

The palm oil value chain in Tanzania

Diagnostics, investment models and action plan for development and innovation



Draft Report, February 2019

Executive Summary

In the poorest region of Tanzania, Kigoma – there are over 30,000 smallholder subsistence palm oil farmers. Meanwhile, the country imports over 500,000 MT of palm oil per annum. Thus, palm oil value chain development offers great potential for both import substitution and poverty alleviation. At the same time, other goals such as environmental conservation, improved nutrition, and gender equality and women's empowerment may be achieved through sustainable palm oil value chain development.

3ADI+ proposes a comprehensive, sustainable food value chain development approach, which requires the action of various stakeholders working at all levels, across the value chain, in support services and the enabling environment. Without the coordination of actors working in unison to achieve common goals in input provision, production, processing, knowledge provision and an enabling business environment, palm oil sector development will not be successful in Tanzania.

3ADI+ proposes a three-pronged approach to develop businesses along the value chains, which are inclusive of at least 10,000 of the palm oil producers located in Kigoma. On the level of production three business models – village clusters, village estates and an industrial plantation, are necessary for an economically feasible yet smallholder inclusive palm oil value chain. The strategy is underpinned by the necessity to expand the use of imported improved *tenera* variety trees in place of unproductive *dura* variety. Most importantly, it is necessary to implement a biodiverse agroforestry production system as opposed to the traditional, unsustainable monocrop palm oil plantations.

In processing, gradual upgrades from the current technology (i.e. Burundi and SIDO expellers), will not be technically and economically viable. Instead, large-scale private sector investment is foreseen in a mill and refinery, which will serve as the anchor to the entire palm oil sector development. This investor will serve as the off-taker for fresh fruit bunches from smallholder plantations and play an important advisory role in ensuring quality and quantity.

In addition, knowledge and further support will be provided by a proposed Kigoma Agricultural Training Centre (KATIC), which will serve as a one-stop shop for all knowledge on palm oil plantations, including production and harvest.

Moreover, good governance is of the utmost importance, and an umbrella cooperative with subchapters will organize smallholder farmers into productive units. The Umbrella Cooperative will provide contractual negotiations and training oversight, as well as critical functions of storage, value addition and marketing for subchapters.

The Government of Tanzania, including local government authorities and relevant agencies, must play a facilitating role the ease of doing business. This will include investment promotion, the provision of land titles, a public health campaign, amongst others.

Finally, it is essential that 3ADI+ partners, including the Food and Agricultural Organization, the United Nations Industrial Development Organization, and Trade Mark East Africa will continue to play a coordinating role in the strategy development and implementation, in partnership with the Ministry of Agricultural and Ministry of Industry Trade and Investment.

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Acronyms

- AfDB – African Development Bank
ASDP – Agricultural Sector Development Program
BoP – Base of Pyramid
CCRO – Certificate of Customary Rights of Occupancy
CPO – Crude palm oil
CPKO – Crude palm kernel oil
DED - District Executive Director
DOBI – Deterioration of Bleachability Index
FAO – Food and Agriculture Organization of the United Nations
FFA – Free fatty acids
FFB – Fresh Fruit Bunch
FPIC - Free Prior Informed consent
GoT – Government of Tanzania
JKT – Jeshi la Kujenga Taifa
KATIC – Kigoma Agricultural Training and Innovation Centre
KiSEZ – Kigoma Special Economic Zone
LGA – Local Government Authorities
MPOB - Malaysia Palm Oil Board
NMB – National Microfinance Bank
PASS – Private Agriculture Sector Support
PKS - Palm Kernel Shells
PKM – Palm Kernel Meal
RPO – Refined palm oil
RSPO – Roundtable on Sustainable Palm Oil
SIDO – Small Industries Development Organization
SIFF – Small Industrial Facilities Fund
SUA – Sokoine University of Agriculture
TBS – Tanzanian Bureau of Standards
TCCIA – Tanzania Chamber of Commerce, Industry and Agriculture
TEMDO – Tanzania Engineering and Manufacturing Design Organization
TFDA – Tanzania Food and Drug Authority
TIRDO – Tanzania Industrial Research and Development Organization
TNBC – Tanzania National Business Council

TPSF – Tanzania Private Sector Foundation

TIC – Tanzania Investment Centre

UNDP – United Nations Development Programme

UNIDO – United Nations Industrial Development Organization

URT- United Republic of Tanzania

WRS – Warehouse receipt system

Introduction

The Accelerator for Agriculture and Agroindustry Development and Innovation Plus (3ADI+) is a global UN value chain and market systems development programme spearheaded by FAO and UNIDO. 3ADI+ was revived under ECOSOC in 2017 and is being pilot-tested in three countries in 2018: Tanzania (palm oil), Bangladesh (livestock) and Suriname (pineapple). In early 2018, the 3ADI+ team consulted with the Ministry of Agriculture (MoA) and the Ministry of Industry, Trade and Investment (MITI) of Tanzania to make an inter-ministerial decision on the 3ADI+ priority value chain. Responding to the high imports of edible oils, palm oil was selected as the priority value chain for 3ADI+ Tanzania. Palm oil accounts for more than a quarter of the country's food imports and 3 percent of the country's total imports as of 2016 (MAFAP, 2013; OEC, 2018). The choice of the value chain is aligned to the Agricultural Sector Development Program (ASDP)-Phase II of Tanzania which mentions oil seeds crops, including palm oil as a priority commodity value chain and indicates that palm oil imports should be reduced by 50 percent (URT, 2017). The sector is also covered in the CAADP framework, SAGCOT, Kilimo Kwanza Resolve and Agricultural Policy (2012). The latest Government initiative led by the Prime Minister's Office has put increased pressure on local Governments as well as Ministries of Agriculture and Industry and Trade to foster the development of the sector.

This document provides results from a diagnostic study on the current state of development of the palm oil value chain and focuses, especially on Kigoma the primary oil palm production region in Tanzania. The report then presents proposed improved businesses and modes of operation in the chain and concludes with an action plan to pave the way forward for a substantial development of the chain. The action plan has a view on regional development in Kigoma and does not only include palm oil but also a number of additional crops and products that together make the overall market system profitable. The document aims to inform policy makers, development agencies and investors on development and investment opportunities. 3ADI+ emphasizes that coordination of efforts is necessary as the development of different segments of the value chain requires simultaneous efforts by various actors; this alone will render sustainable results. The propositions are made on the basis of considerations for inclusiveness (engaging a large number of smallholders and other rural people), ecological sustainability and observing land tenure rights.

The 3ADI+ takes a holistic approach, applying system thinking to value chain analysis and development. It combines the technical approaches of FAO's *Sustainable Food Value Chain Guidelines* and UNIDO's Diagnostics for Industrial Value Chain Development and integrates the latest thinking on value chain development such as innovative business model development and complex adaptive systems thinking.

The work leading to this report were conducted throughout 2018 by the 3ADI+ team, including Cassandra Walker (FAO), Frank Hartwich (UNIDO), Alex Chetkovich, Beatrice Fuchs (Seed Change), Golden Mahove (3ADI+), Andrea Antonelli (UNIDO) and Christoph Roth (3ADI+). The analysis began with a desk review of edible oils in Tanzania, with a focus on palm oil. In May 2018, 3ADI+ was launched with 18 representatives of the MoA and MITI in an inception workshop, including the 3ADI+ ministry focal points Ms Stella Lugongo (MITI)

and Mr Julius Nyalus, succeeded by Mr Eric Mayani (MoA). Another strategic mission was held in July to create partnerships and linkages.

Throughout June-August, Seed Change conducted interviews and focus group discussions to draft the palm oil diagnostic section. Various actors including input suppliers, extensionists, financial services, palm oil producers, processors, cooperatives, market intermediaries, kernel oil processors, soap makers, retailers, consumers, and wholesalers were interviewed. In addition to the primary data collected, secondary data has been revised using Government statistics and analytical works of international agencies. In September, the results of the diagnostic (Section 1&2) were presented to 30 government representatives in a validation workshop held in Dodoma.

In October, palm oil expert – Mr Christoph Roth travelled to Tanzania to help develop the business models and strategic plan for palm oil value chain development. In December, the action plan was presented to the GoT and stakeholders in the sector, with representatives present from Kigoma.

Chapter 1: Analysis of Current Situation

The following chapter analyses the current production situation in Kigoma region, Tanzania's main production area for palm oil, while also looking at national and international markets and detects main constraints to development.

1.1 Overview of the national palm oil value chain

Palm oil is the most widely consumed edible oil in Tanzania and its consumption is expected to further grow. It can be found in supermarkets and corner stores across the country. Palm oil, usually in form of Refined Palm Oil (RPO), is sold at a price point that is accessible to the majority of Tanzania consumers. Crude Palm Oil (CPO) is only sold where local palm oil production is relevant and covers not more than 2% of the national market. Crude Palm Kernel Oil (CPCPKO), a key ingredient in imported and locally produced soaps and shampoos, is imported and where available locally, used for similar purposes.

Tanzania is the 12th largest CPO importer in the world (ITC, 2017) and palm oil products are Tanzania's second largest imported commodity (by value), behind petroleum products. 98% of palm oil consumed is imported from South-East Asia either as CPO and refined in Dar es Salaam by a handful of companies. Additionally, CPKO is imported for ingredients in soap and shampoo production. Domestic demand is currently estimated at 370,000 MT and growing at around 12% per annum (Dalberg, 2017). As Tanzanians continue to increase wealth, palm oil demand will continue to rise, a phenomenon that has already been studied in neighbouring Kenya, a slightly richer country with similar culinary culture that with a lesser population imports three times as much CPO as Tanzania.

Agricultural production estimates for palm oil in Tanzania, vary drastically between 200,000 MT – 500,000 MT (GAFSP, Dalberg, etc.), but estimates converge around domestic production constituting less than 2% of the country's consumption. Domestic production of CPO and CPKO remains a separate sector to the importation, refinement, and retailing of CPO and CPKO. Monthly import volumes show no correlation to harvest in Tanzania nor has a domestic producer emerged as a supplier or competitor to the refiners and processors in Dar es Salaam.

The Government of Tanzania (GoT) is implementing measures to protect the local palm oil industry. According to the 2018 budget statement, the import tariff on CPO increased to 25% up from 10%, and 35% on semi-refined and refined palm products, from 25% in conformity with EAC regulations (3ADI+, 2018). This tariff is yet to flow through to prices and import volumes, but it can be expected to increase prices in the short term as there is no ready domestic production to fill this gap. The short-term effect rather is the subsidization the business of refining imported crude oil. There have been also records on importing refined oil declared as crude oil. Over the medium to long term the increasing demand will need to be met through extending local production or through increasing imports.

Upwards of 90% of the to date admittedly negligible domestic palm oil production in Tanzania comes from the Kigoma region where production, processing and marketing is established in form of a cottage industry characterize through low inputs and low outputs.

The total palm oil produced in the Kigoma region is not known precisely but is estimated to be between 3,000 to 3,500 MT of CPO and 550 to 800 MT of CPKO (Annex 1).

Farmers in Kigoma almost uniformly cultivate low-yielding *dura* variety oil palm trees that have been spreading through natural succession and human exploitation since more than 100 years along river basins and along river valleys in the Kigoma region. People farm in a kind of palm-oil based mixed cropping system in which revenues from palms constitute at least 30-50% of their farm revenues. Farmers produce FFBs and either process them on farm by human-powered machines or sell to another farmer who processes them along with their own FFBs. Farmers sell CPO to middlemen who in turn sell to retailers who sell to the end consumers. No domestically produced CPO is refined. CPO is predominantly sold within in the region, with very little sold outside the region. A minority are processed in diesel-powered machines – the so called SIDO expeller – that replace human power. Overall the current practice of expelling – rather a process of inefficient squeezing of fruits – is by far less efficient than the smallest industrial mills present in other palm oil producing regions of the world. Industrial processing is non-existent despite local CPO expelling being established in Kigoma in its current form since the 1920s.

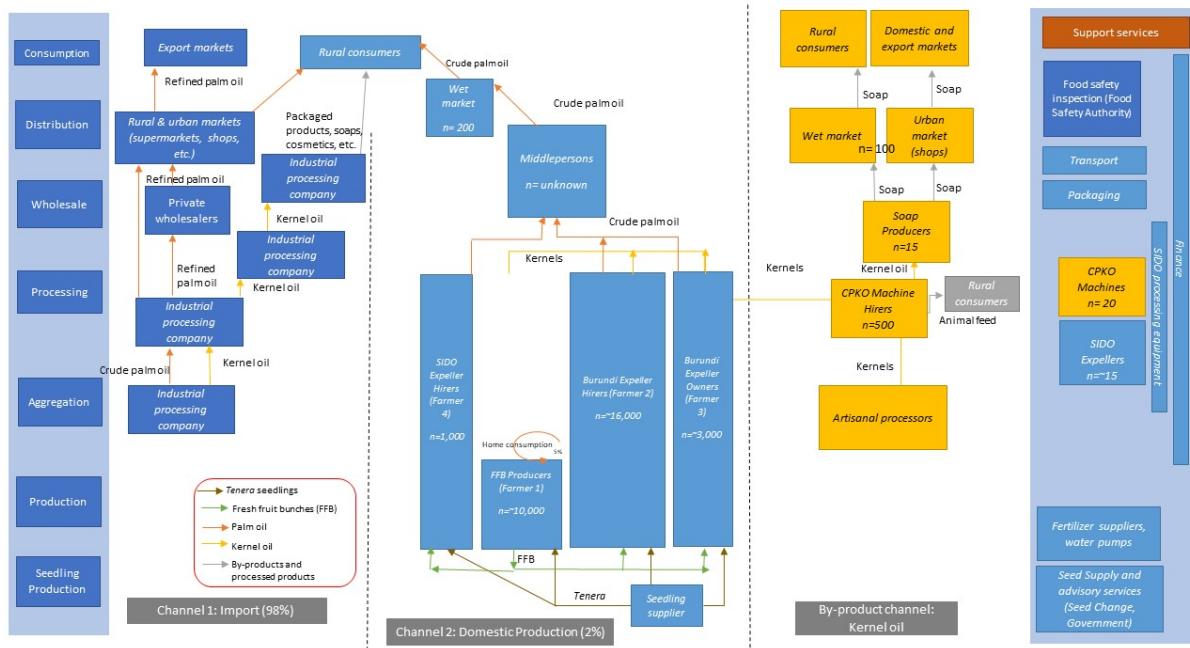
Kernel processing is a side activity engaging mostly women and constitutes a slightly more efficient and profitable branch of the value chain. Kernels are collected for processing, often sold to women who hire machines to extract the CPKO, which in turn is sold to local soap producers. These soap makers produce basic soap products from a combination of the CPKO and caustic soda and retail to end consumers in Kigoma or export to other regions of Tanzania. No actor is vertically integrated, and all processes are labour intensive with slim profit margins. Regardless, a value chain exists with its own unique linkages and interactions. A series of co-ordinated interventions could have large effects for job creation, poverty reduction and import substitution.

In conclusion, the domestic palm oil value chain remains in a rudimentary stage of development. The cultivation of a non-commercial oil palm variety is the key blockage to larger domestic production and in turn the processing, refining, and retailing industry.

1.2 Map of the palm oil value chain

There are two primary channels for palm oil production and consumption in Tanzania – the domestic channel (2%) and imports (98%). In addition, there is the channel of the by-product, crude palm kernel oil (CPKO), and its final products, mainly soap in Kigoma, but it also possible to make margarine, vegetable oil and shortening, creamers, chocolate and ice cream. Figure 1 depicts the value chain map and the actors are described below. There are about 30,000 smallholder palm oil producers in the Kigoma region, 20,000 of whom also process their own FFBs into CPO.

Figure 1: Palm Oil Value Chain Map



Source: the Authors

FFB Producer (Farmer 1): There are about 10,000 farmers who produce FFBs and do not process them, but rather sell to aggregators, most often neighbouring farmers who process the FFBs with other stock.

Burundi Expeller Machine Hirer (Farmer 2): There are about 16,000 farmers who produce FFBs and then rents a Burundi Expeller from neighbouring farmer (Farmer 3) to process their own FFBs. Similar to an FFB Producer (Farmer 1), the actor may on occasion choose to simply sell FFBs rather than process them.

Burundi Expeller Machine Owner (Farmer 3): There are about 3,000 farmers who produce FFBs and own a Burundi Expeller installed at their home, where they process their FFBs into CPO. The actor also rents to Burundi Expeller Machine Hirers (Farmer 2) for a fee of TZS 150-200 per litre of CPO. The actor may purchase FFBs from FFB Producer (Farmer 1) to increase volume.

SIDO Expeller Hirer (Farmer 4): There are about 1,000 farmers who produce FFBs and pay to process at a SIDO Expeller. Similar to an FFB Producer (Farmer 1), the actor may on occasion chose to simply sell FFBs rather than process them.

CPO Middleperson: There are an unknown number of middlepersons (mostly men) who purchase CPO from farmers to sell to CPO Retailers. Farmers may temporarily act as the middleperson if none are present when they want to sell CPO.

CPO Retailer: There are about 200 retailers (mostly women) who purchase CPO from Middlepersons at palm oil centres and sells at local markets to consumers in smaller packages (Figure 2).

CPKO Machine Hirer: There are about 500 women who collect kernels from the processing of FFBs into CPO and/or purchases kernels from farmers in surrounding villages. The actor rents a CPKO Machine to process kernels located at the SIDO complex (3rd image on report

cover). The actor sells CPKO to Soap Producers, and kernel cake directly to buyers for animal feed.

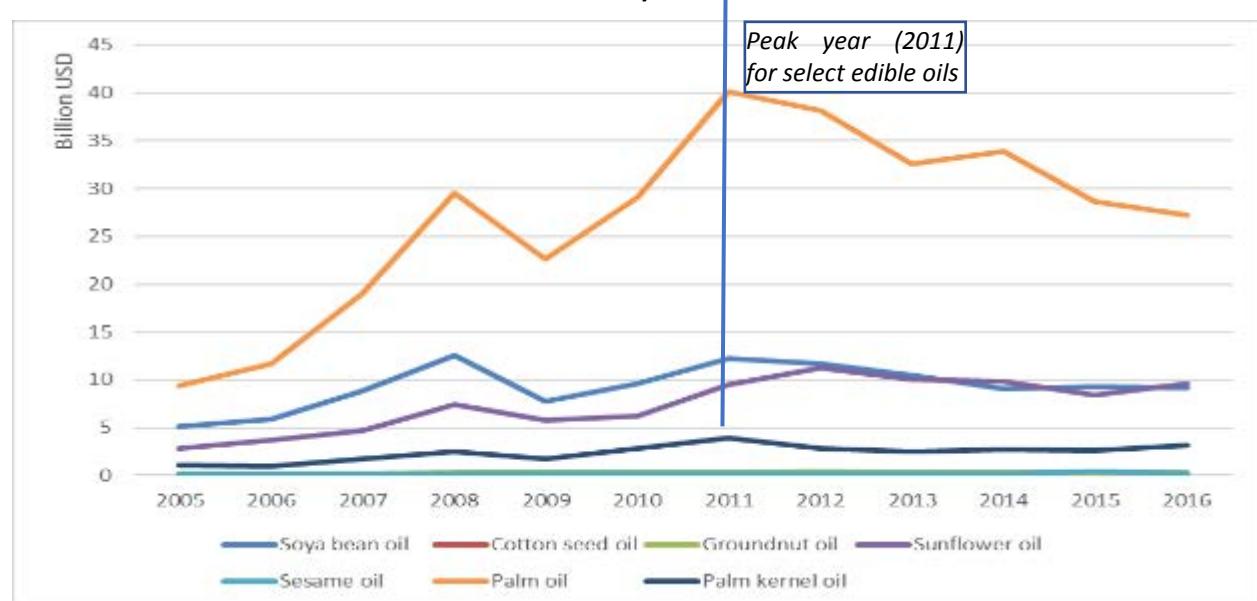
Soap Producer and Retailers: There are approximately 15 soap producers in Kigoma who buy CPKO from CPKO Machine Hirer to make soap at the SIDO complex to sell to Soap Retailers or directly to rural consumers. About 100 soap retailers (mostly women) then purchase the soap from Soap Producers at the factory gate in the SIDO complex to sell to rural consumers.

1.3 Market analysis

1.3.1 International palm oil trends

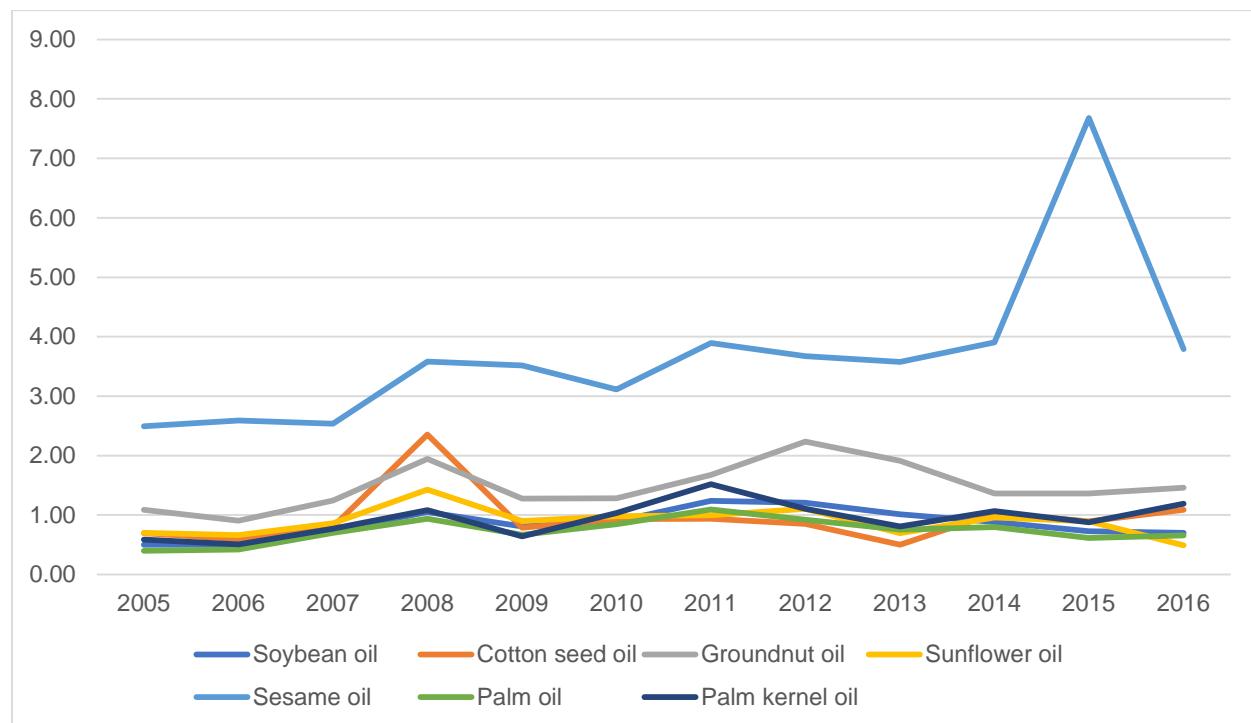
According to data value of global trade of selected edible oils, palm oil (also in combination with palm kernel oil) has a clear edge over the others, followed distantly by soybean and sunflower oil, and with sesame, groundnut and cotton seed oil playing only a minor role (see figure 2). However, when looking at annual growth rates over 2011-2016 (to show recent tendency), the emerging trend is a significant decline for most edible oils resisted only by sunflower among the major edible oils, and by groundnut and sesame oil in recent years among the minor players.

Figure 2: Global trade trends in export values for selected edible oils (billion USD, 2005-2016)



Source: UNCOMTRADE, 2018

By disaggregating the total export values of selected edible oils into quantities and unit values (see Figure 3 for proxy of average global prices), it is mostly the latter to impress the recent downward trends since 2011, offsetting the acceleration of export quantities in the past years (see also table 1).

Figure 3: Global trends in unit values for selected edible oils (USD/KG, 2005-2016)

Source: UNCOMTRADE

Apart from cottonseed oil, the other edible oils recorded peaks in unit values around 2011-2012 to then experience stagnation or declines afterwards. In particular, the leading soybean, palm and sunflower oils showed the most significant declines in unit values in the period 2011-2016.

Table 4: Global exports of selected edible oils (export values, quantities and unit values)

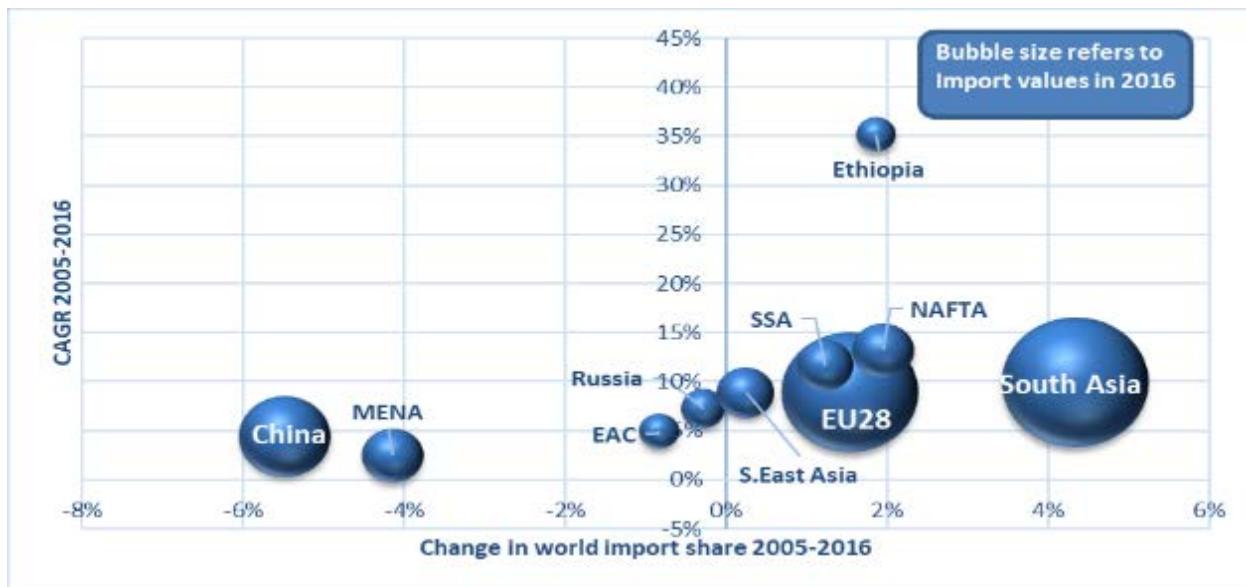
	Export Values		Export Quantities		Unit Values	
	CAGR 05-16	CAGR 11-16	CAGR 05-16	CAGR 11-16	CAGR 05-16	CAGR 11-16
Soybean oil	5.45%	-5.51%	2.26%	5.85%	3.12%	-10.73%
Cotton seed oil	0.67%	-10.40%	-3.31%	-12.99%	4.11%	2.97%
Groundnut oil	3.92%	1.12%	1.19%	3.96%	2.70%	-2.73%
Sunflower oil	11.80%	0.14%	15.46%	15.42%	-3.17%	-13.23%
Sesame oil	6.92%	5.09%	2.93%	5.66%	3.87%	-0.54%
Palm oil	10.14%	-7.48%	5.31%	2.41%	4.58%	-9.66%
Palm kernel oil	10.47%	-4.49%	3.54%	0.24%	6.69%	-4.72%

Source: UNCOMTRADE

Palm oil makes up a significant share of total vegetable oil consumption in the majority of countries (up to 6,000 USD GDP per capita), due mostly to its low price and this is partly reflected by global import shares of palm oil. South Asia is by far the largest importer of

palm oil, followed by the EU¹ and Southeast Asia². Sub-Saharan Africa (SSA), led by Ethiopia, takes a relatively large and growing share with almost 8.5% of global imports in 2016, which is relatively high to their level of GDPs, compared to other world regions. The East African Community (EAC) is instead losing import shares, together with China and Middle East and North Africa (MENA) region, but still growing over 5% (CAGR) across the period 2005-2016.

**Figure 5: Top global importers of aggregate refined and crude palm oil
(world import values, 2005-2016)**



Source: UNCOMTRADE 2018. Note: bubble size refers to import value

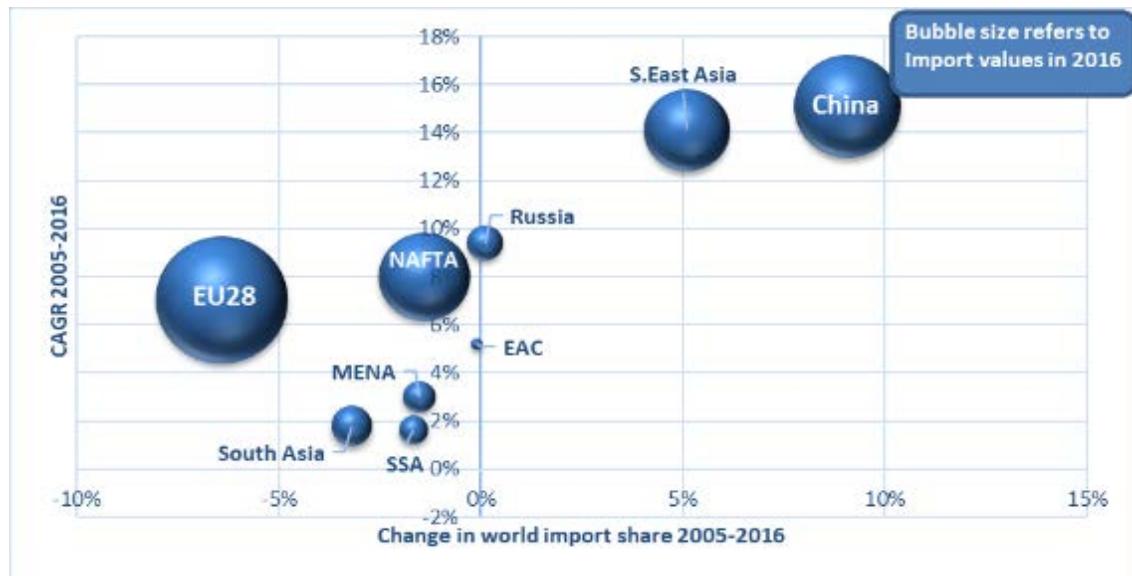
As for sunflower oil, import trends are similar to palm oil, with South (and Central) Asia driving the demand of crude sunflower oil, only surpassed by Europe, but whose demand is stagnant. The EAC remains a potential market for both crude and refined sunflower oil, in terms of both of aggregate growth rates and global import shares.

The total global import values for kernel oil (around 3.36 billion USD in 2016) remain well below total import figure of palm oil (around 25.6 billion USD in 2016). With prices and unit values generally higher for palm kernel oil, the global import shares of the Sub-Saharan and Indian sub-continent areas drop down significantly to around 1.67% and 2.9% respectively from the 29.2% and 8.5% observed with palm oil in 2016. EU 28 remains the largest importer but on a declining path relative to China and Southeast Asia.

¹ Recent agreement by EU negotiators to phase out use of palm oil as bio-fuel by 2030 might affect EU share of global palm oil imports in the future.

² South Asia here groups the following countries: Bangladesh, Bhutan, India, Maldives, Nepal and Pakistan. Southeast Asia includes Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam. Sub-Saharan group here excludes EAC and Ethiopia, otherwise WITS groupings for SSA and MENA were used.

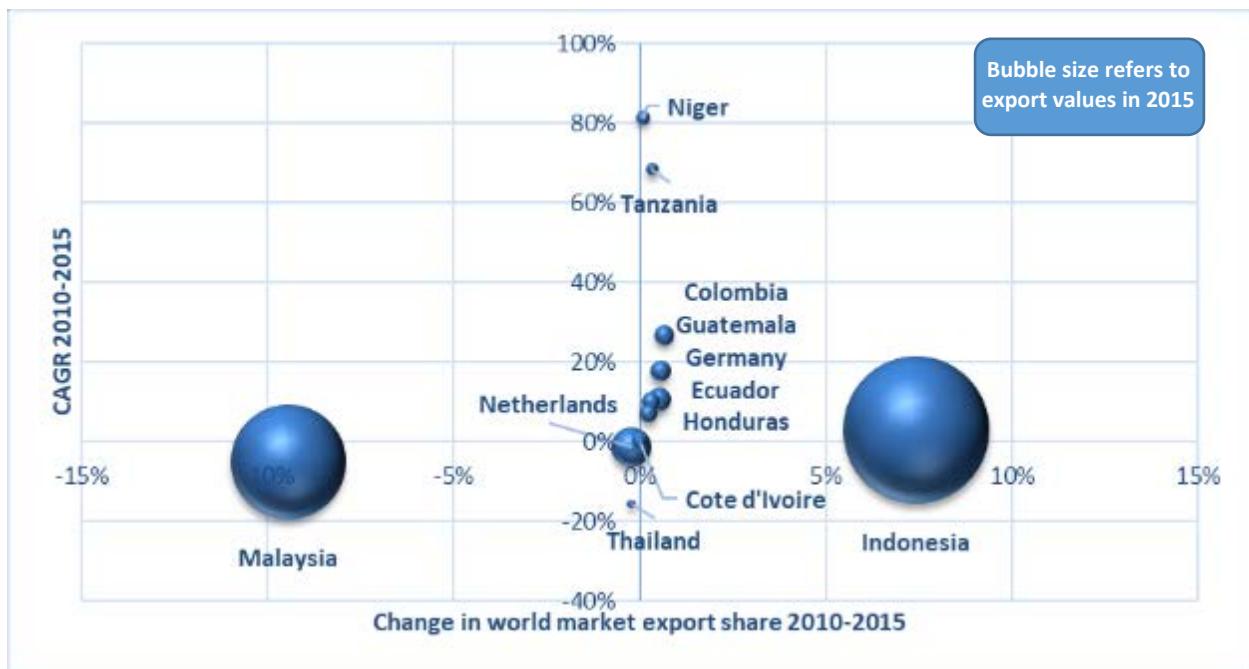
Figure 6: Top global importers of palm kernel oil (world import values, 2005-2016)



Source: UNCOMTRADE 2018. Note: bubble size refers to import value

When looking at global palm oil exports, indicators such as change in world export market share and CAGR were considered, but in a shorter timeframe, 2010-2015, to better assess recent competitiveness trends.

Figure 7: Top global exporters of palm oil (world export values, 2010-2015)



Source: UNCOMTRADE, 2018. Note: bubble size refers to export value

From the above graphs the following main conclusions can be drawn:

- In the past few years, Indonesia has been gradually outpacing Malaysia as the global palm oil exporter, with more than 50% of global market share in 2015, followed distantly

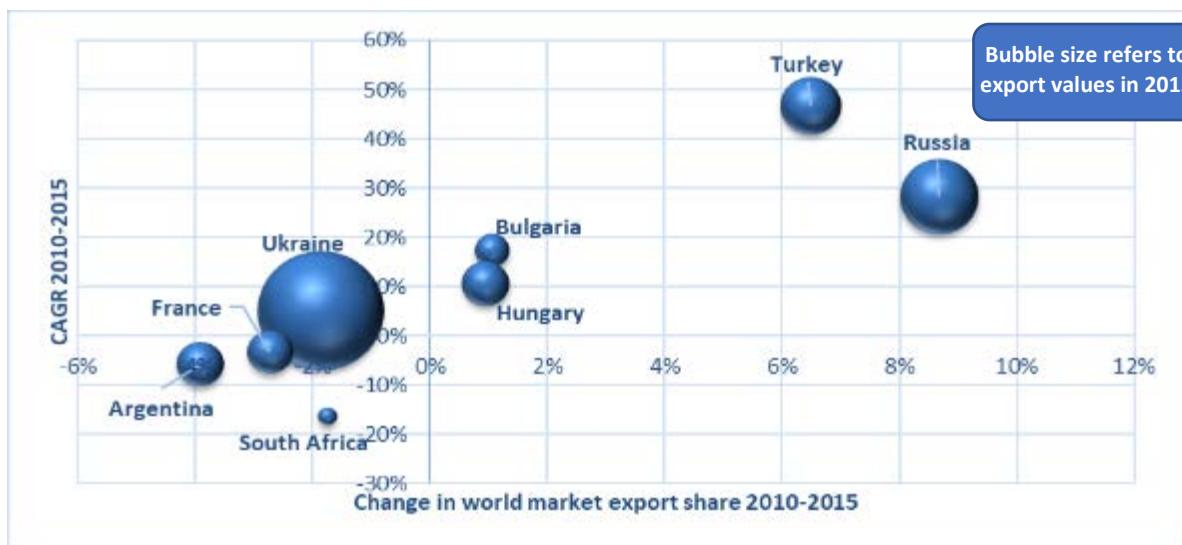
by the Netherlands and Papua New Guinea, whereas Thailand seems to have withdrawn from the arena³;

- This is a consequence of declining export values of Malaysia rather than an increase of them by Indonesia (due mostly to plummeting unit values in 2011-2016);
- Many global players are emerging from Latin America (Colombia, Guatemala, Ecuador, Honduras) showing steady increases in palm oil exports (CAGR in 2010-2015 exceeds 7%) and gaining world market shares;
- New actors are emerging also from West Africa, in particular Niger, registering a record 130 Million USD palm oil export value in 2016, not far from performances recorded for Cote d'Ivoire in 2010-2015 (still missing export data in 2016) and ahead of Ghana (more than 80 Million USD export value in 2016);
- EAC countries like Tanzania and Uganda show high fluctuations;
- In the MENA region, UAE, Oman and Saudi Arabia are witnessing promising export trends. Whereas, in Europe, the Netherlands remains the primary exporter but with falling market shares, as with other European countries, except for Germany and Denmark gaining respectively 0.52% and 0.12% market shares driven by high aggregate growth rate above 10% in the period 2010-2015⁴.

Kernel oil sees again Indonesia and Malaysia dominating the global market taking together 85% of the pie in 2016 (around 60% and 25% respectively). However, interestingly, the same pack of emerging actors from Latin America (Colombia, Guatemala, Ecuador, Honduras) managed to erode around 2.65% of global kernel oil market share against both Indonesia and Malaysia, since 2010 and up to 2016. The Netherlands also increased its global pie share of kernel oil of almost 2% since 2010, experiencing however significant fluctuations across the 2010-2015 period. Similar patterns are observed in the analysis of sunflower oil exports, with two actors (Ukraine and Russia) dominating global trade (more than 50% market share). Ukraine is losing market shares, whereas Russia and Turkey are on a very promising growth path.

³ Data are missing across several years for Papua New Guinea, ranking as the fourth global palm oil exporter in 2011 (almost 630 Million USD) and in 2012 (half billion USD). Using mirror data (world imports of palm oil from Papua New Guinea) shows significant palm oil import values from Papua New Guinea to the world, across the period, but with a declining trend to around 390 Million USD in 2016. Thailand decimated its palm oil exports from more than 430 Million USD in 2013 to just above 40 Million USD in 2016.

⁴ It is interesting to note the gradual withdrawal process of Ukraine from the value chain from 108 Mil USD export value in 2010 to less than one million USD in 2015.

Figure 8: Top global exporters of sunflower oil (world export values, 2010-2015)

Source: UNCOMTRADE, 2018

1.3.2 Regional (East African) palm oil trends

When zooming in on the East African⁵ market, palm oil dominates the import basket (i.e. cotton seed, soybean, groundnut, sesame, sunflower and kernel oils), with a stable share of 96% (see table x below). In the past few years, sunflower oil imports to the region have witnessed more sustained growth compared to palm oil, with an aggregate growth rate in 2005-2016 at 12.68%, more than double that registered for palm oil (4.95%); however, the absolute values remain negligible compared to palm oil (8.2 Million USD in 2016 for sunflower oil compared to 523 Million USD for palm oil)⁶.

Table 9: Values, market shares and CAGR of edible oil imports to the EAC (2005-2016)

	Import Values (1,000 USD)		Shares/total imports		CAGR	
	2005	2016	Share 2005	Share 2016	CAGR 05-16	CAGR 11-16
Soybean oil	5,027.69	4,923.14	1.58%	0.91%	-0.19%	-21.43%
Cottonseed oil	51.00	156.42	0.02%	0.03%	10.73%	-0.85%
Groundnut oil	84.67	102.55	0.03%	0.02%	1.76%	54.57%
Sunflower oil	2,204.70	8,197.72	0.69%	1.51%	12.68%	0.91%
Sesame oil	43.61	35.90	0.01%	0.01%	-1.75%	-0.93%
Palm oil	307,514.03	523,116.33	96.42%	96.24%	4.95%	-7.33%
Palm kernel oil	4,021.54	7,019.14	1.26%	1.29%	5.19%	-11.24%

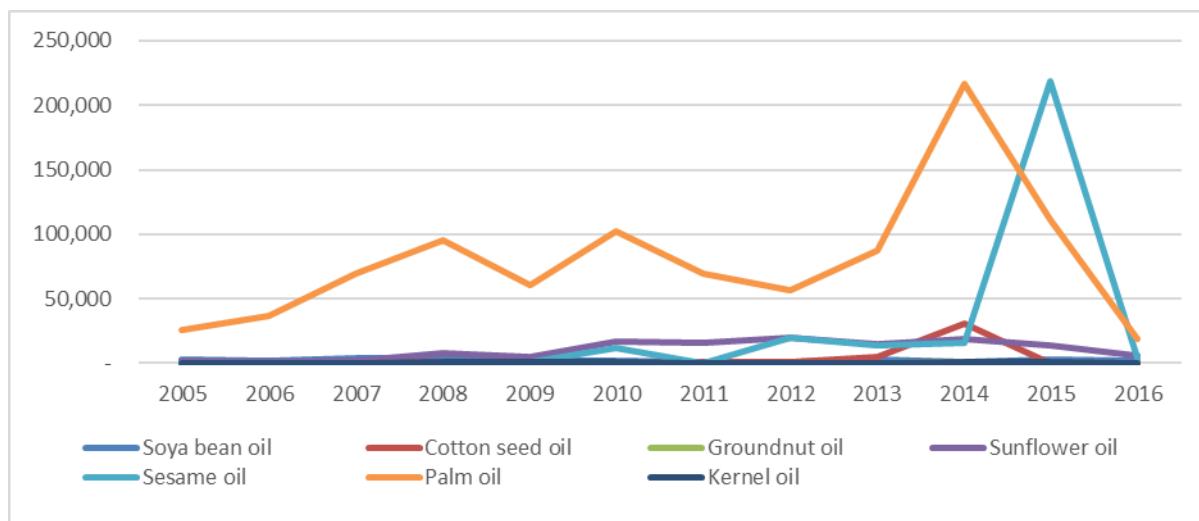
Source: UNCOMTRADE, 2018

⁵ See note number 1.

⁶ Of course here also one needs to consider the accuracy of the data. National statistics may well omit some of the non-reporter or informal border trade.

When assessing the edible oil export basket from the EAC, data show sudden high volatility, making it difficult to identify stable trends across the period 2005-2016⁷. For instance, in 2015 Tanzania recorded an impressive performance exporting around 220M USD of sesame oil to China but suddenly collapsed the following year⁸. Exports of palm oil, mainly from Tanzania to the Republic of Congo, exceeded 200 Million USD in 2014 and 95 Million USD in 2015 but collapsed the following year. Even cotton seed oil had a peak of over 30M USD in 2014 to then disappear in 2015⁹. Sunflower oil exports were more stable between 2010 and 2015 in the range of 15-20M USD.

**Figure 10: Edible oils export trends from the EAC
(export values from the EAC in 1,000USD, 2005-2016)**



Source: UNCOMTRADE, 2018

These trends are however negligible in reverting the negative trade balance of EAC edible oils. Palm oil exports grew too slow compared to imports, with no significant momentum to revert the edible oils' negative trade balance for the EAC.

Table 11: Trade balances for selected edible oils in the EAC (2005-2016)

	2005	2016
Soybean oil	-1,664,010	-3,226,850
Cottonseed oil	372,330	-102,180
Groundnut oil	-58,080	-37,760
Sunflower oil	157,150	-2,527,410
Sesame oil	- 41,680	4,318,400
Palm oil	-281,959,650	-504,116,860
Palm kernel oil	-3,891,710	-6,834,840

Source: UNCOMTRADE

⁷ This is also due to the fact Kenya is missing export data for years 2011-2012 and 2014-2016.

⁸ However, China does not record any import of sesame oil from Tanzania that year.

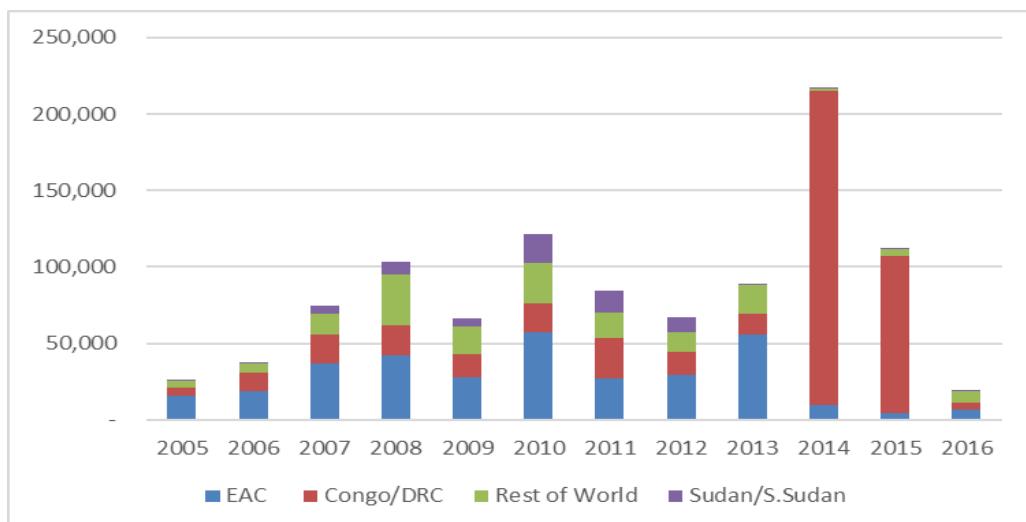
⁹ That was mostly crude cotton seed oil exported from Tanzania to Switzerland.

Within the EAC, Kenya imports most of the palm oil¹⁰, followed by Tanzania and with increasing trend from Uganda. Rwanda and Burundi have a minor share of the imports.

As on the world edible oil market, Indonesia and Malaysia dominate the EAC market, increasing their share in the EAC from almost 75% in 2005 (around 230 Million USD combined palm oil exports to the EAC) to over 90% in 2016 (almost half billion USD, but from more than 800 Million USD in 2013), with limited EAC intra-regional trade (3.72% in 2016)¹¹. Unlike global trends (figure 5), however, Malaysia is the primary exporter to the EAC, followed by Indonesia, and to a lesser extent Singapore. Only Kenya and Uganda managed to export significant values of palm oil of over ten Million USD to the EAC region throughout the period, without gaining market shares. Uganda reached almost 30 Million USD in the period 2011-2012, to settle down around 5 Million USD of palm oil exports more recently (2015-16).

In 2014 export of refined palm oil from Tanzania was at its peak with oil worth 215M USD (100M USD in 2015) to the Republic of Congo and DRC to a lesser extent¹². EAC intra-regional trade (exports from EAC countries to the common market) took around half of the total exports of palm oil on average in the period 2005-2013 before the 2014-2015 boom to Congo. One of the major EAC markets for palm oil, Sudan (before and after the secession of South Sudan), significantly decreased imports of palm oil from Uganda since 2013, due regional instability.

Figure 12: Major destinations of EAC palm oil (export values from the EAC in 1,000 USD, 2005-2016)



Source: UNCOMTRADE, 2018

¹⁰ Lacking data for 2011-12, 2014-16, decision was to keep Kenya import values from previous available year constant.

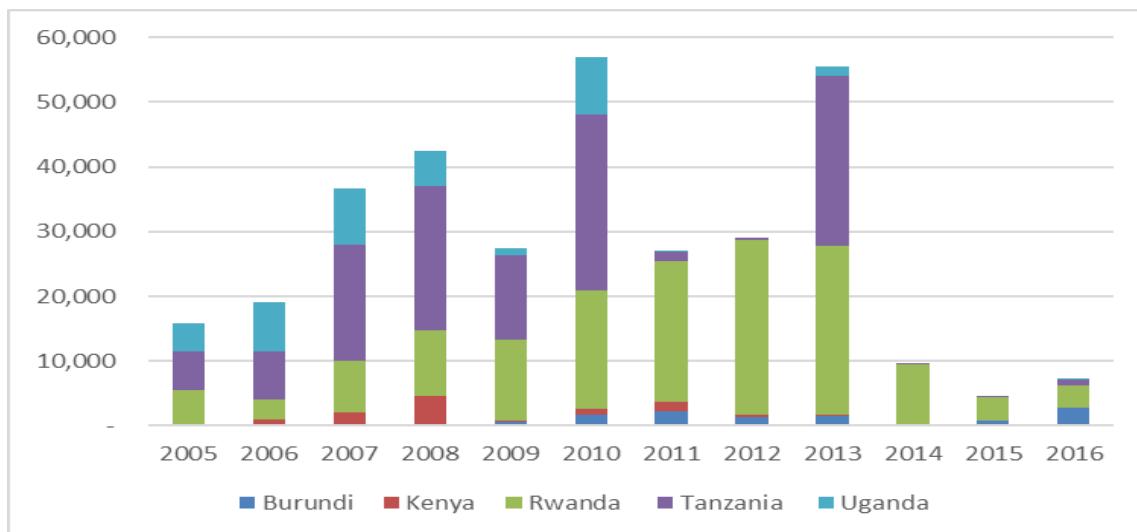
¹¹ In 2016 Kenya contributed 2.54% of market shares, whereas Uganda and Tanzania 1.06% and 0.12% respectively.

¹² For the palm oil export peak to the Republic of Congo in 2014 and 2015, available data do not inform whether the values refer to re-exports with no value addition, or part of the palm oil exported to the Republic of Congo and DRC was refined in Tanzania (being imported from Malaysia/Indonesia). However, next section tries to explain this performance using import data.

In terms of EAC intra-regional trade, crude palm oil, as well as palm nuts/kernels and palm oil cake, do not almost feature in the custom books from EAC to Tanzania and vice versa. The situation is slightly different with regard to refined palm oil, in which Tanzania sustained a trade deficit with Kenya and Uganda since 2008, following a good year of refined palm oil exports to Uganda and Kenya in 2007. The last recorded year, 2016, exhibited an increase to almost 2 Million USD in the exports of refined palm oil to Burundi (see below for further explanation)

Intra-regional trade of palm oil within the EAC is also highly volatile (figure 10). Only Rwanda has a relatively more stable market for palm oil from neighbouring countries, registering increasing exports from EAC to its markets until 2013, to then decline progressively. Tanzania represents another important market for exports of EAC produced palm oil (mostly imported from Kenya), it is undergoing significant fluctuations.

**Figure 13: Intra-EAC trade of palm oil: top markets
(export values from the EAC in 1,000 USD, 2005-2016)**



Source: UNCOMTRADE, 2018

The overall conclusion is that currently there are no stable export patterns of palm oil from EAC partner states to countries within and outside the EAC, including neighbours, to drive domestic production. The production of palm oil is not sufficiently developed and set up for intraregional export and beyond. For the moment, EAC countries focus mostly on filling domestic demand with palm oil imported globally, a market dominated by Southeast Asia.

1.3.3 Domestic edible oil trends

Tanzania's edible oil production, meets less than half of domestic demand, estimated at 755,000 tonnes in 2015, with an ever-increasing domestic demand (3ADI+, 2018). This gap is filled through palm oil imports for refinement and re-packaging in Dar es Salaam, primarily from Malaysia and Indonesia (45% and 37%, respectively), with an import bill of 80-120 million USD per annum. Though the five large processors in Dar have a large refining capacity of about 350-700,000 MT CPO/ year, this industry remains separate to local production based out of Kigoma (Informal conversations with East Coast Oils and Fats and Wilmar Representative). Companies were exporting edible oils regionally (e.g. Kenya,

Uganda, Rwanda, Malawi, DRC) but recent (2016) tariffs are said to be dampening competition (3ADI+, 2018).

The end market for CPO and CPKO from domestically produced FFBs is currently limited to retail consumers in areas adjacent to production due to the low quantity and quality of production. Farmers who process FFBs, either using a machine they own or rent from a neighbour sell CPO to a Middleperson in their village or transport it to their regional centre on the roadside and sell to CPO Retailers, who sell CPO in local markets. The geographical distance from the tree to consumer is estimated at under 50 kilometres.

Usually kernels which are left over from processing are collected by or sold to women who bring them to a CPKO expeller at the soap production cluster called the “SIDO complex” in Kigoma town where they rent services from kernel milling machine owners to extract the CPKO. This oil is then cooked and sold to soap producers at the same complex. The soap is primarily sold to local consumers through soap retailers in Kigoma. However, a small amount is also exported to the DRC and makes its way back to Dar.

Although there is clearly a large demand for CPO and CPKO both regionally and internationally with a market value of USD 27 billion as of 2016 (3ADI+, 2018) the focus here is on import substitution and providing a market to the many smallholder palm oil producers, thus the target end-market is the national market with domestically-produced refined palm oil. Further to this, there may be a long-term view to export palm oil to neighbouring countries, especially Congo and the Democratic Republic of Congo, which has bought refined palm oil from Tanzania in the past.

While refined palm oil and other edible oils like sunflower are deemed to be healthier than locally-produced red CPO, the local palm oil is cheaper and thus more accessible to Kigoma consumers. The sunflower oil industry has heavily invested in marketing products as healthy and zero cholesterol. However, branded and refined (olein) palm oil is still the most affordable edible oil and the taste is preferred to sunflower oil, especially for cooking beans – a staple food in Tanzania. Outside of Kigoma, the market for locally-produced palm oil is unknown, but there is clearly high demand due to its low price-point and high imports and distribution throughout the country. In order to compete with cheap imports, Kigoma palm oil must be produced, packaged and marketed cheaply to reach base of pyramid (BoP) consumers, whilst maintaining food safety. Large refiners, such as East Coast Oils and Fats, which already has a vast network for palm oil wholesaling and distribution throughout the country have indicated an interest in supporting domestic production and could provide a ready market for Kigoma palm oil (Conversations with Company Representatives).

Palm oil produced in Dar es Salaam is sold in a higher value form Korie, Safi, and other refined palm oil brands are sold in supermarkets and corner stores across Tanzania. The oil in these brands is imported from Malaysia and Indonesia as CPO or semi-refined oil and is refined by a handful of companies. As of 2017, there were just five companies importing palm oil for processing (CPO, semi-refined or refined), with the main players being Murzah Wilmar and East Coast Oils and Fats, a subsidiary of Mohammed Enterprises (MeTL), followed by BIDCO, Mukwano, and Best Tigra Industries Limited (GAFSP, 2016). Currently, the palm oil refineries in Dar es Salaam do not purchase locally-produced palm oil from Kigoma, which is located 1,232km and a full one to two days drive away implying high

transportation costs¹³. Both the refined palm oil and the cleaning and sanitation products made using imported CPKO produced by these large refiners are staple groceries across the country and are priced to be accessible to a large segment of the population.

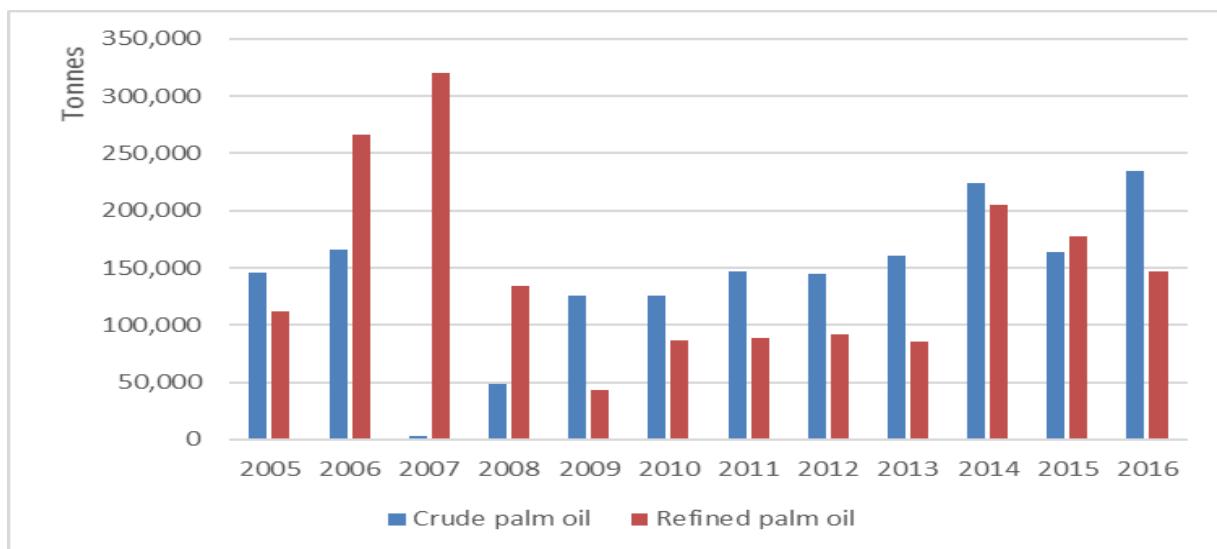
Analysing national market data, there is a general trend in importing higher volumes of crude palm oil compared to refined palm oil, this indicates that refining capacities (mostly around Dar es Salaam) installed in the country are actually used¹⁴. However, after 2010 the share of imported refined palm oil has been oscillating from 37.6% in 2011 to 52% in 2015. Overall, there has been an increasing trend in palm oil imports (quantities) since 2010 (CAGR around 10% in the period 2010-2016), that was not matched at all by palm oil domestic production, lingering around 8,350-8,650 tonnes in the period 2010-2014 for palm oil, and 4,500-5,700 tonnes for kernel oil (FAOstat)



Figure 2 Women selling palm oil in Kigoma

(Source: Frank Hartwich)

Table 14: Imports of palm oil, crude and refined, to Tanzania (Tonnes, 2005-2016)



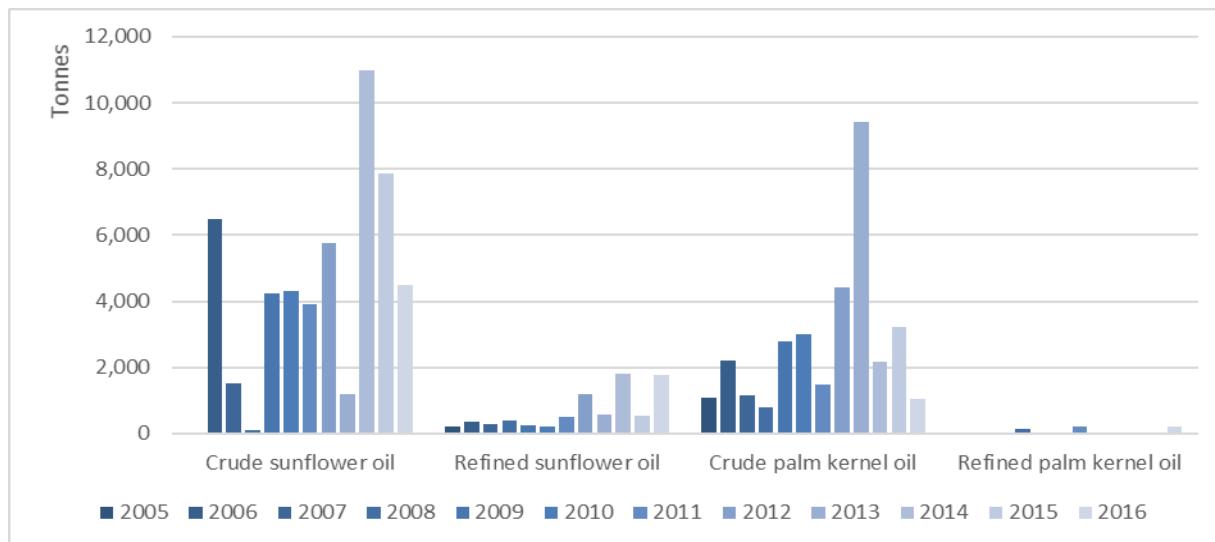
Source: UNCOMTRADE

Palm kernel and sunflower oil imports exhibit significantly lower shares of the refined vis-à-vis crude compared to palm oil. Their import volumes represent only a small fraction of palm oil.

¹³ Estimated at USD 3,000 per roundtrip for a flatbed truck carrying a 27-tonne-load or less if refinery uses its own fleet of trucks (ODI, 2017).

¹⁴ We switch to quantities in this analysis to have more objective flows of crude and refined palm oil.

Table 15: Imports of palm kernel and sunflower oil, crude and refined, to Tanzania (Tonnes, 2005-2016)



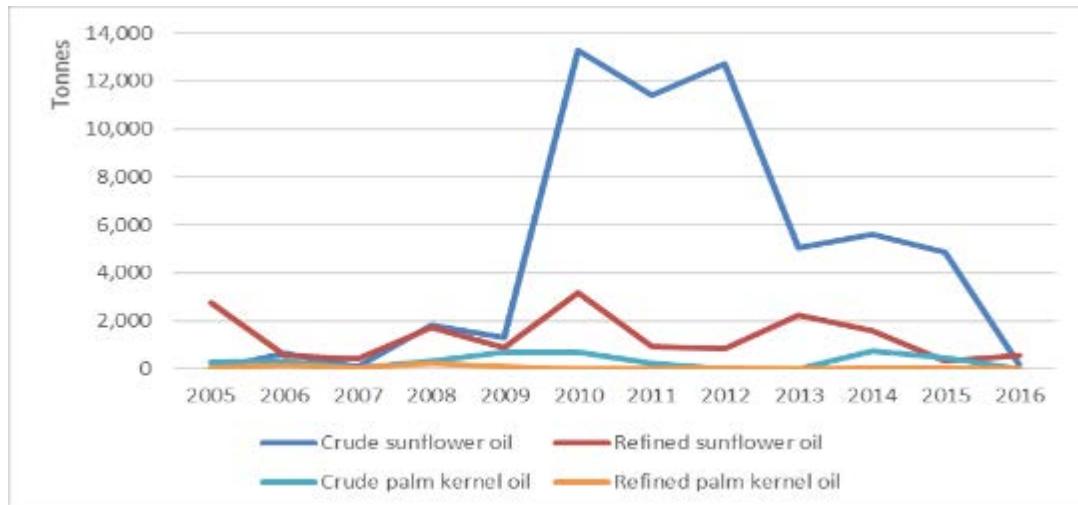
Source: UNCOMTRADE, 2018

Whereas crude palm oil was mostly imported since 2009, exports from Tanzania were predominantly in the refined form including the aforementioned export peak to the Republic of Congo and DRC in 2014-2015. Reported production data from FAO STAT does not indicate any particular increase during those years, whereas imports of both crude and refined palm oil (figure 12), mostly from Malaysia, registered significant increases respectively of around 64,000 and 120,000 tonnes (appr. 1/3 and 2/3) between 2013 and 2014, together above the 147,000 tonnes of refined oil exported to the Republic of Congo that year. Since part of that import increase (around 37,000 tonnes) met the internal demand (other exports were negligible that year), one can make the following assumptions: 1) only the import increase was used for export to the Republic of Congo¹⁵; 2) the proportion of crude and refined palm oil in that extra 37,000 tonnes used in the domestic market was similar to the exported one. In this case, it is possible to argue most of the exported palm oil to Rep. of Congo (around 2/3) was re-exported as refined from Malaysia, whereas around 1/3 (i.e. 50 Thousand tonnes) was refined in Tanzania and then exported to the Republic of Congo.

Compared to palm oil, the palm kernel and sunflower oil exhibit instead an opposite trend, being exported mostly in the crude form.

¹⁵ This assumption seems well founded, as in the previous years most of the import increases tapped into the domestic demand since exports were negligible.

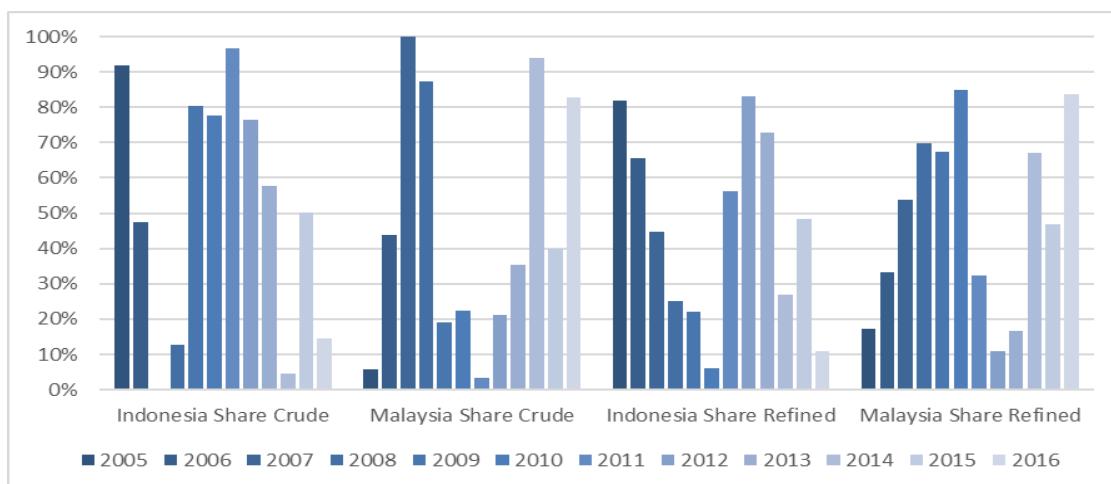
Table 16: Exports of palm kernel and sunflower oil, crude and refined, from Tanzania (Tonnes, 2005-2016)



Source: UNCOMTRADE, 2018

In terms of major palm oil exporters to Tanzania, Malaysia and Indonesia dominate the Tanzanian markets for both refined and crude palm oil. Similar patterns are found with palm kernel oil, with the two countries taking the whole pie of its exports to Tanzania in the crude form.

Table 17: Top exporters of palm oil, crude and refined, to Tanzania (% over import values, 2005-2016)



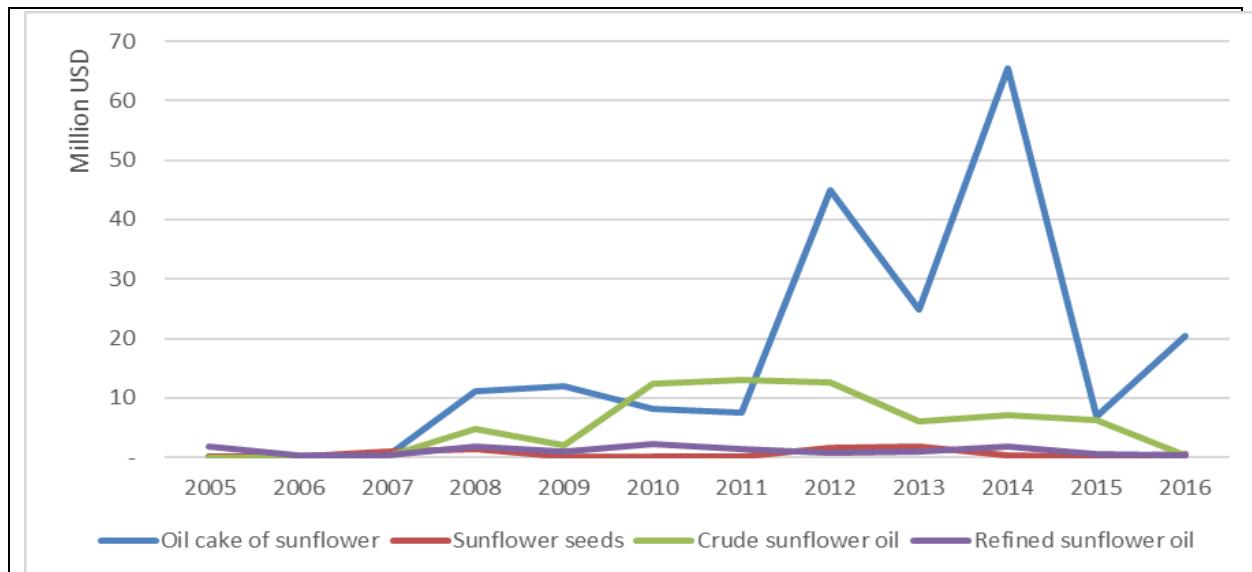
Source: UNCOMTRADE, 2018

Box: Sunflower market trends.

Sunflower oil is the single most important substitution product to palm oil in the edible oil section. The Tanzania Industrial Competitiveness Report 2015 (UNIDO 2016) dedicated an entire subsection (C.1) to the analysis of sunflower oil trade in Tanzania, identifying main trends and market opportunities in the period 2000-2014. Trends have since worsened in

terms of export values and have not seen changes in terms of composition of the export basket, with oilcake of sunflower still leading the way, followed by crude sunflower, and refined sunflower and seeds. Similar to the case of cottonseed and palm kernel oils, Switzerland and Belgium played an important role in importing crude sunflower oil but only for a limited time. In 2016 Tanzanian exports of crude sunflower oil to Switzerland plummeted. Exports of refined sunflower oil to the Netherlands exhibited a similar trend, experiencing high volatility throughout the period.

Table 18: Export of TZ sunflower products (export values in Million USD, 2005-2016)



Source: UNCOMTRADE, 2018

Sunflower oilcake provides a more interesting scenario and opens a short investigation in latest trends on trade of sunflower-related products within the EAC. Indeed, in the period 2005-2016, on the one side Kenya figures as the second main importer of sunflower oil cake from Tanzania reaching a value of almost 31M USD in 2012, behind India which imported almost 62 M USD of sunflower oil cake from Tanzania in 2014. However, exports of other sunflower products from Tanzania to the EAC were negligible throughout the same period with sporadic exceptions¹⁶.

Looking at import values of sunflower oil products to Tanzania, no significant trend emerges. Uganda exported significant export values of sunflower crude oil between 2010 and 2012, whereas Kenya continued exporting limited values of refined sunflower oil in the period 2008-2016, with the highest peak of 426,000 USD reached in 2011.

1.3.4 Import tariffs

In the GoT's most recent budget, import tariffs on CPO increased from 10% to 25% and on semi-refined and refined palm products from 25% to 35%. This measure was taken expressly

¹⁶ In 2013, Tanzania exported over 2 and 0.9 Million USD of crude and refined sunflower oil, respectively, to Kenya. In 2014, Tanzania exported 0.78 and 0.5 Million USD of crude and refined sunflower oil, respectively, to Rwanda.

to facilitate local production. Although these tariffs are set for review in one year's time (around July 2019), the private sector has raised concerns that this will completely halt importation and have disastrous impacts for the sector. Without targeted support to domestic production, the increased tariffs are unlikely to generate domestic production (GAFSP, 2016). Further, there is low degree of substitutability between palm and sunflower oil meaning that tariff policies are largely ineffective in overcoming key sector constraints (MSU, 2018; ANSAF, 2018). Analysts have suggested a wider range of policy measures including government support for smallholders through extension services, for example, over the narrow focus on tariff policies (MSU, 2018; ANSAF, 2018).

1.3.5 Standards and quality

Informal palm oil production and sales in Kigoma do not follow any national or international quality or food safety standards¹⁷. However, by law several permits are required: For oil production to be retailed, the facility and product must be certified by both the Tanzania Food and Drug Authority (TFDA) and the Tanzanian Bureau of Standards (TBS). At the moment, neither TFDA nor TBS have an operational office in Kigoma. The nearest TFDA office is in Tabora, and TBS is in Dar es Salaam. Both entities require product samples, facility inspections, and all staff health records. TBS and TFDA run analysis only for the process of registration.

TBS has a sliding scale fee with fees determined by enterprise size; small, locally owned entities who are registered with (but not necessarily physically present in) the SIDO complex exempted from the registration fee. The cost of bringing the agent(s) to Kigoma, product testing, and preparation of standards documentation can total TZS 400,000. TFDA inspection, product testing and registration fees cost approximately TZS 600,000 and TFDA agent visit costs can exceed TZS 300,000.

Prior to seeking TFDA and TBS approval, the palm oil processor must have a fire safety certificate, which can be obtained after an inspection from the fire department present in Kigoma. Palm oil processors also need an occupational safety certificate and a health certificate issued by the Occupational Safety and Health Authority (OSHA). OSHA does not have an office in Kigoma and agents are required to come from Dodoma at the producer's expense. The OSHA inspection costs TZS 880,000 plus agent visit expenses while the fire inspection costs TZS 100,000.

Ensuring initial compliance before production of a food grade product can begin, at a minimum, costs TZS 2,280,000. Agencies like TBS and TFDA offer little support to certify domestically produced oil, and efforts are needed to decrease the costs of compliance and improve the efficiency for SMEs to access these services.

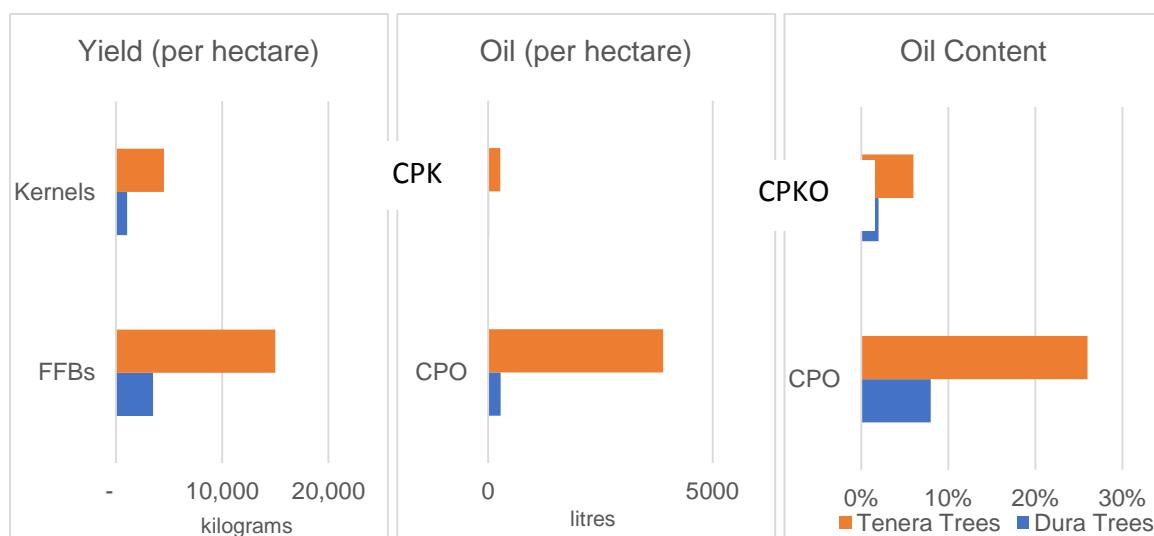
¹⁷ There are several groups in Kigoma that follow these standards for other products, including Kanyoyo Coffee, Golden Harvest Honey, and the water-bottling plants (e.g. Tanzamaji and Afya Water).

1.4 Core value chain

1.4.1 Primary production and harvest

Analysis from Seed Change indicates that there are approximately 30,000 palm oil farmers in Kigoma who cultivate oil palm trees, often alongside rivers (e.g. Ruiche) as one of their primary crops. Intercropping is not common, but farmers often produce inmixed cropping system including cassava, maize, bean production and other crops (Uckert et al., 2015). Palm oil producers almost exclusively cultivate a local *dura* variety of palm oil. The *dura* tree is a species native to Africa and acts as the parent material for many of the commercial varieties used around the world. *Dura* trees are prohibitively low-yielding (ASD, 2014) and the amount of FFBs and their oil content is too low to support mechanized processing (Figure 3). As *dura* oil palm production has limited mechanisation (combine harvesters, etc.) efficiency of production is similar between large and small farms.

Table 19: Productivity of dura vs. tenera varieties



Source: Seed Change Tanzania, 2016

With small plots of land, the average smallholder oil palm farm size in Kigoma ranges from 0.2 to 3 ha, compared to smallholder farmers

↳ Trees are overplanted with 200+ per plot whilst the ideal is 143.

in Malaysia who have on average 6ha (Noor et al., 2017). The majority of palm oil farmers in Kigoma using the *dura* variety reap even lower yields due to: little use of agricultural inputs, poor agricultural management practices, and limited access to capital. They do not use fertilizer, pesticides, or irrigation on their palm oil farms. By no means farmers do follow agricultural best practices in palm oil production, a fact that partly can be explained by low yield, low income and low opportunity costs of labour (Seed Change Tanzania, 2016). Farmers plant trees too close together on their small plots, which results in overcrowding and competition for limited water and nutrients decreasing yields. Sometimes plots are overplanted with 200 or more trees to maximize productivity, whilst the ideal is 143 trees.

↳ The average smallholder oil palm farm size in Kigoma ranges from 0.2 to 3 ha.

With limited ability to leverage their assets¹⁸, farmers are unable to secure loans to purchase improved seedlings or invest in agricultural inputs and improved technologies.

There are no examples of profitable, commercial large-scale plantations in the Kigoma Region. Less than five mid-sized oil palm farms (5-50 ha) are established, which includes a plantation run by the Tanzania Prison Services Department and *Jeshi la Kujenga Taifa* (JKT - the Tanzanian army). The Prison has a 400ha plantation with a mix of *dura* and *tenera*. The overwhelming majority do not have an irrigation system nor use commercial quantities of fertilizer or pesticides¹⁹. Managed by a handful of industrious mid-sized farmers, a subset have begun converting their palm oil farms to *tenera* trees purchased from Seed Change with the goal of establishing commercial small-scale plantations. At this point in time, these farms are an insignificant part of the value chain. Although mid-sized entrepreneurial farmers may represent a development pathway, they do not represent the current state of the industry.

Table 20 Palm oil production estimates

Estimated number of palm oil farmers in Kigoma Region	Estimated aggregate volume of FFBs (MT)	Estimated aggregate volume of CPO (MT)	Estimated value of CPO (USD 1,000s) ²⁰
Dura farmers	30,000	37,500 – 43,750	3,000 – 3,500
Tenera farmers	1,000 ²¹	no yield yet	-

1.4.2 Aggregation (middlepersons)

Aggregation of FFBs from the many small farms is required for cost effective processing. Economies of scale are achieved at the processing phase, where aggregation is required. The market for middlepersons in Kigoma is limited and low value. The palm oil value chain is currently so underdeveloped that little value is placed on formalizing the role of this usually important value chain linking actor. In major palm oil exporting countries, production is reliant on large plantations, networks of outgrowers, and middlepersons to link production to processing and end markets. In Kigoma this type of system does not yet exist.

Middlepersons visit farms and villages to purchase CPO on an ad hoc basis, adding another constraint to the value chain and strengthening smallholder farmer dependence on middlepersons. CPO middlepersons are price-setters in sales transactions with farmers. A middleperson sets prices on limited information based on previous transactions and their assessment of the season. Price setting is an imprecise process and little-to-no information is shared amongst smallholder farmers about recent sales prices. In interviews, farmers

¹⁸ CCROs (most common smallholder land title – if a smallholder has a title) cannot be used as collateral at Tanzanian banks.

¹⁹ There is only one known example of solar-powered water pumps installed on a local entrepreneurs' farm. However, no irrigation system has been installed to support this.

²⁰ Derived from the current average CPO/L sale price in Kigoma.

²¹ It is likely that the 1,000 farmers are also included in the 30,000 dura farmers.

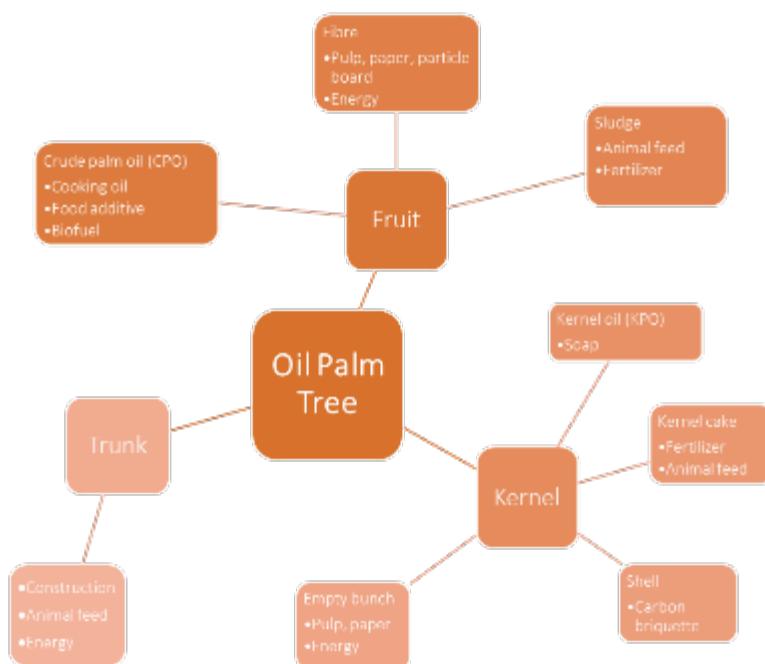
asserted that they are price-takers in this arrangement due to lack of information on market rates. However, middlepersons also said they were susceptible to external market forces, seasonal price fluctuations, and lack of access to capital to grow their businesses. In key informant interviews, middlepersons argued that they set purchase prices exclusively on recent sales and do not engage in rent-seeking with smallholder farmers.

1.4.3 Processing and by-products

Processing of FFBs into CPO, refining of CPO into RPO (not present in Kigoma), and extracting CPKO from kernels are the major processing functions. Processing can be done at a very small scale as seen in Kigoma (200-300 kg of FFBs per day) or at very large scales as seen in major palm production regions (60,000kg of FFBs per hour). Processing FFBs from oil palm trees yields crude palm oil (CPO), which yields kernels that produce crude palm kernel oil (CPKO), and other useful by-products such as kernel cake for animal feed (Figure 4). The existing palm oil value chain in Kigoma is largely focused on capitalizing on CPO and CPKO production. To a lesser extent, waste by-products are used but are not commercially sold (e.g. kernel cake, oil palm trunks, etc.).

Currently, farmers use inefficient human-powered Burundi expellers, often using family labour, or a marginally improved diesel-powered palm oil processor propagated by the Small Industries Development Organization (SIDO). Both methods are inefficient (extraction rates around 6-8%) and laborious, involving undervalued efforts of women, and result in a low-quality product that does not comply with food safety standards. The total production of CPO from the Kigoma region is not known precisely but have been estimated here at 3,000 to 3,500MT of CPO and 700 to 850MT of CPKO (Annex 1).

Table 21: Oil palm tree by-products



Source: Seed Change, 2016

Palm oil

Crude palm oil (CPO) is extracted from pressing oil palm tree FFBs. CPO comes from the *mesocarp*, the fleshy part of the oil palm fruit. Palm oil is traded and sold exclusively as CPO, with little value-added processes such as mechanized processing, refinement, or commercialized packaging. CPO is transacted in 25-litre reusable containers. At the market, it is sold in reused 250ml, 1L and 5L plastic bottles.

There are four types of smallholder oil palm farmers:

1. Farmers who sell FFBs directly to other farmers or middlepersons for processing;
2. Farmers who harvest and process FFBs by hiring a Burundi Expeller;
3. Farmers who harvest, process their own FFBs, purchase other farmers' FFBs, and own a Burundi Expeller;
4. Farmers who harvest and process their own FFBs by hiring a SIDO Expeller.



SIDO Expeller

Source: Jessica Brady, Kagera Village, Kigoma, 2018

There is a large amount of fluidity between farmer 'types'. The same farmer who commonly sells their FFBs to a neighbour for processing may decide to process their FFBs on occasions where extra labour is available (ex. child home from school or relative visiting). Similarly, a farmer who typically processes their own FFBs (either by renting a Burundi Expeller or using their own machine) may decide to sell their FFBs if money is required immediately. Other than proximity to a Burundi or SIDO Expeller machine, there is no discernible demographic difference between farmers who choose different processing strategies.

The first type of smallholder farmer (FFB Producer Farmer 1) sells directly to other farmers (or rarely middlepersons). The price they receive fluctuates depending on the purchaser's visual estimation of the fruit oil content. Neither party can accurately estimate the FFB oil content, so farmers are subject to the purchaser's valuation. Limited by an underdeveloped value chain with a lack of support services including arbitration and governance mechanisms such as contracts, farmers have little recourse to disagree with a valuation of their FFB size and/or oil content.

FFBs are harvested and often not processed for up to seven days by smallholder farmers. Optimal harvest to processing time is within 24 hours, after this, the free fatty acid (FFA) content increases, reducing quality (Annex 2). Although the FFBs are boiled before processing, the current cooking time of one hour is insufficient to prevent the proliferation of FFA nor to obtain decent extraction rates. Cooking the fruits for 6-24 hours would increase yields and properly sterilize the fruits to block the development of FFA. However, processors have little incentive to boil them for longer, as this would increase fuel (wood or charcoal) costs and the payment mechanism is set up according to FFBs rather than processed oil. Further, resultant oil contains high water content from processing, increasing hydrolysis and FFA values. If payment was set according

➡ Optimal harvest to processing time is within 24 hours, after this, the FFA (free fatty acid) content increases dramatically.

to oil yields, this would increase yields of a higher quality oil, meaning greater incomes for farmers.



Burundi Expeller

Source: Beatrice Fuchs, Mahembe Village, Kigoma, 2015

A subset of farmers either pay to use a neighbour's Burundi Expeller (Burundi Expeller Hirer Farmer 2) or own a Burundi Expeller and may purchase FFBs from other farmers (Burundi Expeller Owner Farmer 3). FFBs are boiled and pressed in a Burundi Expeller using an open fire and physical labour to operate the machine (**Error! Reference source not found.**). Ownership of Burundi Expellers is common in villages as they are not prohibitively expensive; approximately one in 12 farmers own one. For those that do not, they are charged a small fee of TZS 150 to TZS 200 per litre of CPO or provide in-kind payment to the owner for use of the machine. Processing 300 kilograms of FFBs takes a full day.

A similar motorized version, locally referred to as a "SIDO Expeller" has become increasingly popular in Kigoma in the past five years (**Error! Reference source not found.**). It is also made up of a metal drum and a wood press, heated over an open fire but runs on a small diesel motor removing the need for manual labour. Some farmers pay a fee to use a SIDO Expeller (SIDO Expeller Hirer Farmer 4).

drum and a wood press, heated over an open fire but runs on a small diesel motor removing the need for manual labour. Some farmers pay a fee to use a SIDO Expeller (SIDO Expeller Hirer Farmer 4).

Kernel oil

Kernel oil (CPKO) is extracted from the nut of the fruit. Kernel oil is the only commercialized by-product of CPO production in Kigoma. Unlike CPO, kernel oil is exported out of the region. The process of extracting CPKO from kernels requires mechanization as manual methods do not provide the force necessary to crack the kernel shell to extract CPKO. The CPKO value chain is dominated by women, likely because it is currently lower value than CPO due to volume. Interviewed farmers reported that because the CPKO is "low value" responsibilities and decision-making regarding kernel collection, processing, and sales are often left to women.

Palm oil kernels are collected from the processing of CPO to be sun dried. Kernels can be stored for up to five months once they are dry before losing their oil content. Farmers then transport their kernels to Kigoma town or sell their kernels to farmers who aggregate kernels in their village (CPKO Machine Users). Generally, CPKO Machine Users (almost entirely women) purchase kernels in 20-litre buckets, referred to as "one tin". Six tins are aggregated and locally referred to as one bag. CPKO Machine Users aim to collect two to three bags before transporting the kernels to the SIDO complex. At this stage, CPKO Machine Users incur similar levies and transport fees as in the CPO value chain.

Approximately 500 people over the course of a year (almost exclusively women) use the kernel processing machines (CPKO Machines) located at the SIDO complex in Kigoma town. There are 20 operational CPKO Machines, each privately owned, however up to 50% on any

given day may not operational due to mechanical failures. Kernel oil can be used in a variety of products (e.g. processed products, soaps, shampoos, cosmetics, etc.). However, in Kigoma, it is used solely for soap-making. CPKO Machine Users pay a fee of approximately TZS 60 per kilogram to CPKO Machine Owners for use. These machines run on electricity and have a capacity to process 2,500 litres of kernel oil per day. However, due to frequent breakages and power outages, this capacity is never met. The price of CPKO fluctuates depending on the season with smaller variation than CPO. CPKO is sold directly to the approximately 15 privately owned soap-making operations. Typically, women will not travel to the processing centre until they have collected 350kg of kernels. This collection process takes several days and can only be completed once or twice per month due to lack of supply of kernels. Once the kernels are collected, women leave their village and typically return after seven days once the full processing and sale of oil is complete.

Kernel Cake

Kernel cake is the main CPKO by-product. It is sold by the bucket and used as animal feed but does not have a formal value chain. There are no kernel cake middlepersons and there is no retail market for kernel cake. Buyers purchase kernel cake directly from CPKO Machine Users at the SIDO complex who sweep up the by-products left on the warehouse floor.

Soap

A nascent soap-making industry exists with 15 soap producers operating at the SIDO complex in Kigoma Town. Soap is produced primarily for local purchase, with exports to Dar es Salaam and other cities across Tanzania as well as regionally to Burundi, DRC and Kenya. Soap is made both manually and electrically. Soap requires combining caustic soda dilution with CPKO. To increase the value of soap, perfumes and dyes are added. After the mixture is created soap is poured into metal or wooden boxes to set. After two days, soap blocks are cut and packaged in assorted sizes: small square bars, long skinny bars, and large bars and branded by each processor.

Soap residue is accumulated during the soap making process which is sold to middlemen, repackaged and sold on to end consumers. Middlepersons travel directly to the SIDO complex to purchase soap waste at a very low cost per kilogram approximately TZS 1,000. This waste is then transported to homes on foot or by local buses where it is re-melted and formed into small, skinny soap bars. Twenty kilograms of soap waste makes approximately 120 bars and represents a negligible portion of total soap sales but is an important market to reach base of pyramid consumers with cheaper products.

1.4.5 Wholesale and retail distribution

Finished products are linked from producers and processors to consumers via wholesalers. Wholesalers sell to distributors and end consumer vendors. Distribution can be through formal channels (such as to supermarkets) or informal through village markets or neighbourhood vendors. In the case of Kigoma, retailing is informal. Farmer/processors package the CPO in 25 litre reusable containers and either: (1) Sell to a middleperson; (2) Sell at a central location (ex. Kahabwa Centre); or (3) Sell directly at markets (ex. Mwanga Market).

Palm oil market salespersons (CPO Retailers) purchase and repackage palm oil in various sized reusable containers (e.g. water bottles) ranging from 500ml to 25L to sell in local markets. Palm oil market salespersons are predominately women. Prices follow market prices at major sales centres such as Kahabwa Centre (Table 22). CPO Retailers transport palm oil via local buses incurring a small transport fee and pay a flat day rate levy of TZS 300 to sell at Kigoma town markets. CPO Retailers are predominately women and ~200 people sell oil palm in Kigoma markets. Kigoma CPO is not formally packaged and sold at retail locations.

Figure x: Principles to be RSPO certified



Source: RSPO

Table 22: FFB and CPO sales prices

	Average	Rainy season (Jan – March)	Dry season (July – Sept)
FFBs sold to middleperson (1kg)	TZS 5,000	TZS 3,000	TZS 7,000
CPO sold to middleperson (25L)	TZS 46,000	TZS 27,000	TZS 60,000
CPO sold at sales centre (25L)	TZS 51,000	TZS 30,000	TZS 64,000

Source: The authors

CPKO is sold directly to the privately-owned soap-making operations at the SIDO complex, as there is no retail market for Kigoma CPKO outside of soap-making. The main market for soap manufactured in Kigoma is local. Soap sellers and market middlepersons must pay a council levy to sell in the local market, identical to palm oil sellers. A very small percentage of Kigoma soap is sold out of the region, chiefly to Dar es Salaam, sold at a higher rate of TZS 3,000 to TZS 4,000 per kilogram. A very small proportion of soap is also purchased by Congolese and Burundian traders who purchase soap directly from soap makers at the SIDO complex. These informal traders traditionally do not pay levies on their goods.

Table 23: CPKO and kernel sales prices

	Average Price	Rainy season (Jan – March)	Dry season (July – Sept)
kernels (1 tin)	TZS 11,000	TZS 8,000	TZS 13,000
CPKO (20L)	TZS 49,000	TZS 40,000	TZS 57,000

Source: The authors

1.6 Extended value chain

1.6.1 Labour market

On-Farm Labour: Farm labourers are not hired on a formal or regular basis instead using family labour or a reciprocal system of labour sharing with neighbouring farmers. On the very rare occasions that farmers do hire extra labour (typically for harvesting FFBs) pay ranges from TZS 2,000 to TZS 5,000 per workday. The majority of family members of farming families typically contribute, in some way, to on-farm labour. However, this is informal work interspersed with other household duties and is not considered a full-time labour substitution.

Processing FFBs: 90% of FFBs are processed in Burundi Expeller machines. Regardless of whether the processor is the owner or the renter of the machine, the work is a family affair. Women and children tend the boiling of the FFBs while men and young men pull the rotor in the Burundi Expeller drum. The boiling of the fruits and skimming of the oil post pressing is a low intensity, low-skilled but time-consuming process. Pressing the fruits in the rotor drum is also time consuming but physically demanding for the two to three people involved. The same jobs and processes are involved for the SIDO Expeller machines. While the SIDO Expellers have a larger capacity and better extraction rate, they follow the same work flow and do not represent time savings to labour nor do they upskill workers. Accordingly, labour costs remain low and casual employment processing FFBs with a Burundi Expeller or a SIDO Expeller do not represent lucrative or specialised employment. A minority of SIDO Expellers employ people full time to process FFBs from farmers. However, apart from this small minority (total employment of ~100 people in the region), processing FFBs is a family farm business.

Processing Kernels: Kernels are processed in the SIDO complex in Kigoma town. No working CPKO extraction machines exist outside this complex. To this point, all work is done by women. Once at the SIDO complex, the CPKO Machine Owner employees process the kernels while the women prepare the kernels or clarify the oil for sale. The collection and transportation of kernels can take a number of weeks to gather a sufficient volume. Women who travel from out of town will often stay in Kigoma for a few days to process their kernels and sell their oil. Over the course of a year more than 500 women will complete this process, however, few do it more than once or twice per month. The modal number of cycles of collecting kernels, processing kernels, and selling kernel oil is ten per year.

Soap Making: Adjacent to the kernel processing in the SIDO complex are Soap Producers. There is one market leader, Tansoap, who have 16 full time employees. There are several much smaller firms in the complex as well who, on average, employee 5 to 8 people. Formal

contracts are rare, although the firms employ the same people from month to month. In total, approximately 120 people are employed making soap.

Wholesale/Retail: FFB processors and CPO Middlemen sell to CPO Retailers in Kigoma town or other smaller regional markets. Most of these CPO Retailers are women who sell palm oil alongside their other fresh produce. Soap Producers are both wholesalers and retailers. They wholesale to customers in Dar es Salaam or cities, they sell blocks of soap to women (Soap Retailers) who retail smaller amounts into the market in Kigoma and sell a minority as retail from their shopfront. In total approximately 100 people derive their income from wholesaling or retailing CPO or soap products.

Extended value chain: The quantities of palm products produced in Kigoma is small and therefore its effect on the extended value chain, while not zero, is minimal. No transporters or input suppliers derive their main income from palm products. Truck owners do transport soap to Dar es Salaam but this is a small revenue stream. Equally input suppliers (fertilizer, farm machinery, etc.) service the palm oil sector but they do not rely on this sector alone for income.

1.6.2 Inputs

There is significant potential for the provision and application of inputs in the palm oil sector in Tanzania. At present, low input use hampers productive yields. Although the hybrid *tenera* variety has improved yields, it is grown marginally, by less than 3% of farmers, and presumed to require greater management including fertilizer and irrigation to achieve potential yields. The proper use of agricultural inputs could dramatically increase yields.

Seeds

Use of high-quality planting materials is the bedrock of a successful palm oil industry. Established palm oil plantations require high-yielding seedlings for replanting and replacement of old trees lost to disease or drought, while nascent industries require trees to expand area under high yielding plantation. Large plantations in other countries often run their own nurseries and supply to smallholder farmers through sale or credit.

Although many smallholder palm oil producers are aware of the existence of improved palm oil varieties, they may not recognize the value of increased yields (perceived as more labour-intensive) or be sceptical due to previous failures. Further, those that recognize the value of improved varieties do not have the finance to purchase new varieties nor the appropriate knowledge needed to properly manage them.

Since the mid-twentieth century several leading companies have engineered a new oil palm variety, called *tenera*. The *tenera* variety maximizes FFB oil content and yield and is thus the commercial variety primarily used in South-East Asia. It is a hybrid of the *dura* tree, the local variety native to Africa and historically farmed in Kigoma, and the *pisifera* tree, a South

The Breeding Challenge

Breeding hybrid oil palm seeds is a long and complicated process. *Dura* and *pisifera* variety must be crossed through a minimum of seven generations to guarantee a pure batch of *tenera*. As each generation takes several years to bear flowers or fruits, the lead time of breeding is 15 to 20 years. Yield losses of even 10% due to improper breeding results in lost revenue year upon year – for two to three decades.

American variety (Figure 8). The *tenera* variety has both higher yields (FFB tonnage) and higher oil content per fruit. The *dura* tree yields 1 to 3 tons of FFBs per hectare with an oil content under 8%. The *tenera* tree yields 10 to 30 tons of FFBs per hectare with an oil content of 22% to 26% (Figure 3) (ASD Costa Rica, 2014). Of the estimated 30,000 total palm oil farmers in Kigoma, less than 1,000 currently farm *tenera* trees, supplied by Seed Change.

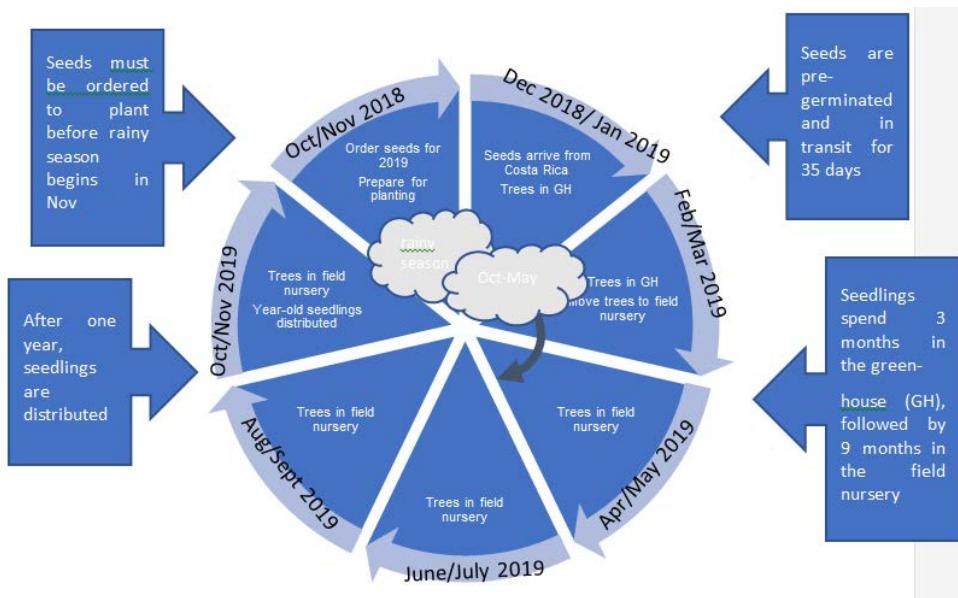
Figure 24: Comparison of three species of oil palm



Source: Chetkovich, 2013

Industry-wide practice is to import pre-germinated seed from a commercial breeder to be nursery-raised for 12 months. The 12-month old seedlings are then strong enough to survive transplanting into the field. There are currently no oil palm seed suppliers in Tanzania nor in East Africa; there are less than 10 recognised breeders supplying seeds to all commercial plantations in the world. It is the industry standard to outsource seed supply to a commercial breeder rather than undergo seed breeding. Even neighbouring countries like Burundi import *tenera* variety seeds from a French-owned company in Nigeria called PalmElit, and from Costa Rican ASD. This is primarily because the risks of breeding a tree with an annual yield of even 10% less than those delivered by commercial breeders or has some susceptibility to disease is too great to warrant any potential cost saving in running a breeding program. Trees are planted once every 20+ years. Trees begin fruiting after 3 years planted on farm, with full production at year 5 and yield beginning to decline at year 25. Any mistakes in planting material costs lost revenue every year.

With seed procurement, planting, and distribution, timing is everything. Seedlings should be transplanted into the field in the beginning third of the rainy season (December to January). This timing for transplant is ideal in terms of soil water content for quick root establishment and growth. In Kigoma, the ideal planting date is early December; new seeds must be planted in the nursery greenhouse, as well as 12-month-old seedlings planted on farms (Table 25).

Table 25: Timeline for seed procurement and distribution

Source: Adapted from Seed Change, 2017

Over the past 10 to 20 years, actors such as government agencies, the Jane Goodall Institute (TACARE project), ActionAid, UNDP and FELISA have sold or distributed a few thousand (<10,000) seedlings purported to be *tenera*. Analysis of mature trees show that a significant proportion of these are in fact *dura* (in some cases as much as 50%). Locally-sourced seeds imported from Burundi and then multiplied locally indicated that the breeding regimes were not of the requisite standard to ensure uniform *tenera* production. Receiving fake “*tenera*” trees that did not yield at a high-level dampened smallholder farmer demand for genuine *tenera* seedlings as it increased farmer suspicion about the quality of seedlings. The only regular supplier of *tenera* seedlings in Tanzania is Seed Change. Seed Change imports pre-germinated seeds from commercial breeders and grows them in their nursery until they are ready for field planting. Seed Change has distributed over 80,000 seedlings since 2014²². With the recent 3ADI+ procurement of 33,000 seeds, Seed Change will distribute another 30,000 seedlings in 2018 and 2019²³. The current cost of a seedling from Seed Change is TZS 6,000 per seedling, with Seed Change incurring a TZS 2,000 loss per seedling made up through fundraising efforts. Seed Change targets smallholders and provides two-year interest-free loans to encourage uptake of improved *tenera*. Current repayment rates are over 60%. Seed Change’s two largest outstanding accounts are with the

Seed Change Seeds

A variety of *tenera* using the Kigoma *dura* as one half of the hybrid has been developed for commercial sale, due to the relatively rare growing conditions which make the genetic material of Kigoma *dura* attractive. It is this variety that Seed Change imports and grows from breeders in Costa Rica to distribute to smallholders.

This variety is also planted in Uganda, Burundi, and Zambia.

²² Distribution by year: 2014 – 4,043 trees; 2015 – 11,555; 2016 – 38,233; 2017 – 27,860.

²³ The number of seedlings distributed is 20% less than what is purchased. Thus the amount distributed in 2018-2019 is 27,000, plus 3,000 currently in the nursery, equating to 30,000.

Kigoma Ujiji Municipal Council and Jeshi la Kujenga Taifa (JKT - the Tanzanian army); if these two accounts were settled, the total repayment rate would jump to 85%. As a non-profit committed to building a smallholder focused sustainable oil palm industry in Kigoma, Seed Change subsidising seedlings to smallholders is an acceptable use of donor funds. However, it is an inherently unsustainable business approach made riskier with non-performing loans.

Irrigation

Palm oil production in Kigoma is primarily rain-fed. Although many farmers manually irrigate vegetable crops during the dry season, this is only on a small scale near rivers and wells and is hence, very labour-intensive. There are no irrigation headworks in Lake Tanganyika nor on any of the many rivers and tributaries that supply the lake. Irrigation is not practiced for palm oil production.

Numerous shops sell irrigation equipment in Kigoma, yet none are targeting palm oil producers nor providing specialised irrigation for palm oil. Small petrol-powered pumps cost around TZS 300,000 and are readily available. These pumps typically last for two years and consume around 1 litre of petrol per hour depending on the conditions. Larger pumps are available from speciality suppliers in Dar es Salaam, Mwanza or Arusha. All required assorted sprinklers, pipes, and connectors are also available. Plenty of irrigation suppliers are present that could respond quickly if demand increased. However, irrigation is not a widely practiced activity for any crop in Tanzania, so specialised support or knowledge is not widespread. As each installation is different (water volume, flow rate, topography, source of water), one size fits all models do not work; each irrigation project needs to be designed and planned with some care as to not waste money or even just for basic irrigation function. The lack of farmers or government extensionists who have this knowledge or are willing to provide it for free is as large an impediment to widespread irrigation adoption as the cost of equipment and maintenance.

Seed Change has tried to promote irrigation use. However, the cost of providing the design of irrigation scheme was high (site visits, discussion with farmer, discussion with suppliers) and uptake was low. Farmers would appreciate the advice given but would not purchase the irrigation equipment through Seed Change due to underestimating the cost, delaying for several months while they saved the money, or sourcing products themselves from other suppliers once they knew what they needed. An integrated contract from Seed Change for installing/providing installation is not considered feasible at this time.

Fertilizer and pesticides

Fertiliser costs in Kigoma are in line with retail fertiliser costs around Tanzania (see overview on prices in Table 26: Fertilizer sales prices in Kigoma (Table 26). There are several bulk suppliers in Kigoma, but they do not carry all fertilisers required for palm plantations. Potassium Chloride (KCl), for example, is very challenging to procure locally. These palm-specific fertilisers can be sourced from Dar es Salaam with some effort. However enough suppliers exist in the key palm centres that if consistent demand was there for certain fertilisers, the market would be able to respond.

Table 26: Fertilizer sales prices in Kigoma

Business	Supplier 1		Supplier 2
Fertilizer	Price (TZS) (50kg)	Retail per kg (TZS)	Price (TZS) (50kg)
Sulphate of Ammonia (SoA)	50,000	1,300	40,000
Nitrogen, Phosphorous, and Potash (Potassium) (NPK)	65,000	1,800	60,000
Calcium Ammonium Nitrate (CAN)	55,000	1,500	48,000
Diammonium phosphate (DAP)	-	-	60,975
Urea	-	-	57,600
Urea (5kg)	-	-	6,500

Similarly, Kigoma has an adequate supply of pesticides and fungicides through several agro-dealers. Several of the pesticides and fungicides commonly used on oil palm are the same as those used to treat horticultural and coffee plants, which are also grown in the Kigoma region. No palm-specific products exist, nor do suppliers and retailers report palm farmers being their main customer, though sufficient products are available for purchase.

Machinery and equipment

On-Farm machinery: Oil palm trees are not a broadacre crop, so harrows, ploughs, seed drills are not required but small tractors and trailers are common on commercial plantations, even smallholder plantations, in South-East Asia. As yet, nothing like this is common in Kigoma. There are no tractor or tractor-implement agents or suppliers in Kigoma.

Processing FFBs: While the vast majority – upwards of 90% - of Kigoma CPO is produced using Burundi Expellers, there are a few processors who use the upgraded SIDO Expeller, originally designed by the Tanzania Industrial Research and Development Organization (TIRDO). The principle is the same except that the SIDO Expellers use a small engine to drive the central rotor rather than by hand. There are approximately 15 working SIDO Expellers in the Kigoma region, while there are around 3,000 Burundi Expellers. They also use a larger drum (300kg vs. 200kg) meaning more fruit can be processed at once. SIDO expellers cost TZS 5,500,000, making them affordable to only a small proportion of people in Kigoma. This is compared to TZS 120,000-240,000 to set up a new Burundi Expeller. The Burundi Expeller can be expected to last longer, is cheaper to run as it has no mechanised parts, and requires less associated infrastructure (water storage tanks, etc.) as the production capacity is smaller. The small engine that powers the SIDO Expeller, like an engine on a small water pump, has a life of approximately two years.

While an upgrade to the Burundi Expeller, the SIDO Expeller is not a viable option if production of FFBs were to rise to a level that would facilitate even the most modest of CPO import substitution. Micro-mills – the smallest commercial mill available on the market and the presumed first step on the industrialisation pathway – process, at minimum, 300 kilograms of FFBs per hour (the total capacity of the SIDO Expeller in one day). To supply FFBs to a 300kg/hr mill, running full time (assumed conservatively to be 8hrs/day, 6 days/week, 48 weeks/year) would require less than 60 hectares of fruiting *tenera* trees. If domestic production of palm oil is to be increased, SIDO Expellers and Burundi Expellers will not be suitable for the volumes of FFBs produced and can quickly become obsolete. An investment in improved processing machinery would naturally follow an increase in FFB production in several years.

Kernel Cracking and Pressing: Kernel processing (CPKO) machines, are available for purchase for TZS 7,500,000. The machine owners have a near monopoly on the palm kernels as it is not possible for farmers to process kernels in a low-cost manner such as farmers can do with FFBs. However, barriers to entry to setting up a cracking machine are low and therefore any monopolistic powers over kernel prices paid to farmers are subject to competition between machine owners. The CPKO Machines are cheap to run (TZS 500,000 per month) and maintain (TZS 100,000 per month). None of the machines are running full time due to a lack of kernel supply, so margins and profits are slim. If the oil was more valuable or returns to CPKO processing were higher it can be assumed that these machine owners who have access to more capital would operate the machines themselves and sell the kernel oil, rather than just making money on equipment rental. In terms of capacity, these small machines are suitable for the initial expansion of FFB production as they are not running at full capacity and the volumes of kernels to be pressed is comparatively less than the volume of FFBs.

Packaging

For the few local processors who sell CPO, packaging materials are sourced from suppliers in Dar es Salaam (mainly from OPIL, part of the Bakhresa group of companies). Similarly, soap producers source packaging materials from Dar es Salaam. As volumes are small, packaging and bottling is done by hand. For CPO Middlepersons and Retailers, packaging materials (re-used plastic containers) are readily available in Kigoma. The use of previously used and unsanitary water bottles and oil containers presents inherent challenges with food safety issues.

1.6.3 Knowledge-based services

Extension and advisory services

Extension services for palm oil producers are very limited in Kigoma, with Seed Change being the primary provider, in support of that

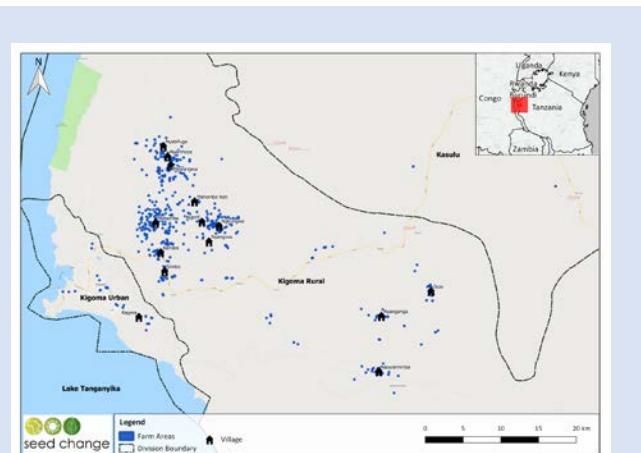


Figure 10 Location of Seed Change farmers

(Source: Seed Change Tanzania, 2017)

provided by local and regional Government extensionists. Government extensionists lack the agronomic knowledge on palm oil plantation management and do not have the capacity (time) to address issues raised by the many scattered smallholder palm oil producers. The use of technology, such as mobile phones, to disseminate agronomic advice and provide a hotline to answer questions is an innovative opportunity that could be explored to address this issue. Further, knowledge on postharvest practices to improve palm oil quality and food safety are of the utmost importance.

Throughout 2016 and 2017 Seed Change trained approximately 800 farmers through the Smallholder Training and Education Program (STEP), which was partially funded by the RSPO and focused on three main areas: agronomic training, financial literacy, and environmental sustainability. Seed Change organized and trained 38 farmer groups over nine months with two lessons per month for each group. During this program, farms were also mapped in preparation for certification as sustainable producers through the RSPO framework (Figure 8). Seed Change's advice is mainly sought out for farming and agronomy related questions and further training has been requested by palm oil producers, but funding is limited.

Market information is limited to informal networks between similar market actors (i.e. market vendors consult with a few market vendors on price). This communication is very informal and over a small geographical area. No institution or organisation provides regular, up-to-date market information. Several years ago, Seed Change tried to provide market information regarding costs of inputs and market prices at various localities in the region. This effort did not lead to much as vendors were loath to provide prices and traders would not disclose purchase prices. Equally challenging, disseminating the information was hard as farmers are disaggregated, radio prices were prohibitively expensive and not all farmers had mobile phones or network coverage. In theory such a scheme should not be hard to set up and run and Seed Change plans to try again in the future.

Laboratory analysis

There is no soil or sophisticated laboratory analysis facilities in Kigoma. Soil analysis can be obtained from commercial fertiliser suppliers such as Yara²⁴ or from research institutes like Sokoine University of Agriculture (SUA). Prices for these tests are currently prohibitive for farmers at TZS 102,000 per sample. Yara does, however, provide a fertiliser recommendation and regime as part of their service.

Oil analysis can be completed with SUA but CPO sold in local markets in Kigoma does not undergo any testing. The CPO testing includes the following parameters: (1) peroxide value, which measures the rancidity of CPO; (2) Free Fatty Acids, which is a determinate for the taste and quality of CPO; (3) Moisture and Impurities, which helps to determine the processing losses and high moisture will also promote microbial growth; and Deterioration of Bleachability Index (DOBI) – – a measure of the ripeness (higher DOBI indicates more ripe) and how easily the resultant processed palm oil can be bleached.²⁵

Water analyses can be conducted by the Lake Tanganyika Basin Authorities (LTBA) in Kigoma. These tests are basic (not covering groundwater supplies) but suitable for testing

²⁴ For more information, see Yara <https://www.yara.co.tz>.

²⁵ See Malaysian Palm Oil Board <http://econ.mpob.gov.my/economy/exporters/PORAM%20STANDARD.html>

water quality and safety for irrigation and human consumption purposes. The tests cost over TZS 650,000 for one sample making them prohibitively expensive for an individual smallholder farmer.

Business development services

Evidence of active business development services in the palm oil sector is hard to find. Government extension in the region lacks capacity to advise on palm oil production. Seed Change provides *ad hoc* advice when sought by farmers or other actors, however, this is informal and infrequent. Seed Change has investment calculators available for farmers to use to calculate investment amounts required and expected return on investment and did write a complete integrated business plan for JKT, however, it was not pursued by the JKT. SIDO, in addition to machinery and maintenance, has a mandate to provide training and regional extension services. However, their primary focus is on technology development and transfer services, and lacks sufficient staff resources to provide sufficient BDS.

The Private Agricultural Sector Support Trust (PASS) provides business development services to the agricultural private sector and helps arrange financing through a system of partial loan guarantees with the National Microfinance Bank (NMB) and CRDB Bank. They opened an office in Kigoma in 2015, yet to date, have not engaged any clients from the palm oil sector and none appear to be on their medium-term horizon.

CRDB, NMB, Pride Tanzania, Bayport Financial and the Tanzania Chamber of Commerce Industry & Agriculture (TCCIA) all offer business development services, the financial agents as part of their loan packages. However, none have worked with any actors – individual smallholder farmers, oil palm farmer groups, oil palm cooperatives or input suppliers such as Seed Change – in the palm oil sector in a business development capacity.

Research and Development

There is no dedicated palm oil research body in Tanzania. Seed Change, in their *shamba darasa* (farmer field school), run pilot irrigation schemes and test fertiliser regimes but, by their own admission, this research is partial at best yielding few actionable outcomes for smallholders. SIDO has developed a handful of machines for various stages of palm oil processing in addition to the CPKO Machine and SIDO Expeller previously discussed - palm oil sterilizer, palm oil digester, palm oil clarifier, palm oil kernel extractor. Of the four additional machines listed, none are for sale.

Internationally, palm oil is a widely researched crop due to deserved attention from social and environmental pressure groups to reduce externalities from oil palm developments. There are high returns on incremental improvements in planting material and plantation management. This incentivises private sector research alongside the public-sector approach of crop boards and tertiary research institutes. Commercial companies working to improve the quality of planting material will continue to do so as long as palm oil remains an economically viable investment. Local research into plantation management, sustainability, climate change adaption, and social context of palm oil developments in Tanzania would be highly useful. Determining the right cover crop or underplanting regime that allows smallholders to generate some income while their trees mature whilst provided a benefit to the trees would be of great value. Determining the right or appropriate fertiliser regime for Kigoma's soil, potentially in concert with irrigation, could increase yields and returns to

smallholders. These and other sorts of field trials, particularly around water conservation and climate change adaption, could pay large dividends to smallholders who invest in a crop like oil palm that has a 20 to 25-year time horizon. Context-specific palm oil research should be the priority of any research initiatives.

➡ Research into plantation management, climate change adaptation, fertilizer application, cover crops, underplanting regimes are needed.

1.6.4 Physical infrastructure

Transport

Kigoma is a remote region of Tanzania with limited transport and utilities infrastructure, which greatly inhibits industrial development. While the road network has seen significant investment and improvements in the past half-decade, trucks are frequently bogged in the wet season and many small bridges remain washed out for extended periods. This causes delays that can run into weeks for transporting cargo between Kigoma and Dar es Salaam. Kigoma is connected to Dar es Salaam through the Central Railway Line that passes through Tabora, Dodoma, and Morogoro en route to Dar es Salaam. Freight trains run several times per week and take 48 to 72 hours to complete the journey. Freight cost on the train is TZS 330 per kilogram to Dar es Salaam (which converts to USD 150 per ton) and TZS 300 per kilogram on a consolidated truck. Both journeys take between three days and one week. Kigoma is linked to Kalemie in the Democratic Republic of Congo and Mpulungu in Zambia by cargo boats and ferry transport. Neither destination is serviced on a regular schedule from Kigoma. However, boats carrying both cargo and passengers travel year-round. There is an all-weather road to Burundi, 63km north of Kigoma. This road runs to Bujumbura and passes through the palm oil producing regions of Burundi. If domestically produced CPO is to compete with cheap Malaysian imports, significant investments in transport infrastructure are needed to keep costs low (\$40/tonne of CPO).

Local trade and transport of domestic CPO is mainly on foot, by bicycle, or local bus. Farmers predominately transport CPO on bicycles or hired transported. Bicycles can carry four to six 25 litre containers at a time. Levies, collected by the local district authorities, are charged for transporting CPO out of the village where it was processed, these come to approximately TZS 200 per 25-litre container. Kernels are transported to town by bicycle, local bus or motorbike-hire, a process which takes one full day.

Small quantities are expensive to transport long distances and Kigoma lacks vital infrastructure that exists in other agricultural hubs in Tanzania. There are currently no major agricultural ventures in Kigoma region so there is little foundation for the oil palm industry to build on. A poor rail system provides irregular, but low cost, connection to Dar es Salaam. The little sales outside of the Kigoma Region rely on buses and trucks as transport to major markets. Large fully loaded 25-30-ton flatbeds should cost USD 55/MT to Dar es Salaam, however train should be much cheaper. These are projections however and transport to Dar es Salaam, currently estimated at USD 150/tonne must compete with Malaysia at USD 40/tonne.

Exports of palm oil products from Kigoma are nearly non-existent. Kigoma shares a border with Burundi and the Democratic Republic of Congo (DRC), both potentially lucrative markets for palm oil. However, trade with Burundi and the DRC is informal and dominated

by traders who irregularly travel to Kigoma and trade is unreliable due to political volatility in both regions.

Electricity

Electricity in Kigoma is supplied by TANESCO through large diesel generators. It costs USD 0.16 per kilowatt hour (KWH) and has a large presence, although short power cuts (<30 minutes) are a common occurrence (5 or 6 times per month). A 5 MW solar power plant has been constructed on the outskirts of Kigoma. This plant is large enough to supply almost all Kigoma's power but due to various disagreements between the plant owner, installation contractor, and the Tanzanian Government the plant is not operational.

Water

The municipal water supply is TZS 22,000 per month for an unlimited volume however the supply is very unreliable and is frequently not working for several months at a time. Many industrial facilities drill their own boreholes and private houses and hotels often have back-up water tanks. For those who cannot afford a borehole or water tank, water can be purchased at TZS 2,000 for 100 litres from vendors who will fill containers in rivers or Lake Tanganyika and transport water around town by bicycle. A large development project to upgrade the water supply is soon to be completed, however, it is already two years delayed and the contractor is facing insolvency.

Water usage in Kigoma is regulated by the Lake Tanganyika Water Basin Authority. Before drilling a borehole, a drilling permit must be acquired and any organisation desiring to use any water from lakes or rivers must get a water use permit. The municipal water supply, which is pumped from Lake Tanganyika is managed by the Kigoma Ujiji Water Supply and Sanitation Authority. There are no large irrigators at present in Kigoma and the Water Basin Authority do not report large stresses on water supply or watershed. There are no irrigation headworks on Lake Tanganyika or any of the rivers and tributaries that feed the lake.

Special Economic Zone

The Kigoma Special Economic Zone (KiSEZ) was established outside Kigoma Town, alongside a complementary set of tax and regulatory incentives to attract investors into export focused industries and encourage establishment of facilities in the zone. These include VAT exemptions on certain imports, work and residence permits for foreign workers, a corporate tax holiday, and dedicated customs staff to assist with export facilitation. To date, only one investor has established a facility in the KiSEZ. There are no sealed roads to or inside the zone nor has power or water been connected. Further, the time to complete the process for KiSEZ establishment averages approximately 2.5 years (Annex 4). The zone currently has 650 hectares ready for development in Phase 1 with more land to follow depending on uptake. However, it is unlikely that establishing a facility in the KiSEZ will be attractive to a palm oil processor the domestic market is the primary target for the CPO produced; thus, it will not meet the requirement of 80% products for export and not qualify for the tax incentives. The KiSEZ is a high cost environment (no roads, no water, no electricity), so without the tax incentives, setting up there would not make financial sense.

1.6.5 Finance

Only a handful of palm oil value chain actors report accessing formal financial services. Bank loans remain rare and hard to qualify for. In interviews both farmers and middlemen stressed the issue of capital as a major hurdle to business. Farmers said there are no accessible sources for loaning money internal or external to their value chain. Middlepersons have no additional capital to lend or loan to farmers and vice versa. Neither group appears to be able to secure loans from formal financial service industry. This thwarts farmers (and middlepersons) ability to expand operations within the value chain. As is the case across Tanzania, formal bank loans are hard to access and come with high interest rates (18% or higher). Microfinance institutions are more willing to loan to farmers and processors but their interest rates are too high, at 25% or higher. Pride Tanzania, a large microfinance institution, have given loans that have been used for equipment purchases.

Across smallholder communities, farmer associations frequently act as formal or informal lending groups allowing farmers to access credit. Many farmers or sole traders are part of local level savings and loans groups. However, these groups do not play a role in upscaling palm oil operations; they are often focused on funding livelihoods improvements such as the purchase of medicines, health care and living expenses. Seed Change has extended loans for trees to several hundred farmers with the median loan size of TZS 110,000. Access to finance for smallholders is always a problem and one only made harder by the longer payoff period required by oil palm trees.

1.6.6 Value chain governance

The palm oil value chain is characterized by many individual farmers, expellers, middlemen and market-women and consumers that all do not exercise any domination over the market. In addition, there is little to no cooperation between farmers nor with other value chain actors. No sustainable supplier contacts have been established by expellers with primary producers or further downstream in the value chain. While actors engage in purchase and trade of products with the same counterparts regularly, all transactions are on a spot market basis. Value chain actors employ workers through on an informal basis. Even employees of soap producers – the most formalised of all actors – report that they are employed informally. Therefore, the governance structure of the value chain can be considered as unarticulated and unstructured.

There are several palm oil producers' cooperatives and groups in Kigoma. However, their reach is limited to a few dozen farmers. Often the group or co-op exists in name only with all members operating as individual economic units with few interactions among them. While there are a handful of edible oils stakeholders' associations in Tanzania, they are largely organized around sunflower oil²⁶. No organisation claims to speak for palm oil stakeholders. Information flow between actors is haphazard. For example, palm oil vendors in one market may know the price at which other vendors are selling their oil in that specific market but will not know the price of oil the next town over. Similarly, farmers and processors are not aware of price differentials or arbitrage opportunities across markets or towns.

²⁶ Various associations include: Tanzania Sunflower Promoters Association (TASUPA); Central Zone Oilseeds Processors' Associations (CEZOSOPA); Tanzania Edible Oilseeds Actors Limited (TEOSA).

Larger industry-wide governance initiatives such as sustainability principles promoted by the Roundtable on Sustainable Palm Oil (RSPO) have been introduced by Seed Change as part of a farmer training package. However, it is unlikely that the certification process will continue as the audit process is prohibitively expensive to farmers and Seed Change (upwards of USD 30,000) and the benefits of certification are severely limited for producers who do not or cannot export to high value markets where a price premium is earned for sustainable palm oil.

A summary of the profit margin analysis in each segment of the value chain is provided with more detailed enterprise performance budgets in Annex 3. Where assumptions have been made, the reasoning and basis of these assumptions can be found in Annex 3, in addition to a summary of issues with data collection. Key features of Table 4 are as follows:

1. **Oil palm production:** the 30,000 smallholder farmers face high operating costs, low yields with resultant low to negative income returns.
2. **Palm oil processing:** the enterprises are utilizing two dominant processing technologies both of which have low outturns. The net effect is that processors have relatively high operating costs and marginal profitability.
3. **CPO Market Intermediaries and CPO Retailers:** these entrepreneurs are operating volume-based enterprise models and face high transaction costs and low margins.
4. **CPKO Machine Operators (hirers and owners):** these entrepreneurs run relatively homogenous enterprises with the former facing low margins while the latter have decent profit margins.
5. **Soap producers and Soap Retailers:** both types of entrepreneurs face relatively high costs and extract very low margins.

From the profit margin analysis (Table 4), one can see that most actors in the value chain operate on a very low profit margin. Higher profit margins are only achieved on the level of expelling machine renting (both on the level of kernel oil and palm oil expelling). However, one needs to look also at the quality of the final product that is produced by this units, the low quality of the oil in fact constitutes the single most limiting factor to further marketing of the product and selling to markets outside Kigoma. The profit margin on the level of production seems to be fair but one needs to also take into consideration the marginal costs of labour and the very low yields both constituting that palm oil production at the current stage is locking producers into poverty.

[Table 4. Kigoma Palm Oil Value Chain Enterprise Analysis \(October 2018\)](#)

Enterprise Type	Income Scale ²⁷	Margin Scale	Key Enterprise Descriptors	Performance
Soap Retailers (100)	TZS0.376m to TZS0.56m	7% to 10%	Relatively similar cost structure enterprises with 90% to 93% operating costs at both high and low-end enterprise size	

²⁷ Note: \$1: TZS 2292

			low profit margins (7% to 10% of revenue)
Soap Producers (15)			Relatively homogenous enterprises with one large outlier player High operating costs at both ends of enterprise size spectrum (81% to 90%)
CPKO Machine Owner (20)	TZS4.5m to TZS4.6m	14% to 22%	Relatively homogenous enterprises moderate operating costs (61% to 64% of revenue) Decent profit margins (36% to 39%) Margin and volume-based enterprise model
CPKO Machine Hirer (500)	TZS0.8m to TZS0.97m	14% to 22%	Relatively homogenous enterprises High operating costs (78% to 86% of revenue) Scale neutral enterprises
CPO Retailer (200)	TZS0.28m to TZS0.6m	2% to 5%	Homogenous high cost structure enterprises (95% to 98% of revenue) Volume based enterprise model with very thin profit margins
CPO Market Intermediary	TZS0.35m to TZS0.86m	2% to 6%	Volume based business model with no product differentiation Scale neutral enterprises with high operating costs (94% to 98% of revenue) Very thin profit margins
SIDO Expeller Owner (15)	TZS0.9m to TZS9.09m	(20%) to 76%	Profitable enterprises with 20% to 76% profit margin spread Economies of scale sensitive enterprise model Relatively low operating costs
SIDO Expeller Hirer (1000)	(TZS0,06m) to TZS0,006m	(23%) to 1%	Relatively high operating costs (ranges between 85% to 123% of revenue base) Marginal profitability for some (10% to 15%)
Burundi Expeller	(TZS0,354m)	(76%) to	High operating costs at lower end of

Owner (3000)	to TZS0,41m	24%	enterprise size (128% to 176%) - diseconomies of scale
			low processing efficiencies
			low returns at lower scale of operation
Burundi Expeller Hirer (16000)	(TZS1,12m) to TZS0,19m	(33%) 57%	Scale sensitive enterprise model
			High operating costs at lower end of enterprise size of less than TZS400k
			Positive cash flows after enterprise size of TZS400k
			Low processing efficiency
FFB Producer (10000)	(TZS0,09m) to TZS0,09m	(20%) 22%	High operating cost of production (78% to 120% of revenue base)
			Low yields
Total (30,000)			

1.6.7 Policies, regulations and laws

The Government of Tanzania has several investor-focused policies and regulations in place. For example, the GoT is working with AGRA, whom FAO is supporting, to implement a Contract Farming Act. A draft bill has been reviewed by the MoA's Policy and Planning Division and the Legal Division. The Tanzania Investment Centre (TIC) facilitates investor access to land and permits for developments and the Export Processing Zone Authority (EPZA) offers generous tax incentives to investors who start operations in one of the Export Processing Zones (EPZ) established around Tanzania, including the Kigoma Special Economic Zone (KiSEZ). Results from these initiatives are hard to determine as implementation is patchy and decreasingly effective as distance from the commercial centre of Dar es Salaam increases.

Tanzania slipped to 137 in the World Bank's Ease of Doing Business Report 2018, down five places since 2017 (World Bank, 2018). Worryingly for agricultural developments, one of the benchmarks which is dragging Tanzania's score lower is "Registering Property". This is despite the efforts of the TIC. The TIC is a "One Stop Shop" for investors issuing certificates as incentives to foreign companies who invest over USD 500,000 or locally owned companies who invest over USD 100,000. These certificates confer tax concessions for things such as importing production related machinery. TIC also facilitates permits (residence, construction, etc.). However, the process of registering a company with the TIC itself requires 18 different documents and visits to 4 different organisations. This pattern is repeated for all the required different permits.²⁸

There are three categories of land in Tanzania: village land, general land, and reserved areas. Village land is administered by the Village Government and all decisions are taken at this level. General land is administered at the district level with the District Council and District Executive Director (DED) having a discretion over land use. General land is often sought by the TIC for investors. Reserved areas include national parks and forest reserves and are protected natural spaces. Smallholder farmers' land is governed at the village level. A Certificate of Customary Rights of Occupancy (CCRO) is issued for village land. However, less than 5% of the total rural population in the Kigoma region has a CCRO. The process of obtaining a CCRO is cumbersome and expensive (Annex X), but without one, a farmer runs the risk of eviction or land conflicts and thus has little incentive to invest in the land – including both soil quality and perennial crops like palm oil. This process usually takes 90 days and costs TZS 200,000 to TZS 300,000 not including the cost of sending the Land Officer to Dar es Salaam, which must be borne by the applicant as well. This process is well out of the capability of smallholders as a result CCRO uptake is very limited.

Obtaining general land for development is an equally time-consuming and cumbersome process. Issuing of land titles is determined on a case by case basis and subject to determination by the handful of district leaders who control the process. The TIC has a land bank of investible land available however even this "fast-tracked" land is subject to approval from the district authorities. Foreign companies and citizens cannot buy land in Tanzania unless they are registered through the TIC. However, TIC's preferred landholding

²⁸ For more information see: Tanzania Investment Centre, "Business Environment," www.tic.co.tz.

arrangement for dealing with foreign investors is a 33-year lease rather than freehold purchase.

Tanzania has a National Land Policy (1995), which integrated gender equity in land distribution, inheritance and ownership. However, youth are not specifically mentioned in this policy, and youth face increasing difficulty in gaining access to land, where it is considered a “bad omen” to inherit land of living parents (FAO, 2014).

1.6.8 Institutional environment

There is no central authority or coordinating body for the palm oil industry in Tanzania, but there are a number of organizations involved. The Jane Goodall Institute in Kigoma works to conserve forests for chimpanzee habitats. Other donor or NGO initiatives currently in Kigoma include Seed Change, PASS who focus on private sector financing (see section 1.6.3 for more details) and the DANIDA-funded Local Investment Climate (LIC) project, which works on addressing the critical constraints to business growth and economic development at the sub-national level.²⁹ Amongst other activities, LIC provided funding to Seed Change in 2014 and 2015. In addition, NIRAS, which is a Danish development consultant company, has been involved in facilitating public-private dialogues on palm oil in Kigoma, gathering relevant sector actors in 2017 and 2018. Historically, the Belgian Government has been interested in the development of the palm oil sector and through the Belgian Technical Cooperation (formerly the Belgian Development Cooperation) helped the Kigoma Municipality developing an investor’s guide, which was heavily focused on palm oil (Municipal Council, 2017). The wider edible oil sector in Tanzania (sunflower, sesame, etc.) is a common focus of development interventions as edible oils are an important part of the Tanzanian diet. Actors involved in edible oils development in Tanzania recently include SNV, Concern Worldwide, UNIDO, FAO, ANSAF, Care, ActionAid, amongst others.

Historically, large scale private sector palm oil initiatives have not come to fruition. Kilombero Plantations Limited, now East Africa’s largest rice producer, initially considered growing oil palm before deciding to focus on rice in the Kilombero Valley in Morogoro. Nava Bharat’s proposed USD 111 million Integrated Oil Palm Project in the Ruvu River spearheaded by the National Development Council (NDC) also failed due to the inability to secure land (Cannon, 2015). Other companies such as African Green Oils, FELISA, and Agrisol have all failed to start their planned developments. All three companies initially started operating between 2005 and 2008 and now more than a decade later, none have any land under cultivation in Tanzania. A combination of problems including securing large parcels of available land, finding financing for marginal investments, or more simply the difficulty of large-scale agriculture has put a stop to these larger private sector initiatives. However, it seems that private sector investments are set to increase on the horizon and may include targeted support to outgrowers.

²⁹ Local Investment Climate, “About Us,” <http://www.lic.or.tz/p/about-us>.

1.6.9 Socio-cultural norms

Socio-cultural norms for labour in the palm oil industry mirror norms for smallholder crop cultivation. FFB production and processing is a family endeavour where all family members, including children, are expected to provide free labour in harvesting and processing FFBs. The subsequent steps in the palm oil value chain follow these same norms with families supporting middlepersons in purchases and transport, retailers in market sales, and kernel oil processing.

Women do not take a lead decision-making role in the household or in production activities. There is a distinct gender division of labour in the CPO value chain. Men are largely responsible for management of oil palm trees and palm oil sales. Women contribute labour in the processing of CPO, but most do not take leadership or have decision making power over the process (for further detail see section 2.1.2.2 – Gender Roles). Many of the time-consuming functions are completed by women whose time is deemed to be less valuable than men's. Women often take principal roles in the CPKO segment of the palm oil value chain because it is culturally viewed as a "women's crop" by the community due to its lower value. Women often fill retailer roles, along with their children, as this is deemed by the community to be a non-labour intense activity. Farmers use family labour to harvest FFBs, often young boys and men, as the harvester has to be agile to climb the tall trees. Child labour is sometimes employed in CPO processing and general farm maintenance.

1.8 Natural Environment

Situated in north western Tanzania, Kigoma is 42,350km², or five percent of Tanzania's land area. At 6.5° south of the equator, it is located within the palm production belt. Kigoma region sits on a gently inclined plateau with steep hills that rise from 800 meters at Lake Tanganyika to 1,750 meters above sea-level in the east (Fubusa, 2010). The region is characterized by a tropical climate with distinct wet and dry seasons. Kigoma is endowed with world-class terrestrial and aquatic natural resources and the region's vegetation consists of woodlands, grasslands and swamps (Fubusa, 2010). Many soils in the region are highly fertile and able to support agriculture (Planning Commission, 1998). Because of this, Kigoma is one of only a handful of districts in Tanzania where oil palm trees are grown, although Kigoma is not necessarily optimal for palm.

Optimal palm production requirements are less than 300 meters above sea level, falling inside the optimal palm production belt 7° north and south of the equator in a high rainfall area inside the palm production belt of with a minimum of 1,200 mm of rainfall per year (Verhye, 2010). Growing at 800 metres above sea level, inside the palm belt, but surviving a water deficit of 400mm over four months, palm production is viable in Kigoma region, however not ideal in a global sense. Furthermore, it

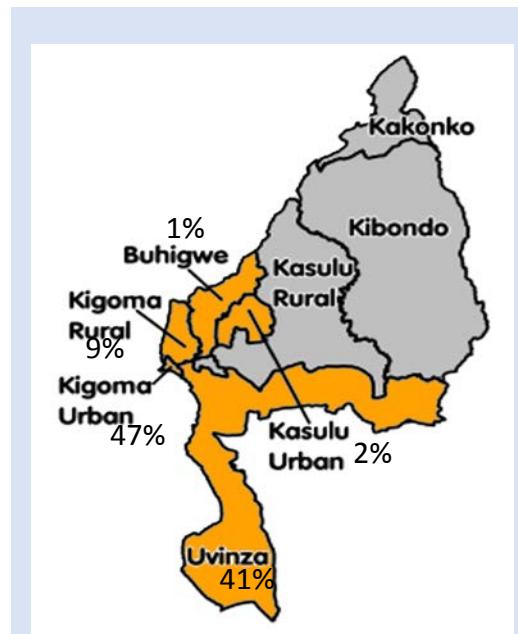


Figure 11 Primary palm oil production regions

is unclear how much land is available for investment and expansion of palm oil production. According to the Kigoma Regional Government, there is 114,018 ha of land available. However, it is unclear where this land is located and if it is suitable for oil palm cultivation. According to estimates by Seed Change, 30,000 ha are currently under the palm oil cultivation. A detailed mapping must be conducted to determine the suitable areas for palm oil expansion, with consideration to distance from town centres, population, and climatic variables.

1.8.1 Soils

The soils of Kigoma vary across the region but can generally be categorized as deep, well-drained, dark, reddish-brown fine, sandy loams along the lake shores that are partly stony and severely eroded. Heavy black soils are found in permanently waterlogged areas and black, clayey soils with high sand content along swamp edges. These soils are highly fertile because of high proportions of sand and silt. In areas of lower elevation soils are dark reddish clay loams with good drainage. Areas of higher elevation are characterised by black and brown alluvial soils. Annex 5 includes more details on soil composition detailing the results of soil tests conducted by Seed Change.

Seed Change conducted several analyses of soil types and created model fertiliser regimes in conjunction with Yara for several soil types in Kigoma. The soil proved to be of marginal quality but suitable for palm oil production. The cation-exchange capacity is very low meaning that the uptake of nutrients will be restricted, and that fertiliser application needs to be distributed throughout the year and timed accurately to avoid leaching. To achieve the full potential yields of high quality *tenera* trees, significant applications of fertilisers (particularly phosphorus and potassium) will be required.

1.8.2 Forests

Kigoma is home to many tropical forests including the famous Gombe National Park and the Albertine Rift Montane forest, among others (WWF, 2017; JGI, 2018). Forested area is highest in the south and east of the region (Figure 13a). In 2015, Kigoma had 3.8 million hectares of forested land, covering 60% of the land area (MNRT, 2015). Nationwide, Tanzania saw a deforestation rate of 372,816 ha/ year between 1995-2010 (MNRT, 2015). Other sources indicate that Kigoma lost 92,600 hectares of tree cover between 2001-2017, estimated at 2.5-5% of forest land (Global Forest Watch, 2018). Central and Southern Kigoma are currently at the highest risk for forest loss (Figure 13b). Researchers from the University of Dar es Salaam have recently concluded that proximate causes of forest loss in Kigoma include agricultural expansion, wood extraction, and the expansion of settlement areas. Underlying factors contributing to these causes include population growth, poverty, poor levels of education, lack of employment, corruption and embezzlement of public funds by politicians and senior government officials, as well as high demand for fuel wood (Makunga and Misana, 2017). Based on these factors, researchers recommend implementing region-wide environmental education, increasing forest patrols, more effectively enforcing laws and providing alternative energy sources (Makunga and Misana, 2017). It will be vital to ensure that the expansion of palm oil production does not impede

upon forested areas and the appropriate measures must be implemented to ensure their protection.



Figure 12a Forest Land in Kigoma

(Source: Global Forest Watch, 2018)

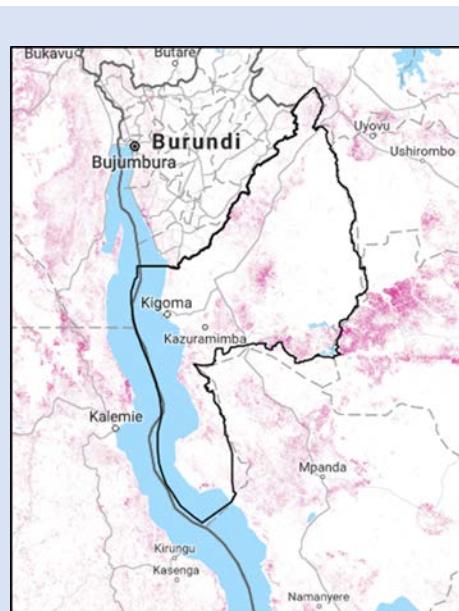


Figure 12b Forest Loss in Kigoma

(Source: Global Forest Watch, 2018)

Remnant forest cover in Kigoma (and around Tanzania) is managed by different authorities depending on the land classification. At the village level, all land including forested land is managed by the village governments. The majority of villages have village forest reserves, areas set aside in the village land use plan for maintaining forest cover. If the village government decides, these forests can be harvested. At the district level, where general land is governed, forests are managed by district staff and the Tanzanian Forestry Service. Enforcement of forest reserves, stopping encroachment from smallholders or stopping illegal harvesting of timber is in the district staff's purview.

1.8.3 Water

Kigoma region has three major perennial rivers: Malagarasi, Luiche, and Ruchugi. The first two rivers comprise the major drainage area and as they descend they lead to river valleys at 1000 meters and swampy and flat delta at 800 meters where the rivers join Lake Tanganyika (Planning Commission, 1998). These rivers provide thousands of Kigoma farmers with irrigation water. There are two agro-economic zones with suitable conditions for oil palm production. First, the lake-shore zone, which sits at an altitude of 800 to 1000 meters with an annual rainfall of ~1000mm. It is a narrow strip of land that sits between Lake Tanganyika and the mountains and is dissected by numerous streams flowing into the lake. Second, the intermediate zone, which is characterized by swampy environments with great potential for irrigation. The zone is 1200 to 1500 meters above sea level and has an annual rainfall of 850 to 1100mm (Planning Commission, 1998). Average monthly precipitation in Kigoma ranges from 2mm in July during the dry season, to 174mm in April (Table 5). As

precipitation is below the optimum for palm oil production (minimum 100mm per month) six months out of the year, it is likely that supplemental irrigation will need to be applied to optimize yields – particularly between June to September. Yield losses of 10% occur for every 100mm increase in soil water deficit (Carr, 2011).

Table 6 Average Monthly Precipitation, Kigoma Region

Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Rainfall (mm)	140	125	146	174	60	6	2	4	19	60	140	157

(Accessed from Climate-Data.org, 2018)

1.8.4 Biodiversity

Kigoma region is biologically diverse with a wide variety of endemic species. The Albertine Rift Montane Forest runs through the western part of the region and contains many species threatened with global extinction as well as habitat for 50% of Africa's bird species, 39% of mammals, 19% of amphibians, and 14% of reptiles (WWF, 2017). The region is also home to over 800 chimpanzees in Kigoma's national parks. Gombe Stream National Park (55km²), was made famous by the work of Dr. Jane Goodall and is home to chimpanzees and baboons among other megafauna. Mahale Mountains National Park (1,729 km²) is also home to hundreds of chimpanzees and has been used for international primate research (Fubusa, 2010). While oil palm has demonstrated a disastrously negative impact on biodiversity in South-East Asia, these impacts are not foreseen in Tanzania and appropriate measures will be implemented to ensure that is the case.

1.8.5 Climate

The region is characterised by a tropical climate with a rainy season from October to May, and a short dry spell of two to three weeks in January or February, followed by a prolonged dry season (Planning Commission, 1998). Annual rainfall is variable, ranging from 600mm-1500mm with heavy rains in the highlands, moderate rain in the lower slopes and low rain in the valleys. Average temperatures vary between 25°C in December and January to 28°C in September (Planning Commission, 1998). Kigoma temperatures fall within the optimum for palm oil range between 24-33°C, with the average monthly temperature not falling below 15°C.

Table 27. Monthly Temperatures, Kigoma Region

°C	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Avg	22.9	23.3	23.2	23.3	23.5	22.7	22.3	23.5	24.3	24.3	22.9	22.7
Min	19.2	19.2	19.2	19.2	18.8	17.2	16.6	17.8	19.2	19.9	19.2	19.1
Max	26.7	27.3	27.3	27.4	28.2	28.2	28.1	29.2	29.5	28.8	26.7	26.3

Source: Climate-Data.org, accessed Oct 2018

Chapter 2: Strategic analysis

In order to put forward a value chain development strategy, (Chapter 3) an analysis of the current state of the value chain must be conducted. The following discusses the main strategic considerations for sustainable palm oil value chain development.

2.1 Economic sustainability

Although the palm oil sector is considered a lucrative business in many other countries (particularly in East Asia), the sector is too underdeveloped in Tanzania to reap any potential economic benefits (e.g. jobs and salaries, taxes). All value chain functions are labour-intensive, with slim profit margins for all actors involved. There are many actors involved, but most of them are operating at the subsistence level and are involved in other activities to supplement their household income. None of the value chain stages in this low-input, low-output system results in economically viable businesses as such. Thus, the sector will not be competitive without sufficient investments all along the chain.

Profit is very much dependent on the international palm oil prices. For example, Malaysian mill's break-even for CPO is 600 USD per metric ton (Table 28 shows volatility of CPO world market prices). Minimum production costs that Malaysian mills calculate operate at 50 USD per metric tonne CPO. Many mills that are not competitive at world market prices (dominated by Malaysia and Indonesia) therefore try to further vertically integrate into the value chain capturing gains from value addition and final products where the profit margins are much higher thus rendering their overall business profitable

Table 28: Crude palm oil world market price fluctuations from 2013 to 2018



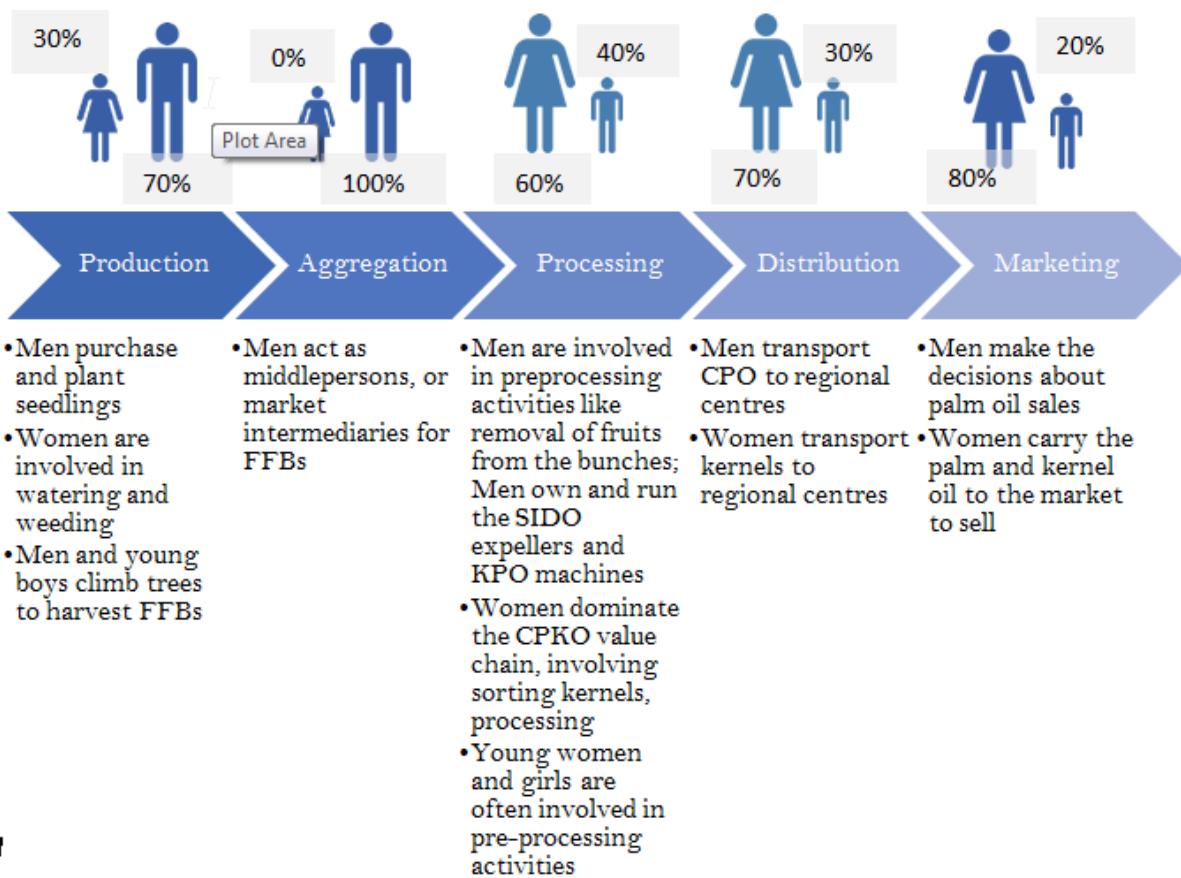
Source: CME Group, 2019

2.2 Social sustainability

Nutrition: There is much debate around the overall healthiness and nutrition impacts on the promotion of palm oil as an edible oil. Some nutrition facts are indelible - palm oil is rich in carotenoids, vitamin A and E and antioxidants. Palm oil and palm kernel oil are high in saturated fats, 50% and 80% respectively (Mukherjee and Mitra, 2009). Saturated fat has been associated with boosting bad LDL cholesterol, which increases risks of heart disease. However, in this context, where food security is of the utmost concern, edible oils like palm oil play an important role in providing dietary fats and can be part of a balanced nutritious diet.

Gender roles: Women tend to be involved in the more time-consuming, downstream value chain activities such as processing and marketing. Whereas men are heavily concentrated in production activities and hold positions of power involving transactions such as middlemen, and as owners of machinery. Men are primarily responsible for decisions related to palm oil businesses.

Table 29: Gender roles across the value chain



Source: The authors

Youth: Youth unemployment and poverty is a fundamental problem in Tanzania, with nearly 2.4 million unemployed, and most of them young. The youth unemployment rate is 17%, compared to general unemployment at 12.9% (FAO, 2014). While youth are generally disinterested in agriculture likely due to the drudgery and low returns, improvements in

innovation and efficiency may entice Kigoma youth to become engaged in the value chain. There are also a great many entrepreneurial opportunities that may interest youth in the supporting functions – such as logistics and marketing.

Poverty: Kigoma is one of the regions with the highest rate of poverty, with almost half of its population (48.9%) below the poverty line. Palm oil has been identified as a strategic crop for both commercial and social impact opportunities (Dalberg, 2017). By increasing the incomes of the more than 30,000 smallholder palm oil producers and artisanal processors, the potential for poverty reduction in Kigoma is great.

Decent work: According to the ILO, there are a number of health and safety standards associated with the cultivation of oil palm (ILO, 2004). These include risk of being hit by falling trees or FFBs, abstaining injuries and abrasions during harvesting and transport, as well as sun exposure – leading to skin cancer and heat exhaustion.

Child labour: According to the International Labour Organization, 36.1% of children in Tanzania are engaged in work activity (2016). However, this figure is likely much higher in rural Kigoma. Child labour is prevalent throughout the palm oil value chain, with young men and boys often involved in the harvesting of FFB, and young women and girls involved in palm oil processing with SIDO machines. Burundi expellers are often operated by young men and boys.

Refugees: There are refugee centres along the western border of Tanzania receiving refugees from Burundi and the Democratic Republic of Congo, and various Refugee Camps (e.g. Nyarugusu, Nduta, Mtendeli) north of Kasulu (ReliefWeb, 2017). However, the primary palm oil production regions are Kigoma Urban and Uvinza, while Kasulu, and the areas where refugees are present have little involvement in palm oil production. The foreseen impacts on refugees through the development of the palm oil value chain are restricted to the possibility of setting up institutional procurement mechanisms with UNHCR to supply palm oil to the refugee camps.

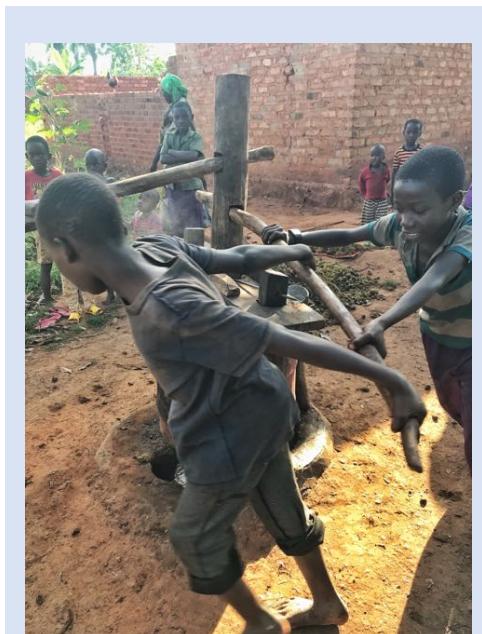


Figure 15 Children operating a Burundi expeller, during school hours.

2.3 Environmental sustainability

Currently, the negative environmental impacts of the domestic palm oil value chain are minimal due to the smallholder and artisanal nature of the industry. Typically palm oil production and processing have the greatest impact on the natural environment through land use change and the application of fertilizers and pesticides. However, the bulk of the processing in Tanzania is human-powered (not requiring fossil fuels), and inputs that have highly negative environmental impacts like chemical fertilizers are not applied. Furthermore, although it is likely that some deforestation was caused by historical land use

change, the impacts caused by palm oil production in particular are impossible to separate from that of agriculture in general.

The primary cause for concern in the current Tanzanian palm oil context is the wastewater from processing, which is highly acidic and a major environmental concern. Palm oil mill effluents (POME), which are currently unmanaged and leach into waterways. POME are eutrophying, acidifying and toxic compounds that pollute both terrestrial and aquatic systems, and release significant amounts of greenhouse gases like methane (Khatun *et al.*, 2017). Treating POME is required in industrial processing facilities in most countries. Treatment is normally done through anaerobic digestions in ponding systems or aerobic systems that use the gas produced for energy production. Once the POME reaches a safe level (measured as “biological oxygen demand” per litre) the water can be released. None of this happens in the processing systems in Tanzania. Residues are left to run into streams or seep into the ground. Current volumes are small, however treating POME will be required if CPO and CPKO production increases.

As the value chain scales up, sound recommendations must be developed, and environmental safeguards implemented to ensure that new plantations do not impinge upon forests or water resources; good agricultural practices are applied in the application of fertilizers and pesticides; and POME is appropriately managed. For example, analysis demonstrates that a mix of organic fertilizer from pruned palm fronds, empty fruit bunches and POME can be used to supplant chemical fertilizers (Raynaud, 2016). It may also be possible to generate bioenergy from oil palm residues (Temu *et al.*, 2013).

2.4 SWOT analysis

At the end of the strategic analysis stands a an analysis of the strengths, weaknesses, opportunities and threats (SWOT Analysis) reveals the following:

Strengths

- Vast cadre of smallholder farmers engaged in palm oil cultivation (30,000)
- Pre-existing service provider for improved seed varieties (Seed Change)
- Organizations interested in scaling up technologies (e.g. SIDO, TIRDO, TEMDO)
- Strong political will for change steered by PMO

Weaknesses

- No food safety measures applied and limited support offered on certification
- Lack of agronomic advice to improve oil palm yield
- Limited financing opportunities to invest in production upgrades
- Problematic processing model – (input v. output-based payment)

Opportunities

- Increasing domestic demand for processed and refined palm oil with potential export to neighbouring countries (e.g. DRC)
- Institutional procurement for refugee camps

- Oil palm in agroforestry systems
- Use of technology (e.g. mobile phones) to deliver agronomic advice via hotlines and text

Threats

- Difficult to identify and secure suitable and available land for palm production
- Food safety issues and costs of compliance
- History of poor coordination of smallholder producers
- Weak public infrastructure (railways and roads to Dodoma and Dar)
- Lack of dialogue between public and private sector
- Non-systemic interventions (focused on only one value chain stage e.g. inputs or processing)
- Poor agronomic practices (e.g. lack of sufficient irrigation)

Chapter 3. Development and innovation opportunities

A main goal of this report is to indicate a path for sustainable (economically, socially and environmentally) development of the palm oil value chain in the country. This is based on the diagnostics (Chapter 1) and the strategic analysis (Chapter 2), but also suggests innovative solutions – in terms of technology and organisation along the chain - proven successful elsewhere. Chapter 3 therefore indicates upgrading opportunities for the palm oil value chain in Tanzania in the context of the agroecological and socioeconomic conditions of the production region, Kigoma, including the remoteness and related high transportation costs to major urban markets towards the coast.

Entry points for the development of the value chain need to consider sources of value creation. The national market for palm-oil products is substantive (not to mention international market potential), in addition to markets for side-products from the mixed cropping system. However, the market can be comfortably captured only if the production is of sufficient scale and the product quality is high enough to justify investment, marketing and logistics. In this case the upscaling of production and quality cannot be achieved through gradual development in small steps; the economics of these intermediary steps do not work out and the products are not marketable. Rather drastic changes are required, on three main levels – 1) inputs, 2) large-scale processing, and 3) agroforestry mixed cropping systems.

The rationale for value chain development lies in increasing production efficiency - the net revenue of the farming system renders the industry competitive. Competitiveness is not achievable otherwise, given imports of increasingly cheap palm oil from international markets as well as the market fluctuations, which would negatively affect smallholder farmers.

The following is a mapping of the new businesses – including production and processing – along the value chain in view of the above entry points and additional actions required to make them viable. New modes of businesses along the value chain will be discussed with regard to primary production, processing and marketing, as well as services and governance.

3.1 Primary production

The focus of improving production is to expand the plantation of improved *tenera* palm oil trees. There are two ways of expanding *tenera*: a) replacing existing *dura* trees on smallholder plots, and b) planting *tenera* in newly-formed plantations. Sufficient land is available for both strategies (feasibility to be confirmed during investment preparation phase – see Annex 6).

However, palm oil production needs to be embedded in a mixed cropping system based on the principles of biodiverse agroforestry systems. Such systems have been applied successfully in agroecological conditions similar to Kigoma (e.g. in Brazil). The system is imperative as with palm oil alone profitability, both for small-holder farmers (20,000 hectare) and the main investor (10,000 hectare) would be too low. Through ecosystem

synergies, the entire intercropping system renders much higher value than palm oil alone which recently has limited profit margins given low world market prices.

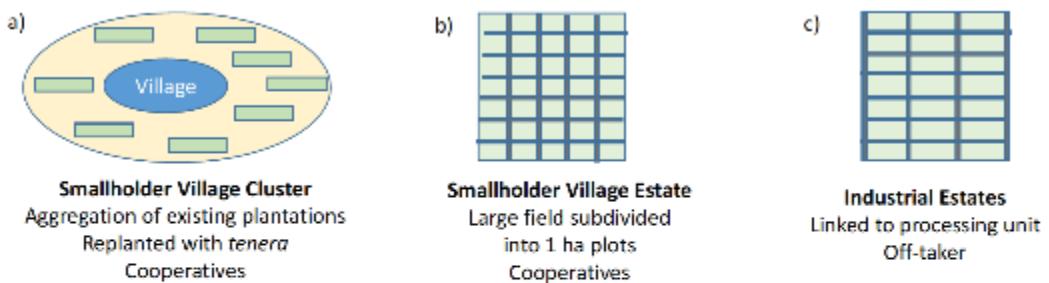
The biodiverse cropping system will include food and cash crops with a proven market – local or beyond - and potential off-takers. The crops will include staples such as cassava, beans, and bananas as well as cash crops such as soya, groundnuts, cocoa, vanilla, ginger, turmeric, black pepper, etc. The detailed mix will be subject to the agronomic and market feasibility studies during the investment preparation phase (see 4.5).

The fragile ecosystem with semi-arid and complex soil conditions in Kigoma would not support typical monoculture palm oil plantation. Instead a biodiverse cropping system can render two to three times and more biomass than the currently applied land use system (zero input - low output systems, or fallow lands with shrubs). Hence the plantations will be CO₂ sequestration-intensive. Soil fertility is achieved through intensive pruning, mulching, use of manure and periodic animal grazing, and the application of nitrogen-fixing (leguminous) cover crops. They also will be eligible for various environmental certifications (e.g. RSPO and organic), as there will be ideally a zero use of pesticides or chemical fertilisers; though certification would only be sought if the market demanded it and price premiums were achieved.

As Kigoma does not have ideal conditions for palm oil production, with an extended dry season that has less than ideal water for three months of the yearly growing cycle, it will be also necessary to engage in irrigation. It is advised that inexpensive gravity-based drip irrigation is used for all plantations. This could involve rain collection tanks and pumps to fill water containers from the river. Such irrigation systems need to become part of the village cluster, village estate and industrial plantations and the related finance models.

Three production models (Figure 16) are recommended allowing for the engagement of a range of actors in palm oil production and production of other crops. Together they constitute a scheme of industry-led palm oil-based plantation and smallholder development. It does not neglect smallholder farmers, rather, it integrates them and uplifts them on a completely new level of production and profitability in a commercial environment. It fully considers the integration of the pre-existing and new smallholder oil palm farmers providing them with options as 1) outgrowers in village clusters, 2) members of estates, 3) and/or as workers across the range of employment opportunities.

Figure 16: Kigoma Palm Oil Production Business Models



Production Model	a) Village Cluster	b) Village Estate	c) Industrial Estates
No. of Potential Ha	15,000-20,000 ha	13,500 ha	10,000 ha (2 x 5,000 ha)
Number of workers	20,000 farmers	13,500 farmers	2,500 jobs

Models are complementary – all three are needed!

Source: Authors elaboration

Production model 1a: Smallholder village clusters

With the support of the Government and development partners promoting the “Kigoma palm oil initiative”, smallholder farmers would become organized in their communities and see if they can identify pieces of their land (re-planting oil palms on existing as well as new fields) that can be grouped into clusters of at least 50 hectares per village. With the support of the initiative, the innovating farmers could clear the land from old *dura* trees and replant *tenera* and cultivate the other crops in the mixed cropping system.

Farmers would also need to form a cooperative (seen as an un-politicized business unit working for the interest of all participants, by the farmers, for the farmers) to send in particular young men and women, for training on plantation management and cooperative administration. They would use the cooperative as vehicle to organize replanting, get contracts with potential buyers (off-takers) to receive seeds for planting, jointly learn about and engage in plantation management, harvesting, storing, packaging and marketing.

The cooperative and its members should make plantation plans that include land preparation and plantation set up as well as provision of seeds, cover crops, other crops, small irrigation and advisory services. The plan shall be pre-financed by an agri-investment fund which would lay out the capital investment up-front and ensure plantation management, harvesting and sales. The plantation plan can alternatively be funded by an off-taker of the harvest (not necessarily only the palm oil processor but also other buyers) in a type of a contract-farming agreement. The plan would be implemented by a local plantation service provider in combination or alternatively with the processors’ plantation teams.

Some 15 to 20 thousand hectares of land have been identified by the authors to be available for this type of renewed plantation via village cluster assuming that all village communities and farmers where this type of land can be found would engage. Certainly, it is reasonable that some would continue the traditional way of production and only adopt at a later stage.

The initiative should therefore start with farmers prone to innovation and early adoption which can be rather found among youth.

Production model 1b: Smallholder village estates

There are communities with smallholder farmers that would have larger patches of land available – around 200 to 500 hectare – and after a thorough process of consultation and discussion could agree among themselves to set the land aside for development into a one entire contiguous completely new and modern plantation with 1-hectare parcels, roads and modern agri-management. Smallholders would not lose the right to the land; but they would not crop it in the traditional way. Rather they would become land and shareholders in the estate with duties of plantation management assigned by the rules of good agricultural plantation management.

Land preparation and planting could be outsourced to a plantation development company which could remain also in the management of the plantation if the smallholders wish to do so. Again, land preparation and plantation set up should be financed by the agri-investment fund or off-takers. Integral part of this business model is the strong engagement of management of the large processing plant (the FFB off-taker) vis à vis (a) supervision of plantation establishments to the highest standards, (b) loan instalment deduction at mill or cooperative level, (c) and ongoing technical assistance to farmers via a professional services company.

Again, and in this case even more importantly, smallholders would need to form a cooperative that would become the legal unit overseeing the plantation and being responsible for its management, which eventually could be outsourced to a professional plantation management company while smallholders would remain with specific tasks of plantation management (e.g. weeding, mulching, harvesting, etc.) corresponding to the share of their land. Each smallholder would get as many plots for they qualify. The cooperative would send its staff to trainings on plantation management and cooperative administration. Its management should be ensured by people that have undergone substantial training in cooperative development and business administration.

Provided the land set aside is large enough, investors from outside could acquire, against a fixed investment package price, shares in the cooperative which correspond to one hectare of land. This would allow to get more investment in the estate. The investors would not acquire land titles as land remains in the hands of the communities. Professional plantation management needs to ensure to pay investors but also smallholder dividends on the profit the estate makes.

Potential areas for such a contiguous village estate could be 7,500 ha of smallholder plantations in the Liuche River Delta (Kigoma Municipality) and at least 2,000 ha in other areas of the Kigoma Region, 2,000 ha in the Uvinza North Catchment and 2,000 ha in the Uvinza South Catchment region, all together 13,500 hectares.

Production model 1c: Industrial plantation

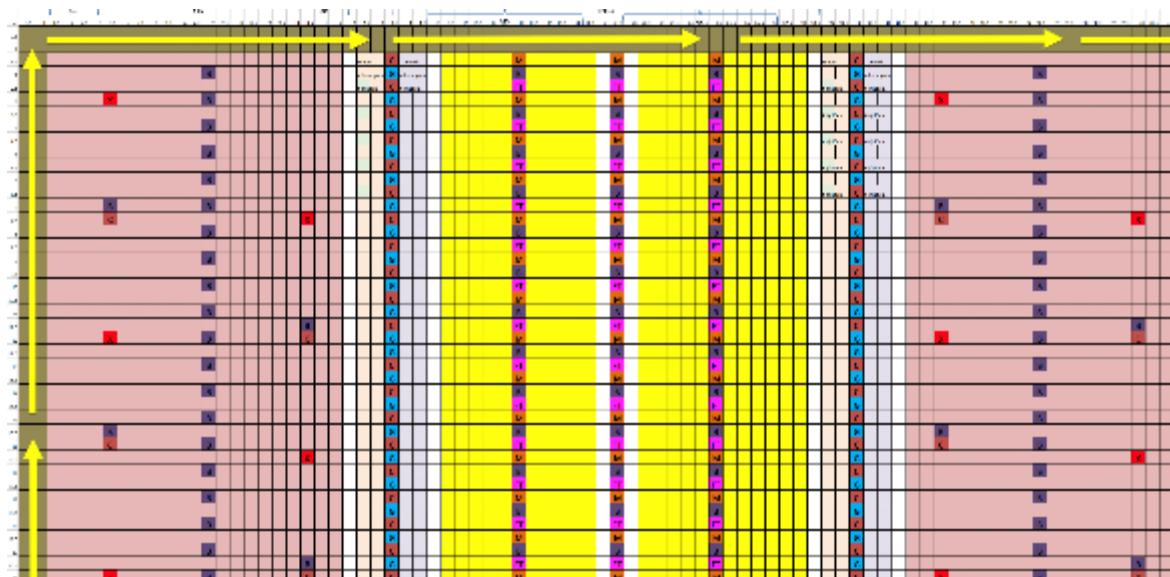
A key element in vitalizing and modernizing palm oil production in Kigoma is the identification of an investor to install a larger scale processing facility to produce high

quality refined palm oil and other products for the domestic market and beyond. The company would need to establish its own oil palm plantation to secure the sourcing of a minimum amount of FFBs to utilize their installed capacity while complementing supplies with FFBs from other producers (smallholders in models 1a and 1b). The company may operate its processing and plantations in an integrated manner, or preferably, create a plantation subsidiary (a plantation company), which manages the entire agroforestry system with multiple crops including oil palms, fruits, spices, trees and cash crops.

Agroforestry production system

Table 30 provides an overview of the type of agroforestry production system that could be used as a model across all three proposed production models. Plantations are planned in different zones in 1 ha zones. In the illustration, oil palms (red squares) in the light pink zones are planted with standard spacing, perennial cover crops, and intercropped with crops like banana (in purple) and cocoa (in orange). In the centre, cash crops are planted in seasonal rotations (e.g. cassava, groundnuts, beans, maize, soy, etc.), and intercropped with crops like cowpeas, beans, maize and groundnuts. In addition, there are three alley crops, which include fruits like banana and mulberry (in pink), as well as timber trees (e.g. Moringa in orange). This model is based on evidence of what worked in Brazil. However, further research must be conducted to determine the right crop combinations for the Kigoma region, with consideration to both market needs and environment.

Table 30: Agroforestry Production Model



Source: Author's elaboration

From the present land availability projections, there is room for one large processor with a 60-90 MT/hour processing facility and assuming that 40% of the production should come from its own plantation of an extension of 10,000 hectares. The study identified at least 10,000 hectares of land available for this type of investment without major issues of accessing and titling, 5,000 ha in Uvinza Center District and 5,000 ha in Uvinza South District.

A well-managed investor identification process shall be applied to attract a potential development-oriented investor in the plantation (and the processing mill). Open bidding may not be the best way to attract investors that are socially and environmentally-conscience and look for positive impact holistically. Therefore, one may also consider investor identification via networking and checking against a range of criteria including a) track record on social inclusion and payment of fair wages, b) track record on environmental sustainability, c) track record in palm oil processing, d) financial capacity, e) motivation to work in Kigoma, f) problem solution capacity.

The investor would deal directly with commercial banks to finance the plantation and mill development. The plantation will source its own seedlings and establish its own nurseries. It will require workers that can be sourced from smallholders currently engaged in palm oil production after further training.

Land availability and acquisition

The land right issues and making land available for new and improved plantations may be considered the single most critical issue in the development of the initiative and. Few major agriculture-related land acquisitions have been realized by investors in Tanzania over the last years and even less have been eventually successful already showing results. In other cases, readily available investors were not able to get access to required land and finally gave up on the investment due to bureaucratic hurdles, incapacity to provide land titles to banks as collateral and NGO pressures.

The Government of Tanzania considers three categories of land in general: a) village (community) land, b) district (state) land (that can be titled and leased to individuals), and c) conservation land. In the case of Kigoma all land available for plantation is in the category of village (community). The Jane Goodall Institute has jointly with the districts and each village developed a categorization of land in conservation-, village forest-, livestock- and cultivation land. The initiative, by all means, needs to limit plantation to zones marked for agricultural cultivation.

The 3ADI+ has engaged in a screening of available land fit for oil palm in mixed cropping system plantations. It also has screened the detailed maps of the Jane Goodall and village zonification. According to these, there seems to be sufficient community land that can be used for plantations. However, the 3ADI+ insists that this land should not be re-categorized into state land and titled to sell it to an investor.

No community or district land shall be sold and transferred. Instead the communities would remain owners of their land but would develop lease-agreements of (e.g. 66 years which corresponds to two palm oil cropping cycles). The community must agree on the use of community land for plantation development and the village consultation process through Free Prior Informed consent (FPIC) leading to this decision needs to be properly documented. Land rights and customary law experts shall be engaged to develop the details of these lease agreements. This applies to the land acquisition in business model 1c. For 1a no lease is required as smallholders remain with their land. For 1b more complex lease agreements need to be developed as the community land is redistributed (in 1-hectare plots) and original smallholder land users and investors need to get fair shares.

An important point is that individual farmers do not have the right to land, it remains with the communities and these have given farmers users' rights. Such customary rights may have given to families generations ago. Village communities track the "who it has been given to" by council of wise men and the village land chief. In the new arrangement, the village community must register and document the land used by the occupying farmer (year of first use, type of use, type of culture, geolocation and surface (polygon, precise family situations and family claims) and be compensated according to an officially agreed on plan.

Cost and profitability

The three models above are complementary and must be developed in parallel; together they only can ensure the profitability of the large processing mill. However, each must individually be economically feasible. Investment considerations will need to be analysed in the financial feasibility study as part of the investment preparation phase (see Annex 6). Table 16 provides a simple summary of the average cost and profit margin considerations for each of the three production models³⁰. The yields are progressive starting with 0 tons/year, moving to 2 tons/year progressing up to 18+ tons/year.

Table 16 Cost and profit calculations for primary production of FFB without irrigation

Calculations per hectares of plantation and year	Current system average	Smallholder Clusters	Smallholder Estates	Industrial estate
Yield assumptions (in 5th year)	1.5 FFB/ha	10 FFB/ha	14 FFB/ha	16 FFB/ha
Investment costs land preparation and planting (broken down per years of use)	0	150	150	150
Labour costs for plantation management	70	215	215	190
Labour costs for harvesting	15	15	15	15
Costs of equipment use	0	0	0	0
Costs for monitoring and safety	0	0	0	0
Total costs	85	480	380	355
Sales FFB at 0.06 USD/ kg	91	610	854	976
Profit	6	130	474	621
Profit margin	7%	21%	55%	63%

Source: The authors

³⁰ Note: Table 16 shows indicative profit margins for plats without irrigation. However, depending on the topography and accessibility to water sources, irrigation may be applied. Costs are 1,800 EUR/ha for irrigation on an industrial plantation (Netafim, Israel).

Table 16 shows that highest profitability is given at the company estate as a professional management of the plantation ensures highest yields. However, model 1b has similar profitability to 1c, assuming that farmers would ensure efficient plantation management. Model 1a is also profitable but at lower levels as the zoning and production will not follow the modern industrial estate model but traditional farm organisation will continue.

The table above, however, provides only a snapshot of profits in a certain year. But yields and profits develop dynamically over time. Table 17 below shows the development from the beginning over a 5-year period for the case of the industrial plantation. It shows that in the early years the value of palm oil only contributes less than 3% to the overall value of production of the plantation and then increases substantially as of the fifth year³¹.

Table 17. Five-year profit margins for mixed cropping system

³¹ Yield is calculated at 8 tonnes/ha/year at 2019 costs of FFB of 0.06 EUR/kg and a low commodity price of 500 EUR/MT of CPO. For industrial plantations, ASD Costa Rica states that obtainable yields range from 2.7-31.2 t/ha/year. However, smallholders will not be able to obtain yields at this high-end (ASD, 2019)

in EURO					
Operating Revenue	Year 1	Year 2	Year 3	Year 4	Year 5
Oil Palm	0	122	366	488	537
Banana	1'808	1'988	1'988	2'187	2'187
Papaya	0	720	1'800		
Mulberry (fresh)	0	0	7'020	7'371	7'740
Eucalyptus leaves	0	0	0	0	0
Cocoa	0	0	408	449	494
Ginger (fresh)	180	194	212	218	224
Onion (fresh)	378	457	457	553	553
Turmeric (fresh)	670	744	818	900	990
Cassava	234	257	283	311	343
Cowpeas	0	0	0	0	0
Groundnuts	55	60	66	73	80
Soybeans	57	62	68	75	83
Maize	234	257	283	311	343
Black Pepper (green)	0	0	292	321	353
Vanilla (green)	0	0	5'400	5'940	6'534
Moringa Pod (Drumstick)	873	970	1'067	1'174	1'291
Total Operating Revenue	4'488	5'833	20'530	20'372	21'751
Direct Production Cost					
Total Direct Cost	1'370	104	116	123	125
Personnel					
- Cost of Personnel	1'992	1'992	2'051	2'051	2'113
Total Personnel Cost	1'992	1'992	2'051	2'051	2'113
Miscellaneous Charges	2'008	2'008	2'068	2'068	2'131
- Fixed expenses	16	16	17	17	18
- Depreciation	30	30	30	30	30
Total Misc: Charges	46	46	47	47	48
Net Profit before Taxes (EBIT)	1'080	3'691	18'315	18'152	19'466
Finance Charges*	0	2'102	2'051	171	0
Taxes on profit	130	443	2'198	2'178	2'336
Net Profit after Taxes	950	1'146	14'066	15'803	17'130
Autofinancing capacity	980	1'176	14'096	15'833	17'160
ROI	25%	30%	372%	418%	453%
"Investment"/Loan:	3'778				
<i>*Loan: 1 year loan holiday change loan and interest in LoandDepreciation</i>					
<i>Loan: Invest Plan Total +Total Direct Cost Year 1 + Cost of Personnel Year 1</i>					

Plantation finance

Oil palm trees, like other tree crops, are a long-term investment. Oil palm plantations are usually relatively easy to finance as yield and harvests in well-established and well-managed plantations are predictable. However, while larger investors may easily absorb financial needs, smallholders usually feel rather challenged to get access to the necessary finance. Financial needs relate to medium term and long-term investments for land acquisition, titling, land-clearing/felling of old *dura* trees as well as establishing new fields, farm rehabilitation through inputs and improved maintenance, and replacement/replanting including lost income in the oil palm immature phase (IFC, 2015).

One option for financing is plantation establishment loans in combination with an outgrower scheme. A large anchor buyer (in this case the processing company described in 1c and 2a), with a financial guarantee/collateral to a commercial bank, can provide plantation establishment loans to out-growers. This would mean that the processing company must ensure managing the plantation in the first 3-5 years, after which the plantation establishment loan is expected to be fully repaid. The processing company will require that (a) smallholders have a title to the land, (b) smallholders are members in a cooperative, (c) land titles are ceded to the company as collateral, and (d) the cooperative gives the plantation company the right to insist on the proper management of farmers' fields until the loans are repaid to the bank. The typical loan terms are as follows:

- 1-year repayment grace period for principal to account for the period when the oil palms are immature and there are positive cash flows produced by the intercropped spices, fruit and cash crops, each producing revenue at different periods every year³². Many short-term crops like peas, groundnuts or beans yield income within 3 or 6 months after planting.
- An optional living stipend can be added to the loan to pay the out-growers during the oil palm immaturity phase
- Commercial banks may finance the plantation establishment on the basis of company guarantees provided by plantation company
- The processing companies provide offtake agreements for the FFBs and other crops from the smallholder plantations.

There is also the option that a processing company does not want to extend its balance sheet to cover many smallholders. In this case impact investors or development finance institutions or a combination of the two need to be invited into financing of the plantation establishment.

³² The revenue depends on the number and type of different crops the farmer chooses to plant and could amount at the start with a gross revenue of 3 million TZS (1300 €) or more per hectare per year.

3.2 Processing (palm oil milling & refining)

The palm oil processing system in Kigoma, using the above described Burundi and SIDO expellers, is characterized by high manual labour input and small throughput and low extraction rates (8 to 10%). Harvested FFBs are often stored in the open for more than 3 days resulting in immediate fruit decay, high content of fatty acids and, ultimately, a low product quality (Uckert et al. 2015). In fact, the current practice poses food health risks and should be abandoned in favour of the modern sector described above. The rudimentary development stage of the industry suggests a complete rethinking and turnaround of the processing function which needs to come to high enough scales and also value side products and other crops to become profitable. Upgrading the current system gradually through introducing small-scale (0,5 – 2 tonnes/hour equipment) alone would not work as the final product has no market that pays off, at a sufficiently high price, the investment. Also, micro-processors would not find sufficient absorptive capacity among the existing processors to ensure modern management. Instead two business models must be envisaged in parallel.

FFB and other crop's quality requires effective coordination from harvesting to processing gate. With regular FFB harvesting year-round every 10 days and no more than 14 days apart per harvest, it will be critical to manage harvesting and bringing volumes of FFB to the mills avoiding bottlenecks in supply and deterioration of quality. Post-harvest handling and quality insurance till processing gate will need to be addressed via trainings through buyers and development agencies.

Processing model 2a: Large processing plant (oil mill & refinery)

In combination with the plantation company (described in model 1c in section 3.2 above) a larger oil mill would need to be set up; it will be the anchor for all development in the region. It would not only process palm oil and kernel oil up to the refined stage and re-use by-products using energy efficient and cleaner production technology (circular economy argument) but also engage in purchasing, processing, packaging and marketing of other products from the mixed cropping system to be established on farmers' fields and by the plantation company.

Most likely, the company would need to look at investing in an above 60 tonne/hour Palm Oil mill which would need to be fed by the fruits of modern oil palm plantations of at least 15,000 hectares, at a yield of 10 MT/ha³³. It would also invest in a palm kernel processing plant to produce CPKO (Crude Palm Kernel Oil) with the by-products of PKS (Palm Kernel Shells) for the production of heat and bio-energy as well as PKM (Palm Kernel Meal) to be sold as ingredient in animal feed or in the production of organic fertilizer (sold back to the plantations)

In order to offset the risk of swinging commodity market prices, the company would also invest in a refinery to produce a) RBD Palm Oil (refined, bleached and deodorized) with the by-product of b) PFAD (Palm Fatty Acid Distillate) for soap production, as well as further

³³ Size of oil mill is based on capacity needed for peak production month. 60MT/hr capacity is calculated based on the needs for the peak month, where at a rate of 16h/day and 25 days/month, 24,000 MT of FFB will be processed, which is 15% of annual production. At 10MT/ha/year of FFB, plantations of 15,000ha are needed.

refining to c) Palm Olein as a branded retail vegetable oil with the by-product of d) Palm Stearin, which finds its market in the food, biscuit, cake and sweets industry. The processor may want to increase the value creation of the refinery with the production of Margarine, creating a complete branded product line “Made in Kigoma” consisting of oils, soaps and margarine.

Processing model 2b: Small-scale processing plants (oil mills)

Once there is clarity that a larger investor will be setting up a palm oil factory and an agricultural fund finances smallholder plantation development, other investors may come in and establish smaller processing plants that can affiliate with village cooperatives and develop outgrower schemes. The microprocessors would a) sell the CPO as their own brand or b) sell the CPO to the large processor’s refinery.

Table 18: Approximate cost and profit calculations for processing plants

<i>All items based on kg of FFB in USD</i>	<i>Burundi Expeller (current) 0,1 t/h</i>	<i>Large mill (≥ 60t/h)</i>	<i>Small mill (2-4t/h)</i>
Costs of FFB (calculated)	0.06	0.06	0.06
Labour costs	0.25	0.15	0.20
Electricity and Water, Diesel	0.30	0.15	0.15
Management and administration	0	0.20	0.10
Total costs	0.61	0.56	0.60
Selling price palm oil (01.2019)	0.66	0.66	0.66
Profit margin	0.05/kg	0.10/kg	0.06/kg

Source: The authors, based on survey data and EBITDA (2018)

The above table hides the fact that both improved mill options require substantial investments, as well as the output is quality is incomparable. In any case the profit is very much dependent on the international palm oil prices.

Processing model 2c: Agri-hubs

The mixed-cropping system produces large quantities (way beyond the tonnage of palm oil) of other agricultural products (i.e. food and forest). These will need to be stored, processed, packaged and marketed. While these activities could potentially be partly taken over by the oil mills, it is likely that a number of additional “agri-hubs” will need to engage in aggregation and readying them for the market through processing, value addition, packaging and labelling. Depending on the composition of the mixed-cropping system the agri-hubs would engage in activities such as processing, flour milling, oil extraction, sizing, packaging, storing, shipping quality control, biofuel production of products including

cassava, leguminous crops, spices, fruits, etc. Thus, certain equipment for drying and processing facilities and processing add value to perishable produce (e.g. juice, jam, dried fruits and high-value products such as spices). Milling units will be needed to produce maize and cassava flour, and starch. Equipment for packaging and labelling will be necessary. A distillery to produce high-value essential oils is foreseen. In addition, processing by-products for a Combined Heat and Power plant (CHP - biomass gasification) is envisioned to produce low-cost heat and power for the transformations units as well as produce Bio-Char and organic fertilizers as marketable products.

Table 19. Investment for Agri-hubs for Value Addition

(Functions of Agri-Hubs)	Investment (EUR)
Cassava Mill and Starch 6 TPH	800,000
Maize Mill 5 TPH	500,000
Essential Oil Distillery 1,000 kg/batch	500,000
Freeze Drying 500 kg/batch	300,000
Juice and Jam Production Unit	300,000
Total Agri-Hub Production Investment	2,400,000

3.3 Sector support functions

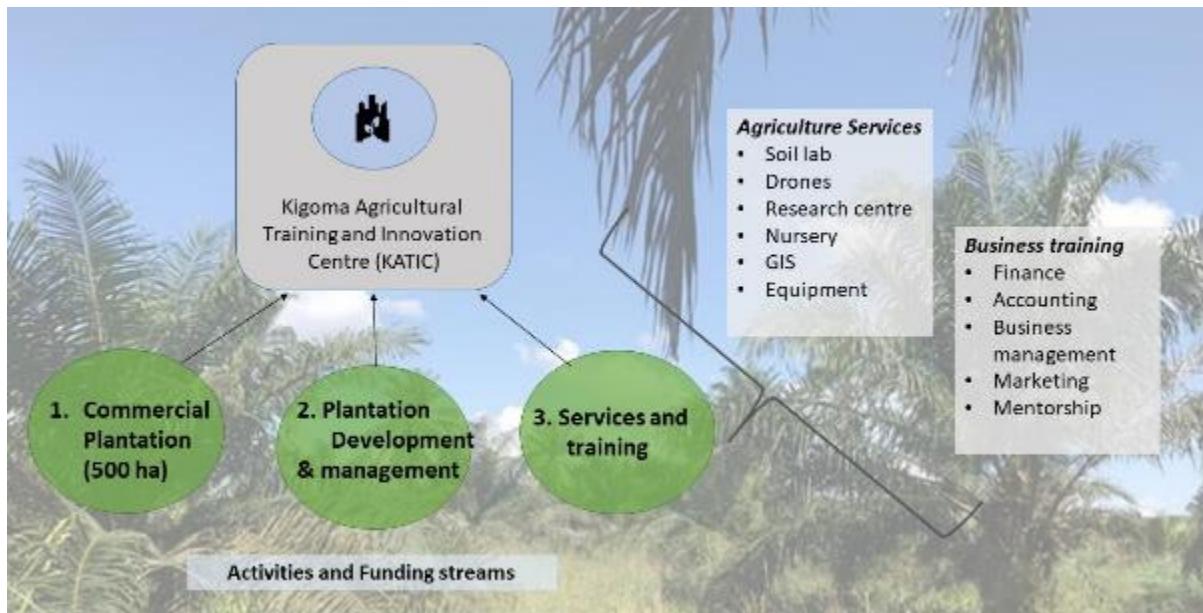
Setting up plantation and processing operations alone would not be sufficient to uplift the sector. Additional operations and services are required as well as coordination efforts to make the whole system work. A conducive enabling environment and a suite of supporting market functions are also required. In that regard, the following supporting functions and enabling environment interventions are required.

Kigoma Agricultural Training and Innovation Centre (KATIC)

Knowledge is lacking in Kigoma amongst farmers and development agents on applying good agricultural practices in plantation management and harvesting. Thus, a dedicated vocational training centre should be set up and operated by an independent institution (e.g. Seed Change or the umbrella cooperative). It should have its own commercial plantation (e.g. around 500 hectares) for demonstration and R&D (trial plantations) but also for rendering profits to ensure its operation. It should also run nurseries and sell seeds. Communities would second two to three trainees to the centre who would receive training on agronomic practices, integrated pest management, sustainable soil management, harvesting and cooperative business administration as well as processing (Detailed equipment needs in Annex 6).

The centre would also operate as a service-for-a-fee organization for the cooperatives and any growers that require advisory support. In collaboration with the large processing company the centre would further ensure adherence to quality standards that start from the choice of planting material all the way to the harvesting of the FFBs. The centre would engage in raising awareness on quality standards and the quality of produce acceptable for the buyers. Targeted awareness and communications will be mounted to transparently communicate the prices paid on the different grades of FFB at the mill and applicable lower grade penalties for poor quality FFBs.

Targeted training will be delivered to smallholder farmers also to emphasize the need for FFB harvests twice a month and the quality specifications of the FFBs to meet the processing standards (e.g. FFB ripeness). Training will also be targeted to set up an efficient and systematic harvesting system with organised fruit collection/delivery. Figure 18. Kigoma Agricultural Training and Innovation Centre (KATIC)



The centre can become an agricultural mentoring hub through apprenticeship for different trades required in the palm oil and cash crop sector. The students will cover both technical classroom training and field work on the oil palm plantations and in processing mills. A range of courses can be covered including business administration, oil palm, cash crop and horticulture agronomy, agribusiness, marketing, accounting, multiple disciplines required in the economic cluster. The school can offer short courses, certified courses and management development courses to serve the growing needs of the agricultural sector. Such a center can be linked to the African Development Bank (AfDB) youth in agribusiness initiative. Another growing need in modernising the Tanzania agriculture industry is the need for well-trained mid-level supervisors on the plantations, in processing and related services in the agricultural sector. The training and mentorship services of the Training centre can amply serve the needs of the sector.

Input provision and transport services

Input provision would need to be scaled up offering in addition to a) hybrid planting materials, 2) organic fertilizer and plant protection, 3) irrigation equipment including rain collection tanks, pumps and gravity-based drip irrigation materials and 4) transport services. Such input and materials provision services may need to also come with advisory service regarding their best use can be partly made available, particularly in the beginning, through KATIC. However, the idea would be that these services are gradually taken over by local private-for-profit operators, eventually graduates from KATIC.

For planting materials private operators can pick up nursery designs and raise their own seedlings, based on important seeds. Organic waste from processing can be sold by the oil mills to private operators that sell and transport them to smallholder producers. Irrigation equipment providers would import equipment and support smallholders installing and

managing it. Transport service providers need to offer transport and logistics services from farm gate to the mills and coordinate with the buyers and producers on time of harvest and picking up of FFBs and other harvested crops for which they need supply chain and logistics training involving smallholder, buyers and transport operators.

For all these operations the operators would eventually require support in developing bankable business plans. Smallholders themselves would need access to inputs loans, through banks and buyers of their produce.

3.4 Cooperative development

Coordination of the more than 30,000 smallholder palm oil producers and artisanal processors scattered throughout the Kigoma Region can help overcome many of the systemic challenges that actors face – from limited access to finance, to knowledge and improved inputs. Palm oil producers' groups could be formed under the leadership of entrepreneurial palm oil champions to assist in the dissemination of information. While ideally, local banks and microfinance institutions should be engaged to provide low-interest, long-term loans, this may not be possible as banks are only located in city centres, far from the rural producers who are unfamiliar with banking systems. Rather, coordination of producers and aggregation of their FFBs may allow for investors to create contract with producers' groups, which could be paired with the provision of improved *tenera* variety seedlings, inputs and extension on loan.

To improve the governance and coordination of the value chain, apolitical cooperatives, following the national cooperative law are envisioned. There will firstly be 1) a professional, well-managed umbrella cooperative, a cooperative union, which will oversee 2) a set of sub-chapter cooperatives engaged in palm oil production in the Kigoma region.

The umbrella cooperative is the key player in the planning of all production, contract and training and extension services together with the village sub-chapters. will assist the sub-chapters in planning of training (delivered by KATIC) and marketing. The most important functions of the union are marketing, storing, and adding value to the farmer's products to local, national and export markets through its own bidding platform, in conjunction with the warehouse receipt system, as well as a network of 5 regional market warehouses and trucking capabilities for transporting the products to those markets. The Farmer's Union will offer storage of products through warehouse receipt systems (WRS) in its own warehouses. Thus, central warehousing facilities (including cold-storage for perishable products) will be necessary to store the various produce, for fruits, vegetables etc. This offers cooperative members the ability to leverage pre- or partial financing.

The union derives its income from 1) per-kg-fees on all products delivered by the farmers to the off-takers (settlement directly from the off-taker) as well as 2) generating profits through value-addition and marketing high-quality raw materials and 3) profit from value-added products through its transformation units. The union is a cooperative and shares its profits after investments and reserves with the village sub-chapters as well as through year-end premiums directly with the farmers based on their production and campaign performance. Various fees and contributions owed by the farmers to the Union, Village cooperatives and service partners are settled directly by the off-taker, itemized and

deducted from the receipts of the farmer. A standard set of training and monitoring services will be charged on a per-kg-fee on all products delivered by the farmers to the off-taker, to be settled directly by the off-taker to KATIC or the service provider.

The village sub-chapter is a management cooperative with its main functions in planning, training and logistics as well as sub-chapter accounting. The sub-chapter, or Village cooperatives, are the primary mechanism for organizing many smallholder farmers. The Village cooperatives is accompanying the farmer's production from planning to harvest and may own or operate vehicles to support logistics. The Village cooperatives negotiates off-take contracts on behalf of its farmer-members with and through the Umbrella cooperative. The Village cooperatives plan and market the farmer's products for its own local market needs. The cooperative is responsible to provide data and reliable services and products of its member farmers to the anchor buyer.

The Village cooperatives may own and/or operate logistics services for its members and may be involved and have sun-drying units for certain products (cocoa, spices) as an intermediate value adding service to those offered at the Umbrella Cooperation.

The members of the Village cooperatives commit to helping each other in times of increased need of labour during planting and harvest. The Village cooperatives is also the platform of exchange of best-practice, experience and know-how amongst farmers who are working within the same conditions.

The Village cooperatives derive income from 1) per-kg-fees on all products delivered by the farmers to the off-takers (settlement directly from the off-taker); 2) generating profits through value addition; and 3) profit-sharing and year-end premiums directly from the Farmer's Union and/or the Off-Takers based on their members' production and campaign performance.

A farmer must be owner or titleholder of a field to become a member and will pay a membership fee based on the size of the field(s). The member's benefits are always in relation to the surface of and production capacity of his field(s). The farmers are contracting parties and thus get paid directly by the off-takers under the negotiated framework contracts. The various fees/contributions which the farmers owe to the union, village-sub-chapters and service partners are settled directly by the off-taker.

Below in Table 20 The Farmers Union looks for a grant/investment to start its first warehousing and production Agri-hub with trucks:

Table 20. Investments needed for Umbrella Cooperative Set-up

Item	Cost (EUR)
<i>Central Warehouse and Offices (1,000 m²)</i>	800,000
<i>Cold Storage (2,800 m³)</i>	200,000
<i>CHP Unit 150 KwH</i>	350,000
<i>5 Regional Warehouses 500 m² each:</i>	500,000

<i>5 Mitsubishi Fuso trucks (5 to 7 tons):</i>	250,000
<i>2 Trucks with 40' Box (40 ton)</i>	200,000
<i>2 Refrigerated trucks (Fuso – 7 tons)</i>	100,000
<i>2 FWD Cars</i>	100,000
<i>Construction Cost /Lab/Misc.</i>	500,000
Total CAPEX	3,000,000
<i>Total OPEX (incl. Cash-flow for Off-Take)</i>	1,000,000
Total Grant/Investment	4,000,000

Table 21. Example off-take plan for a 1-ha plot

Crop	ha %/ha	Seeds	Plant period	Harvest period	Yield target	Off-Taker
Oil Palm	0.325 ha 61%	88 plants	Jan. 19	Feb 21		CPO Mill
Banana	24%	1057 plants	Jan. 19	Sep 19-Jan 20	10'000 kg+	Coop/Agri-Hub
Papaya	7%	288 plants	Jan. 19	Jan 21	1'400-4'000 kg	Coop/Agri-Hub
Ginger	600 m2 8%	1'200 plants	March 19	Dec 19-Feb 20	240–350 kg	Coop/Agri-Hub Essential Oil
Onions	600 m2 8%	3336 plants	March 19	Jun – July 19	1000-2000 kg	Agri-Hub
Turmeric	600 m2 8%	1'200 plants	March 19	Oct 19 – Feb 20	720–1'000 kg	Coop/Agri-Hub Essential Oil
Chili	600 m2 8%	2220 plants	March 19	Aug-Sep 20	120–200 kg	Coop/Agri-Hub Essential Oil
Cow Peas	2'600 m2 26%	1800 plants	March/April 19	June - July19	180-200 kg	Coop/Agri-Hub
Cassava	2600 m2	2600 plants (26%)	March/April 19	Dec 19-Feb 20	1500 kg	Cassava Mill



3.5 Cross cutting issues

In the above, suggestions are made which type of productive and supporting entities are required and what these need to engage in to bring forward palm oil development in Kigoma. However, there are a number of crosscutting issues that need to be dealt with by more than one entity. Therefore, the issues are discussed separately below.

Regional palm oil platform

A regional, Kigoma-development focused palm oil stakeholders' platform, where value chain actors can meet, build business relationships and forge joint actions and alignment of Government regulations ensuring maximization of performance and profitability at all value chain stages will be established. This is not supposed to be a marketing-board-type of regulatory body with price control function but a roundtable. It should be chaired by the Regional Government but have equal shares of public and private actors on its board. It is also a clearing mechanism for conflict of interests along the value chain. It enables communication between processors and farmers on quality standards, transparent price information, grading, and quality improvement incentives to be established. The intervention will also cover payment arrangements between smallholders and processors to minimise post-harvest losses and prevent smallholders selling into quick paying but low remunerative channels. In addition, the platform will focus on improvements to the harvesting cycles to ensure efficient logistics between farm gate and processing units.

Food safety standards

It is recommended that the project follows the industry lead – that is the Malaysia Palm Oil Board (MPOB) – in the creation of a Code of Practices (CoP) detailing requirements on food safety and quality standards (amongst other requirements like sustainability). The MPOB's CoP also requires adherence to international food safety standards such as HACCP, ISO 22000, MS ISO 1480 and MS ISO 1514 (Omar, Kuntom and Bahari, 2012). Furthermore, to ensure the delivery of safe and quality palm oil demands coordination and action across the value chain. At the production level, any chemical fertilizers or pesticides applied must be monitored to ensure that only registered chemicals are applied and within safe allowable limits. If not yet determined for palm oil, the government must endeavour to generate it.

Furthermore, good management practices are necessary at the processing plants to ensure food safety and quality. As palm oil is a food, it must comply with the Tanzania Food, Drugs and Cosmetics Act (2011). Furthermore, it should apply to international best practices (e.g. EU directives) on palm oil production and packaging, which specify maximum allowable limits for various contaminants (e.g. benzo(a)pyrene, dioxin, arsenic and lead) must be followed (Omar, Kuntom and Bahari, 2012). For that purpose, one can consider to further capacitate the Tanzania Food and Drugs Authority to be able to monitor such contaminants.

Contract farming

FAO has assisted the Ministry of Agriculture in developing new legislation on contract farming, which will shape the palm oil offtake agreements. This new legislation is expected

to be ratified in Spring 2019. Furthermore, the 3ADI+ may be able to provide further technical assistance by providing contract farming trainings to prospective buyers and sellers to reduce the associated risks (e.g. side-selling) and build trust among the parties.

The governance and transparency of the contracts between the off-taker (processing unit) and the smallholder farmers must be sufficiently detailed to overcome issues. The cooperative bodies will be responsible for communicating between the anchor buyer and member farmers. The Farmers' Union will help negotiate and develop contracts, which will be based on an agreed four-year planting plan. This plan will include total hectares to be planted, seeding rate, type and quantity planted, harvest dates and expected yields. In addition, this agreement will involve pre-financing through the Farmers' Union indicating inputs to be provided, service to be contracted through KATIC on mentoring of farmers and monitoring of farmer fields and harvests, the guaranteed purchase price and agreement on collection logistics, the form of purchase payment and conditions, and possible premiums (e.g. quality, yield, timeliness, etc.).

Environmental sustainability

The initiative will build green and efficient production systems using improved varieties in organic agroforestry systems. It will also promote technologically-appropriate, efficient processing. Plantation development will be based on an approach that mimics nature using a biodiverse agroforestry system. Oil palm is just one of many intercropped species (oil palm being planted at 2/3 of the monocrop density of 143 trees/ha amongst many other plant and tree species). This system has been applied successfully in regions of agroecological conditions similar to Kigoma, e.g. in Brazil (rainforests) and Asia. The system is imperative as with oil palm alone, profitability, both for small-holder farmers (30,000) and the investor, is too low. Through ecosystem synergies, the entire intercropping system renders much higher value than oil palm alone which recently has proved limited profit margins given current low world market prices.

Furthermore, the fragile ecosystem with semi-arid and complex soil conditions in Kigoma would not support typical monoculture oil palm plantations. Instead, a biodiverse cropping system will be applied that produces and renders 2 to 3 times more biomass than the currently applied land use system (oil palm-based zero input - low output systems or fallow lands with shrubs). Hence the plantations will be CO₂ sequestration-intensive. They also will be eco-certification compliant as there will be zero use of pesticides and chemical fertiliser. Soil fertility is achieved through intensive pruning, mulching, use of manure and periodic animal grazing, and the application of nitrogen-fixing (leguminous) cover crops.

An environmental impact assessment of the plantation system will be conducted in the investment preparation phase which will proof the compliance with highest biological standards as well as biodiversity improvement that fits in the agroecological zone of Kigoma. As the environmental impact assessment will be obviously positive, it shall also provide detailed information on the magnitude of the ecosystem services the system renders.

The biodiverse cropping system will include food, spices, fruit, tree and cash crops that count on a real market and potential off-takers. The crops will include staples such as cassava, beans and maize as well as cash crops such as soya, groundnuts, fruits such as

banana, papaya, cocoa and spices like vanilla, ginger, turmeric, black pepper, etc. The detailed mix will be subject to the feasibility study in the investment preparation phase. While we have made first solid calculations about the potential yields of the mixed cropping system which proofed its high profitability, we will need to conduct in-depth feasibility study on the agronomic and eco-systemic properties of the system engaging internationally renowned experts (targeting knowledge developed in Brazil and Australia), in oil palm, intercropping, soil science, plant health and agroforestry ecosystems.

Chapter 4: An Action Plan for Palm Oil Development in Kigoma

The Government of Tanzania, under the leadership of the Prime Minister's office, is pursuing a palm oil development strategy that predominantly focuses on import substitution predicated on increasing domestic oil palm production. Nonetheless, there are parallel development goals that can and should be achieved with the development of the palm oil industry, namely the alleviation of poverty and increased incomes for rural residents of Kigoma, the main hub for palm oil production in the country and Tanzania's poorest region. Therefore, development models must be inclusive and accruing benefits to an investment group that are sharing with the local population. Thus, what is required is fair profit sharing and labour practices and positive community impact, especially on women and youth empowerment.

Meanwhile it is important to also foster a development model that adheres to the criteria of ecological sustainability, especially considering the politically-charged nature of a controversial crop such as palm oil. Drought, water contamination, loss of soil fertility, erosion and unsustainable land use practices (e.g. slash and burn) are prevailing threats to the environment in the region, which could be negatively impacted by misdirected palm oil sector development activities. There are also nearby conservation areas that are hotspots of biodiversity hosting species at the verge of extinction and these require sustainable land management in their margins.

In sum, palm oil industry development in Kigoma should attain diverse development goals, among them five main sustainable development goals (SDGs): SDG 1) Reducing poverty through increased incomes; SDG 2) Improved food safety and nutrition security; SDG 8) Decent employment generation; SDG 5) Promoting gender equality and valuing women's work; SDG 15) Sustainable production and reduced pressure on forests and water.

The 3ADI+ envisages a growing, domestic palm oil industry upholding the highest international standards, tailored to local social and environmental contexts and supported by transparent and legitimate institutions. It will provide employment and income-generating opportunities for rural women and men, including smallholder palm oil producers, growth opportunities for SMEs and plantation companies. Chapter 3 has outlined the main elements that need to be considered for such a sustainable development of the palm oil industry in Kigoma; chapter 4 now turns it into action proposing a set of activities while suggesting who should do what and putting forward some estimations for the costs this would imply.

4.1 Palm oil industry development strategy

The **vision** is to produce up to 80,000 MT CPO per year which will substitute approximately 15% of the imports of palm oil by the year 2023 as well as uplift up to 30,000 smallholder palm oil producers out of poverty. This domestic-led palm oil sector provides employment for an additional 5,500 rural women and men, and income generation opportunities for 30,000 smallholder farmers.

The concrete goal of the palm oil industry development strategy is to introduce a sustainable, mixed cropping system (with oil palm as the basis) to a large number of existing

and new producers for improved livelihoods. Measuring if such a goal has been achieved will require evaluating the overall competitiveness, resilience and sustainability of the newly introduced market system. The core tenets to attain this goal are predicated on six entry points:

1. **Drastically improve productivity and expand primary production** by applying a new cropping system to upgrade the low-input low-output system currently in place, which is based on unproductive varieties, zero-management practices and family (and child) labour which locks farming households into poverty. This requires removal of old and low-yielding *dura* variety trees and planting new high-yielding varieties in an organic mixed cropping system, which is fertilizer and pesticide inputs. Improving productivity is crucial to make overall production competitive given low prices for crude palm oil on the world market. It is also consistent with lessons learnt from leading global palm oil players like Indonesia and Malaysia.
2. **Set up appropriately-sized processing facilities** that are able to absorb large quantities of fresh fruit bunches in addition to other crops from the mixed cropping system and produce high-quality processed products for both national (palm oil and other crops) and international markets (niche products). The smallholder farmers' business model depends entirely on the existence of an outlet for the FFBs that they produce. Thus, the processor must be able to buy a vast quantity of FFBs and pay fair prices. For the processing business to be economical, it must produce quality products at competitive price, which requires economies of scale (at least 60 MT/hr and 200MT/day milling capacity) and investment in technology and work process organization. The private sector will only invest in such a business if there are good profit margins and an assured supply of quality FFBs.
3. **Leverage large scale investments into production and processing.** While knowledge and technology for 1 and 2 can be transferred through public funds and development assistance, it is the private sector and investors who need to provide the majority of the resources to set up plantations and processing facilities. In addition, a fund needs to be developed to provide farmers with planting material and basic equipment. For such investments to come, it requires an investor friendly business climate that attracts plantation companies and processors.
4. **Develop value chain support services and institutions.** Support services such as agronomic extension services and research, input provision, and finance are important for rendering the plantations and mill profitable and viable, particularly on the smallholder level but also for processing and other SMEs in the sector. In addition to building human capital by training individuals linked to institutions, they must be supported in the application of new knowledge and technology. In addition to crucial value chain services such as the provision of seeds and inputs, extension and agricultural advisory services, soil analysis, transport, certification, quality control and laboratory testing, business development and accounting, provision of market information will be relevant.
5. **Ensure appropriate value chain governance and align policies.** Given the diverse stakeholders that must engage to render the palm oil industry sustainable in Kigoma, coordination bodies need to be developed that ensure equitable participation in decision making, continuous information exchange and conflict resolution. Leaving the governance of the value chain entirely to the private sector is not an option given the limited knowledge and negotiation power of smallholder farmers. Also, relations with the Government need to be streamlined in the

provision of public services (e.g. licensing, customs clearing, provision of public infrastructure, etc.).

6. **Ensure social inclusiveness and good environmental stewardship** as well as conservation of natural resources and biodiversity. Businesses must not be extractive and must equitably share the benefits of upgrading with improved returns for salaries and incomes of smallholders. Absence of this would be unethical and create a social environment with potential for conflict. Therefore, the business models (following section 3.1) need to be inclusive of local stakeholders and allow them to reap some of benefits (i.e. income and otherwise). Further, while some land has been degraded through agricultural activities converting the unique Miombo woodland into grassland with shrubs, the Kigoma region is still largely untouched by industrial farming and contamination. And while unproductive *dura* variety oil palms remain along rivers and low-level watersheds and deltas, any changes to the current oil palm cropping system including installation of plantations must protect and preserve this landscape and biodiversity (including protected areas for chimpanzees) as they form the basis for livelihoods for future generations.

4.2 Proposed actions

To implement this strategy, after a preparation phase (see 4.8), a wide array of actions must be taken by diverse actors independently but working in coordination. Each value chain actor – mobilized from the private sector - will be responsible for multiple actions. In addition, some actions must be carried out by development agencies and funded through development funds and banks. Although it is difficult to imagine, it is necessary to view each action as an individual piece of a puzzle that will form one single project; without one piece, the project will inevitably not have the same outcomes. An overview summary of all the activities has been provided below, envisioned as a 3ADI+ development project, with outputs and activities. This includes activities of development agencies, which are crucial to take this initiative off the ground.

Output 1: Highly-productive and environmentally-friendly oil-palm-based multi-crop plantation systems are established in Kigoma, including plantation companies and commercially-oriented smallholder farmers.

Indicators:

- Hectares of sustainable mixed-cropping system established
- No of community farmers (age and sex disaggregated) engaged in cooperative planting schemes
- No of workers (age and sex disaggregated) employed in the sector deriving incomes from the palm oil sector
- Overall value of production generated in new mixed-cropping system
- Production that is certified environmentally sustainable (sustainable palm oil and mixed cropping in general)

Activity 1.1: Promote private sector investment in the establishment of industrial-scale, environmentally-sustainable oil palm plantations. Based on technical, environmental, social and financial feasibility studies (developed during planning phase), work with the Government and investment promotion agencies such as the Tanzania Investment Centre (TIC) to identify and support interested private sector companies in setting up inclusive palm

oil companies. This would include support the investors in setting up business plans and identify equipment to be sourced, work force to be recruited, permits and feasibility studies to be conducted, land to be acquisitioned, and management models to be applied.

A 1.2: Support the development of cooperatives for palm oil producers. Based on the developed business models (see section 3), the village screening and social feasibility studies (to be developed during planning phase), identify communities with sufficient leadership and a cadre of commercially-oriented smallholder farmers to set up cooperatives. Support sensitization and training of community leaders and members; ensure legal and operational set up of the cooperatives; and facilitate reception of finance and resources.

A 1.3: Foster the development of clear land-use arrangements. Based on the developed business models and additional village screening and environmental and social feasibility studies, available land to be used for village farm and plantation set-up will be identified. In addition to smallholder-managed estates, the project will facilitate the allocation of land to the private sector investors based on the developed land-acquisition and titling and user arrangements developed.

A 1.4: Facilitate the replacement of unproductive palm oil trees and other crop varieties with high-yielding varieties in a sustainable cropping system. Accessing sources of high-quality planting material, inputs, technical assistance, and skills development, propagate the replacement of non-hybrid palm trees and low yielding crop varieties based on environmental and performance assessments. Mixed-agroforestry systems experts need to be hired to develop planting solutions and accompanying implementation through farmers and companies. They will pass knowledge also to the Kigoma Training and Innovation Centre (KATIC, see A3.2) to be set up which will continue to provide advisory services and monitor results.

A 1.5: Support the training of smallholders for sustainable intensification. Until the proposed KATIC centre is set-up, the project foresees the provision of technical support to smallholder cooperatives. Such technical assistance should cover field maintenance practices, organic fertilizer application, harvest and post-harvest practices, financial literacy, occupational health, safety and labour rights.

A 1.6: Ensure impact finance schemes fund plantation development. Based on the technical and financial feasibility studies, develop and facilitate the design of oil palm financing models. While there will be immediate payback to yields of annual crops, the entire investment will have a lag in payback due to the long-term nature of perennial tree crops such as palm oil. Thus, funding solutions must be medium to long-term.

Output 2: Finance and operation of collection centres and processing plants are ensured adding value to FFBs and other crops harvested and marketed.

Indicators:

- Palm oil processors establish and implement transparent FFB quality standards
- No of farmers (age and sex disaggregated) reporting having received a fair price for FFBs.
- Quantities of palm oil processed
- Overall value of processed products being sold

- Amount of products sold certified

A 2.1: Promote private sector investment in the establishment of innovative, industrial-scale palm oil mills and other collection and processing centres (Agri-hubs). Based on technical, environmental, social and financial feasibility studies (developed during planning phase), work with the Government and investment promotion agencies such as the Tanzania Investment Centre (TIC) to identify and support interested private sector companies in setting up collection and processing centres. Further to palm-oil mills, private sector entities will need to set up warehouses, packaging and processing units for all non-palm crops produced in the mixed cropping system. The establishment of such agri-hubs may be achieved through larger anchor-buyers that bring in sufficient knowledge and investment. However, these investors may require investment promotion support, as well as technical and business support. This includes supporting the investors in setting up business plans and identifying equipment to be sourced, work force to be recruited, permits and feasibility studies to be conducted, land to be acquisitioned, and management models to be applied.

A 2.2: Support private sector development to organization FFB transport and logistics. FFB and CPO quality depends on efficient linkages between the processing company and the plantations. It requires raising farmers' awareness on quality standards required by mills for pre- to post-harvest management of the crop. Likewise, other crops need to be transported to the points of collection, processing and marketing. The mills and other buyers most likely want to organize the supply logistics themselves to gain control over product quality and timeliness. However, there is scope for the buyers to at least partly outsource logistics to individual operators. The project shall support such operators in setting up their businesses and eventually the buyers on best ways of outsourcing. A prerequisite may be the formalization of business relationships between farmers and buyers that provide the required incentives (price and guarantee) to smallholders in a transparent way to deliver quality products expectations. At the end, there would be business relationships of mutual trust that replace the current arms-length buying arrangements.

A 2.3: Support cooperatives and cooperative union to organize harvesting and first-level, collection and storage of products. Cooperatives will be expected to agglomerate and store products to a certain extent on their own which they can transport to the buyers on their own, through individual operators or the buyers. The project can support the development of operational plans, accounting, storage management and investments into infrastructure.

A 2.4: Encourage the setup of regional compliance infrastructure in Kigoma: Laboratories and analytical teams need to be set up in Kigoma - best as subsidiaries of national institutions - and made operational and accredited so they can provide necessary soil and product analysis tests and other certifications to ensure compliance of product requirements and adherence to food safety and other standards. A soil analysis and residue testing facility may also be established at KATIC.

A 2.5: Support value chain actors to comply with quality standards: Farmers, processors and marketers need to become part of a quality management system and provide records, measurements and quality assurance procedures for standards compliance. Special quality and standards compliance courses and trainings shall be organized to ensure quality along

the value chain and build compliance capacity. This capacity building role should later be taken over by the private sector and/or KATIC. Where necessary, the norms and regulations for palm oil and other crop production and product certification currently in force, can be adjusted to reflect sectoral realities and policy priorities.

A 2.6: Support collectors and processors to link to important national and international markets. While larger investors, particularly in palm oil production and processing may already have their own strategy for marketing of products, the project may provide active market exploration support needs to be provided to new and smaller collection centres and processors that lack market links. The activity would include support for sending of samples to different markets, covering transport costs, the establishment of lists of potential buyers and provision of overall market information on prices, demand and supply via phone and web applications.

Output 3: The enabling environment is conducive to multiple-crop development.

Indicators:

- Total investment in infrastructure (roads, telecommunication, electricity, water, trains, ships) to support palm oil value chain development.
- Overall domestic and international investment in palm-oil-based mixed cropping systems and processing in Kigoma.
- A range of input suppliers and competent service providers (including KATIC) provide services to Kigoma palm-oil-based market system.
- No of students and professionals graduated.
- Tanzania palm oil sector attracts talent and develops world class cadre to meet the growth and development needs of the sector.
- Value chain coordination achieved.

A 3.1: Facilitate the creation and operation of the Kigoma Agricultural Training and Innovation Centre (KATIC): KATIC will be playing a crucial catalysing, knowledge exchange and service provision function taking over service provision related to extension service, outreach to producers, analysis of production conditions as well as training and capacity strengthening. In order to fulfil these functions effectively it will need to set up a comprehensive business and operation plan and receive substantial funding for infrastructure development (buildings and plantations). In order to be independent from donations in the future it should also develop its own commercial operations starting from running a commercial plantation (that also can be used for demonstration) and the provision of services against a fee. KATIC would function as the principle knowledge exchange and capacity strengthening hub and for that purpose would need to forge exchange programs with international centres of excellence in areas such as sustainable plantation management, agronomy and plant hygiene, soil fertilisation, cooperative development, processing and many more. The project would invest in supporting the planning of KATIC, organisational set up and operation for the first three years providing a professional team of curriculum developers, training facility managers, plantation managers and fundraisers.

A 3.2: Facilitate infrastructure planning and investment through Government and Development Partners: Large scale investments into road, rail and port infrastructure are

underway in Kigoma. The issue is to ensure they become real as soon as possible and operational at the disposition of the plantation, processing and marketing initiatives planned by the project. Through partnership with infrastructure development banks and relevant ministries the project can provide necessary legal and planning support so that investments are made ready. The project, in particular, will work on establishing infrastructural needs to have the plantations operate at full scale while providing sufficient space for non-plantation activities of the population to continue and further develop.

A 3.3: Facilitate setting up of other businesses along the value chain. Further to production and processing the value chain also requires businesses that relate to the import and multiplication of appropriate hybrid planting materials, the production and distribution of organic fertilizer and plant protection materials, sales and installations of irrigation equipment including rain collection tanks, pumps and gravity-based drip irrigation materials as well as transport services. The project can support the setting up and operation of such service provision functions for the initial three years. KATIC can further support the provision of services to clients while the businesses are set up.

A 3.4: Facilitate the organization of a regional palm oil platform: Value chain actors must have access to a platform for raising issues, exchanging information and a mechanism for resolving conflicts. Thus, the development of a palm oil platform is proposed, to form a space for business relationships, cooperation and alignment to be forged.

A 3.5: Encourage a public nutrition campaign to raise awareness on healthy balanced diets: In addition to improving the nutrition of palm oil through proper production and processing methods, it is necessary to couple this with a public health awareness campaign on oil consumption. Particularly in urban centres in Tanzania, where incomes are increasing, it is necessary to encourage reduced consumption of fried foods and promote healthy balanced diet across the board. 3ADI+ will work with the Ministry of Health to develop national dietary guidelines, with recommendations on oil consumption as part of a healthy balanced diet. Table 31 depicts how the propose activities shall be rolled out over time.

4.3 Roles and responsibilities

It is necessary for a range of actors to play a role in the upgrading and expansion of the palm oil sector in Kigoma (Table 32). These actors will primarily come from the private sector, with large investments needed in the processing stage, but also through the coordination of cooperatives at the production stage, as well as private sector support services such as input provision, logistics and transport. In addition to the private sector, the public sector must play a role in facilitating the enabling environment through the establishment and enforcement of regulations, improvement in infrastructure, etc. Finally, development partners under the 3ADI+, spearheaded by FAO and UNIDO, but also with potential for additional support from ILO, AfDB, and other development organizations, have a significant role to play in coordinating the initial set-up and monitoring of development activities.

Table 31: Activity chart over time

	Preparation phase	2020	2021	2022	2023	Beyond 2023
Output 1: Highly-productive and environmentally-friendly oil-palm-based multi-crop plantation systems are established in Kigoma, including plantation companies and commercially-oriented smallholder farmers						
A 1.1: Promote private sector investment in the establishment of industrial-scale, environmentally-sustainable oil palm plantations						
A 1.2: Support the development of cooperatives for palm oil producers						
A 1.3: Foster the development of clear land-use arrangements						
A 1.4: Facilitate the replacement of unproductive palm oil trees and other crop varieties with high-yielding varieties in a sustainable cropping system						
A 1.5: Support the training of smallholders for sustainable intensification						
A 1.6: Ensure impact finance schemes fund plantation development						
Output 2: Finance and operation of collection centres and processing plants are ensured adding value to FFBs and other crops harvested and marketed.						
A 2.1: Promote private sector investment in the establishment of innovative, industrial-scale palm oil mills and other collection and processing centres (Agri-hubs)						
A 2.2: Support private sector development to organization FFB transport and logistics						
A 2.3: Support cooperatives and cooperative union to organize harvesting and first-level, collection and storage of products						
A 2.4: Encourage the setup of regional compliance infrastructure in Kigoma						
A 2.5: Support value chain actors to comply with quality standards						
A 2.6: Support collectors and processors to link to important national and international markets						
Output 3: The enabling environment is conducive to multiple-crop development						
A 3.1: Facilitate the creation and operation of the Kigoma Agricultural Training and Innovation Centre (KATIC)						
A 3.2: Facilitate infrastructure planning and investment through Government and Development Partners						
A 3.3: Facilitate setting up of other businesses along the value chain						
A 3.4: Facilitate the organization of a regional palm oil platform						
A 3.5: Encourage a public nutrition campaign to raise awareness on healthy balanced diets						

Table 32: Palm oil sector development actors to include in development initiative

Stakeholder	Role
Public organisations	
Ministry of Agriculture (MOA)	Oversee the agronomic and environmental aspects of palm oil production models. Ensure that palm oil investors seek appropriate environmental impact assessments.
Ministry of Industry, Trade and Investment (MITI)	Oversee industrial development and investment promotion, particularly processing equipment.
Ministry of Health (MoH)	Lead the public health campaign on the moderation of oil consumption as part of a healthy balanced diet.
Tanzania Investment Centre (TIC)	Facilitate investors' access to land and permits for developments.
Tanzania Food and Drug Authority (TFDA)	Provide food certifications for private sector mills at a reduced cost, closer to Kigoma, if possible.
Tanzania Bureau of Standards (TBS)	Provide standards and certification services in Tanzania, offer services in Kigoma
Occupational Safety and Health Authority (OSHA)	As per the Occupational Health and Safety Act (2003), any company or individual owning or occupying a factory or another workplace in Tanzania must obtain a Certificate of Compliance with the OSHA Chief Inspector. Thus, any new plantations and processing facilities must comply with OSHA certifications and annual inspections. OSHA must ensure palm oil business are free from occupational hazards that may cause injuries or illness to employees by providing OSHA services (including certification and monitoring) closer to Kigoma.
Tanzania Agricultural Research Institute (TARI)	Research into plantation management, climate change adaptation, fertilizer application, cover crops, underplanting regimes in conjunction with KATIC.
Agricultural Non State Actors Forum (ANSAF)	Provide continued research and recommendations on palm oil import tariffs to support sector development.
Tanganyika Basin Authorities (LTBA)	Provides basic water testing services for quality and safety for irrigation and human consumption services
Small Industrial Development Organization (SIDO)	As SIDO already plays a large role in the development of the palm oil sector, SIDO manufactures and sells palm oil and KPO processing equipment and provides an industrial park for KPO and soap processors in Kigoma urban, it ma
National Investment Commission (NIC)	Support the leveraging of investments into the oil palm sector, in conjunction with TIC and 3ADI+
Tanzania Prison Services Department and army (Jeshi la Kujenga Taifa-JKT)	Established an 400ha oil palm plantation in Kigoma rural and has plans to develop a processing mill.
Sokoine University of Agriculture (SUA)	Provide soil analysis as well as oil content analysis testing services for plantation and milling companies. May need to provide secondments to KATIC for analysts.
Associations & NGOs	
Seed Change	Continue providing hybrid <i>tenera</i> seedlings and upscale extension support services with oil palm farmers. Option for leading KATIC.

Stakeholder	Role
Jane Goodall Institute	In partnership with local government authorities, assist with the oversight of environmental protection in oil palm production, particularly near conservation areas. .
Private Agricultural Sector Support Trust (PASS)	Provides business development services to the agricultural private sector and helps to facilitate access to finance through partial loan guarantees with the National Microfinance Bank (NMB) and CRDB Bank
Private sector	
Palm oil producers (individuals and cooperatives)	Smallholders must be willing to invest in improving their production, joining cooperatives and adhere to guidance of the KATIC and indicated in off-taker agreements.
Kigoma Agricultural Training and Innovation Centre (KATIC)	A private sector support service provider is needed to provide essential inputs (e.g. organic fertilizer and seedlings), training on agronomic and business practices, as well as
Mill and Refinery Company	A large-scale mill and refinery company
Transport and Logistics Companies	Some transport and logistics functions may be covered through the cooperatives, however, it is likely that additional support will be needed.
Agro-input dealers	Businesses providing organic fertilizers, biochar and irrigation supplies will be needed.
Financial Institutions	Several financial institutions such as the CRDB, NMB, Pride Tanzania, Bayport Financial provide finance to several enterprises but none in the palm oil sector as yet
3ADI+ Development Partners	
FAO	In conjunction with UNIDO, implement the development actions indicated in the plan. Play an oversight role.
UNIDO	In conjunction with FAO, implement the development actions indicated in the plan. Play an oversight role.
Trade Mark East Africa	Has promised the GoT to support the development of the palm oil sector.
Development Banks (e.g. African Development Bank)	Development Banks like the African Development Bank may be interested to align certain relevant programmes, such as the ENABLE Youth programme and perhaps invest in the 3ADI+ Strategy for Oil Palm Development.

4.4 Tentative (indicative) Budget

Activities	Private Investor	Development Bank Loans	Development Partner Grants	Ag-Fund
Palm Oil Mill, Refinery, Packaging	36,000,000			
Industrial Estate 10'000 ha)	43,000,000			
PET, Plastic Plant	500,000			
Soap Factory	500,000			
Cassava Flour Mill	700,000			
Cassava Starch	700,000			
Drying Facilities	500,000			
Kigoma Ag-Innovation Center			5,200,000	
Cooperative Development			900,000	
Smallholder Village Estates (13,500 ha)				58,050,000
Smallholder Village Clusters (30,000 ha)		24,000,000		
Facilitation (feasibility studies, coordination, mapping, titling, project design)			3,000,000	
Sub-Totals	81,900,000	24,000,000	9,100,000	58,050,000
Total (USD)				173,050,000

4.5 Preparation Phase

A range of preparation activities and feasibility studies are needed in 2019 before concrete actions as part of a concrete project can unfold.

Village consultations: Not all communities, villages, or farmers will be able to and interested in joining the initiative (models 1a and 1b), nor has the initiative, at its current planning stage, factored in the needs of all stakeholders, and smallholders in particular. Therefore, village interest and readiness to participate must be evaluated in a village consultation exercise. This involves visits to communities of teams of anthropologist, rural and cooperative development specialists and representatives of the local Government and various rounds of conversations in which the proposal of joining can be transparently communicated to the community members. At the end, possible criteria for selection of communities should include willingness of community leaders and members to engage in the initiative and the suggested cooperative organization as well as availability of land. The consultations should also pave the way for subsequent (see below) mapping of plantations, legal and ownership model development, land assignment, finance model development, as well as studies on soil, water, weather and other production conditions.

Land survey and titling: As indicated in *Land Availability and Acquisition*, foreseen under the improved production models of Section 3, in all three cases (1a, b and c), land titling is of crucial importance as it ensures smallholders the right to their land and builds the basis for the lease agreements. Therefore, the preparation phase needs to engage in a land use survey and the screening of suitable land paired with soil sampling. Engagement of lawyers specialized in land rights especially associated with communal lands will need to develop a proposal for a legal setup of the plantations. After the mapping and legal study, the Ministry of Land Use can be engaged to make the necessary approvals and oversight. In the process, the district governments would oversee and manage land identification and land titling issues with all the relevant communities. There may be cases where the plantation estate will need to negotiate with occupants on land assigned to the estate. In case that the village communities and the occupants agree the occupants will move and receive a compensation by the village community which may be eventually refunded through the investors. The study needs to identify options and potential buy in for these processes.

Cooperative organization study: After the initial village consultations village leaders and farmer representatives from all selected communities will meet with legal advisors specialized in cooperative matters, to coordinate and define statutes, by-laws, accounting, rules and regulations to create a cooperative organization template. The design of the cooperatives and contract farming outgrower scheme will involve various experts (e.g. Cooperative Development Specialist, Lawyer, FAO Contract Farming Expert). In addition, relevant stakeholders will be informed of the forthcoming palm oil board.

Mixed cropping system development: Develops the agronomic and eco-systemic properties of the system engaging internationally renowned experts (targeting expertise in Brazil and Malaysia) with a track record in palm oil intercropping, soil science, plant health, agroforestry ecosystems as well as plantation infrastructure development. The output will be a design proposal for plantation setup (Production model 1b & 1c) including detailed plantation plan based on mapping, irrigation, road and remote sensing infrastructure and required resource planning

Market analysis and financial and economic feasibility: While calculations on the potential yields in the mixed cropping system indicate high profits, these need to be verified through in-depth feasibility studies. Further, the selected crops must have a local consumer demand or have a ready market outside Kigoma. In addition, at the processing level, the private sector investor will have to make its own calculations for the size of mill, refinery and processing plant needed, based on the estimates of production calculated herein. Other crops may not be processed but need to be only dried, sorted and packaged. The value is also in the diversity combining staple crops that are known with cash crops that are yet to be discovered by the farmers. For example, there is a large opportunity to grow high-value niche products like spices to be dried and transformed into essential oils for export.

Environmental impact assessment: An environmental impact assessment of the proposed mixed cropping plantation systems will be conducted during the investment preparation phase. This will ensure that the systems are in compliance with environmental regulations and identify recommendations for biodiversity improvement in the agroecological zone of Kigoma. As it is expected that the environmental impact assessment for production shall have a net positive impact on the environment, this assessment will also provide detailed information on the magnitude of the ecosystem services the system renders.

Social impact assessment: Various experts will be contracted to carry out social analyses. For example, it is of the utmost importance that a Gender expert is hired to ensure that all proposed activities are gender-sensitive and will do no harm to women through palm oil value chain development.

Kigoma Agricultural Training and Innovation Centre study: A business plan shall be developed for the centre identifying its activities and approach to go about in three areas of operation: 1) plantation and demonstration, 2) training and capacity strengthening and 3) provision of a wide spectrum of services.

Logistics access study and planning: Access of businesses to roads, rail and water transport, electricity, water, as well as telecommunications infrastructure needs to be provided. Given the current status of infrastructure development in Kigoma one needs to develop a strategy for the provision to infrastructure that is both feasible and affordable without overburdening the budgets of the regional and central Governments. Among others the optimal localization of agri-hubs, centres of collection and purchase of products from the plantations (model 1a,b and c) - needs to be established based on a study of transportation costs and available and to-be installed infrastructure.

Below is an approximation to a budget of the preparation phase.

Table 33: Preparation phase plan

	Activities	Actors to engage	Tentative Budget
1. Village consultations	<ul style="list-style-type: none"> • Identify interested villages for clusters • Evaluate readiness of village • Engage youth in the collection of data on the villages 	<ul style="list-style-type: none"> • International Consultant • District Director, MoA, Land Planning • Ward/Village heads • Women Org • Youth Org • Ward/village land stewards • Farmer's Union 	USD 30.000 including international travel, local travel and engagement of local experts
2. Land survey and titling	<ul style="list-style-type: none"> • Evaluate land availability and suitability (e.g. infrastructure and logistics) • Drone mapping of village clusters 	<ul style="list-style-type: none"> • Land surveyor • FAO Land Tenure Expert • Law consultant • Drone consultant 	USD 60.000 including international and local travel and engagement of national and international consultant
3. Cooperative organization study	<ul style="list-style-type: none"> • Develop statutes, purpose and by-laws • Establish coop leadership and management for umbrella, then sub-chapters • Design contract farming agreements • Train KATIC to train cooperatives on contract farming 	<ul style="list-style-type: none"> • Cooperative Development Specialist • Lawyer • FAO Contract Farming Expert • FAO • UNIDO • ILO • TMEA 	USD 40.000 for international travel, local travel and engagement of national and international consultants

	<ul style="list-style-type: none"> arrangements Establish palm oil board 		
4. Mixed cropping system development	<ul style="list-style-type: none"> Soil screening and analysis Design inter-cropping plan Plant pathology and integrated pest management Demonstrate plantation (with KATIC, if possible) 	<ul style="list-style-type: none"> Agronomist Intercropping Specialist Crop Nutritionist and Integrated Pest Management Specialist 	USD 50.000 for international travel, local travel and engagement of national and international consultants
5. Market analysis and financial and economic feasibility	<ul style="list-style-type: none"> Economic feasibility pre-investment needs study 	<ul style="list-style-type: none"> UNIDO COMFAR Analyst Market specialist 	USD 30.000 for international travel, local travel and engagement of international consultants
6. Environmental impact assessment	<ul style="list-style-type: none"> Ensure environmental compliance Estimate environmental impacts 	<ul style="list-style-type: none"> Environmental impact analysis subcontractor 	USD 30.000 for consulting company
7. Social impact assessment	<ul style="list-style-type: none"> Ensure social inclusion Ensure gender sensitivity Develop activities to promote GEWE 	<ul style="list-style-type: none"> Social Scientist Gender Expert Youth Development Specialist UNIDO, FAO 	USD 30.000 for international travel, local travel and engagement of national and international consultants
8. Kigoma Agricultural Training and Innovation Centre	<ul style="list-style-type: none"> Identify suitable organization for KATIC Develop the statutes and purpose 	<ul style="list-style-type: none"> International 3ADI+ consultant Agronomist Curriculum development specialist UNIDO, FAO AFDB 	USD 50.000 for international travel, local travel and engagement of national and international consultants
9. Agri Hub Localization	<ul style="list-style-type: none"> Identify potential locations and parameters for agri-hubs – linked to cooperatives or otherwise Road access to north catchment, Kigoma Road access to south catchment, Mahale Lake shipping – port/jetty Ensure adequate energy and water available 	<ul style="list-style-type: none"> International 3ADI+ consultant Infrastructure development specialists AFDB 	USD 30.000 for international travel, local travel and engagement of national and international consultants

4.6 Next steps

After the preparation phase is complete (Annex 6), a revised action plan with detailed work plan must be submitted to the GoT and shared with relevant stakeholders. If necessary, an additional workshop or high-level policy meetings will be held. The next submission will include the results of the feasibility studies and a detailed work plan or theory of change with timelines (e.g. Gantt chart with all activities) for all stakeholders on board. In addition, the results of the preparation phase will shape the formulation of the Monitoring and Evaluation plan with specific indicators for the implementation of the 3ADI+ Palm Oil Value Chain Development Action Plan, as well as the risk analysis. In any case, the initiative is envisioned to be women and youth-inclusive and the indicators will reflect this accordingly.

Conclusion

Below summarizes the main findings of the diagnostics of the situation of the palm oil value chain and the related market system, with special emphasis on Kigoma and the strategy for the development of the market system.

The market for edible oils in Tanzania has been growing rapidly, but local supply is not able to meet demand. Increased demand can be attributed to urbanisation, income growth and an increase in purchasing power among Tanzanian consumers, as well as a concomitant nutrition transition. Growth in sunflower production has been strong but has not been sufficient to meet the gap in edible oils production, which is mostly filled through imports (60%) from Malaysia and Indonesia (45% and 37%, respectively). Annual demand for edible oils in Tanzania is currently estimated to be some 570,000 tonnes versus local production of 337 400³⁴, amounting to an import bill of 80-120 million USD per annum.

The shortage of edible oil on the domestic market constitutes a food and nutrition security concern. As domestic supply for edible oil meets only about 59% of domestic demand, prices have been rising for a commodity that constitutes a main of oils and fats in local diets. Further, an acute crisis has risen due to import complications. Confronting the high reliance on imports, the Government has introduced tariffs for the importation of crude (10%) and refined edible oils (25%) and is considering increased taxes with the aim of boosting domestic production. Tanzania's Agricultural Sector Development Program (ASDP) II indicates that palm oil imports should be reduced by 50%. However, with the domestic supply not able to react to increased demand for local oils, consumer prices for refined oils have risen sharply.

Local palm oil production could potentially fill the gap and reduce reliance on imports, but the value chain is at a rudimentary stage of development. The share of palm oil in the local production of edible oil is around 1-2%. It is reasonable (as the Tanzanian Government suggests) to revert the negative import dependency on palm oil from Malaysia and Indonesia to meet domestic demand. Sunflower oil production as replacement of imported palm oil is most likely to not ease the worsening edible oil trade balance. Other edible oils like sesame and groundnut, though exhibiting interesting production trends, are still negligible and more apt for export. Reviving domestic palm oil production is a reasonable option but needs to consider rules of systemic development and appropriate technology and economies of scale to become competitive. Export promotion strategies should only be considered if local production levels have picked up significantly but the perspectives on regional markets are promising.

Current production conditions are characterized by stark underdevelopment: Production is concentrated (80%) in the Kigoma region where oil palm trees have grown since the 1920s on some estimated 30 000 hectares where oil is processed for local consumption. Production is non-commercial on small-scale subsistence farms applying mixed-cropping systems. Limited farm management practices are applied to the low-yielding *dura* variety trees. Yields as low as 1 to 3 tons of fresh fruit bunches (FFB) per hectare are attained with an 8% oil content compared to the improved *tenera* variety, which can produce 12 to 40 tons of FFB per hectare with an oil content of 25-30%. Certified improved *tenera* planting

³⁴ Palm Oil Market Brief- Tanzania (FAO and UNIDO, August 2018)

material is available from international breeding companies that have further developed local varieties from Kigoma since the 1980s. However, the Kigoma *tenera* variety needs to be multiplied in nurseries and made accessible to farmers. Farmers then need to apply appropriate and sustainable management practices to the new trees. Developing large scale plant varietal improvement programmes would not be necessary given the availability of quality controlled, certified varieties and would most likely run into technical capacity issues and bind too many resources so that development of other more strategic parts of the value chain cannot be sustained.

At the current stage of development of the value chain there is no appropriate channel to process and market higher amounts of palm oil. Farmers have very little opportunity to sell, add value or market their products. Currently, farmers use inefficient human-powered Burundi expellers, often using family labour, or a marginally improved diesel-powered palm oil processor propagated by the Small Industries Development Organization (SIDO). Both methods are inefficient and laborious, involving undervalued efforts of women, and result in a low-quality product that does not comply with food safety standards. The introduction of more efficient oil mills, however, is not justified given the low-yielding oil palms. The sector is trapped in cycle of low-yielding, family-labour-based operations and investment in either production or processing alone will not break the cycle.

Palm oil products are currently absorbed by local markets. Palm oil producing regions currently supply edible oils to households in the region, but not much beyond. In contrary to palm oil, soap made from kernel oil is processed at a central cluster in Kigoma and marketed across Tanzania. Kernel processing just till the point of soap making is mainly in the hands of women using oil expelling facilities at the cluster against a fee. Kernel oil processing and soap making appear to be profitable businesses that would not need much support further to providing decentralized kernel crackers and oil expellers (to be set up at decentralized processing units, thus saving women from moving to the cluster located in Kigoma town) and technical advice on soap product development and marketing.

Interest in palm oil production in Tanzania was high in the beginning of the millennium for investments in biofuel production but few (if any) of these initiatives became viable. Recently the Government has shown renewed interest to develop the sector. There was high interest in palm oil production for biofuels driven by larger domestic and foreign investors, the availability of (green) capital funds and bullish investors who discovered agriculture as a target. However, the decreasing availability of funds due to the financial crisis of 2008, the difficulties in acquiring land and the general challenges in the national business and investment climate halted these initiatives. The latest Government initiative led by the Prime Minister's Office has put increased pressure on local Governments as well as Ministries of Agriculture and Industry and Trade to foster the development of the sector.

Large-scale investments in palm oil production to increase the supply can have highly positive or negative social and environmental impacts; in any case they may face difficulties to unfold. The development of the palm oil sector in Southeast Asia has clearly demonstrated that capital-intensive monoculture production systems have detrimental environmental impacts (e.g. deforestation, loss of biodiversity, soil loss and degradation, contamination, and greenhouse gas emissions). Large-scale operations typically exclude local communities from engaging in the mixed farming systems that constitutes the basis of their livelihoods. However, due to existing land use and tenure in Tanzania, there are

unlikely to be large tracts of land made available to large-scale investors. Examples can be borrowed from West Africa, Southeast Asia and Latin America where small to medium-sized palm oil producers are inclusive of local communities and farm in mixed cropping or agroforestry systems that improve environmental sustainability through agronomic practices. Further, improved livelihoods through more efficient palm oil production and processing methods can increase incomes and employment opportunities and reduce the work burden for women, who are engaged in many time-consuming activities across the palm oil value chain.

Substantive innovations in production (mixed agroforestry system) and processing are needed but should be introduced gradually, ensuring the creation of sustainable businesses for local communities. This demands the propagation of high-yielding varieties, the introduction of a productive agroforestry system, the application of sound agronomic practices, capacity building at the producer and processor level, investments in improved technologies for processing, drying and packaging, quality control, and linking to consumer markets for commercialisation. The introduction of such innovations can often be accelerated through larger investors that can apply the necessary economies of scale to render operations efficient. However, large investors tend to acquire larger parcels of land to ensure that there is enough primary product to ensure that processing plants are run at capacity. Such investors can balance negative environmental and social impacts if sustainable production systems, outgrower and supply chain management schemes are applied, which create jobs in the local community.

A socially inclusive and environmentally sustainable palm oil CUM other crops plantation and processing project is able to contribute substantial to development goals. The palm oil sector in Tanzania is vastly underdeveloped, but it has substantial growth potential and can contribute to the achievement of development goals. The sector is important for five main sustainable development goals: 1) Reducing poverty through increased incomes; 2) Improved food safety and nutrition security; 3) Decent employment generation; 4) Promoting gender equality and valuing women's work; 5) Sustainable palm oil production and reduced pressure on forests and water.

A small number of large agro-industrial companies reap economic rents from processing and marketing imported palm oil and may continue to do so due to domestic palm oil production remaining uncompetitive for a number of years. Local palm oil production has to prove to be competitive with imported palm oil from global players such as Malaysia and Indonesia. Imports of refined palm oil are currently taxed at 35% to help protect the local palm oil industry. However, the import tax for crude palm oil (CPO) is 25%, leaving room for importers to continue seeking rents in the processing of imported CPO. The importers have expressed a willingness to switch to processing and marketing domestic palm oil if economics work out. This implies, among others, reduced transport costs from Kigoma to Dar es Salaam - where the refining facilities are currently located - and a reliable supply of domestically produced crude palm oil. It is still to be seen if the Government, on arguments of infant industry development, is able to protect, incentivize and subsidize production and processing of domestic palm oil until it can compete with imports of cheap crude palm oil from abroad.

A strategy for the development of the palm oil value chain in Tanzania should be comprehensive and address various systemic development constraints simultaneously. This may include the following activities:

1. **Promote higher yielding (hybrid *tenera*) varieties.** Unproductive, old *dura* trees should be gradually replaced with new varieties. In the short-term, seedlings of improved *tenera* varieties must be made available at subsidized prices and this involves the purchase of seeds and their propagation into seedlings at nurseries. Organizations such as Seed Change have a track record of seedling propagation and distribution. Support should be also given to developing additional nurseries. In the medium term, seedlings should be distributed through no- or low-interest loans and with pre-financing through oil mills. Breeding improved variety palm seedlings locally at specialized institutions is not a necessary condition for the development of the sector as the improved seed varieties are already available elsewhere, and investment in this activity would represent a significant time investment over decades. However, setting up a palm oil seed development facility to test and develop varieties to be certified through the Tanzania Official Seed Certification Institute (TOSCI) should be part of a long-term strategy.
2. **Provide agronomic technical assistance and advisory services on mixed agroforestry systems and intercropping.** Planting of the new varieties needs to follow rules of efficient plantation management. In addition, an agroforestry production system is necessary for increased yields, incomes and increased resilience against price and weather shocks. It must be accompanied by advisory services to improve agronomic practices including tree spacing and planting density, intercropping, mulching and the application of inputs and, where possible, irrigation. Further an effective intercropping and later underplanting strategy is important to ensure early returns from plantations and maintaining diversity, thus spreading risk and increasing resilience, in the farming system. A number of farmer-owned demonstration plots managed by a professional advisory organization and used also for training purposes should be set up so that farmers can see the benefits of the new variety and learn about improved cultivation practices – such as those already conducted by Seed Change. Additionally, Government extensionists need to be trained and capacitated to assist growers with plantation management. Institutions with suitable land, already growing oil palm (including the army and prison services) shall be supported in upgrading their agronomic skills and capacities and, where appropriate, setting up processing units.
3. **Develop businesses following business models 1 a, b and c:** This would basically mean that communities, the private sector and investors will develop businesses. Development agencies such as FAO and UNIDO (via the 3ADI+) as well as Government agencies can support the process via technical assistance and provision of expertise. Based on the feasibility studies to be conducted in the preparation phase (see 4.4) businesses would develop business plans and upon receipt of funding would start operations regarding land preparation and plantation set up.
4. **Help secure land tenure for investors.** The programme can work with the Tanzania Investment Centre (TIC) to identify small to medium-sized swathes of land available and suitable for palm oil production. The Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security (VGGT) can guide the process. Land must be identified in areas that have

suitable agronomic conditions for palm oil production (e.g. rainfall or water availability), soils, temperature, etc. and where local communities agree to the land use by investors. Logistics, distance to urban centers; transport options available shall also be considered. The programme will work with government authorities at the local and national level to elucidate and simplify the procedure for obtaining land and concluding commercial transactions for plantations.

5. **Ensure that safeguards are in place so that increased interest in palm oil production does not put additional pressure on natural resources.** The programme shall provide information that promotes responsible agricultural investments [following the CFS Principles for Responsible Investment in Agriculture and Food Systems (CFS-RAI)]. Land for medium- to large-scale investments in palm oil production must be in areas that are suitable for palm and do not impinge upon forests or water resources. Local government authorities (such as TIC) and conservation organizations (such as TACARE) shall be engaged in promoting investments that prevent damage to the region's natural resources and ensure the responsible development of new plantations. Overall, adherence to principles of the Roundtable on Sustainable Palm Oil (RSPO) must be ensured.
6. Introduce processing models 2a, b and c **Promote investments into a set of processing units and render them into effective businesses ensuring supply through plantation development and out-grower schemes.** Investors that are interested in setting up plantations and processing plants will be supported to acquire land (see 3.) in communities that would welcome such investments and develop bankable business plans drawing from advanced technology designs (see 5). The equipment and installations should be financed through loans that are part of the business plans. The supply from the plantations would ensure minimum operation of processing plants and complemented through outgrower schemes. Outgrower schemes may benefit farmers through an assured market for their products, access to improved varieties, finance, inputs and training through fair contracts with processors.
7. **Introduce energy-efficient and locally-appropriate small- to medium-scale palm oil and other collection centers and processing units.** Solutions must be adapted to local production capacities and reflect availability of energy and access to water. Pilot processing equipment for palm oil and other products, as well as commercial expellers, grinders, sorters, cleaners, dryers and packaging solutions may be imported and established to promote the technology. The equipment needs to be matched with factory layouts that ensure easy handling of products, use of residues and waste management. In the medium-run, local and national manufacturers (e.g. SIDO, TEMDO and private enterprises) can be supported to develop local equipment. Women who currently bear much of the burden of artisanal oil extraction would benefit greatly from improved processing solutions to capture more value from palm and kernel oil and the residues.
8. **Equip a sub-set of existing village processing units with new technology and render them into effective businesses.** Business plans, based on appropriate advanced equipment and factory layouts for processing of palm oil, kernels and other products,

shall be developed for existing and potential operators of processing units that have given proof to their entrepreneurial capacities. There must be also clear ownership model for the facilities and clear arrangements for plant operation need to be put in place. The equipment and installations should be financed through a combination of subsidies and loans that are part of the business plans. Further, the processing plant operators need to be provided with sufficient working capital to be able to buy and process palm oil at sufficient levels of capacity.

9. **Provide business development support services to processors on technical and business administration issues.** Business plans, including the provision of advanced equipment, factory layouts for palm oil and kernel processing, with clear ownership arrangements shall be developed for existing and potential operators of processing units that have given proof to their entrepreneurial capacities. Business development services must support processors with business administration and the application of good manufacturing practices and food safety. The business development services need to be capacitated through processing experts and business development agencies (e.g. LIC etc) that train local business development services (such as SIDO), where possible.
10. **Develop commercialization and marketing strategies, introducing measures of quality and food safety.** Processors shall be supported in marketing palm oil, kernel oil, soap and other products to markets around Kigoma, including the Democratic Republic of Congo. As transport and logistics are scale-sensitive, commercialization consortia can be formed to jointly market products to distant markets. Linkages to potential buyers (e.g. importers in Dar) and distribution networks must be developed to tap into effective marketing and distribution channels. Marketing and public awareness campaigns shall be rolled out using evidence-based information on the nutrition of edible oils, as well as branding that highlight local production. Producers and processors must adhere to best practices on quality and food safety, which includes timely harvesting, handling and transport of FFB, sanitary measures at the processing plants, and appropriate packaging for palm and kernel oil. Best practices for post-harvest and small-scale processing need to be developed. Quality control infrastructure including Government testing laboratories and accreditation agencies may need to be capacitated to support the sector.
11. **Support the setup of a palm oil refinery.** Given the limits of local consumption, the market for palm oil in the production regions will soon be saturated when production will increase through introduction of new varieties. A crucial element for marketing crude palm oil at a larger scale (nationally and export) is to process refined palm oil. This operation requires substantial economies of scale and is best carried out by an agro-industrial company or a larger investor which would be attracted by high profit margins in value addition. The refinery would source crude palm oil from the to-be-established processing plants. While the agro-industrial company/investor may be able to develop factory design and business plans on their own, the programme can provide support in terms of linkages to technology providers and ensuring supply chain arrangements with crude palm oil processors.

- 12. Improve value chain governance through the development of a palm oil stakeholder platform.** The platform should have representatives of farmers, processors, transporters, traders, wholesalers and retailers, Government and development agencies. Monthly meetings shall be facilitated regionally, focusing on coordinated development opportunities and innovations across the sector. The platform would lobby for the palm oil stakeholders' interests to the Government. Part of the taxes on imports of edible oils should be channeled to a sectoral development fund that a board, supervised by a stakeholder committee to be established, would use to finance value chain development interventions, such as provision of market information (e.g. delivered by text message), training and extension as well as R&D.
- 13. Identify and advocate for enabling policies, regulations, and infrastructure development to support local palm oil production and processing.** This may include taxes on imported palm oil as well as regulations on exports, land acquisition, factory establishment, and contract farming. Generally, the parameters for "doing business³⁵" in the palm oil sector in the region must be improved, including an examination of land tenure rights for palm oil plantations and processing units. Links should also be made to infrastructure improvement programmes for road development and electrification.

³⁵ Tanzania is currently ranked 137 of 190 on the ease of doing business index, compared to other East African countries such as Rwanda (41) and Kenya (80). It is particularly difficult to start a business, deal with construction permits, register property and trade across borders (World Bank, 2018).

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Annex 1: Kigoma palm oil production estimations

The total production of the Kigoma region is not known precisely and extrapolating from a subset of farmer interviews returns improbable results due to farmers not being familiar with all required numbers. Therefore, the production was estimated using three different methods of calculation detailed below.

Method 1 Aerial Estimate of Hectares Under Plantation

This method involved using satellite imagery to estimate the hectarage under palm oil production. This estimate was established by multiplying the estimated hectarage under production by the estimated per hectare yield of FFBs, and by the oil content of the FFBs, and by the efficiency of the processing machinery. From the total yield of FFBs, a CPKO estimate was also derived.

Table 34 Aerial estimate of hectares under oil palm plantation

Hectares of oil palm (ha)	30,000
Yield per ha (kg of FFB)	2,000
Total FFBs (kg)	60,000,000
Oil content	8%
Total CPO (MT) Calculated	4,800
Total CPKO (MT) Calculated	1,320
CPO per ha	160

Method 2 Kernel Oil Processing to Estimate CPO Volume

This method worked backwards from the amount of kernel oil processed in the SIDO complex. Taking an estimate of run time of the machinery multiplied by the productivity per hour by an estimate of the percentage of the region's kernels at the SIDO complex, a total production of CPKO was estimated. Working backwards from the CPKO oil produced, it is possible to estimate the corresponding volume of FFBs required to reach the CPKO figure, the amount of CPO this would produce, and the number of hectares required to be under plantation for these oil level.

Table Kernel oil processing to estimate CPO volume

Number of processors machines	20
Litres per hour	22.8
Hours per day	5
Days per year	250
Percentage of Region's kernels at SIDO	80%

Total CPO (MT) Calculated	3,236
Total CPKO (MT) Calculated	713
Hectares of oil palm calculated (ha)	20,227
FFB calculated (kg)	40,450,000

Method 3 Comparison with Published Sources

This method referenced previously published reports on palm oil production in Kigoma and interrogated their claims.

Table Comparison of published sources on palm oil production in Kigoma

	Dalberg Report 2017	Uckert 2015
Total CPO (MT) Reported	4,000	11,956
Total CPKO (MT) Calculated	984	2,940
Hectares of Oil Palm	54,645	163,333

Annex 2: Farm profit margin analysis

Lack of recordkeeping from farming means incomplete knowledge of yield estimates. A mixed farming system makes isolating returns to palm specifically challenging for the farmer. Farmers lack familiarity with standardise units (and no access to scales for measurement), all reported weights/volumes required translation from local measuring units (tin, bucket, bag, etc.). Lack of recordkeeping of means incomplete understanding of their business. These were resolved through measuring the volume/weight of these units and taking an average. For units with large variance a larger sample set was taken to reduce issues with the calculations. Note that fluidity between actor roles is common in situations where labour/time is the lowest incurred cost.

Assumed values used in margin analysis

- Burundi Expeller rent per litre CPO: TZS 170/L – The data received from Burundi Expellers Hirers varied greatly due to unit limitations (describing the cost in terms of buckets, drums, FFBs and other local volumes/masses). Conversion reduces the accuracy of the measurement, and many of the reported units changed based on the particular vessel, an average value from the machine owners was used.
- CPO sales price per litre: TZS 1500/L – An average value of CPO sales price was used. The values given by actors were not consistent between interviewees and other surveys in the value chain.
- CPO yield: 8% – The reported CPO yield for each individual producer varied, with some interviewees reporting numbers which were clearly not feasible (i.e. >100%). To remove these errors from the analysis it was decided to use a yield based on field measurements of inputs and outputs. This estimate was confirmed through discussions with a number of the different interviewees.
- FFB yield per hectare: 2,000kg/ha – Due to discrepancies in yield estimates given by different farmers for similar farms (i.e. yield estimates of 40,000kg of FFB per year) it was decided that in order to get a better understanding in the differences between farmers an assumed yield should be used. Our yield estimate of 2,000kg/ha takes into account different planting densities and from experience is a realistic estimate of the yield of *dura* trees in Kigoma.
- FFB size: 27kg – This was derived through measuring a random sample of FFBs as it would not be possible to measure the FFBs of all producers an assumed number was used. The prices of FFBs was also taken as the average of the high and low prices to reflect the distribution of FFB sizes.
- Kernel tin size: 22.4kg – Average weight based on measurements taken at the SIDO complex.
- Kernel bucket size: 16kg – Average weight based on measurements taken at the SIDO complex.
- CPKO Machine Utilization – In interviews with CPKO Machine Owners, the length of machine running time was discussed in detail, however individual machine owners did not have precise numbers. Based on the discussions focused on: how many buckets were processed in the high season versus the low season, how long the machines were broken, what overall income was received, and how many machines were operating during the times that SIDO was visited during the study, it was decided to estimate and average the operating time of the CPKO Machines. The same process was undertaken to derive figures for the number of times CPKO Machines require repairs as the shaft material/design and working load of each machine were similar.

- CPKO yield: 10% – The CPKO yield for each individual producer varied, with some interviewees reporting numbers which were clearly not feasible (i.e. >100%). To remove these errors from the analysis it was decided to use a yield based on field measurements of inputs and outputs. This estimate was confirmed through discussions with a number of the different interviewees.
- Operating days per month: 26 – This was estimated based on interviews and a 6-day work week. An accurate assessment from individual discussions with actors was not feasible as jobs are informal and highly fluid depending on individual circumstances.
- SIDO Expeller rent per litre of CPO: TZS 165/L – The data received from SIDO Expeller Hirers varied greatly due to unit limitations (describing the cost in terms of buckets, drums, FFBs and other local volumes/masses). Conversion reduces the accuracy of the measurement, and many of the units changed based on the particular vessel, an average value from the machine owners was used.
- The cost of this labour has been included as though it were paid and accordingly this has resulted in negative/very small margins. However, farmers do not pay for the majority of labour on their farm. It is “free” labour either by the farmer or their family members.

Detailed margin analysis calculations³⁶

FFB Producer Only (Farmer 1)

Summary Table	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4	Interviewee 5
Total revenue (TZS)	388,889	244,444	2,770,370	444,444	266,667
Total costs (TZS)	304,000	303,000	2,256,000	533,000	204,000
Total income (TZS)	84,889	- 58,556	514,370	- 88,556	62,667
Income per hectare per year (TZS/Ha)	84,889	- 97,593	75,643	- 73,796	78,333

Burundi Expeller Machine Hirer (Farmer 2)

Summary Table	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4	Interviewee 5
Total revenue (TZS)	202,929	202,929	202,929	473,500	676,429
Total costs (TZS)	260,320	195,320	270,320	204,080	312,400
Total income (TZS)	- 57,391	7,609	- 67,391	269,420	364,029
Income per hectare per year (TZS/Ha)	- 95,652	12,681	- 112,319	192,443	182,014

Burundi Expeller Machine Owner (Farmer 3)

Summary Table	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4	Interviewee 5

³⁶ **Detailed Economic Calculations** for complete margin analysis calculations are available upon request.

Total revenue (TZS)	622,354	642,854	464,273	632,117	1,765,143
Total costs (TZS)	792,786	611,357	818,771	807,286	1,349,714
Total income (TZS)	- 170,431	31,497	- 354,498	- 163,169	415,429
Income per CPO litre processed per year (TZS/L)	-79	12	-295	-453	144

SIDO Expeller Hirer (Farmer 4)

Summary Table	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4	Interviewee 5
Total revenue (TZS)	135,286	329,286	461,000	263,429	270,571
Total costs (TZS)	134,560	332,900	392,960	325,120	275,120
Total income (TZS)	726	- 3,614	68,040	- 61,691	- 4,549
Income per hectare per year (TZS/Ha)	1,814	- 3,614	48,600	- 77,114	- 5,686

SIDO Expeller Owner (Farmer 5)

Summary Table	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4
Total revenue (TZS)	622,354	642,854	464,273	632,117
Total costs (TZS)	792,786	611,357	818,771	807,286
Total income (TZS)	- 170,431	31,497	- 354,498	- 163,169
Income per CPO litre processed per year (TZS/L)	- 79	12	- 295	- 453

CPO Middleperson

Summary Table	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4
Total revenue (TZS)	8,160,000	22,080,000	4,368,000	5,760,000
Total costs (TZS)	8,010,400	21,426,000	4,281,200	5,406,500
Total income (TZS)	149,600	654,000	86,800	353,500
Income per litre of CPO per year (TZS/L)	334	584	387	1,263

CPO Retailer

Summary Table	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4
Total revenue (TZS)	9,522,857	3,360,000	8,640,000	11,424,000
Total costs (TZS)	9,262,697	3,300,384	8,359,920	10,821,164
Total income (TZS)	260,160	59,616	280,080	602,836

Income per litre of CPO per year (TZS/L)	49	44	56	106
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CPKO Machine Hirer

Summary Table	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4
Total revenue (TZS)	4,374,240	5,154,200	4,556,500	5,688,231
Total costs (TZS)	3,405,024	4,187,250	3,849,375	4,885,800
Total income (TZS)	969,216	966,950	707,125	802,431
Income per kg of kernels per year (TZS/kg)	150	120	105	93

CPKO Machine Owner

Summary Table	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4
Total revenue (TZS)	12,500,000	10,156,250	10,156,250	11,718,750
Total costs (TZS)	1,931,429	1,697,500	1,817,500	1,917,500
Total income (TZS)	4,517,571	3,827,500	3,994,290	4,572,450
Income per kg of kernels per year (TZS/kg)	32	31	32	37

Soap Producers

Summary Table	Interviewee 1	Interviewee 2
Total revenue (TZS)	154,500,000	29,777,778
Total costs (TZS)	117,507,893	26,901,643
Total income, after tax (TZS)	20,054,375	2,026,135
Income per kg of soap per year (TZS/kg)	37	17

Soap Retailer

Summary Table	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4
Total revenue (TZS)	8,640,000	2,880,000	3,840,000	1,920,000
Total costs (TZS)	8,071,800	2,599,800	3,456,000	1,728,000
Total income (TZS)	568,200	280,200	376,200	184,200
Income per kg of soap per year (TZS/kg)	164	265	294	262

Annex 3: Processes for certification

To obtain a CCRO the following process must be followed

1. A farmer applies to the Village Executive Officer (VEO); for an individual who is not a resident of the village, the applicant must be accompanied by at least 5 village residents.
2. The Village Council determines whether there are any boundary conflicts surrounding the land in question.
3. If the Village Council approves the application, it is sent to the District for processing.
4. The VEO presents the application to the DED who, in turn, approves it and passes the application to the Land Officer.
5. The DED signs and pass the letter to the Land Officer.
6. The VEO, the Land Officer, and the Land Surveyor Secretariat jointly determine the cost of land surveying.
7. The Land Officer and the VEO determine the certificate preparation and registration fee.
8. The VEO is charged with collecting the fees from the applicant.
9. The VEO pays to the Treasury of DED.
10. The Land Surveyor surveys the farm.
11. The survey plan is submitted to the Land Officer who starts to prepare the certificate.
12. The Land Officer travels to Dar es Salaam to collect official, crested paper. This takes 14 days.
13. Once the paper is issued, the certificate is written, and the land officer returns from Dar es Salaam. The VEO or farmer collects the certificate from the District Offices.

To operate in the KiSEZ, the following are required (associated costs in brackets):

- Register a new entity in Tanzania. Existing businesses cannot shift to the KiSEZ to take advantage of the tax incentives (USD 1,000).
- Submit a business plan to the regional authorities for approval.
- Be granted a lease from the regional authorities (USD 0.15/m² per year).
- Conduct an Environmental Impact Assessment through National Environmental Management Council (TZS 10,000,000).
- Present the lease agreement to the EPZA and pay for a Developer License (USD 5,000).
- Develop site within two years.
- Apply for an Operator License through the EPZA (USD 800).
- Ensure that 80% of products by value are exported.