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TomCo Energy PLC
Palm Oil Project in Sierra Leone

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1. Introduction

TomCo Energy PLC is interested in starting a palm oil production business in the Makeni area of Sierra Leone. The idea is to test the market by installing a low-capacity palm oil mill at modest cost, purchasing oil palm fruit bunches from local farmers, then producing and marketing crude palm oil to local purchasers.

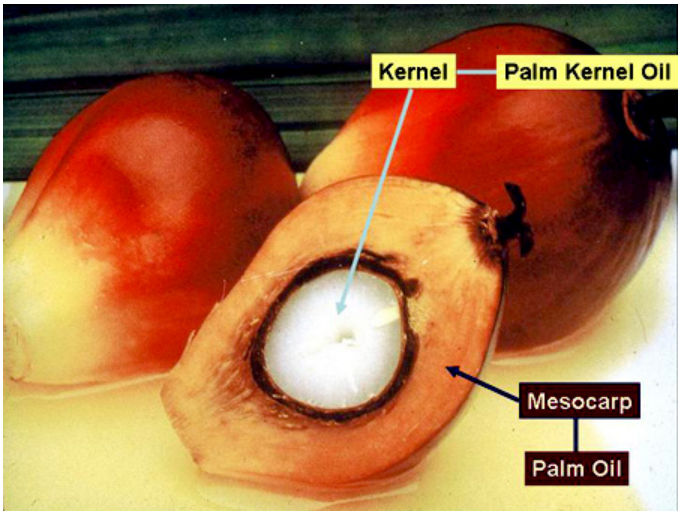
The purpose of this report is to briefly describe the oil palm industry in Sierra Leone to give background knowledge, then to go into detail about the specific project plan and its costs, benefits, and likely commercial potential for the Company. In collecting data and information for this report, a field trip was made to Sierra Leone by the Consultant, and TomCo CEO Mr Christopher Brown.

2. Brief Introduction to Oil Palms

Oil palms are indigenous to West and Central Africa. There are three main varieties; dura, pisifera, and tenera.

All three produce fruit bunches, but curiously they are indistinguishable by their outward appearance. It is only by bisecting a sample of fruit from the bunch that it can be determined which variety it is. It is only the difference in the physical properties of the fruit that distinguish one variety of palm from another.

Oil palm fruit yields two types of oil, both of which have commercial value; palm oil, and palm kernel oil. The red palm oil is found in the fibrous mesocarp surrounding the nut, whilst the clear light yellow palm kernel oil comes from the kernel of the nut.



The source of palm oil and palm kernel oil

In modern tenera oil palms the amount of palm oil in the mesocarp is approximately 24-25% compared to the weight of the whole bunch, whilst palm kernel oil represents about 1.75%.

2.1 Dura Palms

Dura is the naturally occurring type of oil palm that is found in large numbers in the wild across West and Central Africa, including Sierra Leone. The palms are usually tall, often 12-15 metres in height, and often confused with coconuts because of their physical similarities. The fruit bunches produced are small, usually 3 – 7 kg. The fruit from these bunches are characterised by large nuts having thick shells, surrounded by a thin layer of oil bearing fibre known as the mesocarp.

Typical stands of wild dura palms near Port Loko

Method used to climb to harvest palms

There was much development and breeding of dura palms in the early years; to the point where the physical properties became sufficiently interesting for them to be planted commercially. These palms were also very tall upon reaching maturity, but the bunches were now much larger and heavier. Indeed there are still plantations in Sierra Leone planted in the fifties and sixties made up of these improved dura palms, and bunch weights up to and beyond 30 kg are common.

Small fruit bunches from wild dura palms

Large bunch from improved dura palm

Although bunch weights and vigour of the palm s were considerably improved, there was little success in either reducing the size of the nuts, or increasing the thickness of the layer of mesocarp, so the oil to bunch ratio remained low.

Because of the height of mature dura palms, and the absence of any suitable tools, harvesting was, and still is, achieved by climbing the palms using a harness.

2.2 Pisifera Palms

These are also naturally occurring palms but in far fewer numbers than dura palms. Pisifera palms are female sterile type, and cannot be reproduced in normal ways, it being very difficult to germinate the seeds. Fruiting is also very erratic; it often does not even start until the palms are 10 to 12 years old. A notable characteristic of the fruit is that it is shell-less. Because of the absence of a shell there was work done to try to improve the negative characteristics of pisifera palms with a view to producing palms with higher oil content than dura. It seems some potential was seen in the work, but because of the breeding difficulties, and the need to redesign large parts of palm oil mills to process shell less fruit, the commercial development of pisifera palms is unlikely.

2.3 Tenera Palms

The tenera variety of oil palms is a crossed dura and pisifera hybrid that is the universal standard in oil palm planting material these days. The variety successfully increased the oil to bunch weight from approximately 16% for dura up to 23%, mostly by a significant reduction in the size of nuts, and also by the thickness of the shell.

Modern breeding techniques have also successfully developed tenera palms specifically for the local conditions found in West/Central Africa. The seedlings are bred with inbuilt resistance to fusarium

wilt (a devastating oil palm disease prevalent in the Region), and are also drought resistant which enables them to withstand the long dry season.

Typical commercial tenera oil palm plantation

Heavily laden tenera oil palm

Tenera Fresh Fruit Bunch

2.4 Difference Between Dura and Tenera Fruit

The benefits of developing the tenera hybrid can be clearly seen in the photos below. The smaller nuts, thinner shell, and enlarged mesocarp are self-evident. The increase in palm oil content is about fifty percent for tenera fruit over dura.

Bisected oil palm fruit, showing the difference in physical properties between dura and tenera. Note the thicker oil bearing fibre (mesocarp) of the tenera fruit.

Examples showing the difference in nut sizes between dura and tenera fruit.

3. Agronomic Conditions for Oil Palm Plantations

3.1. Soil conditions

Although oil palms can grow in a wide range of soil conditions, there are certain characteristics that have shown to be conducive to good growth and high yields:

- High level of soil fertility
- Sandy clay loam of fine texture with good moisture holding capacity
- Soil of pH 4 or higher preferred, though oil palms can tolerate acidic soils
- Deep soils which permit unhindered root development, without any compact layers of clay or hard laterite close to the surface

From various reports describing the agricultural potential of soils in the Port Loko area, they can be summarised as being for much of the area a top layer of friable, mineral rich (iron) reddish brown soils, up to a metre in depth, overlaying increasingly lateritic layers. These conditions would seem to be very good for oil palm growth, which allow easy root development to at least two metres.

3.2. Climate

The ideal climate range known to be best for growing oil palms is an annual average temperature range between 24 and 28 degrees Celsius, with little daily variation in average temperature. The lowest tolerable temperature is 19c with the upper limit being an average of 32c.

High yielding oil palms also require regular sunshine, a minimum of 5-7 hours daily.

Most parts of Sierra Leone, including Makeni and Port Loko areas, comfortably meet all these criteria.

3.3. Rainfall

Rainfall is the single biggest factor that impacts the successful development of oil palms. Typically oil palms need more than 2,000mm annually, which should be evenly distributed throughout the year. Any month where rainfall is less than 100mm is considered dry, and will negatively impact yields.

The average annual rainfall for Rokupr rice research station, which is located near to Port Loko, for the period 1977 – 1988 was recorded as 2,796mm. GeoffPalm, an oil palm company owned by the Indian SIVA Group planted 2,500 hectares at Mange in 2012. For the year 2010 they recorded annual rainfall of 3,321mm with the months of January, February, and March recording less than 100mm.

The table below shows the annual and monthly average rainfall figures for a number of West African oil palm growing Countries. The picture presented is not completely accurate because the Sierra Leone's data came from a single source and location. However, it does strongly indicate that rainfall in Sierra Leone is at least as high as all these other Countries, and probably

the highest. It shows rainfall is well above the nominal 2,000mm required for good oil palm growth.

Months	Sierra Leone *	Congo #	Ghana #	Liberia #	Ivory Coast #
	1977-1988	5 yrs ave	25 yrs ave	5 yrs ave	6 yrs ave
Jan	1	34	39	36	21
Feb	6	31	78	54	58
Mar	4	114	116	114	113
Apr	55	170	142	133	145
May	185	244	217	205	181
Jun	340	179	275	184	166
Jul	638	164	145	93	98
Aug	678	226	91	69	68
Sep	432	155	148	193	170
Oct	311	342	213	220	196
Nov	108	714	141	142	148
Dec	37	51	71	43	24
Total	2795	2424	1676	1486	1388

**Data from Rokupr rice research station*

#Data from Unipalm and CIRAD research centres

3.4. Conclusions

The combined data from climate, soils, and rainfall shows Sierra Leone to be highly suited to growing oil palms. The only negative factor concerns the long dry season. With four to five dry months per year when there is less than 100mm, this has a definite impact on fruit yields. With historical data in the Country almost non-existent, forecasting achievable yields involves more optimistic guesswork than studying trends and evidence available. The same applies to the monthly yield profile. Nearly all Countries in West and Central Africa have an annual dry season to some degree, and this has shown to result in a very uneven spread of the annual crop on a month by month basis. In Ghana for example, records show that more than 50% of the annual crop is delivered in only four months (March, April, May, and June). Unfortunately, in the case of SL where there are no reliable records, it remains to be seen what the actual spread will be.

Although the dry season limits annual crop yields, palm oil production in Sierra Leone is still a very worthwhile and profitable business. One only has to observe the present rate of investment and interest coming from large, international plantation companies to see this.

4. Marketing Conditions for Palm Products

4.1. Parallel markets for palm oil

Unlike the major palm oil producing countries from Asia, in West and Central Africa palm oil is widely consumed in its natural form by the population, and is a staple of their diet. Palm oil has been consumed in Africa for hundreds of years, and as such the oil came from naturally occurring wild dura palms. Although reliable information is difficult to find, it is generally thought that a high percentage of palm oil consumed in Sierra Leone today comes from the improved dura palms rather than the native variety.

Because of the difficulty in stripping the fruit from the fruit bunches when they are freshly harvested, traditionally bunches are left to dry out for up to a week or so, by which time the fruit has loosened and can be easily removed manually. During this waiting period the free fatty acids contained in the palm oil rise, and continue rising until such time as the fruit is cooked. Dura palm oil contains a high level of carotene giving it a dark red colour, and it is this colour together with the acidic taste that distinguishes red artisanal oil for consumption from the oil produced by tenera plantations. Despite tenera palm oil becoming more and more available in the Country, the population seems to remain stubbornly averse to consuming it. The situation created is one where there exist two completely separate and independent markets for palm oil.

4.2. Local market

The local market concerns the red palm oil described above. It is produced in villages using ages-old techniques that are extremely inefficient, use no machinery, and are very labour intensive. The oil is generally sold in reused 20 litre plastic containers to women traders who then either resell it to market traders, or resell it to the public themselves. When selling to the public the oil is measured out using either a glass bottle, or a small tin. It is then poured into a small plastic bag and tied off.

Of course, a large proportion of local oil finds its way into the many markets in and around Freetown, and even there it is sold in a similar way.

Palm oil measuring bottle and tin

Palm oil and artisanal soap on sale together

Another view of how palm oil is decanted for retail sale

Old, dirty, and otherwise contaminated oil deemed unsuitable for consumption is sold for a lower price for local soap making activities.

4.3. Industrial market

This is the market concerning palm oil produced from tenera palms. Since the seventies the vast majority of new seedlings imported into the Country have been of the tenera variety, indeed it is no longer easy to find dura seedlings for purchase. The early plantations were mostly organised, if not owned, by the government, plus there were other areas where assistance was given to local communities to develop smallholdings. In more recent times, since the end of the civil war, larger international plantation companies have started to invest in the sector. SOCFINCO, a large Belgian plantation Company, and also SIVA Group from India, are both very near to starting palm oil production from their substantial plantation holdings. A British Company named GoldTree is already in production at a plantation based in the East of the Country.

The palm oil to be produced by this group is destined to be sold into either; (a) an undeveloped fast moving consumer goods manufacturing environment within the Country, probably only in modest volumes, or (b) to be exported in bulk.

Unless there is a sudden and large shift in consumer preferences, it seems very unlikely much of the tenera palm oil will be sold for consumption.

4.4. Added Value Products from Palm Oil

Refined palm oil is used in a wide variety of products globally; the main ones being vegetable oils, margarine and spreads, soap products, food and snacks industry, health products, etc. Although knowledge of palm oil is not widespread in Western countries, it finds its way into the ingredients list of thousands of products with household names.

4.5. Palm Oil Marketing opportunities in Sierra Leone

There appear to be several good marketing opportunities available for selling palm oil for consumption. Although data is not available, indications are that the market is buoyant, without fear of saturation in the foreseeable future. The market vendors, although not difficult to find, were not present in large numbers, and there was little evidence of roadside sales taking place.

Palm oil in the market

Palm oil being sold on the road to Guinea

There is some concern whether the palm oil to be produced by TomCo will be readily saleable as red oil for consumption. The feeling is that this will not pose a major concern for the following reasons:

- The palms which will feed the mill are mostly very old tenera palms. They were some of the first varieties of the early teneras progenies, and as such still had some dura characteristics.
- Despite the majority of the palms being tenera, there will still be a noticeable proportion of dura, which will influence the makeup of the final oil produced.
- From the visits made to plantations during the trip, there was plenty of evidence of villagers producing palm oil from tenera palms. Where else would this oil be sold other than in the local markets? This oil is no different from what TomCo will produce.

4.6. Packaged Palm Oil

It was noted from the single supermarket it was possible to visit during the recent trip that there were no packaged palm oil products for sale of any kind, neither bottled or in larger plastic containers. This was surprising as it has been shown in several other countries that such products are very popular; it is not always easy or desirable to venture into the open markets. Many people would prefer the convenience of buying their palm oil in a nicely packaged bottle, or sachet, along with their other groceries from a supermarket, especially the rapidly emerging middle class working in towns.

The packaging and wholesaling of palm oil for consumption in bottles or plastic sachets holds promise, there should be ready markets in the towns and areas where oil palms are not present, or for export to neighbouring countries. Even exporting of such products could be of interest,

there is certainly a large and hungry market for palm oil amongst the Diaspora living in Europe and the USA.

4.7. Opportunities for Investment in Fast Moving Consumer Goods (FMCG) Industries

Markets for industrial volumes of palm oil from plantation companies would seem to be mostly export-based, largely because of the small number of manufacturing companies operating in the Country that need it. It would seem quite likely that one or more of the large international plantation companies currently setting up in Sierra Leone will at some time start to include value added manufacturing. For example, as far as is known, currently there are no vegetable oil refinery facilities anywhere in the Sierra Leone. All refined and fractionated yellow vegetable oil is currently imported, mostly from Indonesia. Indeed it is the empty 20 litre plastic containers in which the imported vegetable oil is packaged that is reused just about everywhere for artisanal palm oil packaging and transport.

It is a similar story for soap products. Apart from the artisanal soaps manufactured in the villages for sale in the market, the vast majority of all soap products are imported. Apparently, there are three companies located in Freetown who manufacture soap products. Their presence in the market place was not very apparent however. During a quick visit to a supermarket in the middle of Freetown of the dozens of different toilet, laundry, and detergent soaps on display, only one was manufactured locally. Unfortunately, the local one stood out only because of its low quality, which also includes the packaging.

There is undoubtedly great potential for investment in FMCGs in Sierra Leone, especially those requiring palm based products amongst their main raw materials.

5. Brief Description of Palm Oil Milling Process

The various processes used in a palm oil mill to convert fresh fruit bunches into the commercial products of crude palm oil (CPO) and palm kernels (PK) can be summarised as follows:

1) FFB Reception
2) FFB Sterilising
3) Bunch Stripping
4) De-oiling
5) Clarification & Storage
6) Nut/Kernel Extraction

1) **FFB Reception** As truckloads of FFB are received at the mill from the plantation, they are first weighed by crossing a weighbridge which is normally located close to the main gate. Once weighed the truck proceeds to discharge its load ready for the next process. The truck then crosses the weighbridge on its way out for re-weighing. The difference between the two weightings is of course the tare weight of the FFB received.

2) **FFB Sterilising** – This is simply the cooking of the fresh fruit bunches. When fruit bunches are harvested from the palm trees the Free Ffatty Acids (FFA) in the oil contained therein starts to rapidly increase, from less than 1% up to 5% in a matter of 4-6 days. The rise in FFA can only be arrested by cooking the fruit, and for this reason commercial plantation companies nearly always have a policy of "harvest today, process today". There is often a premium price paid for low FFA palm oil, and penalties should it find its way above 5%, so the sooner it can be cooked, the better the result. In larger mills, say 5 tonnes FFBFFB/hr upwards, the FFB is cooked in large pressurised autoclaves known as sterilisers, typically using wet steam at a pressure of 3 bar for a minimum of 90 minutes. However, the same can be achieved by cooking the fruit in non-pressurised vessels at atmospheric steam pressure; it simply takes longer (approximately double the time). This is a much simpler, lower cost option which is normally used in small mills.

Pressurised autoclave sterilisers

Non pressurised cooker

3) **Bunch Stripping** – After the FFB has been cooked it is then passed into a rotating drum machine known as a bunch stripper. During the cooking process the many small, egg-like "fruitlets" found on a fruit bunch become loosened from their stalks. Once inside the rotating drum of the stripper these fruitlets are detached by the aggressive rolling action caused by the machine. The stripped fruitlets fall through the bottom of the drum and are carried away, whilst the empty bunch stalks find their way to the end of the drum and are transported away. The empty bunches are commonly returned to the plantation for mulching purposes, whilst also adding some nutritional value to the soil.

Note: What is being referred to here as "fruitlets" is actually where the palm oil is found. The fruitlets are about the same size and shape as small chicken eggs, and comprise a nut in the centre, surrounded by a thick layer of fibrous material, which is jacketed by a thin, tough skin. The fibrous matter, known as the mesocarp, is what contains the palm oil.

The palm nut referred to above comprises a kernel, and an outer shell. Palm oil mills normally recover the palm kernels because they also contain commercially valuable oil known as palm kernel oil (PKO).

4) **De-Oiling** – This is the key station in a mill where the palm oil is extracted from the cooked fruit. The first step involves a machine known as a digester, which is simply a large stirring machine. Here the cooked fruit is re-heated, and vigorously stirred by large rotating beater arms, converting it into a hot pulp. From the digester the hot pulp is fed into a screw type palm oil press where high pressure is applied to it, which forces the oil to exit the mesocarp, and is directed away. What is left behind is a mixture of fibre and nuts, which is known as press cake.

Example of a screw press

Screw press with digester above

5) **Clarification** – This is the station where the palm oil is cleaned up into a condition presentable for sale. When the oil is first extracted at the press it is not pure, rather it is just a part of a mixture known as "press juice" comprising palm oil, non-oily solids (dirt and sand), and water. The function of the clarification station is to separate the oil from the water and solids. In simple terms the mixture is heated in a large vessel known as a continuous settling tank and allowed to settle out; the water and solids falling to the bottom whilst the red palm oil rises to the top. The oil is "creamed" off the top and then passed for

drying to remove the remaining moisture it contains. The oil is now of merchantable quality and is sent to bulk storage.

6) **Nut/Kernel Recovery** – After the oil had been extracted, the press-cake that remains contains a mixture of fibre and nuts. These are separated by feeding the mixture into a vertical tube known as a velocity column. From the top of the column a measured suction is applied sufficient to lift the fibre, but not the nuts. Thus the fibre is lifted away and stocked for use as biomass for the boiler, whilst the nuts fall to the ground where they are collected and transported to the next step in the process. From here the nuts are fed into a cracking machine, the output being what is known as a cracked mixture comprising the intact kernel and cracked and broken shell pieces. The kernels are then separated from the shell pieces by a 2 stage process, of which there are several different methods. The result however is the same; the cracked shell ends up in a storage bin also destined for the boiler furnaces, and the kernels are sent to a drying silo where the moisture content is lowered down to less than 8%. After drying, the kernels are either bagged for sale, or sent for oil extraction if the mill has the appropriate plant installed.

Services

The milling process depends heavily on certain services that form large and essential parts of mill design:

1) Steam Supply
2) Electricity Supply
3) Water Supply

1) **Steam Supply** – steam is the life blood of a palm oil mill. It is used for heating right through the process range, but it also has another vital role. In large mills, steam is the energy source used to drive a turbine alternator to provide all the electrical power the mill needs to operate.

2) **Electricitiy Supply** – in industrial sized mills, power principally comes from a steam driven turbine alternator whilst the mill is operational, but is often backed up by diesel powered generators. The diesel generators, or national grid supply if available, are necessary all the time the mill is not running (i.e. whenever the boiler pressure is insufficient to maintain the turbine online). Smaller mills however cannot produce sufficient high pressure steam to drive a turbine, and are therefore limited to either grid or diesel generator sourced electricity supply.

3) **Water Supply** – the principal need for water is for steam generation. A 60 tph palm oil mill for example requires approximately 36 tonnes of water per hour for steam generation alone. Most of this is consumed as steam in the sterilisers. Hot water is used at many other points throughout the process range, including washing down purposes.

6. Makarie Palm Oil Production Project

6.1. Background information on the project

Makarie was singled out for TomCo's palm oil production business because of the ready availability of fresh fruit bunches (FFB) from nearby village plantations. The spread and density of the plantations were pin-pointed, measured, and mapped using Google Earth Pro techniques. The findings were also verified by several visits to these villages.

This cluster of oil palm plantations is somewhat unusual. It is quite rare to find such a large number of plantations owned by small farmers which have obviously been planted to a professional standard. Although nearly all of the palms are now very old (more than 35 years) their condition indicates they were well maintained in their formative years. This is evidenced by the low mortality rate (not many gaps), the still well-developed canopy, and the resultant absence of weeds.

Despite the absence of fertiliser applications over the years, the fruit bunches being produced by these palms are very large and heavy, with plenty weighing 25 – 30 kg or more.

When evaluating any project that seeks to install a palm oil mill with the intention of producing palm oil based on feedstock purchased from others, the overriding questions are always (a) "is there sufficient FFB to operate the mill to its potential?", (b)"is the supply guaranteed?", and (c) "can it be purchased at a reasonable price?". In most cases, there are simply too many uncertainties to justify the risk, but happily in the case of the Makarie project all these conditions have been met.

6.2. FFB Availability

The plantations mapping exercise mentioned above identified just over 1,800 hectares of plantations in reasonably close proximity (all within a 20 kilometre radius of the mill site). For mature commercial plantations properly maintained and fertilised in Sierra Leone, an average yield expected would be around 18 – 20 tonnes of FFBFFB/ha/yr. For the same plantation without the benefit of fertiliser, the yield would be somewhere in the range of 10 – 12 tonnes FFBFFB/ha/yr. In this case however, where the maintenance has not been good in the later years, there has never been any fertiliser application, and the palms are now very old, an average yield of 5 tonnes FFBFFB/ha/yr has been assumed. This is considered a conservative and reasonable forecast for these circumstances. This all adds up to an average annual crop of approximately 9000 tonnes of FFB, yielding about 1,530 tonnes of CPO (assuming 17% extraction rate), which has a value of $1.086 million at current world price.

6.3. Guarantee of Supply

The processes farmers and villagers use to extract the palm oil from their oil palm bunches are very strenuous and time consuming. It is very hard, dirty work to say the least.

Oil Recovery Pit

Fruit Stripping

Pounding Cooked Fruit

Having inspected the spent fibre after the completion of oil extraction, it is estimated the extraction process recovered no more than 9% of the available oil, leaving roughly the same amount behind. Based upon 1 tonne of FFB, the oil recovery rate would be 9/100 x 1000 kg = 90 kg. This is equal to approximately 99 litres of oil, with a saleable value of approximately 99 x Le 4,500 = Le 445,500/6000 = $74.25

The alternative to extracting the oil is to sell the FFB to TomCo for $60 per tonne. So the choice is to either:

a) Harvest the fruit bunches, transport them from the plantation to the processing area, store them for one week for drying, manually strip the fruit from the bunches, load into a drum and add water, set fire underneath the drum and cook overnight. Come back next day, transfer cooked fruit into pounding pot, pound the fruit into a mash to loosen the oil in the fibre, transfer the mash into the water pit, enter the pit and further pound the mash using bare feet and/or pounding stick, scoop the palm oil off from the surface of the water with a cup and store in container. Remove fibre and nut residue from the pit and discard. Find buyers and sell the oil. If the oil is deemed to be consumption quality it is sold for the equivalent of $74.25, much less if it is deemed only suitable for soap making. Or...
b) Harvest the fruit bunches and sell them for cash immediately to TomCo for $60/tonne.

The lure of immediate cash, and the avoidance of all the time spent, by so many, doing such hard work will be an easy and obvious choice. This is the only guarantee of supply required.

6.4. Purchase Price

The price negotiated for purchase of FFB from the farmers is $60/tonne. Traditionally, across much of West/Central Africa the price has been set at 10% of the cost of 1 tonne of CPO (Rotterdam price – 3 month futures). Currently, the price is around the $710/tonne mark so the $60/tonne looks reasonable at first. However, in most cases the 10% of CPO cost is a mill gate price which means it is based upon the fruit being delivered to the mill. In TomCo's case however the intention is to collect the FFB from the villages using their own trucks. It is fortunate therefore that the plantations are mostly very close to the mill, so the

$60 per tonne is still ok. Typical transport charges for FFB vary between $5 - $8/tonne depending upon efficiency, distance, cost of fuel, etc.

6.5. Manufacturing Strategy and Planning

The first priority in a project of this nature is to limit early exposure until such time that the feed stock supply is assured. This will be achieved by installing a small, low cost 1 tph palm oil processing plant, and confirming the availability of FFB by opening for production and noting the rate of increase of fruit being made available by farmers. It should not take too many weeks to gain an insight into future prospects. Hopefully the uptake by farmers will meet, or exceed the calculated estimates, which will provide the confidence required to press ahead with the 2 tph mill upgrade, and the installation of the planned added value manufacturing components.

The added manufacturing production facilities planned are a CPOCPO bottling operation, and a soap production plant, both of which are very closely linked to palm oil. The table below shows the planned installation schedule for upgrades and additions to the basic 1 tph palm oil mill.

INSTALLATION PLAN FOR INDUSTRIAL PLANTS																
	2016		2017				2018				2019					
1 tph Palm Oil Mill	C	C	C	1 tph	1 tph	1 tph										
2 tph Upgraded Palm Oil Mill						C	2 tph	2 tph	2 tph	2 tph	2 tph	2 tph	2 tph	2 tph		
CPO Packaging Plant 2tpd						C	2 tph	2 tph	2 tph	2 tph	2 tph	2 tph	2 tph	2 tph		
Soap Plant 2tpd							C	C	1 tpd	1 tpd	2 tpd	2 tpd	2 tpd	2 tpd		

1 tph Palm Oil Mill

The first installation will of course be the basic 1 tph palm oil mill. With a project green light in July for activities to start in August, it is hoped the mill can be commissioned before the onset of the next peak fruit period starting in March 2017. The critical item in the supply chain is the steam boiler, which has a manufacturing lead time of 4 months. As a consequence, it is planned to ship the mill in two consignments from India. The first consignment will comprise machinery and materials readily available, and this will enable installation work to start as soon as possible. The second consignment will comprise the boiler plus all the bespoke machinery that will be fabricated in India.

Upgrade From 1 tph to 2 tph

The first priority will be to upgrade the palm oil mill capacity from 1 tph up to 2 tph, and this is planned for commissioning as early as first quarter 2018. Should the FFB inputs exceed current estimates by a considerable amount the mill would need an additional upgrade to 3 tph but as things stand 2 tph will suffice by working longer hours in the peak periods.

CPO Packaging Plant 2 Tpd

It is believed that an untapped market exists for palm oil in sachets. Unlike marketing palm oil in PET bottles, the machinery requirements are modest and simple, and far lower in cost.

The intention is to install a facility capable of filling 1000 sachets per hour (far higher than our requirement, but the smallest available) ready for commissioning first quarter of 2018. Should everything follow the plan, it will be possible to ship the machinery together with the 2 tph palm oil mill upgrade machinery from India.

The sachet filling machine will be capable of filling various sized sachets meaning that besides the standard 1 litre, 500 ml and even 250 ml will be possible. It is believed the smaller sized options will yield higher unit cost returns than the standard 1 litre sachets.

The sachets are supplied in rolls of 1000 metres, with labelling pre-printed. It will make good sense to order sufficient sachets for one year's planned production along with the sachet filling machine. Sales packaging will be branded custom sized corrugated cardboard cartons which will be purchased along with the filling machine and the sachet rolls from India.

All sales will be wholesale. It is estimated the selling price of CPOCPO in sachets will be more than double that of CPO sold in 20 litre containers.

Soap Plant 2 Tpd

Soap is an excellent added value product line to associate with a palm oil operation. The basic make up of soap is:

- 55% crude palm oil
- 5% palm kernel oil
- 10% caustic soda
- 5% filler (eg calcium carbonate, silicate/bentonite)
- 25% water

There are several product options available. Notable amongst these being powder laundry soap, which appears to be very popular in the markets visited. Bar type laundry soap (Savon de Marseilles) is certainly a possible starter product, although there was very little evidence of similar products in the markets. However, this could simply be because nobody has strongly marketed such products yet. One sample was found in a supermarket in Freetown, however the quality was poor. There is strong hope for bar laundry soap because it is a proven popular product in many similar countries in West/Central Africa where there are good soap manufacturing companies operating.

Locally manufactured laundry soap; hard bar type, and powder.

Beyond these basic laundry soap products, possibilities exist to manufacture toilet bar soap (with fragrance and colour), liquid detergent soap, and several others. The market for light coloured perfumed toilet soap would be far more challenging to break into such is the huge range of imports on sale. Most of these originate from Indonesia, which is now the largest palm oil producer in the world. As they manufacture is such large volumes, it might prove very difficult to compete with them.

Locally manufactured toilet soap

As Makeni is a rural town it would seem to make sense, certainly in the short and mid term, to concentrate on filling the soap needs of the rural population rather than trying to get the upperhand over imports in Freetown.

Imported toilet soap

Imported powder detergent soap

The production of soap is planned to start at a modest volume of 1 tpd, this to build experience in new areas and skills, not least of which will be distribution and marketing. Commissioning of the initial plant is currently scheduled for August 2018. Maximum production of 2 tpd is expected to start at the beginning of 2019

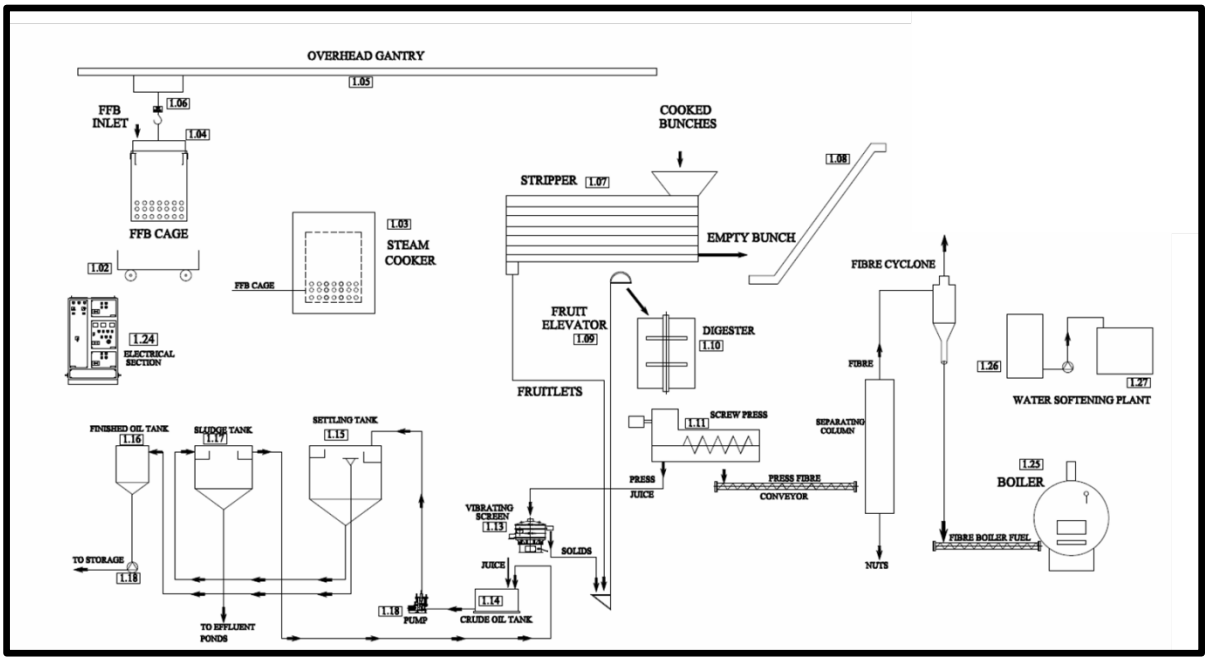
6.6. TomCo Palm Oil Mill Installation

The production of crude palm oil is the core business element in this project, so the palm oil mill's design, efficiency, and reliability are key to the business's success.

Palm oil mills of such a low capacity as 1 tonne FFB/hr. are not widely available. In Asia where there is no tradition of smallholder or village level farming of oil palms, the smallest palm oil mills available start at 20 tph, or as is more often than not these days 30 tph. So oil mill supply contractors from that area have no experience, nor interest, in supplying these comparatively small mills. There are a few known suppliers of low capacity mills based in Europe, each of whom follow their own widely differing design philosophy. Consequently, there is no basic design that can be called conventional in this range.

The design of the Tomco mill is one that is simple and fairly compact, yet efficient, using the least sophisticated technology and equipment that will still deliver the extraction efficiency required. Notably for this sized mill, a separate steam boiler is included as the heat source to meet the needs for cooking FFB, and also for other processes requiring controlled heat across the machinery range. The basic layout design has made provision for the mill to be upgraded to a maximum of 2 tph. Furthermore, several key machinery items, including the boiler, bunch stripper, and the overhead electric hoist will be sized at the outset to meet the higher capacity requirements of the future.

Below is the flow chart of the proposed Tomco palm oil mill.



6.6.1. Mill Performance

The project estimates for the palm oil recovery rate as compared to FFB delivered will be 17% for the first nine months of operations, then increasing to 17.7% from the start of 2018.

The actual extraction rate achievable will depend to some extent by the volume of dura that is supplied along with the tenera fruit to the mill. At present there is no way of knowing with any certainty what this might be, although there appeared to be a considerable majority of tenera from the limited number of tests run on the recent visit. The table below shows the effect on overall extraction rate

Effects of varying Tenera/Dura Splits on Overall Extraction Rate					
Extraction Rates:		Tenera: 18%		Dura: 16%	
FFB Split of 1000 kg	Tenera	800	700	600	500
	Dura	200	300	400	500
CPO Yield in kgs	Tenera	144	126	108	90
	Dura	32	48	64	80
Total CPO kgs		176	174	172	170
Overall Extraction Rate:		**17.6%**	**17.4%**	**17.2%**	**17.0%**

So even if the split between tenera and dura were to be 50/50, which is thought to be highly unlikely, the overall extraction rate would still be 17%. The extraction rates used in the projections can therefore be considered conservative.

However, the actual mill performance is not simply a matter of extraction rate. The rate is not determined solely by the mill's performance. The quality, age, and type of fruit also has a large influence. So the more meaningful and accurate way of measuring palm oil mill efficiency is to calculate its extraction efficiency. This is achieved by carefully measuring all the oil losses through the process then calculating thus: Efficiency = CPO/(CPO + CPO Losses). The most advanced mills available can exceed 95% extraction efficiency, however for Makarie 87 – 90% will be acceptable. This will be achieved by restricting processing oil losses to 2.5%. So, assuming an extraction rate of 17.5%,

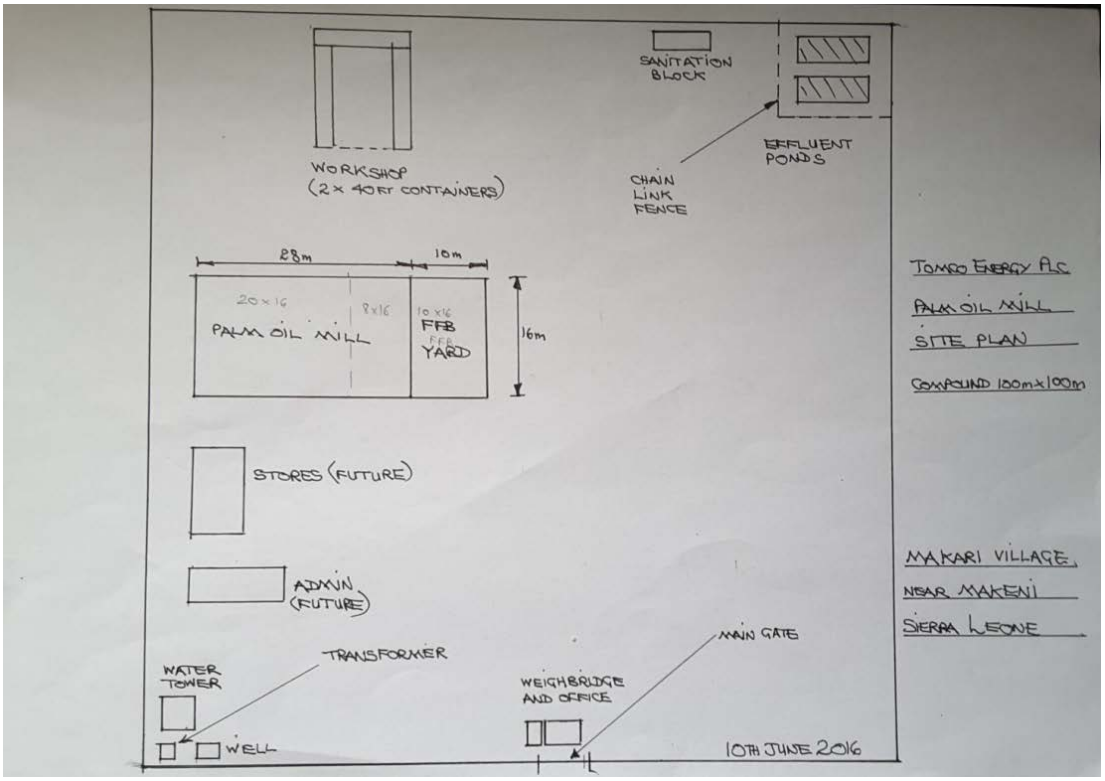
Extraction Efficiency = 17.5/(17.5 + 2.5) = 87.5%

The mill will be ruggedly constructed to be able to work long hours at maximum capacity without frequent breakdowns, or other unplanned stoppages. Unplanned breakdown maintenance will be kept to a minimum by a comprehensive preventive maintenance programme.

6.6.2. Site Layout

Below is a rough sketch of the planned site layout. The land parcel is 100 metres square, with a gentle slope away from the mill building towards the effluent lagoons.

The mill and the main gate have been positioned to minimise the length of road required for FFB trucks. Upon entering the mill compound FFB trucks will be weighed on the weighbridge, then proceed to unload onto the FFB yard. Once unloaded they will pass over the weighbridge again so that the tonnage delivered can be computed.



The buildings and services have been arranged as far as practical towards the left hand side of the sketch in order to preserve plenty of free space for future developments (eg soap factory, CPO packaging plant, etc)

One of the reasons for siting the project in this particular location is the close proximity of the overhead transmission lines of the MT national grid. Power is one of the two main costs of operating palm oil mills, and the availability of grid power should represent a considerable saving compared to operating diesel powered generators.

Some of the early work has already started on the site.

The water supply to the site is via a hand dug well. The main work on the well has already been done. It was considered important to get it done before the onset of the rainy season when the water table rises considerably.

The completed well

The well under construction

Work has also started on site clearance. It was first cleared of all underbrush by means of a local labour contract, but more recently a bulldozer has been hired to knock down and de-stump the many old palms and other trees. This work is approximately 75% complete.

Land clearance work in progress at Makarie site

6.6.3. Construction and installation schedule

It is planned to source 100% of the mill from an experienced engineering company in India. They have supplied up to 70% of a previous mill installed by the Consultant so they already have good knowledge of palm oil mills. On this occasion they will also manufacture some machinery that is new to them so there will be some development work necessary. It was first intended to manufacture approximately 30% of the mill machinery in Sierra Leone, but it soon became apparent there is a total lack of engineering equipment and supplies available, which prompted the move to get everything from India.

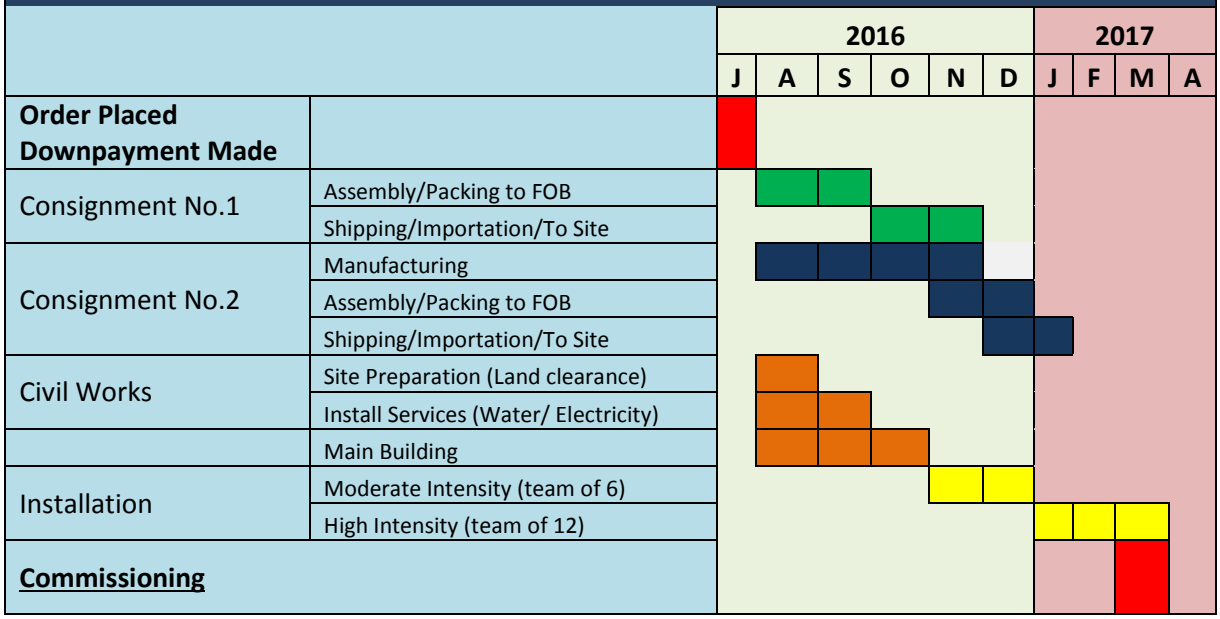
More than 50% of the mill machinery will be readily available, whilst others will take time to fabricate and locate. Consequently, as mentioned previously, it is intended to split delivery

of the mill into two consignments, with the first hopefully shipping within two months of the deposit being paid.

The boiler manufacturer has advised that delivery is 4 months from down payment. Should down payment on the boiler be done late in July 2016, or the 1st of August, then it would be available ex-works by the end of November. Taking into account special packing, stuffing into container(s), transport to FOB, shipping, clearance (which will likely take place during the end of year holiday period), and inland transportation, it is unlikely to arrive on site before mid-January 2017 at the earliest. Installing the boiler, and all the other bespoke machinery accompanying it before the planned commissioning date on 1st March 2017 will be just about possible with concentrated effort and determination.

The opportunities for slippage in the schedule are several, and beyond Tomco's control so the planned commissioning date should be considered as tentative at best.

SUPPLY & CONSTRUCTION SCHEDULE FOR 1 TPH PALM OIL MILL



7. The Business Model

In summary, the business seeks to produce and market crude palm oil, and other add value products, taking advantage of the abundance of oil palm fresh fruit bunches available in the area surrounding Makarie. The opportunity exists because of the lack of processing facilities currently available, and also because the farmers would much prefer to sell their fruit for cash than process it themselves because of the arduous labour involved, the time it takes, and the low oil recovery rate.

With much interest already shown by farmers, it is anticipated there will be a very fast uptake, and FFB supply will be strong right from the off. If the FFB estimates turn out to be accurate the 1tph mill will quickly become unable to cope. Once that has been the situation for a few

months sufficient confidence will exist to proceed with the upgrade project to double the mill's processing capacity to 2tph and also to press on with the other add on processing facilities.

For all of 2017 the only saleable products will be crude palm oil, and a small quantity of palm kernels. The palm oil will be sold in 20 litre drums hopefully supplied by customers. Using the sales rate currently prevailing in the local markets will render total sales of $924,425 for the 10 months production in the year.

The year 2018 will see the start of 2tph processing in the palm oil mill, and also the simultaneous commissioning of the CPO packaging facility, both planned for commissioning in the first month of the year. These will be followed by the start-up of soap production during August. The combined effect of all these changes will be a reduction in the volume of sales of CPO in 20 litre containers as the oil is diverted over to the packaging and soap making facilities. The higher value of the products emanating however results in a robust increase in revenue. The sale of CPO in sachets has the largest effect as the soap plant is not commissioned until August. Total sales for the year are $1.844 million, rising to $2.546 million in 2019, which is mostly attributable to the full year of soap production.

The palm oil mill represents the lion's share of operating costs, with personnel and electricity being the major costs after FFB purchasing. For the 3 years production electricity supply averaged 8.6% of total mill operating costs, personnel accounted for 13.6%, and FFB supply 71.3%.

The other major parameters are all clearly shown on the extract below.

The initial investment required for the business is $500,000 which will cover the installation of the 1 tph mill, with further calls for $150,000 for each of 2017 and 2018. These last two calls are modest because of the strong positive cash flow of the business.

8. SUMMARY

As previously stated, the crucial factor in the success of the business is the supply of FFB, and the available evidence all indicates there will be more than sufficient to sustain this business. The next most important factor is the selling price of the products offered to the market, and in these the estimates made have been conservative.

Consequently, as the figures confirm, this has every chance of becoming a successful, thriving business, with further expansion and development options possible that have not even been mentioned here.

SL Palm Oil Business Model				
	2016	2017	2018	2019
FFB TOTAL		**6,591**	**8,012**	**8,303**
PRODUCTION				
CPO PRODUCTION		1,121	1,402	1,453
PK PRODUCTION		297	361	374
SOAP PRODUCTION			120	576
REVENUE				
CPO Bulk Sales		924,425	661,720	515,573
CPO in Sachets			871,560	871,560
CPO to Soap Making			29,822	141,293
Total CPO Sales		**924,425**	**1,539,225**	**1,387,133**
Total PK Sales			**81,121**	**84,063**
Total Soap Sales			**223,920**	**1,074,816**
TOTAL SALES REVENUE		**924,425**	**1,844,266**	**2,546,012**
OPERATING COSTS				
PALM OIL MILL COSTS				
FFB PURCHASING		**395,476**	**480,715**	**498,150**
PERSONNEL TOTAL		**65,600**	**98,520**	**98,520**
FFB TRANSPORT TOTAL		**14,469**	**17,588**	**18,226**
ELECTRICITY SUPPLY TOTAL		**47,328**	**59,062**	**59,062**
MILL MAINTENANCE TOTAL		**21,230**	**26,228**	**26,228**
MILL OPERATING TOTAL		**544,104**	**682,113**	**700,186**
UNIT COST CPO/Tonne		**486**	**486**	**482**
CPO PACKAGING OPERATING TOTAL			**104,787**	**104,787**
SOAP MAKING OPERATING TOTAL			**74,740**	**338,167**
OPERATING COSTS TOTAL		**544,104**	**861,640**	**1,143,140**
GROSS PROFIT		**380,321**	**982,626**	**1,402,872**
Gross Margin		**41%**	**53%**	**55%**
OVERHEADS TOTAL		**41,994**	**62,804**	**71,663**
DEPRECIATION TOTAL		**35,674**	**73,103**	**303,671**
EBIT		**302,653**	**846,720**	**1,027,538**
Margin		**33%**	**46%**	**40%**
CAPITAL EXPENDITURE				
Palm Oil Mill 1 TPH	346,509			
Palm Oil Mill 1-2 TPH UG		215,376		
Site Civil Works Phase 1	119,670			
Site Civil Works Phase 2		120,197		
CPO Packaging Plant 2TPD		145,800		
Soap Plant 2 TPD			274,800	
8T Truck Costs	20,000	60,000		
CAPITAL EXPENDITURE TOTAL	**486,179**	**541,373**	**274,800**	**0**
CASH FLOW				
Opening Position		13,821	69,505	927,331
Capital Introduced	500,000	150,000	150,000	
Revenue		991,161	1,844,266	2,546,012
Capital Expenditure	-486,179	-541,373	-274,800	
Operating Expenditure		-544,104	-861,640	-1,143,140
Closing Position	13,821	69,505	927,331	2,330,203