and the Natural Capital Protocol (Natural Capital Coalition, 2016), valuation can extend beyond montization to include qualitative, quantitative, and monetary approaches, or a combination of these.

Value-Chain Stages / Visible and Invisible flows	Production (and associated waste)			Processing and Distribution (and associated waste)			Consumption (and associated waste)
	Landscape	Infrastructure and Manufacturing	Farm	Wholesale	Food and Beverage	Retail	Industry/Household/ Hospitality
Captured by System of National Accounts (SNA) (Profits, Wages, Taxes net of Subsidies, etc.)							
Provisioning (Materials, Energy, etc.)							
Regulation and maintenance (Soil, Water, Habitat for biodiversity, etc.)							
Cultural (Heritage, Recreation, etc.)							
Health (Nutrition, Diseases, Antibiotic resistance, etc.)							
Pollution (Nitrates, Pesticides, Heavy metals, etc.)							
Emissions (CO_2, CH_4, etc.)							
Social values (Food security, Gender equality, etc.)							
Risks and uncertainties (Resilience, Health, etc.)							

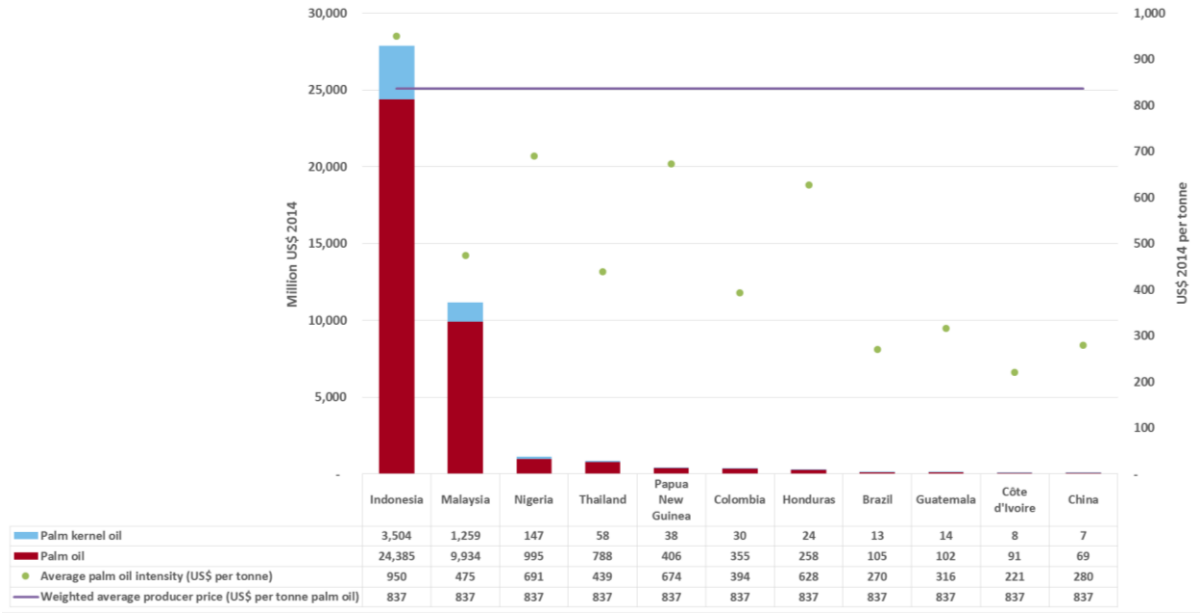
Countries included in the materiality assessment are Indonesia, Malaysia, Thailand, Nigeria, Colombia, Papua New Guinea, Guatemala, Honduras, Côte d'Ivoire, Brazil and China. The methodology followed by the research involves identifying the main natural capital impact costs of palm oil production and measuring them in physical terms such as tonnes of greenhouse gas (GHG) emissions. They are then converted into monetary values or natural capital costs. A similar strategy is applied for the measurement of the human capital costs in the case study.

MATERIALITY ASSESSMENT RESULTS

The results show that palm oil production in the 11 countries assessed has a natural capital cost of $43 billion per year compared to the commodity's annual value of $50bn. Of this cost, crude palm oil accounts for $37.5bn while palm kernel oil accounts for $5bn. Indonesia has by far the biggest share of the total natural capital cost at 66%, while Malaysia is second at 26%.

Overall, producing one tonne of crude palm oil (CPO) has a natural capital cost of $790 while one tonne of palm kernel oil costs $897 in 2013. If these costs were added to the weighted average market price of $837 per tonne of palm oil in 2013, the overall cost per tonne would almost double. The natural capital intensity of palm oil production varies widely between countries, which may have implications for siting palm oil operations or sourcing palm oil (see Figure 0.1).

FIGURE 0.2: TOTAL NATURAL CAPITAL COST AND INTENSITY



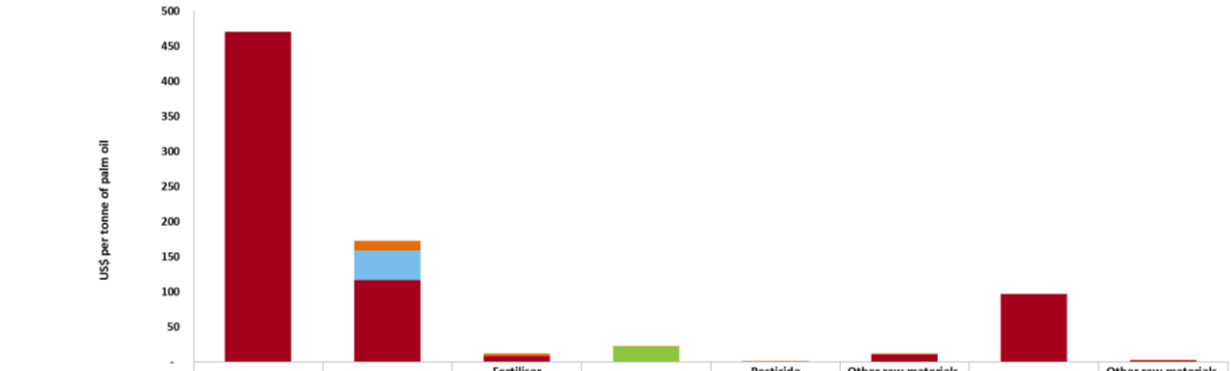
	Indonesia	Malaysia	Nigeria	Thailand	Papua New Guinea	Colombia	Honduras	Brazil	Guatemala	Côte d'Ivoire	China
Palm kernel oil	3,504	1,259	147	58	38	30	24	13	14	8	7
Palm oil	24,385	9,934	995	788	406	355	258	105	102	91	69
Average palm oil intensity (US$ per tonne)	950	475	691	439	674	394	628	270	316	221	280
Weighted average producer price (US$ per tonne palm oil)	837	837	837	837	837	837	837	837	837	837	837

The cost of Indonesia's palm oil industry is driven by the large size of its production and its high natural capital intensity. The total natural capital cost of palm oil production in Indonesia is almost $28bn while its natural capital intensity is $950 per tonne. Land-use change is the biggest single impact in Indonesia, mostly due to GHG emissions from peatland drainage and clearing rainforest.

Palm oil production in Malaysia has much lower natural capital intensity than Indonesia due to the lower cost of land conversion. Only 12% of Malaysia's plantations are planted on peatland and 30% on forested land.

Climate change due to GHG emissions from palm oil production, mostly as a result of land-use change, is responsible for 89% of the natural capital cost per tonne of palm oil. The use of fertilizers is responsible for 22% of the cost. Palm oil mill effluent contributes 12% of the cost, largely as a result of the climate change impacts of methane emissions. The impacts of pesticides contributes 3% of the cost per tonne. The upstream impacts from manufacturing fertilizers, pesticides and other raw material inputs are responsible for 3% of the cost (see Figure 0.2).

FIGURE 0.3: INTENSITY PER TONNE SPLIT BY PRACTICES AND IMPACT TYPE



	Land use change	Fertiliser application	Fertiliser manufacturing	Pesticide application	Pesticide manufacturing	Other raw materials, planting phase	Emissions from POME	Other raw materials, milling and refining
Health toxicity	-	14	4	1	1	2	-	0
Ecosystem toxicity - marine	-	0	0	0	0	0	-	0
Ecosystem toxicity - freshwater	-	43	0	0	0	0	-	0
Ecosystem toxicity - terrestrial	-	0	0	22	0	0	-	0
GHGs	470	116	8	-	1	10	97	2

INDONESIAN CASE STUDY RESULTS

The case study on Indonesia shows how natural and human capital accounting can be used to assess alternative palm oil production practices that reduce the impact costs of the sector. These costs can be compared to the financial costs of the practices to inform decisions over which to implement. The case study illustrates this approach by focusing on three practices with the largest natural capital costs and two practices with substantial expected human capital costs: land selection and clearing, fertilizer application, and palm oil mill effluent remediation, as well as wages and occupational health and safety. The research does not attempt to assess an exhaustive range of practices, but to illustrate the usefulness of natural and human capital accounting as an assessment tool.

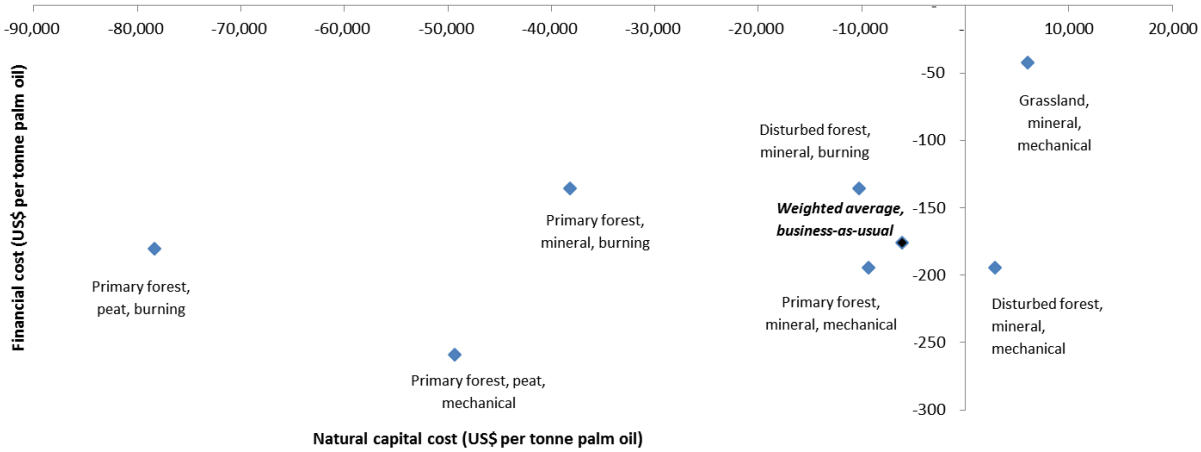
FIGURE 0.4: LIFE CYCLE STAGE AND PRACTICE SCOPE FOR THE INDONESIA CASE STUDY

The results show that converting primary forest on peat soil using burning techniques has highest natural capital cost due to GHG emissions and air pollution[2]. On average, burning a hectare of

[2] Other ecosystem services rendered by natural ecosystems, and lost through land conversion, as well as other impacts of air pollution, are excluded from the scope of this study.

primary forest on peat soil releases 29 grams of pollutants to air; a hectare of primary forest on mineral soil releases 28 grams; and a hectare of disturbed forest on mineral soil releases 13 grams. At the other end of the spectrum of analyzed scenarios, converting grassland and already-disturbed forest using mechanical means yields a natural capital benefit as the palm oil plantation sequesters more carbon than the previous land use. The results also show that converting forest or peatland by burning appears less financially costly than mechanical means, but entails a higher natural capital cost (see Figure 0.3).

FIGURE 0.5: NATURAL AND FINANCIAL CAPITAL COSTS OF LAND CLEARING TECHNIQUES OVER LIFETIME OF PLANTATION



Over the lifetime of the plantation, using an optimized mix of organic fertilizer containing pruned palm oil fronds, empty fruit bunches (EFBs) and palm oil mill effluent (POME) combined with chemical fertilizers has the lowest natural capital cost at $1,640 per tonne palm oil, compared to $3,080 per tonne palm oil where chemical fertilizer use is not optimized. The optimization scenario also has the lowest financial cost due to the lower quantity of fertilizer.

Installing methane capture equipment on palm oil mill effluent (POME) treatment processes to generate energy is also identified as best practice to reduce natural capital costs. It also results in a 17% financial cost saving due to a hypothetical sale of carbon credits.

The results also show that underpayment and occupational health impacts have a total human capital cost of $592 per full-time employee, or $34 per tonne of palm oil and $53 per tonne of palm kernel oil. If plantation owners paid a living wage to casual workers, the human capital cost of underpayment would be reduced to zero, while plantations remain profitable with margins reducing from 28% to 24%. The human capital return on investment for this intervention is 11%, which means that the decrease in human capital costs is higher than the decrease in the net cash flow of the plantation.

Wearing personal protective equipment (PPE) reduces instances of pesticide poisoning, cutting the human capital cost of occupational health by 6%. The human capital return on investment for this intervention is 130%. As these results do not take into account positive effects of improved labor conditions on net cash flow or projected financial losses due to reputational and other risks, they should not be considered as a complete financial business case analysis for these interventions, but

as a means to include human capital costs in business decision making.

FIGURE 0.6: DIRECT EFFECT OF INTERVENTIONS ON HUMAN CAPITAL COSTS AND NET CASH FLOW OF A PLANTATION[3]

This research makes a series of recommendations for business, financial institutions and policymakers, as well as identifying areas for further research.

RECOMMENDATIONS FOR BUSINESS

- Companies in the palm oil production sector should consider the use of natural and human capital accounting to assess the risks to their businesses posed by the environmental and social impacts of palm oil production. Factors such as tougher regulation and enforcement, changing consumer demand and reputational damage risk could force companies to pay the natural and human capital costs of palm oil production, threatening future revenues.
- Investors and banks are advised to assess their exposure to the natural and human capital costs of the palm oil sector in their equity portfolios and loan books. The internalization of natural and human capital costs could affect shareholder value and the ability of companies to repay loans. Investors and banks should engage with palm oil companies that have the

[3] The change in net cash flow of a plantation represents the net financial investment needed to implement interventions. It not only includes increased labour costs (due to the payment of living wages) and purchasing costs of PPE, but also a change in interests paid on debts, taxes and depreciation.

highest natural and human capital costs to assess what they are doing to minimize the risks to their business.

- This research has demonstrated the applicability of natural and human capital accounting to decision making by revealing the hidden costs of production in the palm oil sector and shortlisting priority cost areas for businesses to focus on. For example, on the natural capital side it has identified the growing and milling practices having the highest impact: land use change and the associated carbon emissions contributing 89% to the cost of one tonne of palm oil; fertilizer application contributes 22% (with 67% from GHGs, 25% from toxic substances to freshwater environment, and 8% from toxic substances to human health) and the management of palm oil mill effluent emissions (POME) which is the third most costly practice in terms of environmental cost, contributing 12% of total costs, due to methane emissions contributing to climate change. On the social side it has found that on average underpayment of workers is a larger issue in the sector then occupational accidents, with human capital costs of the former being twice the size of the latter. The research showed that underpayment is predominantly an issue for casual workers and that the human capital cost of occupational accidents is mainly driven by fatal accidents and cases of acute pesticide poisoning.
- Furthermore, companies should consider implementing best practices for palm production to improve overall performance and reduce natural and human capital costs. Palm oil producers could use natural and human capital accounting to assess a range of alternative practices to see which would have the greatest benefit for their operations.
- This research has also demonstrated the applicability of natural and human capital accounting to decision making by revealing the potential of an array of interventions to manage the above costs and their required investments. For example, analysis has revealed that using an optimized mix of organic fertilizer containing pruned palm oil fronds, empty fruit bunches and palm oil mill effluent combined with chemical fertilizers has the lowest natural capital cost and also the lowest financial cost due to the lower quantity of fertilizer needed. On the social side, it has revealed that if plantation owners paid a living wage to casual workers, the human capital cost of underpayment would be reduced to zero, while plantations remain profitable with margins reducing from 28% to 24%. Purchasing more personal protective equipment to reduce instances of pesticide poisoning was found to cause a large reduction in human capital costs compared to the required financial cost, translating in a human capital return on investment of 130%.

RECOMMENDATIONS FOR POLICY

- Policymakers should introduce measures to internalize the natural and human capital costs of palm oil production to create incentives for companies to improve performance. Such measures could take the form of environmental and social taxes, regulations, or voluntary agreements. Natural and human capital accounting could be used to devise these measures.
- Policymakers should bring together companies, investors, campaign groups, academics and consultancies to create a framework for natural and human capital valuation and integrated accounting. Such a framework is important to ensure consistent measurement of natural and human capital. The Natural Capital Coalition, which has created a Protocol and supporting sector guidance for natural capital accounting, provides an important model

(Natural Capital Coalition, 2016).

- Further research should be conducted to:
    - Measure qualitatively and quantitatively the natural and human capital benefits of palm oil production
    - Measure qualitatively and quantitatively the positive and negative natural and human capital effects downstream from palm oil production should also be carried out
    - Measure the complete financial, natural and human capital costs and benefits of alternative production practices and other interventions. This should also consider how the investment costs of implementing these measures could be financed and shared along the supply chain
    - Monetize operational, marketing and product risks, as well as legal, regulatory, reputational and financial risks associated with natural and human capital costs.

READER'S GUIDE

1. The **Introduction** will first describe consumption and production trends, followed by an introduction of the TEEB eco-agri-food system framework. This is the major framework used in this study to assess all negative relations between palm oil production systems on one hand and the human (economic & social) system and ecosystems and biodiversity on the other hand

2. The **Scope and Methodology** highlights the overarching aims and objectives of this analysis, as well as the main activities included within the scope, followed by an introduction to the framework for assessment: the high-level approach used in this study to quantify and value the impacts and dependencies of palm oil production systems.

3. The **Materiality Assessment** section calculates the costs of palm oil and palm kernel oil production in the top eleven producing countries. The country with the highest total natural capital cost is identified, as well as practices that contribute the most to these costs. These form the basis for the subsequent section

4. The **Case Study** on Indonesia focuses on five practices and assesses the natural, human and financial cost implications of possible interventions. Practices include land conversion, fertilizer application, methane capture from palm oil effluent ponds, wages and occupational health and safety practices. Each section provides a description of the prevalent practice, possible interventions, a quantification and valuation of natural or human and financial implications, and an assessment of the main barriers and opportunities for change.

5. The **Recommendations** section concludes the report with recommendations for business, investors and policy makers and suggested future research.