Nature footprint and opportunities assessment

Pilot: Palm oil and cotton in Tanzania

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Context and objectives

Context

The Foreign, Commonwealth & Development Office (FCDO) of the Government of the United Kingdom is supporting a 5-week effort to assess **nature impacts** of manufacturing in Tanzania

The focus of this diagnostic is on two important commodities, **palm oil** and **cotton**, both of which are key growth opportunities for Tanzania's value-added manufacturers

Working with **a partner company** provides a practical example of how companies in Tanzania can evaluate their nature footprints and identify and prioritize actions to take

Objectives

This work follows a two-phase approach, aligned to TNFD's LEAP framework

1. Phase 1 prioritizes the segments of the palm oil and cotton value chains with the **most material nature footprints,** using a two-pronged analysis:
   - Identifying each segment's potential **impact on the state of nature** by conducting a geospatial analysis of 15+ nature indicators
   - Modeling the **pressures each segment exerts on nature** (e.g., land use, resource use, pollution) through asset-level data collection and interpolation against benchmarks

   This work provides some of the key information needed for the Locate and Evaluate steps of TNFD's LEAP framework

2. Phase 2 will focus on **impact mitigation levers**
   - **Shortlist opportunities** to accelerate performance on nature indicators
   - Compare and prioritize levers and detail out a limited set of priorities

   This work provides some of the information needed for the Assess and Prepare steps of TNFD's LEAP framework

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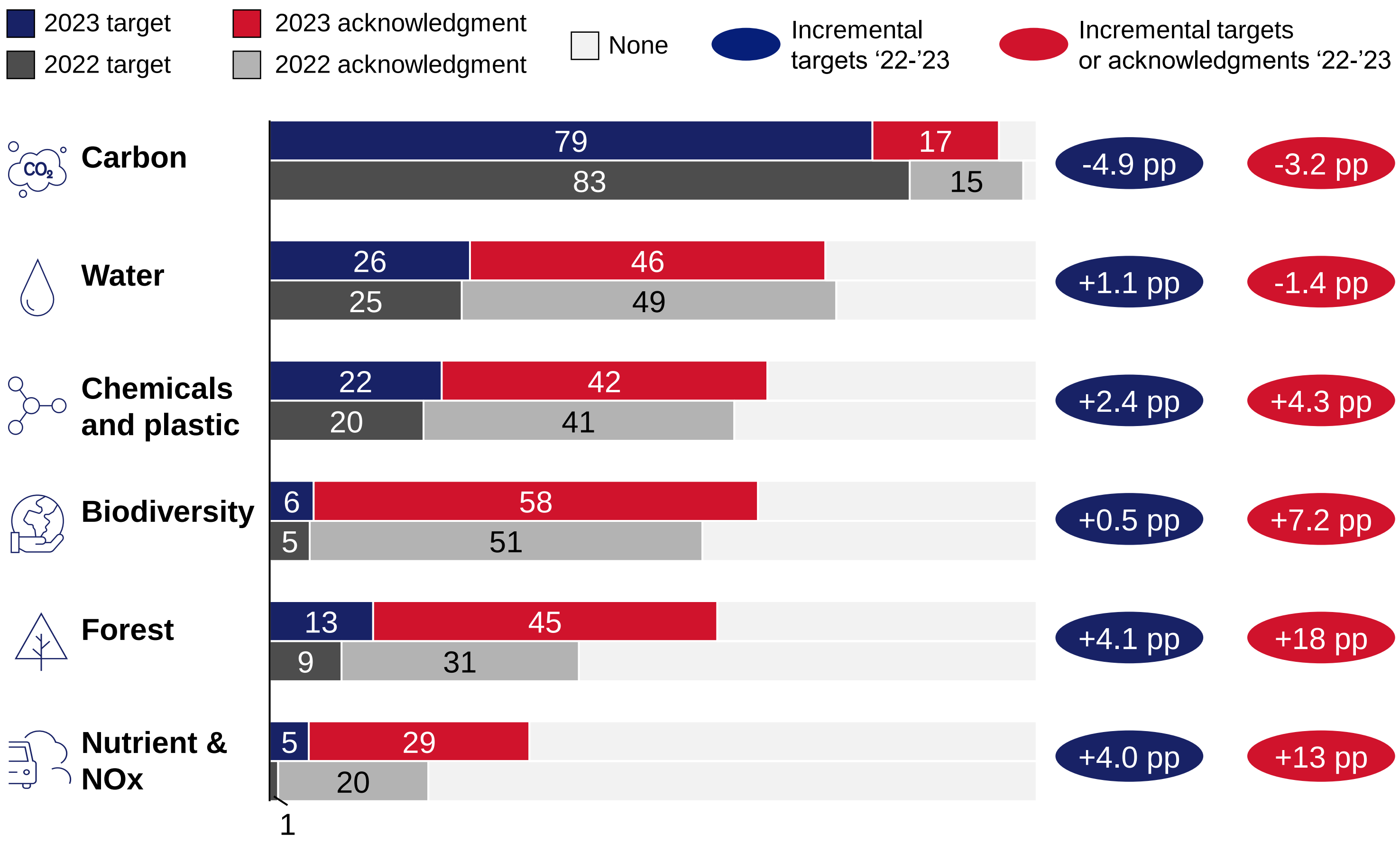
Corporates are increasingly setting targets broadly on nature, going beyond carbon

Share of Fortune Global 500 companies with nature-related targets or acknowledgments, %[1]



1. "Target" means the company has a quantified, time-bound, and outcome-oriented target, goal, or commitment that applies to the entire organization. "Acknowledgement" means the company mentions the dimension of nature but does not have a target as defined above.

Source: Fortune Global 500 company sustainability reports; Engineering News; FMN; AXIAN; Massmart; WWF; Babcock International

Corporate commitments in Africa

Flour Mills of Nigeria implemented energy recovery systems to reduce CO2 emissions

PepsiCo South Africa is pioneering water efficient practices

Massmart (South Africa) is transitioning to fully recyclable single and multi-use shopping bags

AXIAN Telecom (Mauritius) created a biodiversity management procedure to guide activities

Groupe Decolvenaere (Cameroon), Pallisco (Cameroon), and Transformation Reef Cameroun joined WWF's Central African Forrest and Trade Network

Babcock South Africa implemented one of the country's first NOx abatement projects

A nature-positive ambition and nature strategy can position companies in emerging markets for a nature-positive future

Several trends highlight the necessity of shifting to a nature positive approach

Growing physical risks from nature

Companies face physical risks because of their dependences on nature, e.g., from crop failures, water supply disruptions, and extreme weather

Increasing awareness of corporate impacts on nature

In some markets, consumer preferences and investor decisions are increasingly influenced by companies' environmental reputations

New investor and supply chain requirements

Investors and buyers, such as food and beverage companies, are pushing for companies to understand and address nature-related risks

Regulatory pressures in home and export markets

Countries are increasingly implementing regulations to protect and preserve natural capital, including regulations that apply to imported goods[1]

Companies that understand and address nature-related risks and impacts could potentially…

- Create a reputational benefit from being nature-positive
- Minimize operational and supply chain disruptions
- Access new investors
- Sell products in export markets with strong supply chain regulations on nature
- Command a price premium for certain products

1. This trend that will likely accelerate following the adoption of the Global Biodiversity Framework (GBF) in 2022; see the EU's Deforestation-Free Products Regulation

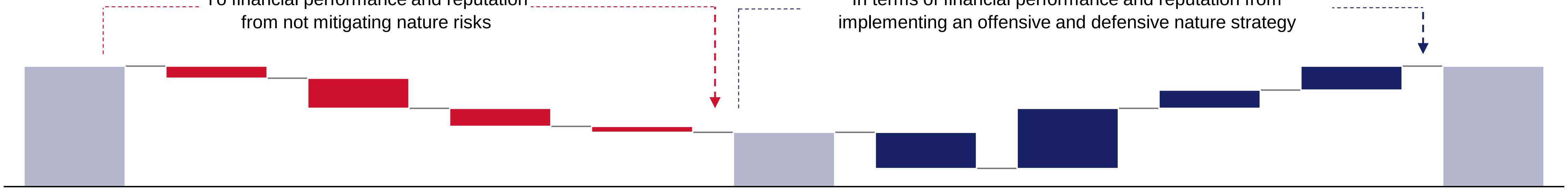
Source: Global Consumer Confidence Survey by Nielsen, CDP Climate Change Report 2019 and 2021, Edelman Data x Intelligence, World Economic Forum, The Guardian

Value could potentially be created through nature risk mitigation and new initiatives to boost nature-related revenues

ILLUSTRATIVE

Value at risk
To financial performance and reputation from not mitigating nature risks

Value creation
In terms of financial performance and reputation from implementing an offensive and defensive nature strategy



	Transition nature risk	Physical nature risk	Reputational risk	Financing risk	Cost to mitigate nature risks	Cost saving from risk mitigation	Value unlock from risk mitigation	Nature positive product market growth
	Nature risks from nature policy and regulation e.g. deforestation penalties	Lost output from the disruption of ecosystem services	Poor nature record leads to brand damage and loss in market share	Poor nature record closes access to certain sources of financing	Initial investment required to mitigate risk	Avoidance of nature costs e.g., regulatory costs	New value unlocks e.g., reputational gain, staff retention, new investors	Develop new products & enter new markets
African example	Silicon Smelters (FerroAtlántica) was fined 3 million rand for toxic emissions	Pollution across Africa is diminishing economic productivity and impairing human capital formation	Corporate greenwashing in Africa such as with the cocoa value chain in Ghana	After significant investment in the African palm oil industry, the IFC suspended all palm oil investments in 2009	Safaricom made a site cost tool to manage the fuelling process and reduce energy inefficiency	As a result of Safaricom's tool, average fuel spend was reduced by 60 litres (~40%) per day	Airtel Africa emphasized its environmental efforts as an integral part of its more general corporate mission	Total Energy Kenya now sells Excellium fuel – a relatively clean fuel – at most of its service stations
Corporate implications	Regulations either within country or in export markets could limit corporates' abilities to sell palm/cotton products	Improper irrigation techniques or planting could exacerbate water scarcity such that harvests are disrupted	Deforestation and loss of critical habitats on owned land or from suppliers harms company image	Negative environmental impacts could reduce available financing because lenders are less willing to invest	Invest in direct operations and supplier programs to ensure best-practice irrigation	Irrigation can increase yield per hectare and reduce risks from increased pressure on water scarcity	Corporates could ensure adherence to sustainability standards, improving reputation and access to financing	Develop and market new sustainable products

← **Do nothing** → ← **Mitigate risks** → ← **Unlock value** →

Source: Bloomberg; Sekyere 2023; Fisher et al. 2021; Safaricom; Airtel Africa; Total Energy Kenya; Reuters

Example: Measuring company nature footprints and adopting sustainable standards could help access international financing[1]

Large institutional investors are beginning to make nature-related disclosures a prerequisite for investment

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70%	of investors prefer investment funds with better carbon footprints
532	investment firms with $39 trillion AUM have called for nature-positive policies
1,200+	Entities support the Taskforce on Nature-related Financial Disclosures (TNFD)
5,600+	members from 23 countries have joined the Roundtable on Sustainable Palm Oil (RSPO)
2,500+	members have joined Better Cotton, which promotes better standards in cotton farming

IFC $400m loan to Olam Palm Gabon (currently pending)[2]

The IFC's first palm-oil related loan in 14 years will provide $400m to Olam Palm Gabon to maintain palm oil plantations and develop related infrastructure

- **Benefits** include a longer loan tenor, access to new lenders through the IFC's parallel lenders program, and the IFC's self-proclaimed "stamp of approval"
- **Requirements** include development of a sustainability strategy to achieve RSPO certification, a biodiversity action plan, and human rights measures to protect landholders, among others

European Bank for Reconstruction and Development $70m loan to FE Indorama Agro LLC (Uzbekistan, 2020)[2]

The EBRD provided $70 million in loan financing to FE Indorama Agro LLC as part of a $285 million project to optimize cotton farming to achieve Better Cotton Initiative standards

- **Benefits** include "terms not readily available in the local market" and "additional comfort [for] investors by mitigating non-financial risks"
- **Requirements** include development of an occupational health and safety management system, an environmental and social management plan, and a livelihood restoration scheme to empower local communities

1. There is no conclusive evidence, however, that action on nature systematically leads to a lower cost of capital or better investment terms
2. See Appendix for more detailed case study; the status of the IFC project financing is "pending approval" as of January 2024

Source: Royal Bank of Canada; The Institutional Investors Group on Climate Change; Banking Exchange; Roundtable on Sustainable Palm Oil

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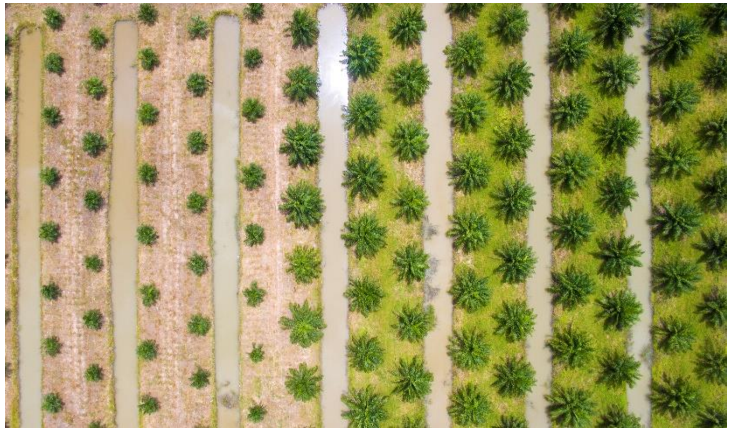
Corporates interface with nature via their economic activities

Economic activity creates pressures on nature which result in impacts

Activity

Economic and business activities and assets across the value chain that exert pressure on nature at business interfaces with nature

Example: Plantation operations and processing (e.g., palm oil extraction and refining)



Pressure or impact driver

Stressors on nature generated by economic activity, including:

- Ecosystem use and conversion
- Resource use
- Pollution
- GHG emissions

Example: Land conversion at the oil palm plantation, pollution from mill (e.g., waste materials)

Impact

Changes in the state of nature and ecosystem services caused by drivers and pressures, including:

- Biodiversity loss
- Ecosystem integrity
- Water stress

Example: Biodiversity loss (e.g., habitat destruction) and ecosystem degradation

Note: Framework is aligned with SBTN and TNFD guidance

Footprinting methodology focuses on locating activities and estimating impact drivers

Nature footprint methodology and alignment to TNFD LEAP approach (see Appendix for full details)

Phase 1: Nature footprint (A–D) | **Phase 2: Mitigation[2]** (E)

	A. Identify value chain	B. Assess materiality	C. Locate potential nature impacts	D. Estimate impact drivers / pressures	E. Identify levers to mitigate impacts
Description	Define company activities by sector and value chain	Identify which impact drivers are most material at each stage of value chain	Locate all activities and identify interfaces with nature	Assess the scale of impact drivers both quantitatively and qualitatively	Develop and prioritize a set of levers to reduce impacts on nature[2]
Approach	For selected sectors, develop a high-level view of the key stages of the value chain and list activities at each stage	Use SBTN's sectoral materiality assessment tool and validate with expert assessment of local conditions	For select material stages, use geospatial analysis to identify interfaces and evaluate potential for impact	For select material stages and impact drivers, calculate impact drivers using a mix of direct reporting and proxy data	Develop longlist of mitigation levers and prioritize based on high-level assessment of impact and feasibility
Alignment to TNFD LEAP approach[1]	LEAP step L1, to map all activities and direct operations	LEAP steps L2, E1, and E4, to screen potential impacts, identify impact drivers, and assess which are material	LEAP steps L1, L3, and L4, to map activities and identify interfaces by ecosystem, biome, and sensitive locations	LEAP steps E1, E2, and E3 to select, identify, and measure impact drivers and impacts	LEAP steps A1 and A4 to identify and prioritize opportunities for action

1.The TNFD framework is meant for corporates and financial institutions; its application to a country- or sector-level assessment is imperfect
2.See appendix for prioritization considerations

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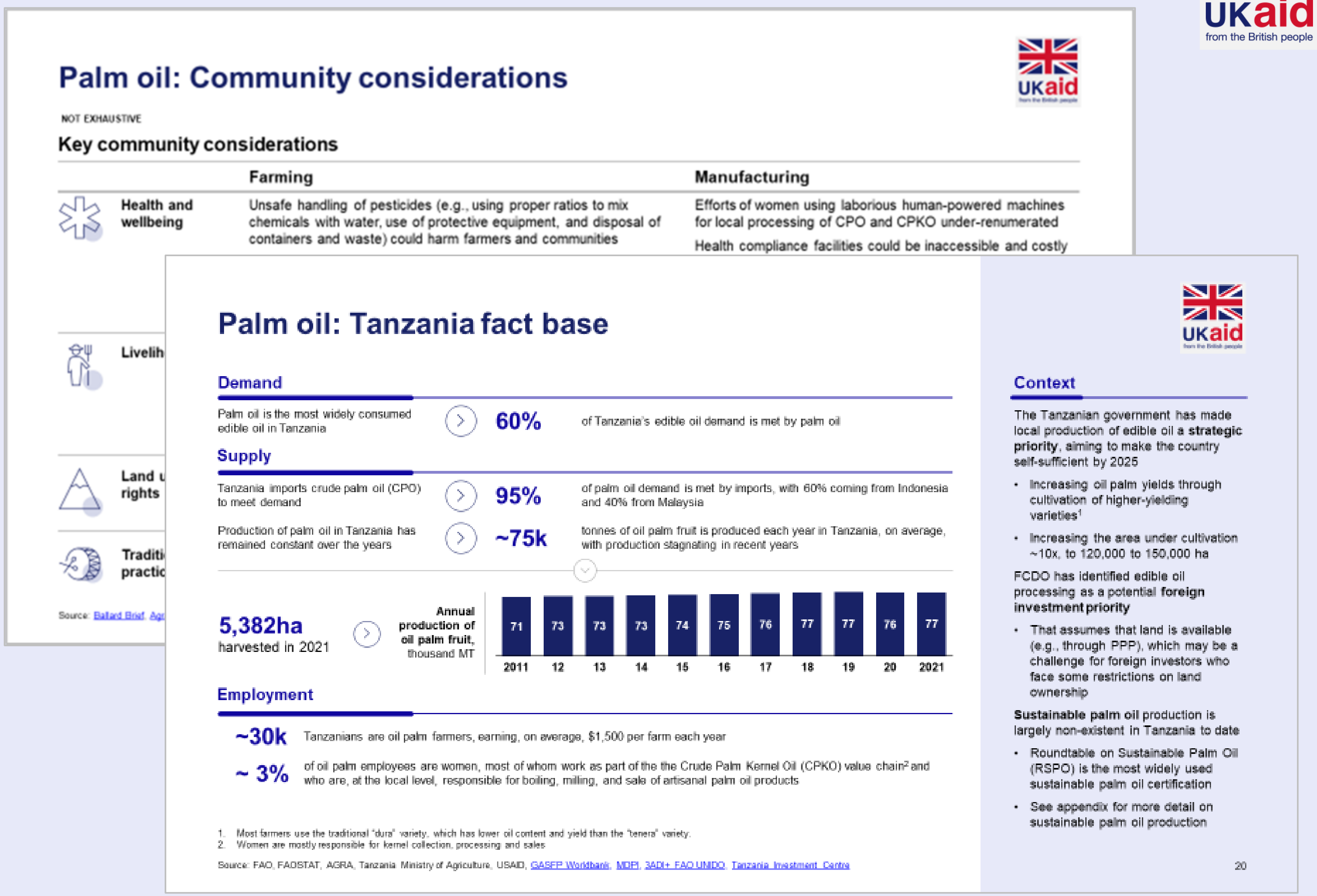
Sector context

Provide important context on sector with a double-click on important community considerations

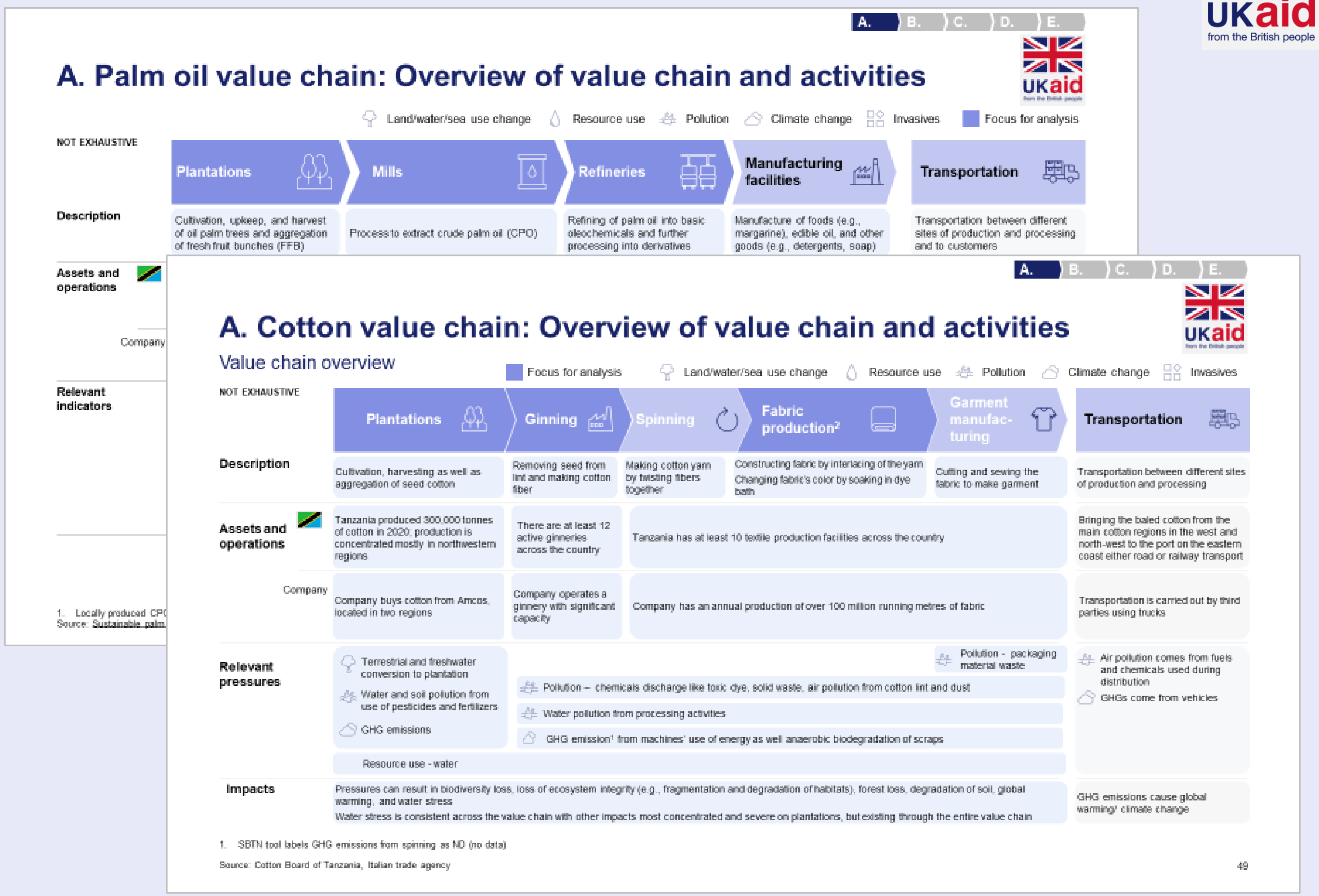


See Appendix for detailed view of analyses

A. Value Chain

Develop a high-level overview of the sector value chain

Can include company-specific information



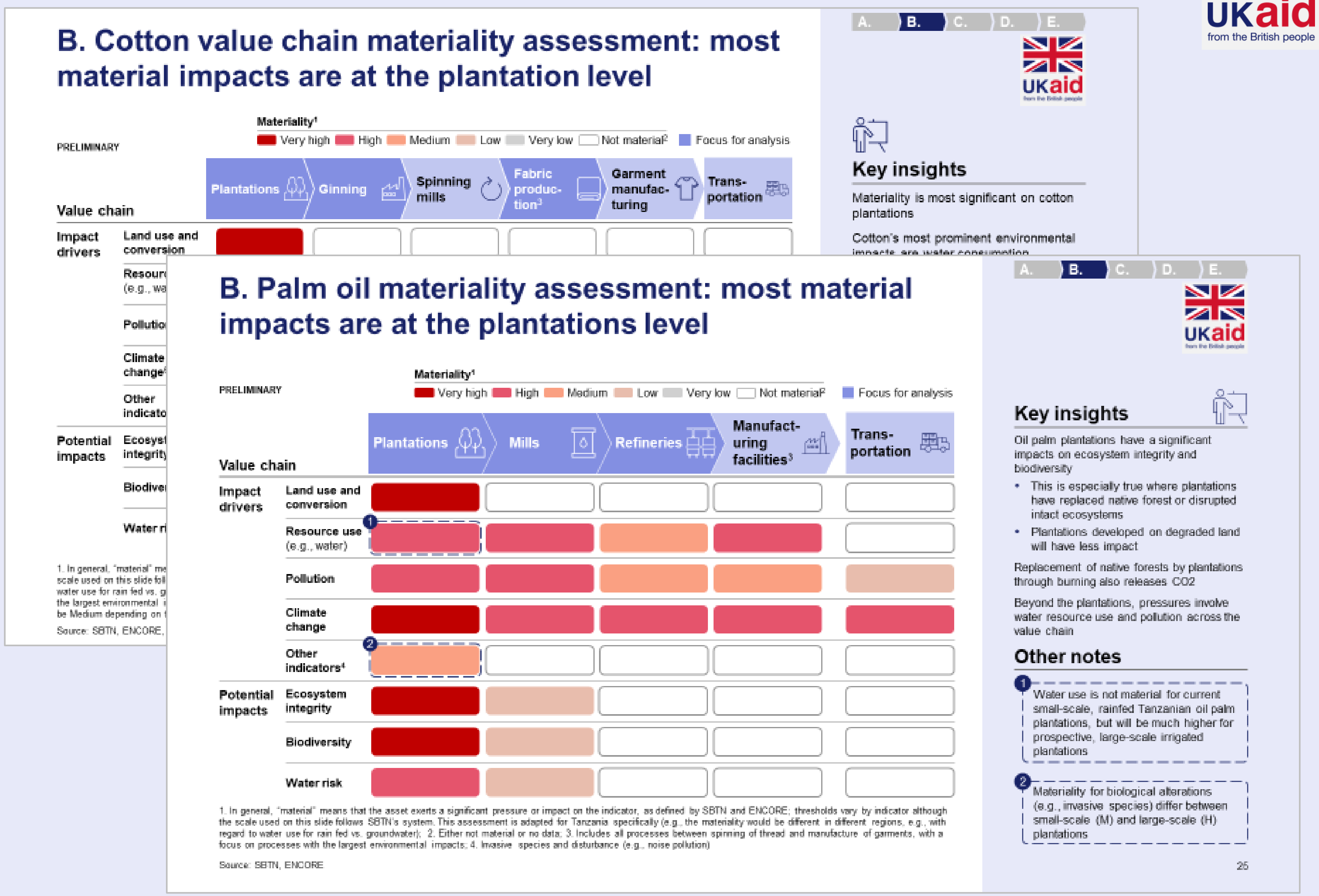
See Appendix for detailed view of analyses

B. Materiality

Use SBTN tool and expert assessment to identify which “impact drivers” or “pressures” are most material at each stage of value chain

Subsequent analyses will focus on these stages

See Appendix for detailed view of analyses



B. Palm oil materiality assessment: most material impacts are at the plantations level

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Materiality[1]

Very high | High | Medium | Low | Very low | Not material[2] | Focus for analysis

Value chain		Plantations	Mills	Refineries	Manufacturing facilities[3]	Transportation
Impact drivers	**Land use and conversion**	Very high	Not material	Not material	Not material	Not material
	Resource use (e.g., water)	High (1)	High	Medium	High	Not material
	Pollution	High	High	Medium	Medium	Low
	Climate change	Very high	High	High	High	High
	Other indicators[4]	Medium (2)	Not material	Not material	Not material	Not material
Potential impacts	**Ecosystem integrity**	Very high	Low	Not material	Not material	Not material
	Biodiversity	Very high	Low	Not material	Not material	Not material
	Water risk	High	Low	Not material	Not material	Not material

1. In general, "material" means that the asset exerts a significant pressure or impact on the indicator, as defined by SBTN and ENCORE; thresholds vary by indicator although the scale used on this slide follows SBTN's system. This assessment is adapted for Tanzania specifically (e.g., the materiality would be different in different regions, e.g., with regard to water use for rain fed vs. groundwater); 2. Either not material or no data; 3. Includes all processes between spinning of thread and manufacture of garments, with a focus on processes with the largest environmental impacts; 4. Invasive species and disturbance (e.g., noise pollution)

Source: SBTN, ENCORE

Key insights

Oil palm plantations have a significant impacts on ecosystem integrity and biodiversity

- This is especially true where plantations have replaced native forest or disrupted intact ecosystems
- Plantations developed on degraded land will have less impact

Replacement of native forests by plantations through burning also releases CO2

Beyond the plantations, pressures involve water resource use and pollution across the value chain

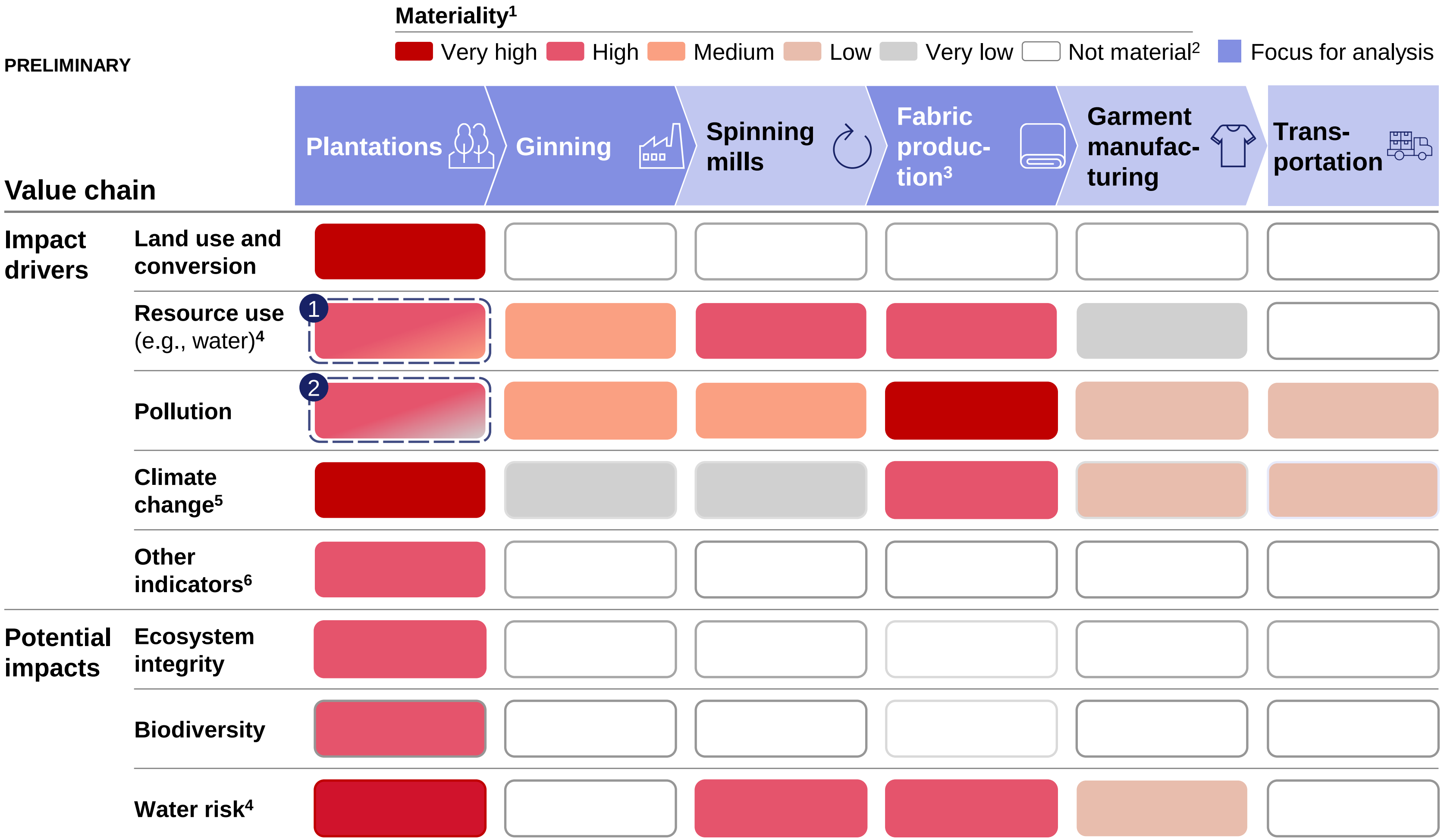
Other notes

1. Water use is not material for current small-scale, rainfed Tanzanian oil palm plantations, but will be much higher for prospective, large-scale irrigated plantations

2. Materiality for biological alterations (e.g., invasive species) differ between small-scale (M) and large-scale (H) plantations

B. Cotton value chain materiality assessment: most material impacts are at the plantation level

PRELIMINARY



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Source: SBTN, ENCORE, WorldWidelifeFund, Trvst

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Key insights

Materiality is most significant on cotton plantations

Cotton's most prominent environmental impacts are water consumption, pollution, and conversion of habitat

- Cotton is one of the largest users of water among all agricultural commodities
- Runoff of pesticides and fertilizer can lead to water pollution, health risks, ecosystem disruption, loss of biodiversity, and economic implications for local communities

1 Water use materiality is medium for current rainfed cotton growing, but could be higher if irrigation is introduced

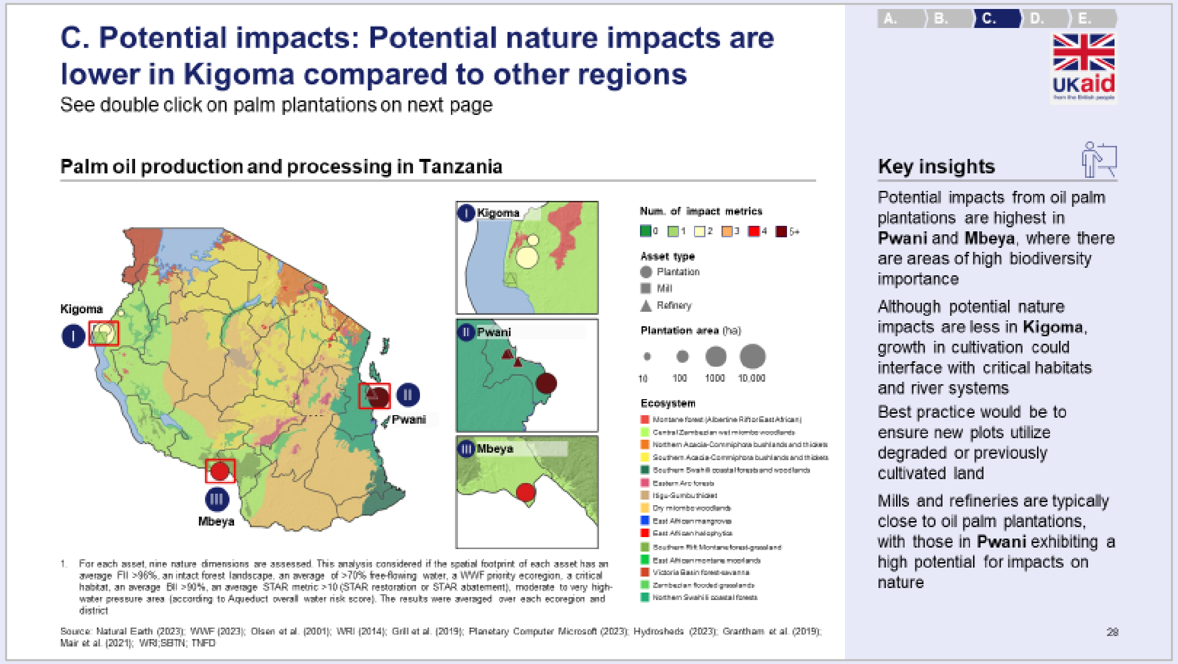
2 Pesticide pollution is high, while other sources of pollution are medium to very low

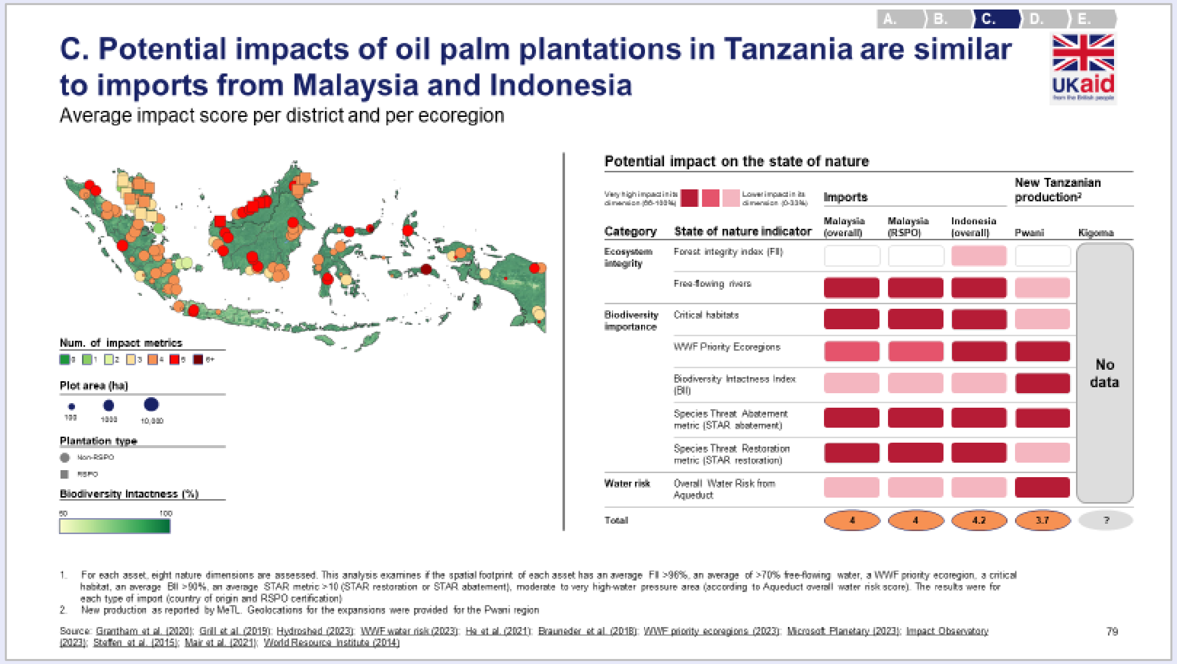
C. Potential impacts

Locate all activities and identify interfaces with nature to assess potential impacts

Multiple analyses can be run by region, stage of value chain, supplier, etc.

See Appendix for detailed view of analyses

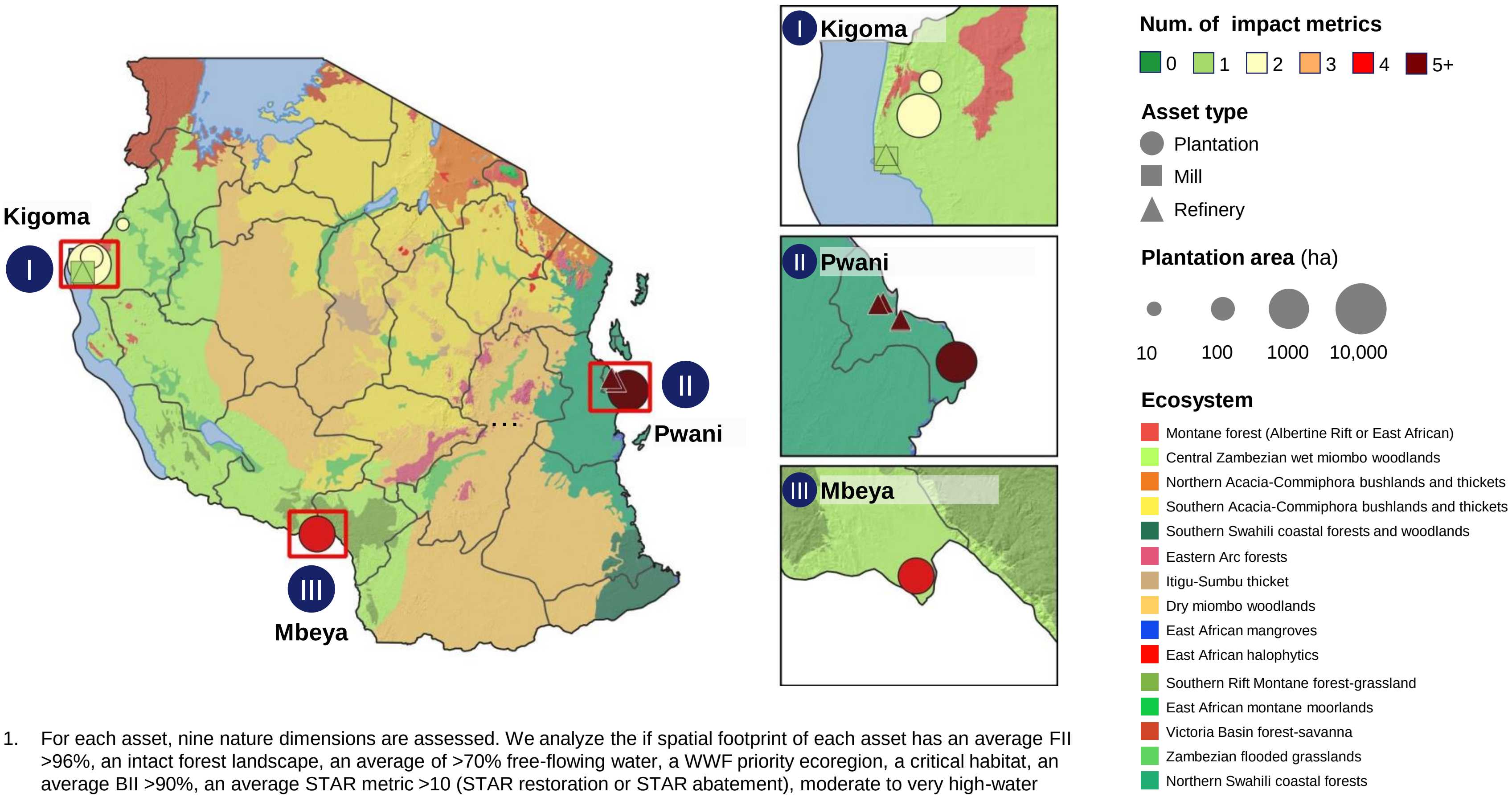




C. Potential impacts: Potential nature impacts are lower in Kigoma compared to other regions

See double click on palm plantations on next page

Palm oil production and processing in Tanzania



1. For each asset, nine nature dimensions are assessed. We analyze the if spatial footprint of each asset has an average FII >96%, an intact forest landscape, an average of >70% free-flowing water, a WWF priority ecoregion, a critical habitat, an average BII >90%, an average STAR metric >10 (STAR restoration or STAR abatement), moderate to very high-water pressure area (according to Aqueduct overall water risk score). The results were averaged over each ecoregion and district

Source: Natural Earth (2023); WWF (2023); Olsen et al. (2001); WRI (2014); Grill et al. (2019); Planetary Computer Microsoft (2023); Hydrosheds (2023); Grantham et al. (2019); Mair et al. (2021); WRI;SBTN; TNFD

Key insights

Potential impacts from oil palm plantations are highest in **Pwani** and **Mbeya**, where there are areas of high biodiversity importance

Although potential nature impacts are less in **Kigoma**, growth in cultivation could interface with critical habitats and river systems

Best practice would be to ensure new plots utilize degraded or previously cultivated land

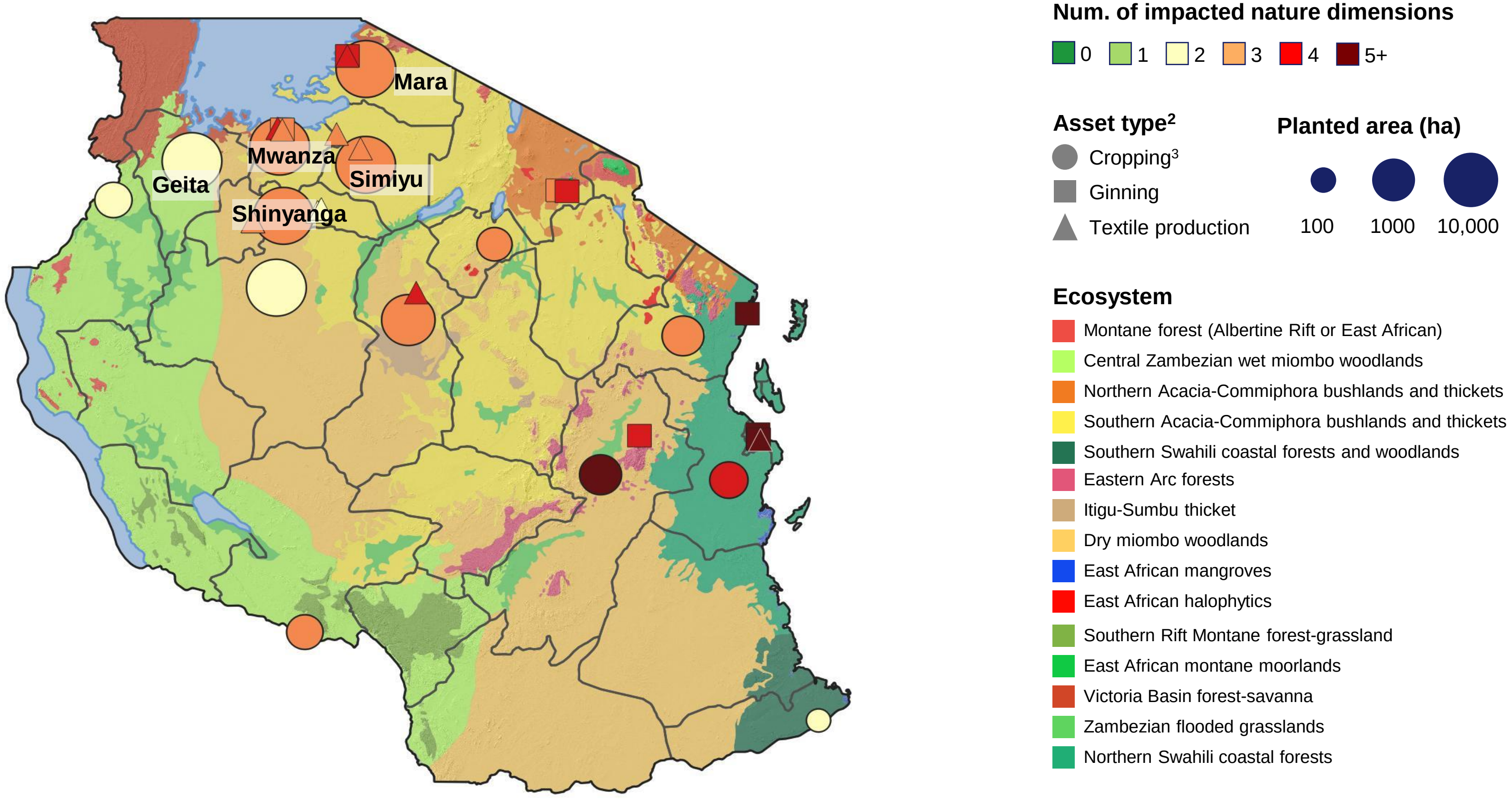
Mills and refineries are typically close to oil palm plantations, with those in **Pwani** exhibiting a high potential for impacts on nature

C. Potential impacts: Most cotton production occurs in the north of the country

Potential impact overview by province[1]

PRELIMINARY

Cotton production and processing in Tanzania



Key insights

Tanzania's **top 5 cotton growing regions** are Simiyu, Mwanza, Shinyanga, Geita, and Mara, all in the northwest

Combined, these regions account for **~92%** of Tanzania's cotton farmland

Nearly **75%** of Tanzania's cotton is grown in the north of the country in *Southern Acacia Commiphora bushlands and thickets*

Although the potential for nature impacts in this ecoregion is lower, the exact location of plantations matters, as elevated **water risks** are present, which cotton plantations can exacerbate

Gins and textile production facilities are generally located near cotton plantations, but are distributed throughout the country

1. For each asset, nine nature dimensions are assessed. This analysis considered if the spatial footprint of each asset has an average FII >96%, an intact forest landscape, an average of >70% free-flowing water, a WWF priority ecoregion, a critical habitat, an average BII >90%, an average STAR metric >10 (STAR restoration or STAR abatement), moderate to very high-water pressure area (according to Aqueduct overall water risk score). The results were averaged over district; 2. Location data for ginning and textile production was collected bottom-up and may be incomplete; 3. The planted area is derived from national statistics and the ecosystem map developed by Olsen et al. (2017); cotton production is aggregated per district and ecosystem

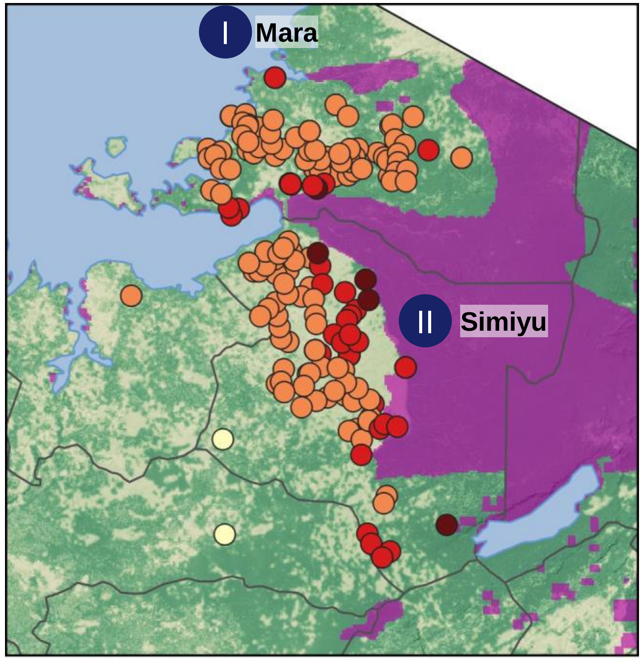
Source: Natural Earth (2023); WWF (2023); Olsen et al. (2001); WRI (2014); Grill et al. (2019); Planetary Computer Microsoft (2023); Hydrosheds (2023); Grantham et al. (2019); Mair et al. (2021); WRI;SBTN; TNFD; National Sample Census of Agriculture 2019/2020 (NBS Tanzania)

C. The company currently sources some of its cotton from areas adjacent to critical habitats

PRELIMINARY

Very high impact in its dimension (66-100%) — Lower impact in its dimension (0-33%)

Source farms and potential impacts[1]



Cotton farm

Number of impact metrics

0 1 2 3 4 5+

BII (%)

50 100

Critical habitat

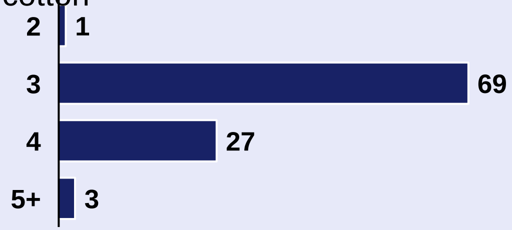
Average impact score per region

Category	State of nature indicator	I Mara	II Simiyu
	Forest integrity index (FII)		
	Intact Forest Landscapes		
	Free-flowing rivers		
	Critical habitats		
	WWF Priority Ecoregions		
	Biodiversity Intactness Index (BII)		
	Species Threat Abatement metric (STAR abatement)		
	Species Threat Restoration metric (STAR restoration)		
	Overall Water Risk from Aqueduct		
		3.2	3.3

Key insights

Mara and Simiyu include many farms close to the **Serengeti National Park**, where there is a higher potential impact

Origin of company cotton by number of impact metrics, % of cotton



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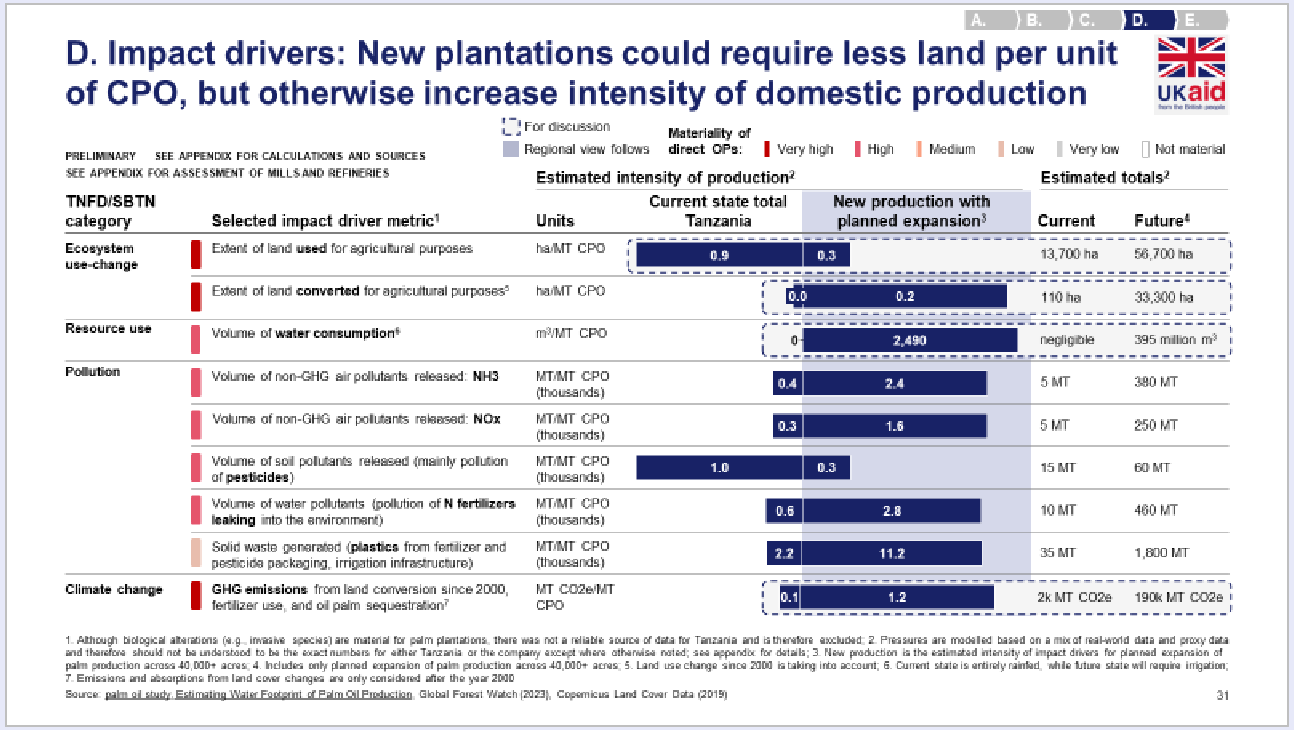
Source: Natural Earth (2023); WWF (2023); Olsen et al. (2001); WRI (2014); Grill et al. (2019); Planetary Computer Microsoft (2023); Hydrosheds (2023); Grantham et al. (2019); Mair et al. (2021); Global Forest Watch (2023), WRI;SBTN; TNFD

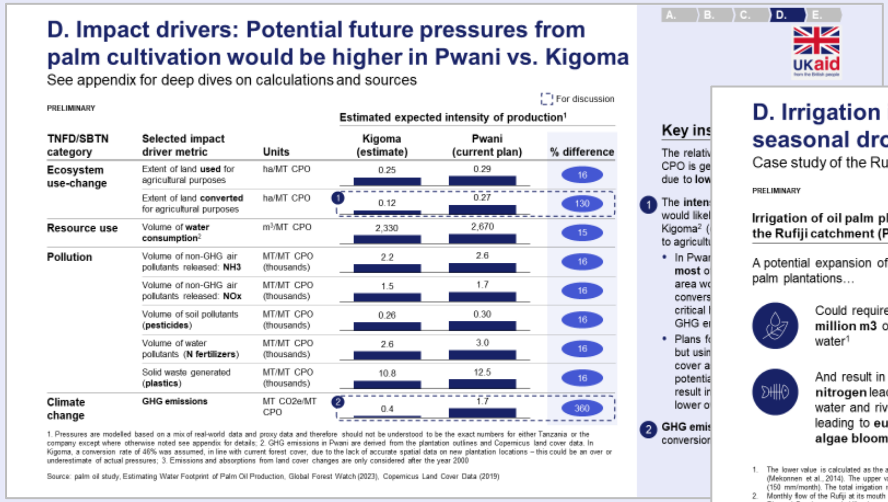
D. Impact drivers and pressures

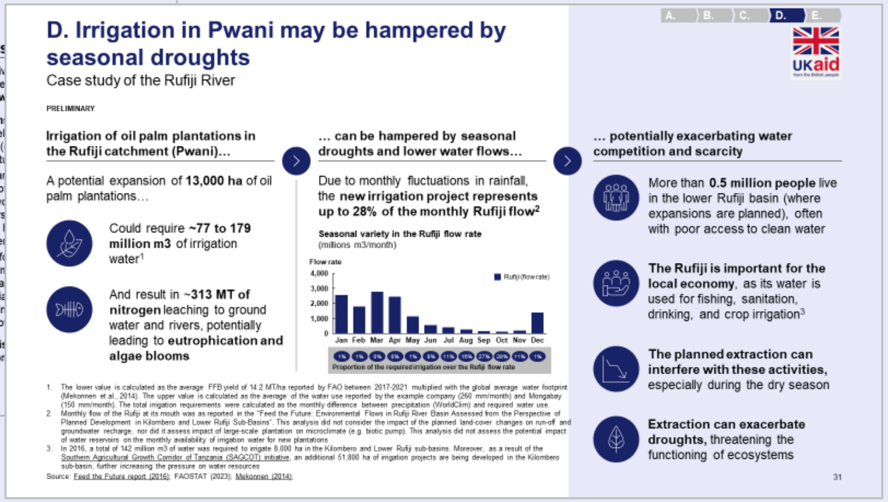
Assess the scale of impact drivers/pressures both quantitatively and qualitatively

Perform deep dive analyses by region and by pressure as needed

See Appendix for detailed view of analyses







D. Impact drivers: New plantations could require less land per unit of CPO, but otherwise increase intensity of domestic production

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For discussion
Regional view follows

Materiality of direct OPs: Very high | High | Medium | Low | Very low | Not material

PRELIMINARY SEE APPENDIX FOR CALCULATIONS AND SOURCES
SEE APPENDIX FOR ASSESSMENT OF MILLS AND REFINERIES

TNFD/SBTN category	Selected impact driver metric[1]	Units	Estimated intensity of production[2]: Current state total Tanzania	Estimated intensity of production[2]: New production with planned expansion[3]	Estimated totals[2]: Current	Estimated totals[2]: Future[4]
Ecosystem use-change	Extent of land **used** for agricultural purposes	ha/MT CPO	0.9	0.3	13,700 ha	56,700 ha
	Extent of land **converted** for agricultural purposes[5]	ha/MT CPO	0.0	0.2	110 ha	33,300 ha
Resource use	Volume of **water consumption**[6]	m^3/MT CPO	0	2,490	negligible	395 million m^3
Pollution	Volume of non-GHG air pollutants released: **NH3**	MT/MT CPO (thousands)	0.4	2.4	5 MT	380 MT
	Volume of non-GHG air pollutants released: **NOx**	MT/MT CPO (thousands)	0.3	1.6	5 MT	250 MT
	Volume of soil pollutants released (mainly pollution of **pesticides**)	MT/MT CPO (thousands)	1.0	0.3	15 MT	60 MT
	Volume of water pollutants (pollution of **N fertilizers leaking** into the environment)	MT/MT CPO (thousands)	0.6	2.8	10 MT	460 MT
	Solid waste generated (**plastics** from fertilizer and pesticide packaging, irrigation infrastructure)	MT/MT CPO (thousands)	2.2	11.2	35 MT	1,800 MT
Climate change	**GHG emissions** from land conversion since 2000, fertilizer use, and oil palm sequestration[7]	MT CO2e/MT CPO	0.1	1.2	2k MT CO2e	190k MT CO2e

1. Although biological alterations (e.g., invasive species) are material for palm plantations, there was not a reliable source of data for Tanzania and is therefore excluded; 2. Pressures are modelled based on a mix of real-world data and proxy data and therefore should not be understood to be the exact numbers for either Tanzania or the company except where otherwise noted; see appendix for details; 3. New production is the estimated intensity of impact drivers for planned expansion of palm production across 40,000+ acres; 4. Includes only planned expansion of palm production across 40,000+ acres; 5. Land use change since 2000 is taking into account; 6. Current state is entirely rainfed, while future state will require irrigation; 7. Emissions and absorptions from land cover changes are only considered after the year 2000

Source: palm oil study, Estimating Water Footprint of Palm Oil Production, Global Forest Watch (2023), Copernicus Land Cover Data (2019)

D. Impact drivers: Potential future pressures from palm cultivation would be higher in Pwani vs. Kigoma

See appendix for deep dives on calculations and sources

For discussion

PRELIMINARY

TNFD/SBTN category	Selected impact driver metric	Units	Estimated expected intensity of production[1]: Kigoma (estimate)	Pwani (current plan)	% difference
Ecosystem use-change	Extent of land **used** for agricultural purposes	ha/MT CPO	0.25	0.29	16
	1 Extent of land **converted** for agricultural purposes	ha/MT CPO	0.12	0.27	130
Resource use	Volume of **water consumption**[2]	m^3/MT CPO	2,330	2,670	15
Pollution	Volume of non-GHG air pollutants released: **NH3**	MT/MT CPO (thousands)	2.2	2.6	16
	Volume of non-GHG air pollutants released: **NOx**	MT/MT CPO (thousands)	1.5	1.7	16
	Volume of soil pollutants (**pesticides**)	MT/MT CPO (thousands)	0.26	0.30	16
	Volume of water pollutants (**N fertilizers**)	MT/MT CPO (thousands)	2.6	3.0	16
	Solid waste generated (**plastics**)	MT/MT CPO (thousands)	10.8	12.5	16
Climate change	2 **GHG emissions**	MT CO2e/MT CPO	0.4	1.7	360

1. Pressures are modelled based on a mix of real-world data and proxy data and therefore should not be understood to be the exact numbers for either Tanzania or the company except where otherwise noted see appendix for details; 2. GHG emissions in Pwani are derived from the plantation outlines and Copernicus land cover data. In Kigoma, a conversion rate of 46% was assumed, in line with current forest cover, due to the lack of accurate spatial data on new plantation locations – this could be an over or underestimate of actual pressures; 3. Emissions and absorptions from land cover changes are only considered after the year 2000

Source: palm oil study, Estimating Water Footprint of Palm Oil Production, Global Forest Watch (2023), Copernicus Land Cover Data (2019)

Key insights

The relative pressure per unit of CPO is generally higher in Pwani due to **lower average yields**

1. The **intensity of land conversion** would likely be higher in Pwani than Kigoma[2] (e.g., the conversion of land to agriculture)
   - In Pwani, based on current plans, **most** of the potential plantation area would result in land conversion
   - Plans for Kigoma are not known, but using average forest/woodland cover as a proxy **46%** of the potential plantation area could result in land conversion with a lower overlap with critical habitats
2. **GHG emissions** rise along with land conversion

Palm oil: Take-aways from nature footprinting

For Tanzania

- Tanzanian plantations can match the productivity of imports, with new palm varieties **increasing yields 2-3x** compared to current, small-scale domestic production
- Oil palm plantation development could create **100,000+ new jobs**[1] in Tanzania
- **Pressures on nature would increase**; including only one company's plans (40,000+ ha, ~30% of the government target), total pressures vs. current state would be
  - **~300x** land conversion driven by oil palms (additional ~33,000 ha)
  - **~95x** GHGs from land conversion and the associated loss of woodlands/forests for new oil palm plantations
  - **>40,000x** increase in oil palm water consumption given need to switch from rainfed to irrigation
- Careful planning is needed to site plantations where pressures can be absorbed with minimal impact

For company

- The company's plans for palm oil are still in early stages, creating an opportunity to **account for potential nature impacts and dependencies in planning**
- Most of the current planned plantation area in **Pwani** is likely to result in land conversion and the loss of woodlands and forests, which would **negatively impact the company's ability to access international financing** and to sell into Western supply chains
  - **International investors and buyers** expect companies exposed to palm oil supply chains to, at minimum, **adopt a suite of No Deforestation, Peat and Exploitation (NDPE) policies**[2]
- Company plans for plantations in **Kigoma** could be affected by limited water available for irrigation (which would likely be required to achieve planned yields)
  - For example, monthly fluctuations in rainfall mean that up to 28% of the water flowing in the Rufiji River in October could be needed to irrigate company palms

1. Across direct, indirect, and induced jobs; assumes development of 100,000 ha
2. Many international and local banks have adopted NDPE policies that bar them from serving or lending to companies that violate these rules (see Appendix); the definition of deforestation can vary by region and regulation; Tanzania defines "forests" as areas ≥0.5ha with crown cover ≥10% of area and average tree height ≥3m (per Tanzania's Forest Emission Level Submission to the UNFCCC (2016)); this also aligns with the definition used in the EUDR

Cotton: Take-aways from nature footprinting

For Tanzania

- **Yield improvement of up to 2x could be achieved** with the application of fertilizer, increases in irrigation, and adoption of new cotton seed strains
  - This would increase land use efficiency (and reduce pressure on land use conversion) but likely **increase other nature pressures** (e.g., water consumption and pollution)**, which** would have to be assessed and managed
  - Improvement in on-farm practices would likely need to **include incentives**, such as finance, to drive farmer adoption, as well as political support
- Wider adoption of water treatment and recycling could **halve wastewater pollution and the volume of freshwater required** for fabric production

For example company

- There is an opportunity for the company to work with their cotton farmers to **improve yields**
  - Better on-farm practices could help **insulate the company from fluctuations in domestic cotton production** (e.g., irrigated crops are less variable than rain-fed)
  - Improved crop yields may also help **lower costs for farmers**, and therefore input prices for the company
- The company could also use its position as a leading domestic buyer of cotton to **partner with others** (e.g., NGOs, government, other buyers) to influence on-farm practices more broadly
- **Converting coal-powered boilers to cleaner sources of energy** (e.g., natural gas, biomass) could reduce the company's carbon footprint

E. Lever identification

Develop a long list of levers to reduce impacts on nature

See Appendix for detailed view of analyses

Palm oil: Sector-wide opportunities to reduce pressures on nature (1/4)

Oil palm plantations

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Pressures on nature | Ecosystem use-change | Resource use | Pollution | Climate change | Biodiversity and ecosystem integrity

Category	Sub-category	Technical lever	Primary pressures addressed
Land-use optimization	Land identification	Avoid planting in areas with high biodiversity importance (e.g., critical habitats) and/or priority ecosystems (e.g., peatlands, tropical forests, mangroves), or areas requiring deforestation	
		Plant in areas that do not require use change and do not displace existing activities to priority ecosystems (e.g., brownfield lands, closed mines, degraded land)	
	Crop placement	Place palms within plantation area to minimize pressures to nature and maximize yields (e.g., avoid planting on slopes where there is erosion risk, spacing sprouts in a triangular pattern to get around 145 plants per hectare)	
	Buffer protection	Plant buffer crops to safeguard habitats around fields to reduce invasive species, human-nature conflict, runoff, and wildfires, among other pressures	
Farming practices	Regenerative agriculture	Use cover crops, such as legumes, as oil palms mature to improve soil fertility and health and to reduce soil erosion	
		Use intercropping techniques with common intercrops (e.g., Black pepper vines, beans, maize, cassava) to help prevent spread of pests and diseases, increase soil fertility, and reduce need for fertilizers	
		Implement agroforestry by integrating livestock, such as poultry or small ruminants, into the oil palm plantation, which can help in nutrient cycling, pest control, etc. (only applicable for small holdings)	
	Seed selection	Use oil palm varieties best optimized for local conditions (e.g., disease-resistant, pest resistant, adopted to climate change)	
		Use oil palm varieties best optimized for yields (e.g., e.g., Tenera instead of Dura)	
		Select oil palm varieties with low Free Fatty Acid content to get higher quality output after processing	

Source: Intercropping, oil palm cultivation and management

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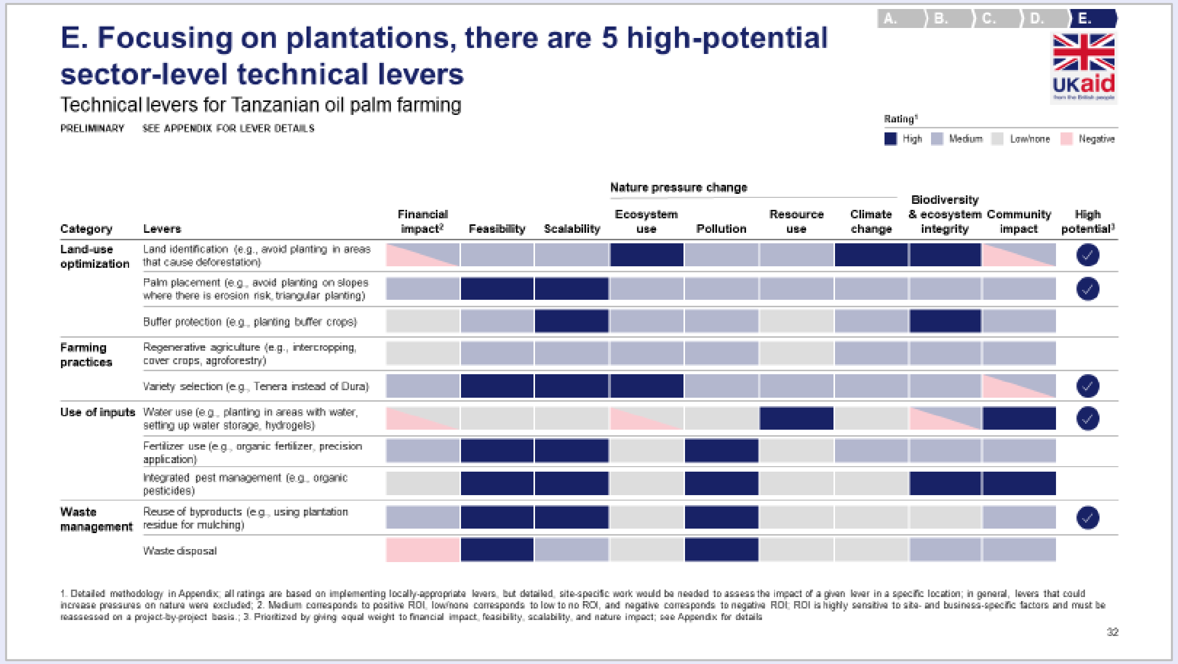
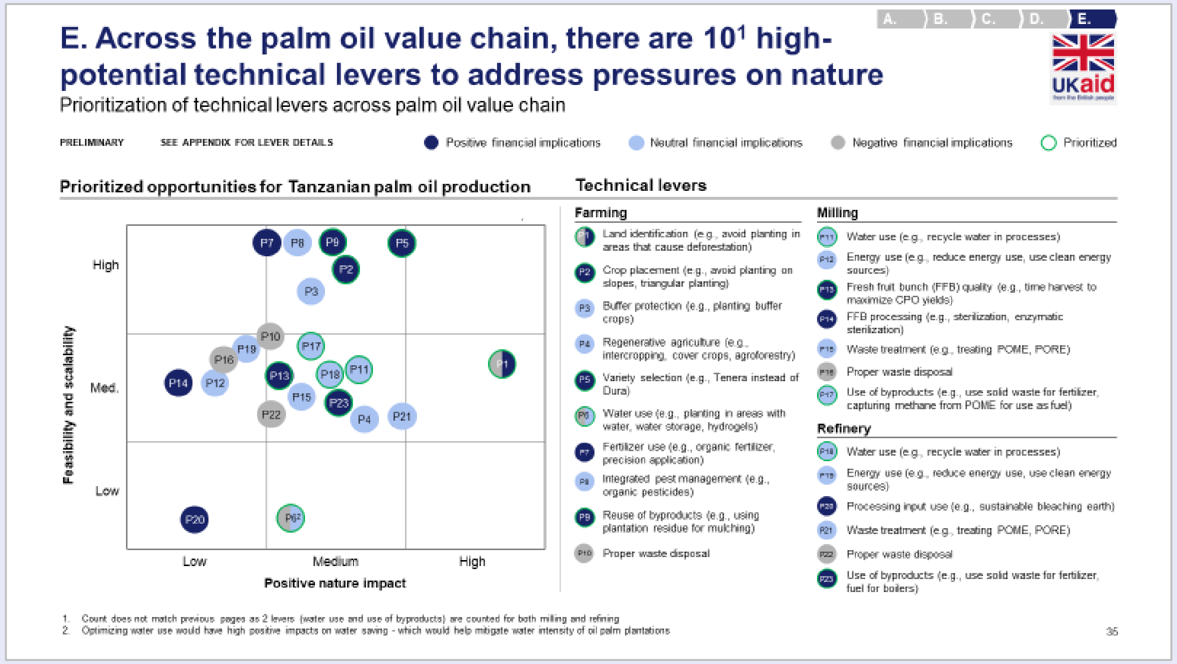
A. B. C. D. E.

E. Lever prioritization

Prioritize a set of levers to reduce impacts on nature





See Appendix for detailed view of analyses, including deep dive on prioritization considerations

Methodology for prioritizing sector-level technical levers

Tanzania-specific qualitative assessment across six criteria

Double-click follows

		High	Medium	Low / negative
Financial impact	Will the lever generate positive, negative, or neutral ROI?	Positive	Neutral	Negative
Feasibility	How quickly could a lever be implemented, technically?	<1 year to implement	1-3 years to implement	3+ years to implement
Scalability	How much of the value chain stage could the lever apply to?	>75%	25-75%	>25%
Nature improvement	To what extent will the lever reduce pressure on 4 areas of nature?[1]	Significant reduction	Some reduction	No change or negative impact
Biodiversity & ecosystem integrity	What are the expected impacts to biodiversity and ecosystems?	Positive	Neutral	Negative
Community impact	What are the expected impacts to affected local communities?	Positive	Neutral	Negative

In general, levers with obvious negative impacts on nature or communities were excluded

1. Ecosystem use-change, pollution, resource use and climate change

Focusing on plantations, there are 5 high-potential sector-level technical levers

Technical levers for Tanzanian oil palm farming

PRELIMINARY **SEE APPENDIX FOR LEVER DETAILS**

Rating[1]: High | Medium | Low/none | Negative

Category	Levers	Financial impact[2]	Feasibility	Scalability	Nature pressure change: Ecosystem use	Pollution	Resource use	Climate change	Biodiversity & ecosystem integrity	Community impact	High potential[3]
Land-use optimization	Land identification (e.g., avoid planting in areas that cause deforestation)	Negative/Medium	Medium	Medium	High	Medium	Medium	High	High	Negative/Medium	✓
	Palm placement (e.g., avoid planting on slopes where there is erosion risk, triangular planting)	Medium	High	High	Medium	Medium	Medium	Medium	Medium	Medium	✓
	Buffer protection (e.g., planting buffer crops)	Low/none	Medium	High	Medium	Medium	Low/none	Medium	High	Medium	
Farming practices	Regenerative agriculture (e.g., intercropping, cover crops, agroforestry)	Low/none	Medium	Medium	Medium	Medium	Low/none	Medium	Medium	Medium	
	Variety selection (e.g., Tenera instead of Dura)	Medium	High	High	High	Medium	Medium	Medium	Medium	Negative/Medium	✓
Use of inputs	Water use (e.g., planting in areas with water, setting up water storage, hydrogels)	Negative/Low/none	Low/none	Low/none	Negative/Low/none	Low/none	High	Low/none	Negative/Medium	High	✓
	Fertilizer use (e.g., organic fertilizer, precision application)	Medium	High	High	Low/none	High	Low/none	Medium	Medium	Medium	
	Integrated pest management (e.g., organic pesticides)	Low/none	High	High	Low/none	High	Low/none	Low/none	High	High	
Waste management	Reuse of byproducts (e.g., using plantation residue for mulching)	Medium	High	High	Low/none	High	Low/none	Low/none	Low/none	Medium	✓
	Waste disposal	Negative	High	Medium	Low/none	High	Low/none	Low/none	Medium	Medium	

1. Detailed methodology in Appendix; all ratings are based on implementing locally-appropriate levers, but detailed, site-specific work would be needed to assess the impact of a given lever in a specific location; in general, levers that could increase pressures on nature were excluded; 2. Medium corresponds to positive ROI, low/none corresponds to low to no ROI, and negative corresponds to negative ROI; ROI is highly sensitive to site- and business-specific factors and must be reassessed on a project-by-project basis.; 3. Prioritized by giving equal weight to financial impact, feasibility, scalability, and nature impact; see Appendix for details

Across the palm oil value chain, there are 10[1] high-potential technical levers to address pressures on nature

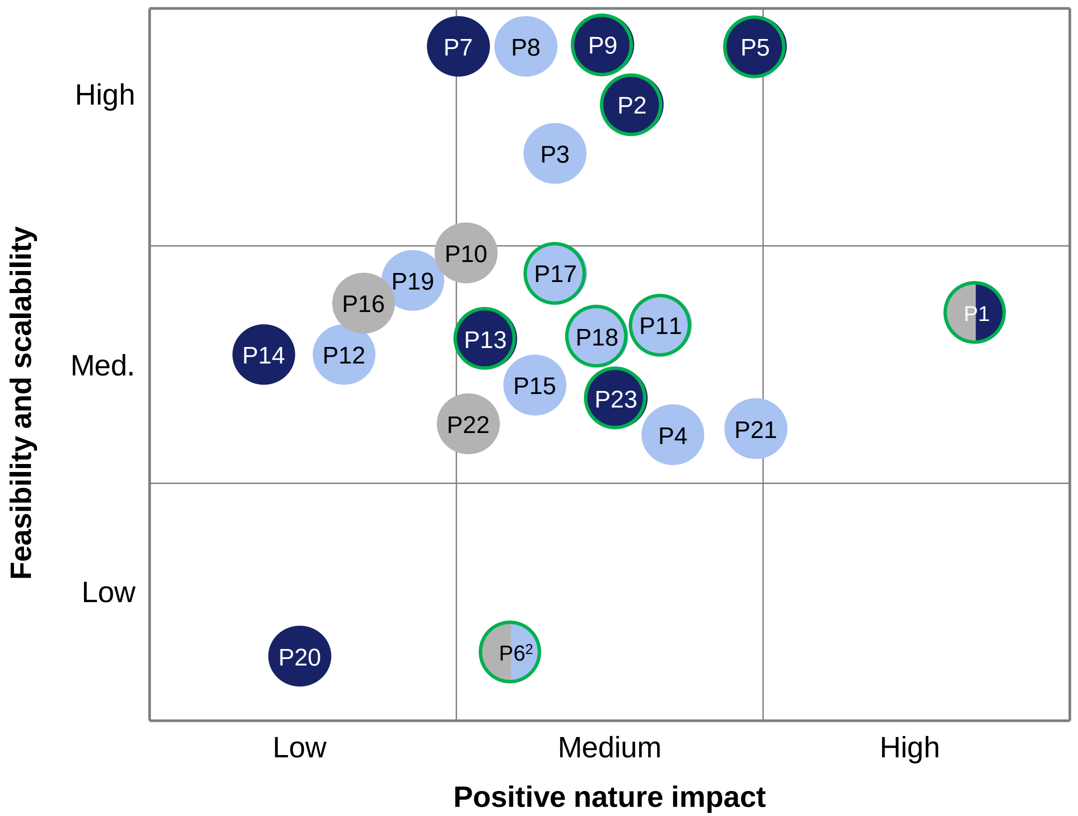
Prioritization of technical levers across palm oil value chain

UKaid from the British people

PRELIMINARY **SEE APPENDIX FOR LEVER DETAILS**

Positive financial implications · Neutral financial implications · Negative financial implications · Prioritized

Prioritized opportunities for Tanzanian palm oil production



Technical levers

Farming

- P1 Land identification (e.g., avoid planting in areas that cause deforestation)
- P2 Crop placement (e.g., avoid planting on slopes, triangular planting)
- P3 Buffer protection (e.g., planting buffer crops)
- P4 Regenerative agriculture (e.g., intercropping, cover crops, agroforestry)
- P5 Variety selection (e.g., Tenera instead of Dura)
- P6 Water use (e.g., planting in areas with water, water storage, hydrogels)
- P7 Fertilizer use (e.g., organic fertilizer, precision application)
- P8 Integrated pest management (e.g., organic pesticides)
- P9 Reuse of byproducts (e.g., using plantation residue for mulching)
- P10 Proper waste disposal

Milling

- P11 Water use (e.g., recycle water in processes)
- P12 Energy use (e.g., reduce energy use, use clean energy sources)
- P13 Fresh fruit bunch (FFB) quality (e.g., time harvest to maximize CPO yields)
- P14 FFB processing (e.g., sterilization, enzymatic sterilization)
- P15 Waste treatment (e.g., treating POME, PORE)
- P16 Proper waste disposal
- P17 Use of byproducts (e.g., use solid waste for fertilizer, capturing methane from POME for use as fuel)

Refinery

- P18 Water use (e.g., recycle water in processes)
- P19 Energy use (e.g., reduce energy use, use clean energy sources)
- P20 Processing input use (e.g., sustainable bleaching earth)
- P21 Waste treatment (e.g., treating POME, PORE)
- P22 Proper waste disposal
- P23 Use of byproducts (e.g., use solid waste for fertilizer, fuel for boilers)

1. Count does not match previous pages as 2 levers (water use and use of byproducts) are counted for both milling and refining
2. Optimizing water use would have high positive impacts on water saving - which would help mitigate water intensity of oil palm plantations

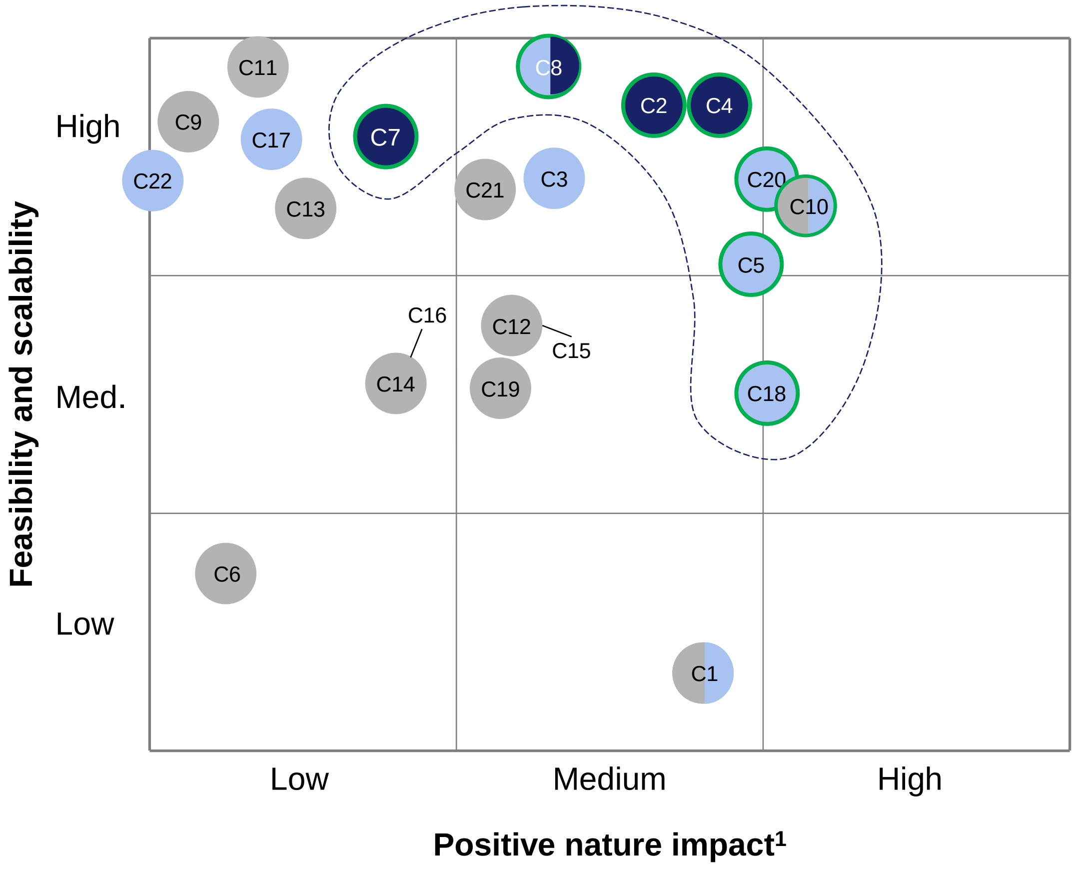
Across the cotton value chain, there are 8 high-potential technical levers to address pressures on nature

Prioritization of technical levers across cotton value chain

PRELIMINARY **SEE APPENDIX FOR LEVER DETAILS**

Positive financial implications | Neutral financial implications | Negative financial implications | Prioritized

Prioritized opportunities for Tanzanian cotton production



Technical levers

Farming

- C1 Agricultural land selection (avoid planting on lands within priority ecosystems and high biodiversity)
- C2 Crop placement (place crops within farm area to minimize pressures to nature and maximize yields)
- C3 Buffer protection (safeguarding habitats)
- C4 Planting techniques (seeds selection, plantation timing, plantation spacing)
- C5 Regenerative agriculture (intercropping, no-till farming, cover crops)
- C6 Water use (sprinkler irrigation systems, rainwater harvesting, deficit irrigation schedule)
- C7 Fertilizer use
- C8 Pesticide use and pest management
- C9 Energy use (using clean energy to transport fertilizers and pesticides, use biogas for short distances)
- C10 Reuse of by-products
- C11 Proper waste disposal

Ginning

- C12 Energy use (produce electricity onsite, use clean energy/biogas in transportation)
- C13 Environmental controls (dust collection systems)
- C14 Use of ginning by-products (cotton seeds, lint, hulls, meal)

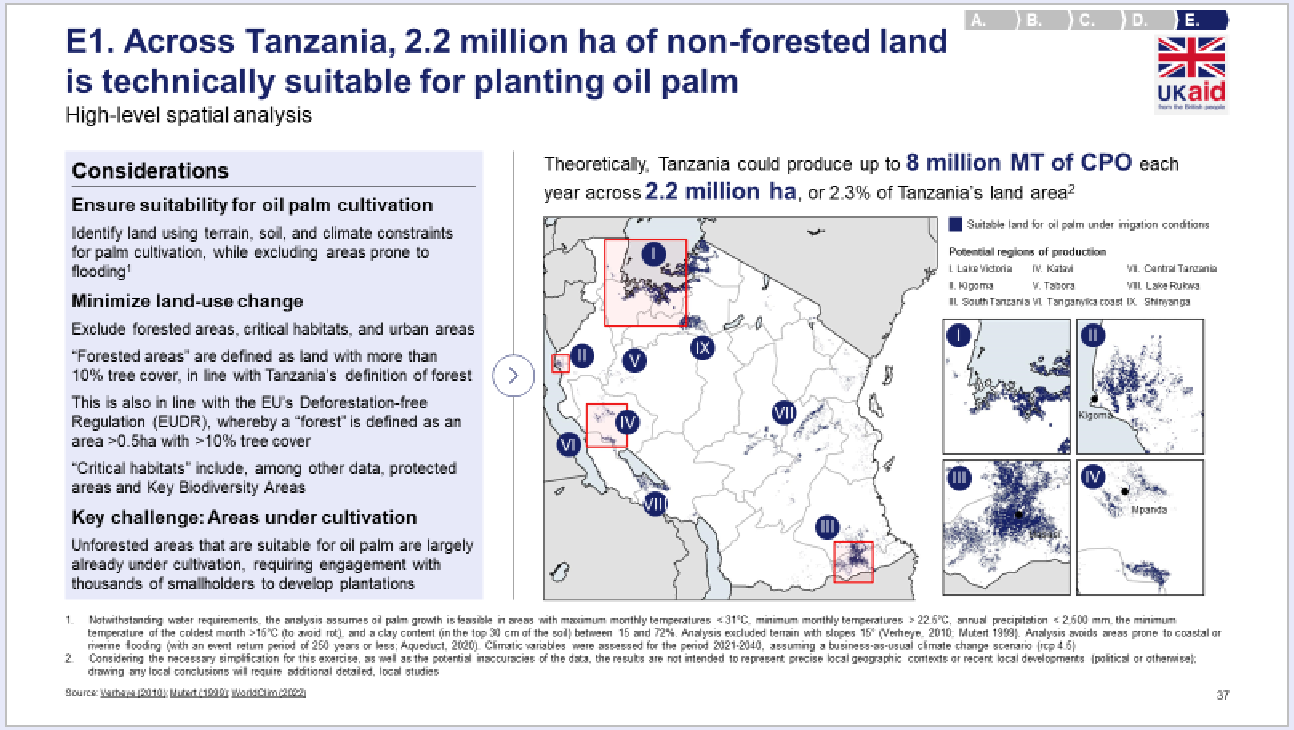
Fabric production

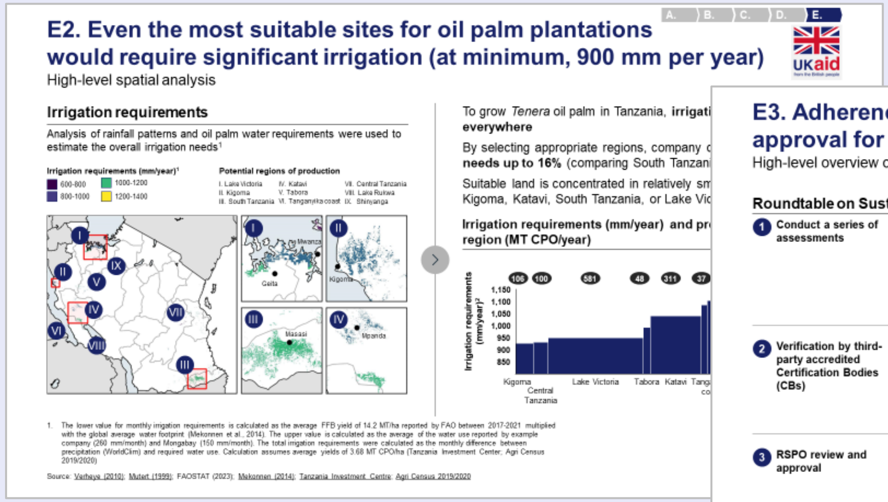
- C15 Energy use (produce electricity onsite, use clean energy/biogas in transportation, fuel sources for boilers)
- C16 Use of fabric production by-products (wastewater sludge, fabric scraps)
- C17 Cotton use (e.g., reducing overall cotton requirements)
- C18 Water use (water-saving technologies, water treatment facilities, reverse osmosis)
- C19 Chemicals use (use less polluting chemicals, reduce chemical use)
- C20 Waste treatment (e.g., set up or expand water treatment facilities)
- C21 Waste disposal (e.g., ensure that waste is disposed of in an environmentally sound fashion)
- C22 Reuse of inputs (recover and re-use material)

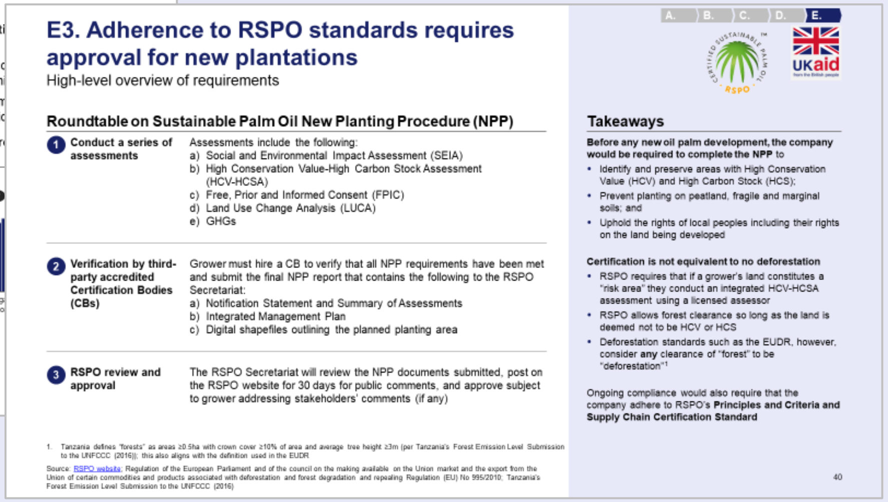
E. Lever deep dives

Deep dive into specific recommendations with bespoke analyses and context-specific guidance

See Appendix for detailed view of analyses







Recommendations for company

Key opportunities

PRELIMINARY

Recommendation

1. Site all palm oil plantations so that they do not cause any deforestation as defined by Tanzania’s government[1]

2. Ensure that water is available for plantations by locating near sources and implementing levers that can help alleviate seasonal water scarcity

3. Apply for RSPO certification for all oil palm plantations and ensure plantations adhere to standards (e.g., follow RSPO’s New Planting Procedure (NPP), including conducting an HCV-HCSA[2])

4. Ensure implementation of “amelioration” measures already identified by company (intercropping, precision fertilizer, etc.)

5. Pursue alternative monetization pathways (e.g., carbon credits) where existing land holdings include priority ecosystems, areas of high biodiversity importance, or land at risk of deforestation

6. Engage smallholder cotton suppliers to ensure that highest-potential technical levers are implemented on the farm

1.Tanzania defines “forests” as areas ≥0.5ha with crown cover ≥10% of area and average tree height ≥3m (per Tanzania's Forest Emission Level Submission to the UNFCCC (2016)); Note that if the company intends to export to the EU it would also need to site plantations to avoid “forest degradation” per the EU’s Deforestation-free Regulation (see Appendix); 2. High Conservation Value-High Carbon Stock Assessment; requires third party verification

Source: Regulation of the European Parliament and of the council on the making available on the Union market and the export from the Union of certain commodities and products associated with deforestation and forest degradation and repealing Regulation (EU) No 995/2010; Tanzania's Forest Emission Level Submission to the UNFCCC (2016)

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Why nature matters

Footprint approach

Example analyses

Check-list approach for investment

Appendix: Selected palm oil example analyses

Appendix: TNFD

Investor nature checklist

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Step	Instructions
1 Assess the materiality of nature impacts for the investment sector	Evaluate sector's material impacts on nature, leveraging the SBTN materiality assessment tool. For high-impact pressures, run SBTN's value chain assessment to understand the sector's contributions to environmental pressures across the value chain.
2 Identify relevant sustainability standards	Conduct a web search for commodity or sector-relevant sustainability standards (e.g., RSPO certification for palm oil).
3 Understand target's sustainability certifications	Review target's sustainability reports to understand if target and has attained any certifications. Research competitors' reports to understand how target's certifications compare to competitors.
4 Identify existing disclosures on nature from target	Review target's sustainability reports and website to identify relevant nature disclosures, including risks. Research competitors' reports to assess how the target's disclosures compare to peers.
5 Assess target's nature-related commitments	Review target's sustainability reports and website to understand nature-related commitments. Research competitors to evaluate how these commitments compare to peers.
6 Evaluate internal nature governance	Work with target to identify and interview key stakeholders to understand what role nature plays in decision making, as well as existing data infrastructure to track the target's nature footprint.
As needed, gather detailed nature footprint from target	Where nature impacts have high materiality and other red flags have been raised above (e.g., incidents impact nature), require target to disclose footprint during diligence to evaluate impact.

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Palm oil: Context and key findings

Context

- **95% of Tanzania's crude palm oil (CPO) is imported** (~420,000 MT of CPO annually), with small-scale domestic production in Kigoma, Pwani, and Mbeya
- The Tanzanian government has previously announced its intention to replace edible oil imports with local production by the end of 2025, although this target is now unlikely to be achieved[1]
  - This could mean **increasing the area under cultivation ~10x**, to 120,000 - 150,000 ha
- The company **currently imports all its CPO** from RSPO-certified[2] sources in Indonesia (~60%) and Malaysia (~40%)
- Company plans to replace its imports with domestic production
  - Phase 1 of the company's plan includes **planting 40,000+ ha in Tanzania** to produce up to 150,000 MT of CPO/year
  - It has identified potential locations for **~30,000 ha in Pwani**, with the remainder intended for Kigoma
  - The company has not yet identified specific locations in **Kigoma**

1. It takes at least 3 years for a palm plant to produce fruit; 2. Roundtable on Sustainable Palm Oil

Key findings from footprint analysis

- Since most CPO is currently imported, current domestic impacts and pressures from the palm oil value chain are low
- However, the expansion of large-scale palm cultivation to replace imports could result in future **disruptions to biodiversity and ecosystem integrity**
  - According to current siting plans, most of the company's potential new plantations in **Pwani** could result in land use change
  - Although sites for **Kigoma** are not yet know, there is potential for habitat loss there as well, albeit estimated to be lower
  - Compared to **Kigoma**, planting in **Pwani** could also require **~16%** more land, and result in **~129%** more land use change, **~15%** more water consumption, and **~366%** more GHG emissions per unit CPO
- **Increased effluent from palm oil milling** is another potential pressure, although projected impacts from company operations are limited due plans for effective treatment and diversion of waste for fertilizer and other uses
- Pressures from **refining** are limited

Palm oil: Take-aways from nature footprinting

For Tanzania

- Tanzanian plantations can match the productivity of imports, with new palm varieties **increasing yields 2-3x** compared to current, small-scale domestic production
- Oil palm plantation development could create **100,000+ new jobs**[1] in Tanzania
- **Pressures on nature would increase**; including only one company's plans (40,000+ ha, ~30% of the government target), total pressures vs. current state would be
  - **~300x** land conversion driven by oil palms (additional ~33,000 ha)
  - **~95x** GHGs from land conversion and the associated loss of woodlands/forests for new oil palm plantations
  - **>40,000x** increase in oil palm water consumption given need to switch from rainfed to irrigation
- Careful planning is needed to site plantations where pressures can be absorbed with minimal impact

For company

- The company's plans for palm oil are still in early stages, creating an opportunity to **account for potential nature impacts and dependencies in planning**
- Most of the current planned plantation area in **Pwani** is likely to result in land conversion and the loss of woodlands and forests, which would **negatively impact the company's ability to access international financing** and to sell into Western supply chains
  - **International investors and buyers** expect companies exposed to palm oil supply chains to, at minimum, **adopt a suite of No Deforestation, Peat and Exploitation (NDPE) policies**[2]
- Company plans for plantations in **Kigoma** could be affected by limited water available for irrigation (which would likely be required to achieve planned yields)
  - For example, monthly fluctuations in rainfall mean that up to 28% of the water flowing in the Rufiji River in October could be needed to irrigate company palms

1. Across direct, indirect, and induced jobs; assumes development of 100,000 ha
2. Many international and local banks have adopted NDPE policies that bar them from serving or lending to companies that violate these rules (see Appendix); the definition of deforestation can vary by region and regulation; Tanzania defines "forests" as areas ≥0.5ha with crown cover ≥10% of area and average tree height ≥3m (per Tanzania's Forest Emission Level Submission to the UNFCCC (2016)); this also aligns with the definition used in the EUDR

Palm oil: Tanzania fact base

Demand

Palm oil is the most widely consumed edible oil in Tanzania — **60%** of Tanzania's edible oil demand is met by palm oil

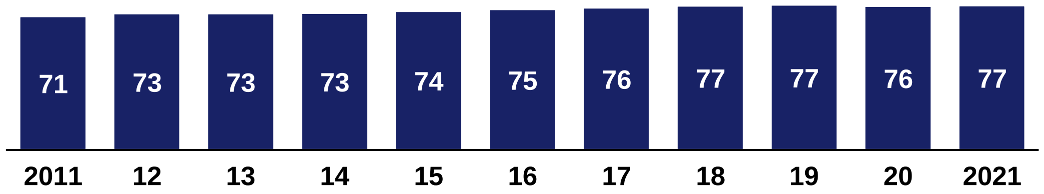
Supply

Tanzania imports crude palm oil (CPO) to meet demand — **95%** of palm oil demand is met by imports, with 60% coming from Indonesia and 40% from Malaysia

Production of palm oil in Tanzania has remained constant over the years — **~75k** tonnes of oil palm fruit is produced each year in Tanzania, on average, with production stagnating in recent years

5,382ha
harvested in 2021

Annual production of oil palm fruit, thousand MT



Employment

~30k Tanzanians are oil palm farmers, earning, on average, $1,500 per farm each year

~ 3% of oil palm employees are women, most of whom work as part of the the Crude Palm Kernel Oil (CPKO) value chain[2] and who are, at the local level, responsible for boiling, milling, and sale of artisanal palm oil products

1. Most farmers use the traditional "dura" variety, which has lower oil content and yield than the "tenera" variety.
2. Women are mostly responsible for kernel collection, processing and sales

Source: FAO, FAOSTAT, AGRA, Tanzania Ministry of Agriculture, USAID, GASFP Worldbank, MDPI, 3ADI+ FAO UNIDO, Tanzania Investment Centre

Context

The Tanzanian government has made local production of edible oil a **strategic priority**, aiming to make the country self-sufficient by 2025

- Increasing oil palm yields through cultivation of higher-yielding varieties[1]
- Increasing the area under cultivation ~10x, to 120,000 to 150,000 ha

FCDO has identified edible oil processing as a potential **foreign investment priority**

- That assumes that land is available (e.g., through PPP), which may be a challenge for foreign investors who face some restrictions on land ownership

Sustainable palm oil production is largely non-existent in Tanzania to date

- Roundtable on Sustainable Palm Oil (RSPO) is the most widely used sustainable palm oil certification
- See appendix for more detail on sustainable palm oil production

Palm oil: Community considerations

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Key community considerations

	Farming	Manufacturing
Health and wellbeing	Unsafe handling of pesticides (e.g., using proper ratios to mix chemicals with water, use of protective equipment, and disposal of containers and waste) could harm farmers and communities Risk from injuries during harvest and sun exposure Pollution from agricultural runoff (fertilizer, pesticide) could leach into aquifers & reduce available water and harm humans if consumed	Efforts of women using laborious human-powered machines for local processing of CPO and CPKO under-renumerated Health compliance facilities could be inaccessible and costly for local processors in Kigoma Pollutants from refineries (e.g., POME and PORE) could leach into aquifers and reduce available water and harm humans
Livelihoods	Palm development could potentially create 100,000+ new jobs New plantations could create competition with existing and less-efficient smallholders, depressing prices Use of scarce water resources or pollution of water could harm local communities' ability to pursue other economic activities	Small profit margins for local, small-scale CPO and CPKO producers due to low quality produce and sale being limited to consumers in areas adjacent to production
Land use rights	Land rights disputes are common for oil palm plantations, with RSPO providing specific guidance for how companies are expected to ensure permission to use identified plots for plantations; further study is needed in Tanzania to understand whether there are competing claims on plots identified for development	
Traditional practices	Further study is needed in Tanzania to understand whether and where groups pursue traditional practices on lands slated for future development	

Source: Ballard Brief, Agra, africaascountry, Kigoma Palm, 3ADI+ , IIED

A. Palm oil value chain: Overview of value chain and activities

Land/water/sea use change | Resource use | Pollution | Climate change | Invasives | Focus for analysis

NOT EXHAUSTIVE

	Plantations	Mills	Refineries	Manufacturing facilities	Transportation
Description	Cultivation, upkeep, and harvest of oil palm trees and aggregation of fresh fruit bunches (FFB)	Process to extract crude palm oil (CPO)	Refining of palm oil into basic oleochemicals and further processing into derivatives	Manufacture of foods (e.g., margarine), edible oil, and other goods (e.g., detergents, soap)	Transportation between different sites of production and processing and to customers
Assets and operations (Tanzania)	5,312 ha harvested for oil palm fruit in 2021 Estimated 76,675 MT oil palm fruit produced in 2021	~9,000-20,000 MT of CPO produced domestically each year[1]	Tanzania produces close to 360,000 MT of palm olein (used for edible oil) and ~80,000 MT of palm stearin (used for margarine, cooking fats) as well as soaps		CPO transported to refineries by train and trucks (typically from Kigoma to Dar es Salaam)
Company	Company plans to develop plantations in Tanzania to produce CPO	Imports all its CPO needs, sourced from Indonesia (60%) and Malaysia (40%)	Company processes crude palm oil in its own refinery		Transportation carried out by third parties
Relevant indicators	Terrestrial conversion to plantation Pollution from use of pesticides and fertilizers GHG emissions	Solid waste and pollution from milling activities	Pollution - Residue discharge, solid waste, air pollution Food waste	Pollution - packaging material waste Pollution - Residue discharge, solid waste, air pollution Food waste	Air pollution from fuels and chemicals used during distribution GHG emissions from vehicles
		GHG emissions from machines' use of energy (Mills, Refineries, Manufacturing facilities)			
	Resource use - water (Plantations through Manufacturing facilities)				
	Pressures can result in biodiversity loss, loss of ecosystem integrity (e.g., fragmentation and degradation of habitats), forest loss, degradation of soil, global warming, and water stress Impacts are most concentrated and severe on plantations, but exist through the entire value chain				GHG emissions cause global warming/ climate change

1. Locally produced CPO is mostly consumed within local villages before finding its way to refineries; Tanzania imports another ~420,000 MT of CPO each year

Source: Sustainable palm oil choice, FAOSTAT, Unido Palm oil value chain in Tanzania

B. Palm oil materiality assessment: most material impacts are at the plantations level

PRELIMINARY

Materiality[1]

Very high | High | Medium | Low | Very low | Not material[2] | Focus for analysis

Value chain		Plantations	Mills	Refineries	Manufacturing facilities[3]	Transportation
Impact drivers	**Land use and conversion**	Very high	Not material	Not material	Not material	Not material
	Resource use (e.g., water)	High (1)	High	Medium	High	Not material
	Pollution	High	High	Medium	Medium	Low
	Climate change	Very high	High	High	High	High
	Other indicators[4]	Medium (2)	Not material	Not material	Not material	Not material
Potential impacts	**Ecosystem integrity**	Very high	Low	Not material	Not material	Not material
	Biodiversity	Very high	Low	Not material	Not material	Not material
	Water risk	High	Low	Not material	Not material	Not material

1. In general, "material" means that the asset exerts a significant pressure or impact on the indicator, as defined by SBTN and ENCORE; thresholds vary by indicator although the scale used on this slide follows SBTN's system. This assessment is adapted for Tanzania specifically (e.g., the materiality would be different in different regions, e.g., with regard to water use for rain fed vs. groundwater); 2. Either not material or no data; 3. Includes all processes between spinning of thread and manufacture of garments, with a focus on processes with the largest environmental impacts; 4. Invasive species and disturbance (e.g., noise pollution)

Source: SBTN, ENCORE

Key insights

Oil palm plantations have a significant impacts on ecosystem integrity and biodiversity

- This is especially true where plantations have replaced native forest or disrupted intact ecosystems
- Plantations developed on degraded land will have less impact

Replacement of native forests by plantations through burning also releases CO2

Beyond the plantations, pressures involve water resource use and pollution across the value chain

Other notes

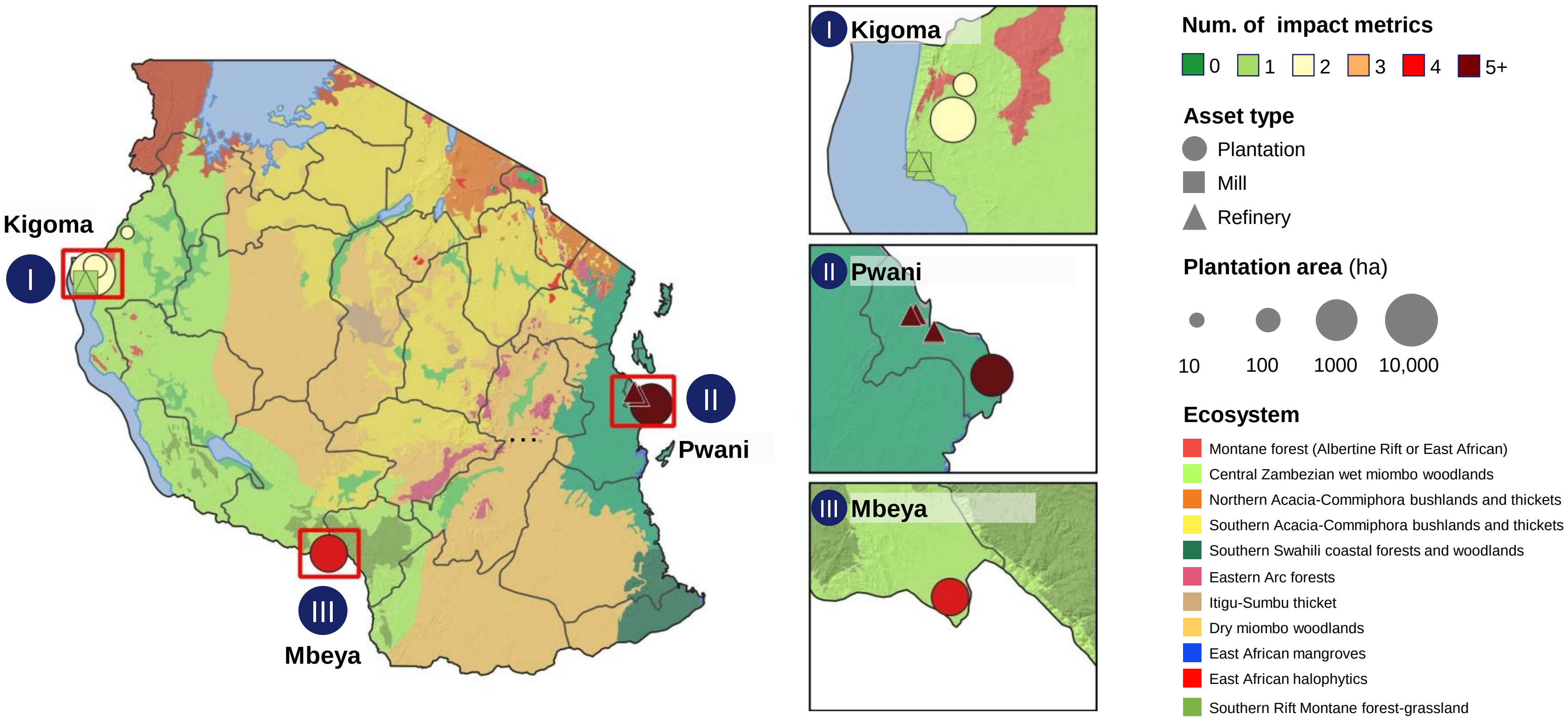
1. Water use is not material for current small-scale, rainfed Tanzanian oil palm plantations, but will be much higher for prospective, large-scale irrigated plantations

2. Materiality for biological alterations (e.g., invasive species) differ between small-scale (M) and large-scale (H) plantations

C. Potential impacts: Potential nature impacts are lower in Kigoma compared to other regions

See double click on palm plantations on next page

Palm oil production and processing in Tanzania



1. For each asset, nine nature dimensions are assessed. This analysis considered if the spatial footprint of each asset has an average FII >96%, an intact forest landscape, an average of >70% free-flowing water, a WWF priority ecoregion, a critical habitat, an average BII >90%, an average STAR metric >10 (STAR restoration or STAR abatement), moderate to very high-water pressure area (according to Aqueduct overall water risk score). The results were averaged over each ecoregion and district

Source: Natural Earth (2023); WWF (2023); Olsen et al. (2001); WRI (2014); Grill et al. (2019); Planetary Computer Microsoft (2023); Hydrosheds (2023); Grantham et al. (2019); Mair et al. (2021); WRI;SBTN; TNFD

Key insights

Potential impacts from oil palm plantations are highest in **Pwani** and **Mbeya**, where there are areas of high biodiversity importance

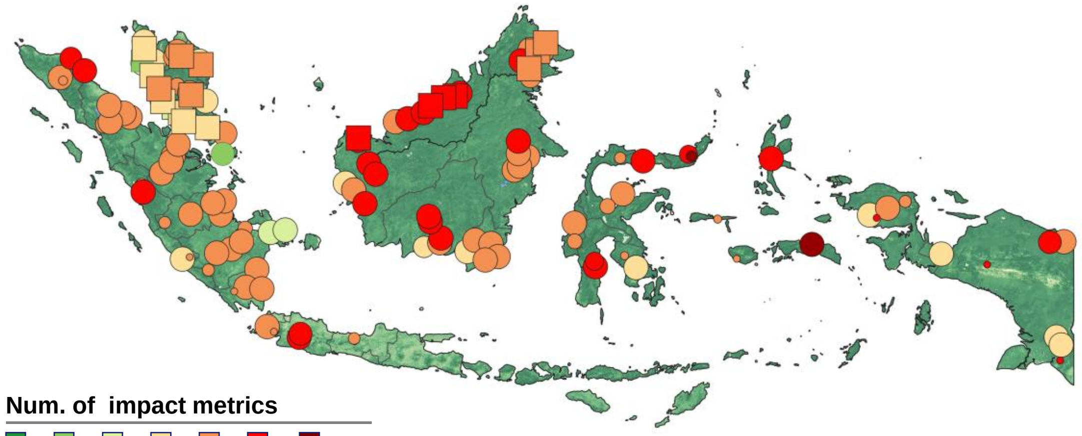
Although potential nature impacts are less in **Kigoma**, growth in cultivation could interface with critical habitats and river systems

Best practice would be to ensure new plots utilize degraded or previously cultivated land

Mills and refineries are typically close to oil palm plantations, with those in **Pwani** exhibiting a high potential for impacts on nature

C. Potential impacts of oil palm plantations in Tanzania are similar to imports from Malaysia and Indonesia

Average impact score per district and per ecoregion



Num. of impact metrics

0 | 1 | 2 | 3 | 4 | 5 | 6+

Plot area (ha)

100 | 1000 | 10,000

Plantation type

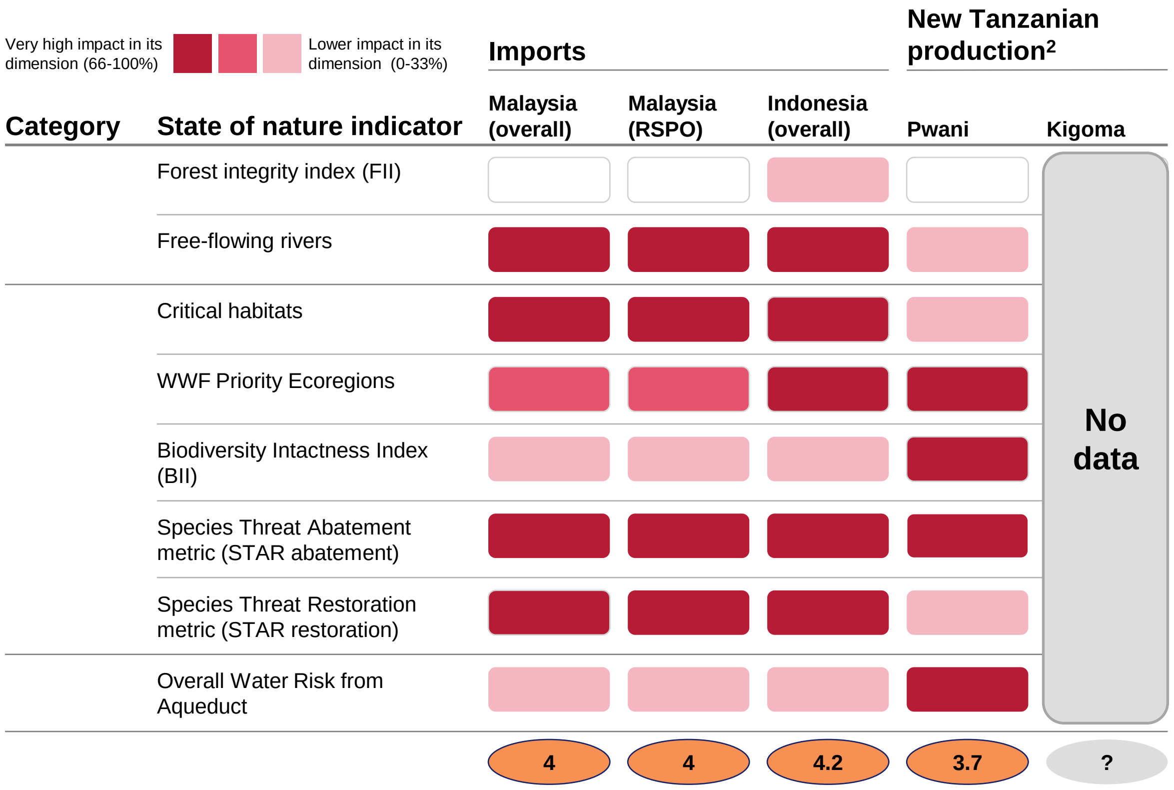
Non-RSPO

RSPO

Biodiversity Intactness (%)

50 – 100

Potential impact on the state of nature



1. For each asset, eight nature dimensions are assessed. This analysis examines if the spatial footprint of each asset has an average FII >96%, an average of >70% free-flowing water, a WWF priority ecoregion, a critical habitat, an average BII >90%, an average STAR metric >10 (STAR restoration or STAR abatement), moderate to very high-water pressure area (according to Aqueduct overall water risk score). The results were for each type of import (country of origin and RSPO certification)
2. New production as reported by company. Geolocations for the expansions were provided for the Pwani region

Source: Grantham et al. (2020); Grill et al. (2019); Hydroshed (2023); WWF water risk (2023); He et al. (2021); Brauneder et al. (2018); WWF priority ecoregions (2023); Microsoft Planetary (2023); Impact Observatory (2023); Steffen et al. (2015); Mair et al. (2021); World Resource Institute (2014)

D. Impact drivers: New plantations could require less land per unit of CPO, but otherwise increase intensity of domestic production

UKaid from the British people

For discussion

Regional view follows

Materiality of direct OPs: Very high | High | Medium | Low | Very low | Not material

PRELIMINARY **SEE APPENDIX FOR CALCULATIONS AND SOURCES**

SEE APPENDIX FOR ASSESSMENT OF MILLS AND REFINERIES

			Estimated intensity of production[2]		Estimated totals[2]	
TNFD/SBTN category	**Selected impact driver metric[1]**	**Units**	**Current state total Tanzania**	**New production with planned expansion[3]**	**Current**	**Future[4]**
Ecosystem use-change	Extent of land **used** for agricultural purposes	ha/MT CPO	0.9	0.3	13,700 ha	56,700 ha
	Extent of land **converted** for agricultural purposes[5]	ha/MT CPO	0.0	0.2	110 ha	33,300 ha
Resource use	Volume of **water consumption**[6]	m^3/MT CPO	0	2,490	negligible	395 million m^3
Pollution	Volume of non-GHG air pollutants released: **NH3**	MT/MT CPO (thousands)	0.4	2.4	5 MT	380 MT
	Volume of non-GHG air pollutants released: **NOx**	MT/MT CPO (thousands)	0.3	1.6	5 MT	250 MT
	Volume of soil pollutants released (mainly pollution of **pesticides**)	MT/MT CPO (thousands)	1.0	0.3	15 MT	60 MT
	Volume of water pollutants (pollution of **N fertilizers leaking** into the environment)	MT/MT CPO (thousands)	0.6	2.8	10 MT	460 MT
	Solid waste generated (**plastics** from fertilizer and pesticide packaging, irrigation infrastructure)	MT/MT CPO (thousands)	2.2	11.2	35 MT	1,800 MT
Climate change	**GHG emissions** from land conversion since 2000, fertilizer use, and oil palm sequestration[7]	MT CO2e/MT CPO	0.1	1.2	2k MT CO2e	190k MT CO2e

1. Although biological alterations (e.g., invasive species) are material for palm plantations, there was not a reliable source of data for Tanzania and is therefore excluded; 2. Pressures are modelled based on a mix of real-world data and proxy data and therefore should not be understood to be the exact numbers for either Tanzania or the company except where otherwise noted; see appendix for details; 3. New production is the estimated intensity of impact drivers for planned expansion of palm production across 40,000+ acres; 4. Includes only planned expansion of palm production across 40,000+ acres; 5. Land use change since 2000 is taking into account; 6. Current state is entirely rainfed, while future state will require irrigation; 7. Emissions and absorptions from land cover changes are only considered after the year 2000

Source: palm oil study, Estimating Water Footprint of Palm Oil Production, Global Forest Watch (2023), Copernicus Land Cover Data (2019)

D. Impact drivers: Potential future pressures from palm cultivation would be higher in Pwani vs. Kigoma

See appendix for deep dives on calculations and sources

For discussion

PRELIMINARY

Estimated expected intensity of production[1]

TNFD/SBTN category	Selected impact driver metric	Units	Kigoma (estimate)	Pwani (current plan)	% difference
Ecosystem use-change	Extent of land **used** for agricultural purposes	ha/MT CPO	0.25	0.29	16
	Extent of land **converted** for agricultural purposes	ha/MT CPO	1 0.12	0.27	130
Resource use	Volume of **water consumption**[2]	m^3/MT CPO	2,330	2,670	15
Pollution	Volume of non-GHG air pollutants released: **NH3**	MT/MT CPO (thousands)	2.2	2.6	16
	Volume of non-GHG air pollutants released: **NOx**	MT/MT CPO (thousands)	1.5	1.7	16
	Volume of soil pollutants (**pesticides**)	MT/MT CPO (thousands)	0.26	0.30	16
	Volume of water pollutants (**N fertilizers**)	MT/MT CPO (thousands)	2.6	3.0	16
	Solid waste generated (**plastics**)	MT/MT CPO (thousands)	10.8	12.5	16
Climate change	**GHG emissions**	MT CO2e/MT CPO	2 0.4	1.7	360

1. Pressures are modelled based on a mix of real-world data and proxy data and therefore should not be understood to be the exact numbers for either Tanzania or the company except where otherwise noted see appendix for details; 2. GHG emissions in Pwani are derived from the plantation outlines and Copernicus land cover data. In Kigoma, a conversion rate of 46% was assumed, in line with current forest cover, due to the lack of accurate spatial data on new plantation locations – this could be an over or underestimate of actual pressures; 3. Emissions and absorptions from land cover changes are only considered after the year 2000

Source: palm oil study, Estimating Water Footprint of Palm Oil Production, Global Forest Watch (2023), Copernicus Land Cover Data (2019)

Key insights

The relative pressure per unit of CPO is generally higher in Pwani due to **lower average yields**

1. The **intensity of land conversion** would likely be higher in Pwani than Kigoma[2] (e.g., the conversion of land to agriculture)
   - In Pwani, based on current plans, **most** of the potential plantation area would result in land conversion, overlapping with critical habitats and driving greater GHG emissions
   - Plans for Kigoma are not known, but using average forest/woodland cover as a proxy **46%** of the potential plantation area could result in land conversion with a lower overlap with critical habitats
2. **GHG emissions** rise along with land conversion

D. Irrigation in Pwani may be hampered by seasonal droughts

Case study of the Rufiji River

PRELIMINARY

Irrigation of oil palm plantations in the Rufiji catchment (Pwani)…

A potential expansion of **13,000 ha** of oil palm plantations…

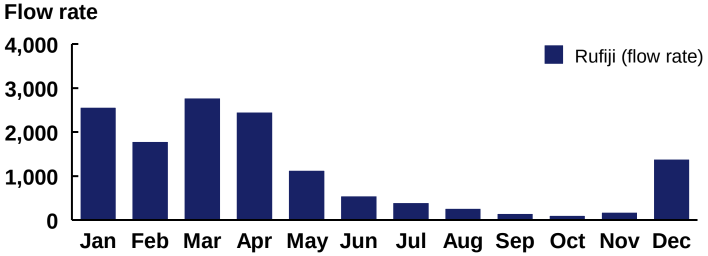
Could require **~77 to 179 million m3** of irrigation water[1]

And result in ~**313 MT of nitrogen** leaching to ground water and rivers, potentially leading to **eutrophication and algae blooms**

… can be hampered by seasonal droughts and lower water flows…

Due to monthly fluctuations in rainfall, the **new irrigation project represents up to 28% of the monthly Rufiji flow**[2]

Seasonal variety in the Rufiji flow rate
(millions m3/month)



Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1%	1%	0%	0%	1%	8%	11%	16%	27%	28%	11%	1%

Proportion of the required irrigation over the Rufiji flow rate

… potentially exacerbating water competition and scarcity

More than **0.5 million people** live in the lower Rufiji basin (where expansions are planned), often with poor access to clean water

The Rufiji is important for the local economy, as its water is used for fishing, sanitation, drinking, and crop irrigation[3]

The planned extraction can interfere with these activities, especially during the dry season

Extraction can exacerbate droughts, threatening the functioning of ecosystems

1. The lower value is calculated as the average FFB yield of 14.2 MT/ha reported by FAO between 2017-2021 multiplied with the global average water footprint (Mekonnen et al., 2014). The upper value is calculated as the average of the water use reported by the example company (260 mm/month) and Mongabay (150 mm/month). The total irrigation requirements were calculated as the monthly difference between precipitation (WorldClim) and required water use.
2. Monthly flow of the Rufiji at its mouth was as reported in the "Feed the Future: Environmental Flows in Rufiji River Basin Assessed from the Perspective of Planned Development in Kilombero and Lower Rufiji Sub-Basins“. This analysis did not consider the impact of the planned land-cover changes on run-off and groundwater recharge, nor did it assess impact of large-scale plantation on microclimate (e.g. biotic pump). This analysis did not assess the potential impact of water reservoirs on the monthly availability of irrigation water for new plantations
3. In 2016, a total of 142 million m3 of water was required to irrigate 8,000 ha in the Kilombero and Lower Rufiji sub-basins. Moreover, as a result of the Southern Agricultural Growth Corridor of Tanzania (SAGCOT) initiative, an additional 51,800 ha of irrigation projects are being developed in the Kilombero sub-basin, further increasing the pressure on water resources

Source: Feed the Future report (2016); FAOSTAT (2023); Mekonnen (2014);

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E. Sector-wide opportunities to reduce pressures on nature (1/4)

Oil palm plantations

NOT EXHAUSTIVE

Pressures on nature | Ecosystem use-change | Resource use | Pollution | Climate change | Biodiversity and ecosystem integrity

Category	Sub-category	Technical lever	Primary pressures addressed
Land-use optimization	**Land identification**	Avoid planting in areas with high biodiversity importance (e.g., critical habitats) and/or priority ecosystems (e.g., peatlands, tropical forests, mangroves), or areas requiring deforestation	
		Plant in areas that do not require use change and do not displace existing activities to priority ecosystems (e.g., brownfield lands, closed mines, degraded land)	
	Crop placement	Place palms within plantation area to minimize pressures to nature and maximize yields (e.g., avoid planting on slopes where there is erosion risk, spacing sprouts in a triangular pattern to get around 145 plants per hectare)	
	Buffer protection	Plant buffer crops to safeguard habitats around fields to reduce invasive species, human-nature conflict, runoff, and wildfires, among other pressures	
Farming practices	**Regenerative agriculture**	Use cover crops, such as legumes, as oil palms mature to improve soil fertility and health and to reduce soil erosion	
		Use intercropping techniques with common intercrops (e.g., Black pepper vines, beans, maize, cassava) to help prevent spread of pests and diseases, increase soil fertility, and reduce need for fertilizers	
		Implement agroforestry by integrating livestock, such as poultry or small ruminants, into the oil palm plantation, which can help in nutrient cycling, pest control, etc. (only applicable for small holdings)	
	Seed selection	Use oil palm varieties best optimized for local conditions (e.g., disease-resistant, pest resistant, adopted to climate change)	
		Use oil palm varieties best optimized for yields (e.g., e.g., Tenera instead of Dura)	
		Select oil palm varieties with low Free Fatty Acid content to get higher quality output after processing	

Source: Intercropping, oil palm cultivation and management

E. Sector-wide opportunities to reduce pressures on nature (2/4)

Oil palm plantations

NOT EXHAUSTIVE

Pressures on nature | Ecosystem use-change | Resource use | Pollution | Climate change | Biodiversity and ecosystem integrity

Category	Sub-category	Technical lever	Primary pressures addressed
Use of inputs	**Water use**	Prioritize planting in areas without the need for artificial irrigation	Ecosystem use-change; Resource use
		Use drip irrigation systems that deliver water directly to the roots of the palm trees	Ecosystem use-change; Resource use
		Set up water storage systems, such as reservoirs, to harvest water from rain or to divert other natural sources during wet periods	Resource use
		Use deficit irrigation schedules to maximize water use efficiency for higher yields per unit of irrigation water applied	Ecosystem use-change; Resource use
		Adopt innovative water-saving technologies such as hydrogels, moisture sensors, weather forecasting tools, etc.	Ecosystem use-change; Resource use
	Fertilizer use	Optimize fertilizer application, i.e., avoid using excessive amounts of fertilizer and apply only the amount required for growth	Resource use; Pollution
		Use direct injection of the fertilizer into the soil near the roots, instead of the traditional application of nitrogen fertilizer on the surface	Resource use; Pollution
	Integrated pest management	Use practices such as selective weeding and sanitation to reduce pest populations	Ecosystem use-change; Pollution
		Set an ‘action threshold’ at which pest control action should be taken to control overapplication	Ecosystem use-change; Pollution
		Use drift-reducing adjuvants to ensure chemicals from pesticides do not evaporate in the air	Pollution
		Use organic pesticides (e.g., Neem oil)	Pollution
		Use nature-based solution for pest control e.g., introduce beneficial insects to contribute to pest control by preying on herbivorous insect pests	Pollution
Waste management	**Reuse of byproducts**	Recycle palm plantation residues for use as fertilizers e.g., divert plantation solid waste (EFB) for mulching	Pollution
	Waste disposal	Ensure proper disposal of farm waste (e.g., packaging waste)	Pollution

Source: Drip Irrigation for palm

E. Sector-wide opportunities to reduce pressures on nature (3/4)

Palm oil milling

NOT EXHAUSTIVE

Pressures on nature | Ecosystem use-change | Resource use | Pollution | Climate change | Biodiversity and ecosystem integrity

Category	Sub-category	Technical lever	Primary pressures addressed
Input optimization	**Water use**	Filter out the water used for sterilization to extract remaining oil and reuse the water for different processes	Resource use, Pollution, Climate change
	Energy use	Optimize sterilization time and temperature for high quality CPO output, which would avoid re-sterilization of the palm fruit and save energy and water	Resource use, Pollution, Climate change
		Use renewable energy sources to operate milling machines e.g., hydropower or onsite power generation	Pollution, Climate change
Process optimization	**Fresh fruit bunch (FFB) quality**	Practice proper FFB harvesting, such as harvesting at the right maturity stage, which can impact the oil quality and the overall oil yield	Ecosystem use-change, Resource use, Pollution
		Ensure the processing of FFB within 24 hours of harvesting to minimize free fatty acid and ensure quality and yield (e.g., set up milling sites near plantation)	Ecosystem use-change, Resource use, Pollution
	FFB processing	Apply optimum sterilization to soften the palm fruit for maximumm CPO yield during pressing	Ecosystem use-change
		Use enzymatic extraction to extract higher volume of CPO from mesocarp	Ecosystem use-change
Waste management	**Waste treatment**	Set up treatment systems to treat milling wastewater (POME), reduce pollution discharge, and recycle water for production (e.g., evaporation technology to vaporize and recover water)	Resource use, Pollution
	Disposal	Ensure that waste is disposed of in an environmentally sound fashion (e.g., pollutants cannot leach to environment)	Resource use, Pollution
	Use of byproducts	Use the solid waste from POME treatment as fertilizer in plantations, thus reducing the use of NPK based fertilizers	Pollution
		Capture methane emitted from POME treatment facilities to use for biogas production	Pollution, Climate change
		Use the palm kernel shell and mesocarp fiber as fuel for boilers	Pollution, Climate change

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E. Sector-wide opportunities to reduce pressures on nature (4/4)

Palm oil refining

NOT EXHAUSTIVE

Pressures on nature | Ecosystem use-change | Resource use | Pollution | Climate change | Biodiversity and ecosystem integrity

Category	Sub-category	Technical lever	Primary pressures addressed
Input optimization	**Processing inputs use**	Apply electronic feedback loops to optimize the quantity of acid added in degumming stage, to make sure only impurities are separated out and not desirable oil components	Pollution
		Add biodegradable surfactants to aid in the removal of gums from crude palm oil	Pollution
		Use organic acids e.g., lactic acid, acetic acid as an alternative to phosphoric acid in the degumming process	Pollution
		Use enzymes during the degumming process to reduce the use of chemicals	Pollution
		Identify and apply optimum amount of bleaching earth for bleaching process, to avoid excess absorption of desirable oil by the bleaching earth	Pollution
		Use sustainable bleaching earth e.g., recycled earth	Pollution
	Water use	Recycle wastewater for refinery consumption, through PORE treatment	Resource use, Pollution
	Energy use	Use renewable energy sources to operate milling machines e.g., hydropower or onsite power generation	Pollution, Climate change
Waste management	**Waste treatment**	Set up or expand water treatment facilities (e.g., activated sludge system) to treat wastewater (PORE) and reduce pollution discharge	Resource use, Pollution
	Disposal	Ensure that waste is disposed of in an environmentally sound fashion (e.g., pollutants cannot leach to environment)	Pollution
	Use of byproducts	Use palm fatty acid distillate (PFAD), extracted from deodorization as a feedstock for biodiesel production	Pollution, Climate change

E. Focusing on plantations, there are 5 high-potential sector-level technical levers

Technical levers for Tanzanian oil palm farming

PRELIMINARY **SEE APPENDIX FOR LEVER DETAILS**

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Rating[1]: High | Medium | Low/none | Negative

					Nature pressure change					
Category	**Levers**	**Financial impact[2]**	**Feasibility**	**Scalability**	**Ecosystem use**	**Pollution**	**Resource use**	**Climate change**	**Biodiversity & ecosystem integrity**	**Community impact**	**High potential[3]**
Land-use optimization	Land identification (e.g., avoid planting in areas that cause deforestation)	Negative/Medium	Medium	Medium	High	Medium	Medium	High	High	Negative/Medium	✓
	Palm placement (e.g., avoid planting on slopes where there is erosion risk, triangular planting)	Medium	High	High	Medium	Medium	Medium	Medium	Medium	Medium	✓
	Buffer protection (e.g., planting buffer crops)	Low/none	Medium	High	Medium	Medium	Low/none	Medium	High	Medium	
Farming practices	Regenerative agriculture (e.g., intercropping, cover crops, agroforestry)	Low/none	Medium	Medium	Medium	Medium	Low/none	Medium	Medium	Medium	
	Variety selection (e.g., Tenera instead of Dura)	Medium	High	High	High	Medium	Medium	Medium	Medium	Negative/Medium	✓
Use of inputs	Water use (e.g., planting in areas with water, setting up water storage, hydrogels)	Negative/Low/none	Low/none	Low/none	Negative/Low/none	Low/none	High	Low/none	Negative/Medium	High	✓
	Fertilizer use (e.g., organic fertilizer, precision application)	Medium	High	High	Low/none	High	Low/none	Medium	Medium	Medium	
	Integrated pest management (e.g., organic pesticides)	Low/none	High	High	Low/none	High	Low/none	Low/none	High	High	
Waste management	Reuse of byproducts (e.g., using plantation residue for mulching)	Medium	High	High	Low/none	High	Low/none	Low/none	Low/none	Medium	✓
	Waste disposal	Negative	High	Medium	Low/none	High	Low/none	Low/none	Medium	Medium	

1. Detailed methodology in Appendix; all ratings are based on implementing locally-appropriate levers, but detailed, site-specific work would be needed to assess the impact of a given lever in a specific location; in general, levers that could increase pressures on nature were excluded; 2. Medium corresponds to positive ROI, low/none corresponds to low to no ROI, and negative corresponds to negative ROI; ROI is highly sensitive to site- and business-specific factors and must be reassessed on a project-by-project basis.; 3. Prioritized by giving equal weight to financial impact, feasibility, scalability, and nature impact; see Appendix for details

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E. There are 3 sector-level technical levers for milling and refinery

Technical levers for Tanzanian palm oil milling and refinery

PRELIMINARY **SEE APPENDIX FOR LEVER DETAILS**

Value chain stage: Milling, Refinery
Rating[1]: High, Medium, Low/none, Negative

Category	Levers	Value chain stage	Financial impact[2]	Feasibility	Scalability	Nature pressure change: Ecosystem use	Nature pressure change: Pollution	Nature pressure change: Resource use	Nature pressure change: Climate change	Biodiversity & ecosystem integrity	Community impact	High potential[3]
Input optimization	Water use (e.g., recycle water in processes)	Milling, Refinery	Low/none	Medium	Medium	Low/none	High	High	Low/none	Low/none	Medium	✓
	Energy use (e.g., reduce energy use, use clean energy sources)	Milling, Refinery	Low/none	Medium	Medium	Low/none	Low/none	Medium	Medium	Low/none	Medium	
	Processing input use (e.g., sustainable bleaching earth)	Refinery	Low/none–Medium	Low/none	Low/none	Low/none	Medium	Low/none	Low/none	Low/none	Medium	
Process optimization	Fresh fruit bunch (FFB) quality (e.g., time harvest to maximize CPO yields)	Milling	Medium	High	High	Medium	Medium	Low/none	Low/none	Medium	Medium	✓
	FFB processing (e.g., sterilization, enzymatic sterilization)	Milling	Medium	Medium	Medium	Low/none	Medium	Low/none	Low/none	Low/none	Low/none	
Waste management	Waste treatment (e.g., treating POME, PORE)	Milling, Refinery	Low/none	Medium	Medium	Low/none	High	High	Low/none	Low/none	Medium	
	Proper waste disposal	Milling, Refinery	Negative	Medium	Medium	Low/none	High	Low/none	Low/none	Low/none	Low/none	
	Use of byproducts (e.g., use solid waste for fertilizer, capturing methane as fuel)	Milling, Refinery	Low/none–Medium	Medium	Medium	Low/none	High	High	Low/none	Low/none	Medium	✓

1. Detailed methodology in Appendix; all ratings are based on implementing locally-appropriate levers, but detailed, site-specific work would be needed to assess the impact of a given lever in a specific location; in general, levers that could increase pressures on nature were excluded; 2. Medium corresponds to positive ROI, low/none corresponds to low to no ROI, and negative corresponds to negative ROI; ROI is highly sensitive to site- and business-specific factors and must be reassessed on a project-by-project basis.; 3. Prioritized by giving equal weight to financial impact, feasibility, scalability, and nature impact; see Appendix for details

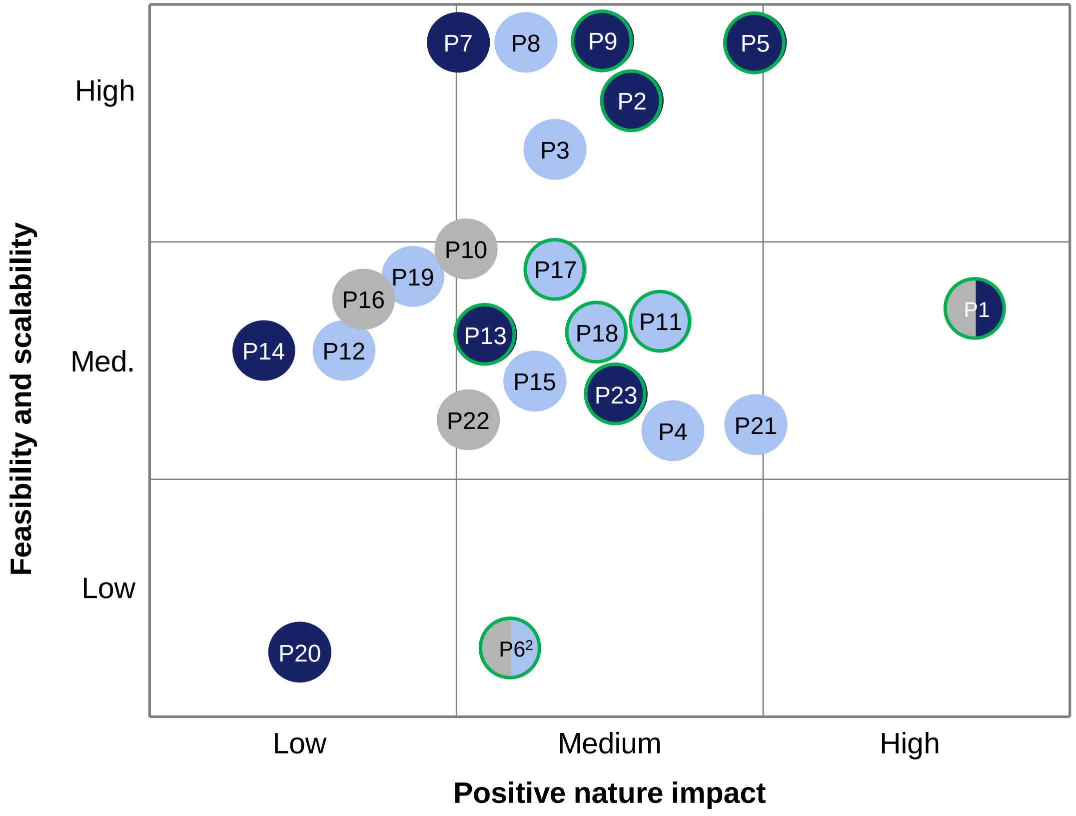
E. Across the palm oil value chain, there are 10[1] high-potential technical levers to address pressures on nature

Prioritization of technical levers across palm oil value chain

PRELIMINARY **SEE APPENDIX FOR LEVER DETAILS**

Positive financial implications · Neutral financial implications · Negative financial implications · Prioritized

Prioritized opportunities for Tanzanian palm oil production



Technical levers

Farming

- P1 Land identification (e.g., avoid planting in areas that cause deforestation)
- P2 Crop placement (e.g., avoid planting on slopes, triangular planting)
- P3 Buffer protection (e.g., planting buffer crops)
- P4 Regenerative agriculture (e.g., intercropping, cover crops, agroforestry)
- P5 Variety selection (e.g., Tenera instead of Dura)
- P6 Water use (e.g., planting in areas with water, water storage, hydrogels)
- P7 Fertilizer use (e.g., organic fertilizer, precision application)
- P8 Integrated pest management (e.g., organic pesticides)
- P9 Reuse of byproducts (e.g., using plantation residue for mulching)
- P10 Proper waste disposal

Milling

- P11 Water use (e.g., recycle water in processes)
- P12 Energy use (e.g., reduce energy use, use clean energy sources)
- P13 Fresh fruit bunch (FFB) quality (e.g., time harvest to maximize CPO yields)
- P14 FFB processing (e.g., sterilization, enzymatic sterilization)
- P15 Waste treatment (e.g., treating POME, PORE)
- P16 Proper waste disposal
- P17 Use of byproducts (e.g., use solid waste for fertilizer, capturing methane from POME for use as fuel)

Refinery

- P18 Water use (e.g., recycle water in processes)
- P19 Energy use (e.g., reduce energy use, use clean energy sources)
- P20 Processing input use (e.g., sustainable bleaching earth)
- P21 Waste treatment (e.g., treating POME, PORE)
- P22 Proper waste disposal
- P23 Use of byproducts (e.g., use solid waste for fertilizer, fuel for boilers)

1. Count does not match previous pages as 2 levers (water use and use of byproducts) are counted for both milling and refining
2. Optimizing water use would have high positive impacts on water saving - which would help mitigate water intensity of oil palm plantations

Recommendations for company

Key opportunities

PRELIMINARY

Recommendation

1. Site all palm oil plantations so that they do not cause any deforestation as defined by Tanzania's government[1]
2. Ensure that water is available for plantations by locating near sources and implementing levers that can help alleviate seasonal water scarcity
3. Apply for RSPO certification for all oil palm plantations and ensure plantations adhere to standards (e.g., follow RSPO's New Planting Procedure (NPP), including conducting an HCV-HCSA[2])
4. Ensure implementation of "amelioration" measures already identified by company (intercropping, precision fertilizer, etc.)
5. Pursue alternative monetization pathways (e.g., carbon credits) where existing land holdings include priority ecosystems, areas of high biodiversity importance, or land at risk of deforestation
6. Engage smallholder cotton suppliers to ensure that highest-potential technical levers are implemented on the farm

1.Tanzania defines "forests" as areas ≥0.5ha with crown cover ≥10% of area and average tree height ≥3m (per Tanzania's Forest Emission Level Submission to the UNFCCC (2016)); Note that if the company intends to export to the EU it would also need to site plantations to avoid "forest degradation" per the EU's Deforestation-free Regulation (see Appendix); 2. High Conservation Value-High Carbon Stock Assessment; requires third party verification

Source: Regulation of the European Parliament and of the council on the making available on the Union market and the export from the Union of certain commodities and products associated with deforestation and forest degradation and repealing Regulation (EU) No 995/2010; Tanzania's Forest Emission Level Submission to the UNFCCC (2016)

1. Across Tanzania, 2.2 million ha of non-forested land is technically suitable for planting oil palm

High-level spatial analysis

Considerations

Ensure suitability for oil palm cultivation

Identify land using terrain, soil, and climate constraints for palm cultivation, while excluding areas prone to flooding[1]

Minimize land-use change

Exclude forested areas, critical habitats, and urban areas

"Forested areas" are defined as land with more than 10% tree cover, in line with Tanzania's definition of forest

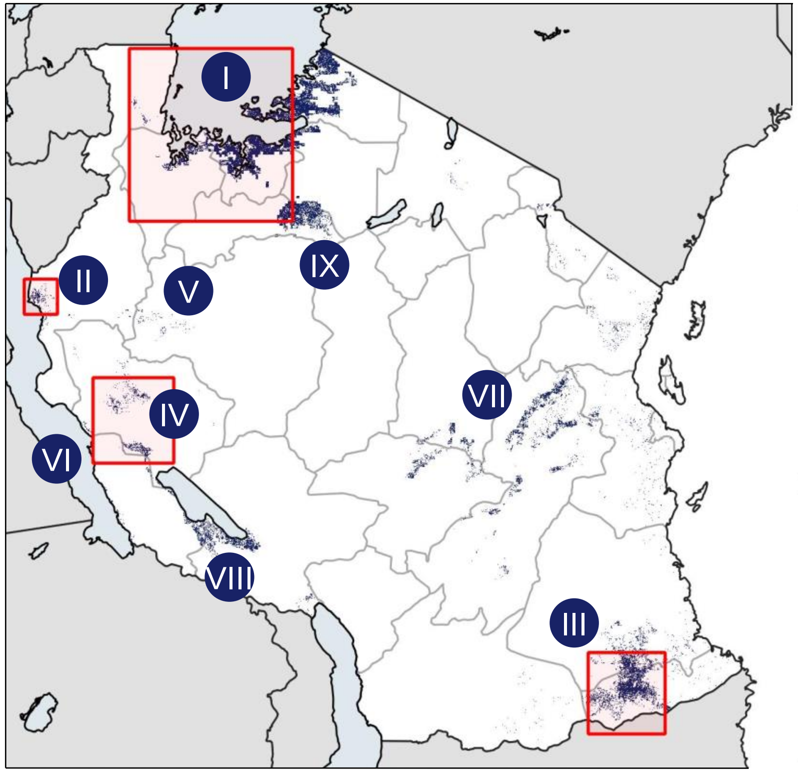
This is also in line with the EU's Deforestation-free Regulation (EUDR), whereby a "forest" is defined as an area >0.5ha with >10% tree cover

"Critical habitats" include, among other data, protected areas and Key Biodiversity Areas

To manage: Implementation complexity

Unforested areas that are suitable for oil palm are largely already under cultivation, requiring engagement with smallholders to develop plantations

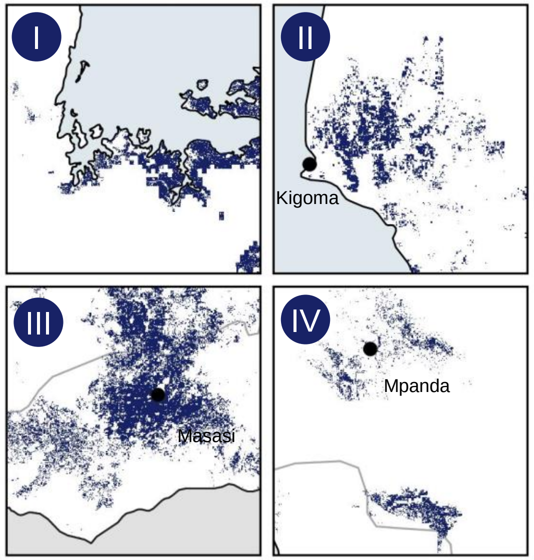
Theoretically, Tanzania could produce up to **8 million MT of CPO** each year across **2.2 million ha**, or 2.3% of Tanzania's land area[2]



Suitable land for oil palm under irrigation conditions

Potential regions of production

I. Lake Victoria
II. Kigoma
III. South Tanzania
IV. Katavi
V. Tabora
VI. Tanganyika coast
VII. Central Tanzania
VIII. Lake Rukwa
IX. Shinyanga



1. Notwithstanding water requirements, the analysis assumes oil palm growth is feasible in areas with maximum monthly temperatures < 31°C, minimum monthly temperatures > 22.5°C, annual precipitation < 2,500 mm, the minimum temperature of the coldest month >15°C (to avoid rot), and a clay content (in the top 30 cm of the soil) between 15 and 72%. Analysis excluded terrain with slopes 15° (Verheye, 2010; Mutert 1999). Analysis avoids areas prone to coastal or riverine flooding (with an event return period of 250 years or less; Aqueduct, 2020). Climatic variables were assessed for the period 2021-2040, assuming a business-as-usual climate change scenario (rcp 4.5)
2. Considering the necessary simplification for this exercise, as well as the potential inaccuracies of the data, the results are not intended to represent precise local geographic contexts or recent local developments (political or otherwise); drawing any local conclusions will require additional detailed, local studies

Source: Verheye (2010); Mutert (1999); WorldClim (2022)

2. However, overlaying water risk reduces that suitable area by ~75%, to 0.5 million ha

High-level spatial analysis

Additional considerations

Exclude areas prone to water risk

Aqueduct's water risk metric combines baseline water stress, interannual variability, seasonal variability, flood occurrence, drought severity, groundwater stress, access to water, water quality, regulatory and reputational factors,
and other contextual information

Additionally, this analysis excludes areas that will experience medium to high water stress under future climatic conditions

Original considerations

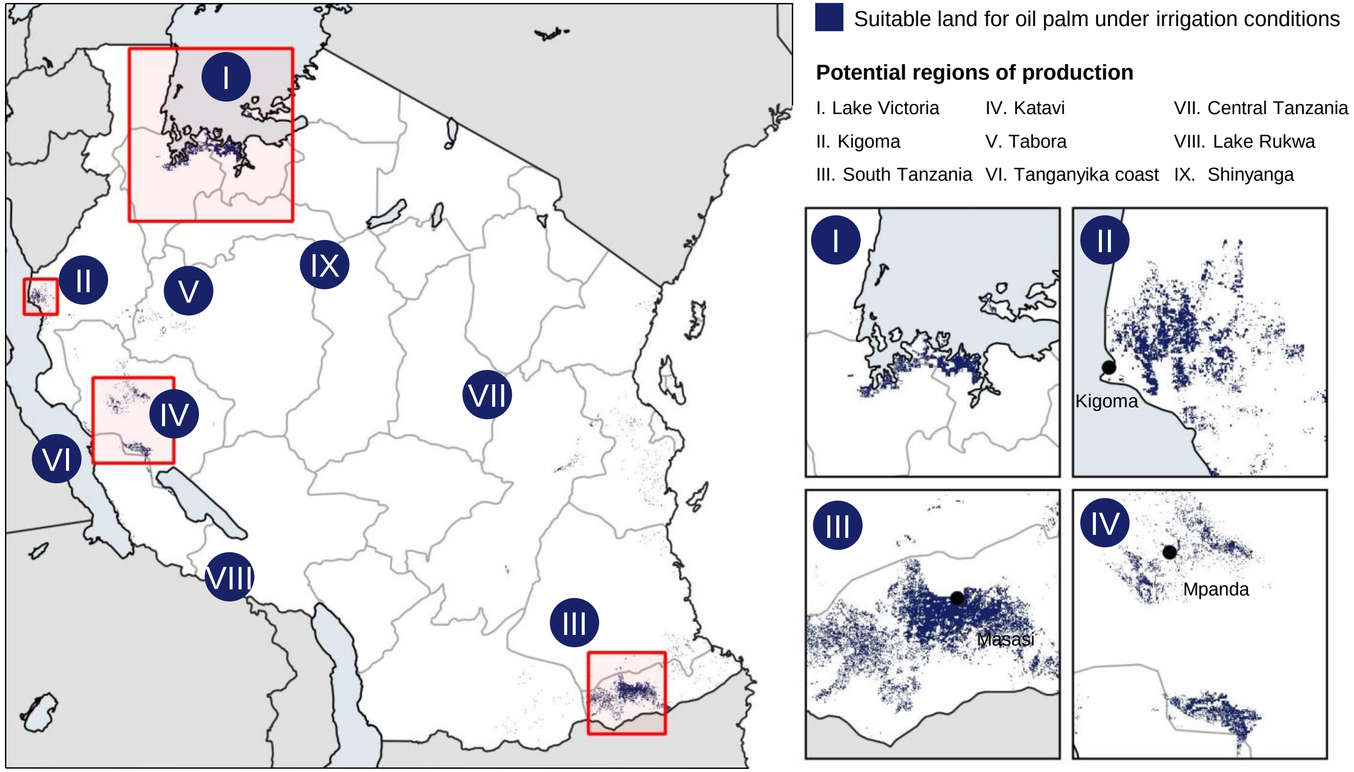
Ensure suitability for oil palm

Identify land using terrain, soil, and climate constraints for palm cultivation, while excluding areas prone to flooding[1]

Minimize land-use change

Exclude forested areas, critical habitats, and urban areas

Excluding areas of medium-high water risk, Tanzania could produce up to **2 million MT of CPO** each year across **0.5 million ha**[2]



1. Notwithstanding water requirements, the analysis assumes oil palm growth is feasible in areas with maximum monthly temperatures < 31°C, minimum monthly temperatures > 22.5°C, annual precipitation < 2,500 mm, the minimum temperature of the coldest month >15°C (to avoid rot), and a clay content (in the top 30 cm of the soil) between 15 and 72%. Analysis excluded terrain with slopes 15° (Verheye, 2010; Mutert 1999). Analysis avoids areas prone to coastal or riverine flooding (with an event return period of 250 years or less; Aqueduct, 2020). Climatic variables were assessed for the period 2021-2040, assuming a business-as-usual climate change scenario (rcp 4.5)
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Source: Verheye (2010); Mutert (1999); WorldClim (2022); Aqueduct (2014)

2. Even the most suitable sites for oil palm plantations would require significant irrigation (at minimum, 900 mm per year)

High-level spatial analysis

Irrigation requirements

Analysis of rainfall patterns and oil palm water requirements were used to estimate the overall irrigation needs[1]

Irrigation requirements (mm/year)[1]

- 600-800
- 800-1000
- 1000-1200
- 1200-1400

Potential regions of production

I. Lake Victoria
II. Kigoma
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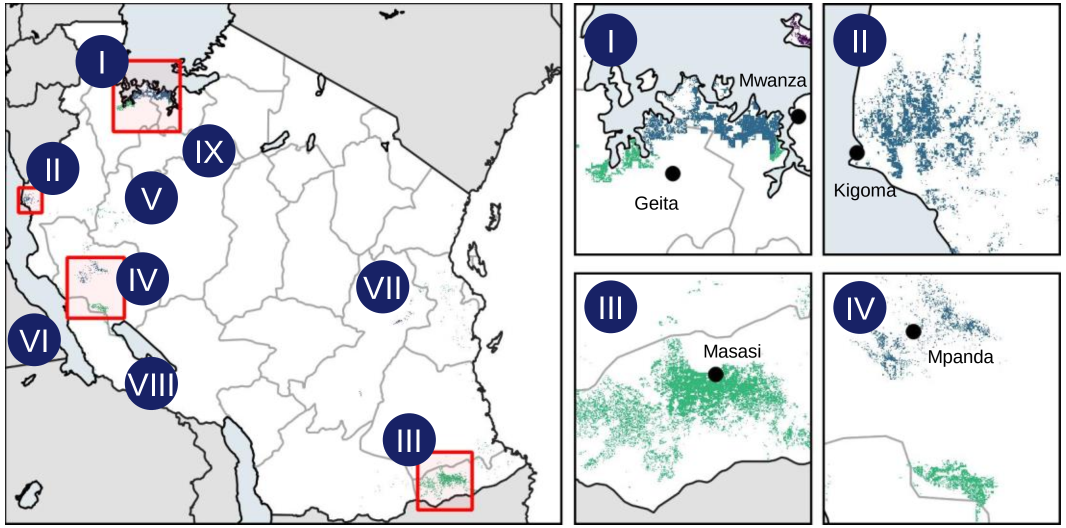
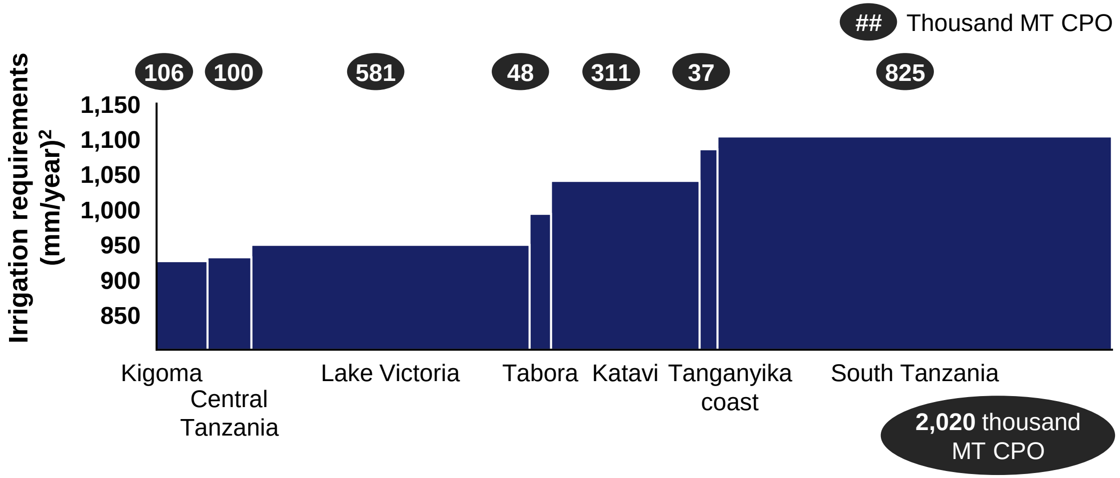


To grow *Tenera* oil palm in Tanzania, **irrigation is required everywhere**

By selecting appropriate regions, company could **reduce irrigation needs up to 16%** (comparing South Tanzania to Kigoma)

Suitable land is concentrated in relatively small areas within Kigoma, Katavi, South Tanzania, or Lake Victoria

Irrigation requirements (mm/year) and production potential per region (MT CPO/year)



1. The lower value for monthly irrigation requirements is calculated as the average FFB yield of 14.2 MT/ha reported by FAO between 2017-2021 multiplied with the global average water footprint (Mekonnen et al., 2014). The upper value is calculated as the average of the water use reported by example company (260 mm/month) and Mongabay (150 mm/month). The total irrigation requirements were calculated as the monthly difference between precipitation (WorldClim) and required water use. Calculation assumes average yields of 3.68 MT CPO/ha (Tanzania Investment Center; Agri Census 2019/2020)

Source: Verheye (2010); Mutert (1999); FAOSTAT (2023); Mekonnen (2014); Tanzania Investment Centre; Agri Census 2019/2020

3. Adherence to RSPO standards requires approval for new plantations

High-level overview of requirements

Roundtable on Sustainable Palm Oil New Planting Procedure (NPP)

1	**Conduct a series of assessments**	Assessments include the following: a) Social and Environmental Impact Assessment (SEIA) b) High Conservation Value-High Carbon Stock Assessment (HCV-HCSA) c) Free, Prior and Informed Consent (FPIC) d) Land Use Change Analysis (LUCA) e) GHGs
2	**Verification by third-party accredited Certification Bodies (CBs)**	Grower must hire a CB to verify that all NPP requirements have been met and submit the final NPP report that contains the following to the RSPO Secretariat: a) Notification Statement and Summary of Assessments b) Integrated Management Plan c) Digital shapefiles outlining the planned planting area
3	**RSPO review and approval**	The RSPO Secretariat will review the NPP documents submitted, post on the RSPO website for 30 days for public comments, and approve subject to grower addressing stakeholders' comments (if any)

Takeaways

Before any new oil palm development, the company would be required to complete the NPP to

- Identify and preserve areas with High Conservation Value (HCV) and High Carbon Stock (HCS);
- Prevent planting on peatland, fragile and marginal soils; and
- Uphold the rights of local peoples including their rights on the land being developed

Certification is not equivalent to no deforestation

- RSPO requires that if a grower's land constitutes a "risk area" they conduct an integrated HCV-HCSA assessment using a licensed assessor
- RSPO allows forest clearance so long as the land is deemed not to be HCV or HCS
- Deforestation standards such as the EUDR, however, consider **any** clearance of "forest" to be "deforestation"[1]

Ongoing compliance would also require that the company adhere to RSPO's **Principles and Criteria and Supply Chain Certification Standard**

1. Tanzania defines "forests" as areas ≥0.5ha with crown cover ≥10% of area and average tree height ≥3m (per Tanzania's Forest Emission Level Submission to the UNFCCC (2016)); this also aligns with the definition used in the EUDR

Source: RSPO website; Regulation of the European Parliament and of the council on the making available on the Union market and the export from the Union of certain commodities and products associated with deforestation and forest degradation and repealing Regulation (EU) No 995/2010; Tanzania's Forest Emission Level Submission to the UNFCCC (2016)

Contents

Why nature matters

Footprint approach

Example analyses

Check-list approach for investment

Appendix: Selected palm oil example analyses

Appendix: TNFD

Foot printing methodology focuses on locating activities and estimating impact drivers

Nature footprint methodology and alignment to TNFD LEAP approach

	Phase 1: Nature footprint				Phase 2: Mitigation
	A. Identify value chain	**B. Assess materiality**	**C. Locate potential nature impacts**	**D. Estimate impact drivers / pressures**	**Identify levers to mitigate impacts**
Description	Define company activities by sector and value chain	Identify which impact drivers are most material at each stage of value chain	Locate all activities and identify interfaces with nature	Assess the scale of impact drivers both quantitatively and qualitatively	Develop and prioritize a set of levers to reduce impacts on nature
Approach	For selected sectors, develop a high-level view of the key stages of the value chain and list activities at each stage	Use SBTN's sectoral materiality assessment tool and validate with expert assessment of local conditions	For select material stages, use geospatial analysis to identify interfaces and evaluate potential for impact	For select material stages and impact drivers, calculate impact drivers using a mix of direct reporting and proxy data	Develop longlist of mitigation levers and prioritize based on high-level assessment of impact and feasibility
Alignment to TNFD LEAP approach[1]	LEAP step L1, to map all activities and direct operations	LEAP steps L2, E1, and E4, to screen potential impacts, identify impact drivers, and assess which are material	LEAP steps L1, L3, and L4, to map activities and identify interfaces by ecosystem, biome, and sensitive locations	LEAP steps E1, E2, and E3 to select, identify, and measure impact drivers and impacts	LEAP steps A1 and A4 to identify and prioritize opportunities for action
Key additional TNFD disclosure requirements	Mapping all assets and activities for the entire company across all sectors	Assessment of business dependencies on nature Listing of environmental assets and services	Exhaustive of all material stages for the entire company across all sectors[2]	Direct measurement of a broader set of impact drivers[3] for whole company Measurement of changes in state of nature and ecosystem services[4]	Translation into financial risks and financial materiality Preparation of strategic plan, target setting, management processes, and reporting

1. The TNFD framework is meant for corporates and financial institutions; its application to a country- or sector-level assessment is imperfect
2. For this exercise, a limited set of material stages were used for analysis, rather than all material stages
3. TNFD allows direct measures to be excluded where it is not possible to measure, but requires a plan to achieve direct measurement in the future and disclosure of methodologies used to estimate impacts and impact drivers
4. Although TNFD uses a "leading indicators" approach, which emphasizes measuring impact drivers, an understanding of how company activities and external factors can impact nature is also required; like footnote 2, TNFD allows for wide leeway where organizations are not initially able to measure such impacts but encourages the adoption of monitoring techniques over time

A footprint assessment is only a first step, as the TNFD requires additional categories of disclosure

A full TNFD-compliant disclosure can take multiple years

Direct relevance of footprint assessment

TNFD disclosure categories	Governance	Strategy	Risk & Impact Management	Metrics & Targets
Description	Disclose the organization's governance around nature-related dependencies, impacts, risks & opportunities	Disclose the actual and potential dependencies, impacts, risks and opportunities on the organisation's businesses, strategy and financial planning	Disclose how the organization identifies, assesses and manages nature-related dependencies, impacts, risks and opportunities	Disclose the metrics and targets used to assess and manage relevant nature-related dependencies, impacts, risks and opportunities
Re-commended disclosures	A. Describe the board's oversight of nature-related dependencies, impacts, risks and opportunities	A. Describe the nature-related dependencies, impacts, risks and opportunities the organization has identified over the short, medium, and long term	A(i). Describe the organization's processes for identifying and assessing dependencies, impacts, risks and opportunities in its direct operations A(ii). Describe the organisation's processes for identifying, assessing and prioritising nature-related dependencies, impacts, risks and opportunities in its upstream and downstream value chain(s)	A. Disclose the metrics used by the organization to assess and manage material nature-related risks and opportunities in line with its strategy and risk management process
	B. Describe management's role in assessing and managing nature-related dependencies, impacts, risks and opportunities	B. Describe the effect nature-related dependencies, impacts, risks and opportunities have had on the organisation's business model, value chain, strategy and financial planning	B. Describe the organisation's processes for managing nature-related dependencies, impacts, risks and opportunities	B. Disclose the metrics used by the organization to assess and manage dependencies and impacts on nature
	C. Describe the organization's human rights policies, engagement activities, and oversight by the board and management with respect to Indigenous Peoples, Local Communities, affected and other stakeholders during the nature-related assessments and responses	C. Describe the resilience of the organisation's strategy to nature-related risks and opportunities, taking into consideration different scenarios . D. Disclose the locations of assets and/or activities in the organisation's direct operations and, where possible, upstream and downstream value chain(s) that meet the criteria for priority locations.	C. Describe how processes for identifying, assessing, prioritising and monitoring nature-related risks are integrated into and inform the organisation's overall risk management processes	C. Describe the targets and goals used by the organisation to manage nature-related dependencies, impacts, risks and opportunities and its performance against these

Source: Recommendations of the Taskforce on Nature-related Financial Disclosures (September 2023)

Companies can follow LEAP approach to generate the key outputs required to disclose TNFD

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KEY OUTPUTS FROM LEAP APPROACH

	Locate	Evaluate	Assess	Prepare
Objective	**Understand and identify** organization’s nature dependencies, impacts, risks, and opportunities	Understand the organization's potentially **material dependencies and impacts** on nature.	**Filter for material risks and opportunities**	**Decide how the organization should respond** to the material nature-related issues
Key concepts analyzed	Span of business and value chain (or capital portfolio) Nature Interface Sensitive Locations	Scale and scope of dependency and impact Materiality	Prioritization Risk & Opportunity Physical, transition, liability, and systemic nature risks Green premium and competitiveness	**4 Pillars of Recommended Disclosures** **Core global metrics** **Core sector metrics** **Additional recommended metrics**
Outputs	List of moderate and high nature dependencies and impacts (by **sector, value chain, geography**) List or map of ecologically sensitive locations Understanding of % of business / value chain / portfolio assessed for its interface with nature	List of relevant environmental assets List of dependencies and impacts on nature and analysis **Prioritized list of material dependencies and impacts**	Longlist of relevant nature-related risks and opportunities Shortlist of **priority locations** Outline of process used to integrate nature risks and opportunities to existing risk processes	Discussion of risk management processes and governance Nature targets and goals Publication of TNFD disclosures

Source: TNFD Guidance on the identification and assessment of nature-related issues: the LEAP Approach

Core Metrics: TNFD recommends reporters, regardless of sectors, to disclose core indicators

Placeholder indicators

Category	No.	Indicator	Metrics (not exhaustive)
Climate change		GHG emissions	GHG emissions
Land/freshwater/ ocean-use change	C 1.0	Total spatial footprint	Total **spatial footprint (km2)**
	C1.1	Extent of land/freshwater/ocean-use change	**Extent of land/freshwater/ocean ecosystem use change or conserved/restored (km2)**
Pollution/ pollution removal	C 2.0	Pollutants released to soil split by type	Total **pollutants released to soil** split by type (tonnes)
	C 2.1	Wastewater discharged	**Volume of wastewater discharged and concentrations of key pollutants** in the wastewater discharged (m3)
	C 2.2	Waste generation and disposal	Total **amount of hazardous waste** generated (tonnes)
	C 2.3	Plastic pollution	Total **weight of plastics** used, sold or broken down (tonnes).
	C 2.4	Non-GHG air pollutants	Total **non-GHG air pollutants** (tonnes incl PM2.5, NO, SO, NMVOC, NH3)
Resource use/ replenishment	C 3.0	Water withdrawal and consumption from areas of water scarcity	**Water withdrawal and consumption** from areas of water stress
	C 3.1	Quantity of high-risk natural commodities sourced from land/ocean/freshwater	Quantity of **high-risk natural commodities** sourced from land/ocean/freshwater (tonnes, % change) and under sustainable management plan
Invasive alien species	C 4.0	Measures against unintentional introduction of invasive alien species	Proportion of high-risk activities operated under appropriate measures to prevent unintentional introduction of IAS
State of nature	C 5.0 C 6.0	Ecosystem condition Species extinction risk	Under development: Level of ecosystem condition by type of ecosystem and business activity; and Species extinction risk.
Risk	C 7.0 C 7.1	**Value of assets assessed as vulnerable to**: 1) physical risks and 2) transition risks.	
	C 7.2	Description and value of significant fines/penalties received/litigation action in the year due to negative nature-related impacts	
Opportunity	C 7.3	Amount of **capital, financing or investment deployed towards nature-related opportunities,** by type of opportunity, with reference to a green investment taxonomy.	
	C 7.4	Increase and proportion of revenue from products and services producing demonstrable positive impacts on nature	

Source: TNFD (2023) Recommendations of the Taskforce on nature-related financial disclosures

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