



MIT SCALE RESEARCH REPORT

The MIT Global Supply Chain and Logistics Excellence (SCALE) Network is an international alliance of leading-edge research and education centers, dedicated to the development and dissemination of global innovation in supply chain and logistics.

The Global SCALE Network allows faculty, researchers, students, and affiliated companies from all six centers around the world to pool their expertise and collaborate on projects that will create supply chain and logistics innovations with global applications.

This reprint is intended to communicate research results of innovative supply chain research completed by faculty, researchers, and students of the Global SCALE Network, thereby contributing to the greater public knowledge about supply chains.

For more information, contact
MIT Global SCALE Network

Postal Address:
Massachusetts Institute of Technology 77
Massachusetts Avenue, Cambridge, MA 02139 (USA)

Location:
Building E40, Room 267
1 Amherst St.

Access:
Telephone: +1 617-253-5320
Fax: +1 617-253-4560

Email: scale@mit.edu
Website: scale.mit.edu

Research Report: MISI-2015-13
Upstream Supply Chain Analysis for Oil Palm
Mohamed Amine Ben Chikh El Fegoun

For full thesis version please contact:

Professor Shardul Phadnis

Director of Research

MISI

No. 2A, Persiaran Tebar Layar, Seksyen

U8, Bukit Jelutong, Shah Alam,

40150 Selangor, Malaysia.

Phone: +6 03 7841 4845

Email: sphadnis@misi.edu.my

Upstream Supply Chain Analysis for Oil Palm

By Mohamed Amine Ben Chikh El Fegoun
Thesis Advisor: Dr. Asad Ata

Summary:

Once a company goes to palm oil supply chain, it goes incredibly complex. This thesis targets to study the upstream supply chain in Malaysia focusing on a simple dealer model. Players in the upstream include: Independent Smallholder Farmers (ISHFs), Collection Centers (CCs), Dealers and Mills. In this project, value chain mapping and quantitative analysis were used. Results demonstrated the complexity of the supply chain to trace backward sustainability, and identified inefficiencies residing between ISHF and mill. Ways to avoid these inefficiencies and to improve the system were presented.



Mohamed Amine Ben Chikh El Fegoun received his M. Sc. in Micro & Nano-Systems from the Swiss Institute of Technology of Lausanne (EPFL). As an undergraduate, Amine received a B. Sc. in Microengineering from the EPFL. Prior to the MSCM program, he worked for Endosense (today St. Jude Medical), a Geneva-based biomedical company in the clinical department.

KEY INSIGHTS

1. Higher value created to the FFB product and most profit made by the ISHF. However, ISHF and mills have a less equitable share of the pie and the system seems to be biased toward the CC.
2. RSPO certification would create a win-win situation for the ISHF and dealer: ISHF would face an increase of at least 11% in his yearly profit compared to 18% for the dealer.
3. The variability in the monthly supply and an increased volume of supply would not impact the overall working process of the system and specifically the mills.

Introduction

Applying a “comprehensive” plan for sustainable supply chain for most of the consumer goods companies and fast-food giants in their palm oil sourcing would provide probably one of the biggest challenges in their ability to trace and eliminate controversial materials from their products. These sustainable plans essentially focus on

reducing deforestation in sourcing palm oil. Thus, several companies and food providers are placing new efforts to target ingredients that meet the increased concern and demand for health- and socially-conscious consumers (Phillips et Morris 2015).

Palm oil presents special challenges in the supply chain, because it is used in different ways in different products. Even if a company has only one major supplier, this doesn't solve the problem. In fact, that may represent only a tier supplier and this latter may have multiple sub-tiers of suppliers that in turn may have a multitudinous source of palm oil. This may include thousands of independent smallholder farmers, with many dealers in between. For instance, a mill may take its Fresh Fruit Bunch supply from various sources mixing them together then processes the oil and send Palm kernel extracted to Kernel Crushing plants. Thus, trying to move backward to trace and figure out the sustainability may not be feasible in some case, which supports the incredible complex aspect of the upstream supply chain in the Oil Palm industry, specifically in Malaysia.

This paper helps establish a better understanding of the upstream supply chain via a series of field trip and data collection designed to identify the different challenges residing in upstream SC and illuminate on how inefficiencies may be avoided to achieve a sustainable production in Malaysia and trace backward the palm oil supply.

The Oil Palm industry

The palm oil, like any edible vegetable oil, is extracted from a plant, namely the oil palm. The palm oil is the most produced tropical oil worldwide providing the highest yield compared to all other sources of oil such as soybean, rapeseed or sunflower. It is also used to make biofuel. Two to three year after palm plantation, ripe fruits are ready to be collected in the form of Fresh Fruit Bunches (FFB). Each FFB contains a bunch of fruitlets that are the source of the palm oil. The fruitlet is composed of two main parts: the fibrous Mesocarp, which would provide the Crude Palm Oil (CPO) and the Palm Kernel, which would produce the Palm Kernel Oil (PKO). The Palm Oil and the Palm Kernel Oil are slightly different from their composition and especially their ratio of saturated and unsaturated fatty acids. Palm Oil has a balanced ratio between saturated and unsaturated fatty acid and Palm Kernel Oil has mainly saturated fatty acids, which is broadly similar to the composition of coconut oil.

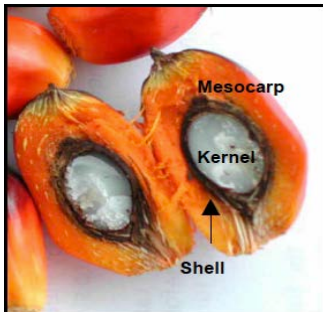


Figure 1 Cross Section of a Fruitlet (WWF 2002)

The special interest to palm oil comes primarily from its characteristic for high productivity up to 10 times higher than any other edible oil, which allowed a lower cost for a high outcome, and that palm oil represents one of the few highly saturated fats (palm oil 41% saturated and palm kernel oil 81%). According to US department of Agriculture, around 62.4 million of palm oil was produced in 2014 worldwide for the use of thousands of products ranging from cooking oil, cleaning products to cosmetics. With a continuous growing global demand for palm oil, the Oil Palm industry experienced a large-scale expansion of oil palm plantation in many parts of the world. As one of the main producer of palm oil worldwide, Malaysia, together with Indonesia, produce about 85% of the world's palm oil in 2012.

Often the expansion of Oil Palm industry has environment and social costs where the expansion takes place at the expense of forest area, peatlands and people local's land

that lead to environmental degradation and loss of ecosystem services, loss of biodiversity, increasing land conflict and anthropogenic climate change (WWF 2008). Therefore, large-scale palm oil production and growth has increased public concerns regarding the environmental and social impact and an increased need for sustainability and accountability.

During the last decade, many organizations and actors from different sector of the Oil Palm industry have worked on developing and applying global standards for sustainable palm oil. The Roundtable for Sustainable Palm Oil (RSPO) was created in 2004 as a non-profit association under Swiss Law to promote the crop and use of sustainable palm oil.

The supply chain in the Oil Palm industry consists of many businesses from the upstream FFB growers to the downstream Oleochemical manufacturer. These businesses are linked together across the value chain from the upstream to the downstream and may be divided into 4 sub-sectors: FFB growers and millers define the upstream supply chain where the refiners and oleochemical manufacturers compose are part of the downstream. Refiners include refiners for CPO and Kernel Crushing Plants for processing the Crude Palm Kernel Oil (CPKO).



Figure 2 Value Chain of the Oil Palm industry (Source: Author)

In the Malaysian landscape, there are several categories of FFB growers. In this study, only ISHF are considered within a simple dealer model. The ISHFs are unorganized smallholders and play a significant role in the Oil Palm industry with a farm size less than 4 Ha. They are considered as essential to the industry due to their cumulative significance in terms of planted area of 15% in 2014 and production.

Methodology

In this study, the work was divided into several steps. First we restricted the scope to a simple dealer model as illustrated below. The model only considers ISHF as source of FFB. The reason to study the ISHF as growers is that all the ISHF in the mills' network were not RSPO-

certified for sustainable production. The model also include collection center as an aggregating point and only company mills. The dealer plays the role of intermediate and license holder between the CC and the mill.

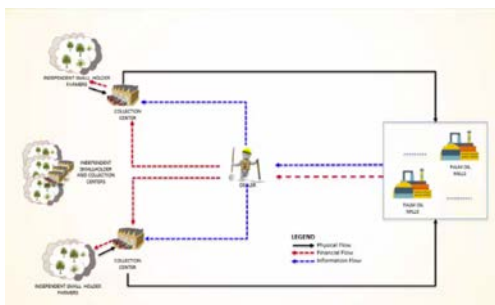


Figure 3 A simplistic Model for the Upstream Supply Chain: Dealer 1 (Ata et. al 2015)

The analysis was based essentially on the value chain mapping, defining attribute for each actor of the upstream to identify the value created to the product and profitability of the system. This was followed by a sensitivity analysis to assess the system reaction to a change in the ISHF production cost and ISHF income. Once the value chain completed, the financial impact of sustainable production on the ISHF and dealer was studied. Further, the variability of the monthly supply to the mills was analyzed. Finally, a comparison of the cost of two supply chain models for RSPO-certified production was performed, namely the Book & Claim model, used through the GreenPalm platform, and the Mass Balance system.

Results

This research first reaffirmed the supply-driven aspect of the SC where the ISHF deliver to the collection center whatever they collect. Results show that the ISHF create the most value with up to 67% of the total value created and benefit with the highest share of the pie with 64% of total profit across the SC. However, the delta difference between these percentages is -3% for ISHF where the mill has a delta of -4% and the CC + 7%. This “delta” metric provides a direct measure of the equitability of the share of the pie between the stakeholders. Results indicated that ISHFs and mills are having a less equitable share of the overall value chain. It seems that existing system is structured so as to favor the collection centers, while the ISHFs are at a disadvantage as showed in Table 1.

The analysis on the impact of sustainable production on the system showed that the both ISHF and dealer would

Table 1 Quantitative Analysis of the Value Chain

Actors	Purchasing Price	Selling Price	Production Cost	Total cost	Value Added	% Added Value	Net Profit	% Of Total Net Profit	% Profit - % Value added
ISHF	RM 105	RM 428	RM 149	RM 254	RM 323	67%	RM174	63.85%	-3%
CC	RM 428	RM 514	RM 18	RM 446	RM 86	18%	RM 68	24.89%	7%
Dealer	RM 514	RM 516	RM -	RM 514	RM 2	0.415%	RM 2	0.73%	0.320%
Mill	RM 516	RM 588	RM 43	RM 559	RM 72	15%	RM 29	10.53%	-4%
Total			RM 210	RM 1,773	RM 482	100%	RM272	100%	0%

benefit from an increase of their profit. In fact, the ISHF would see his yearly profit increased by more than 11% up to 18% where the premium price increase from 0 to 2%, respectively. This higher income for ISHF is essentially obtained from the increase in ISHF’s yield by 3 tones per hectare per year.

Concerning the supply-demand mismatch analysis, results showed that the monthly variability in the FFB supply would not impact the system and especially the mill’s working capacity. The analysis provided further that a potential increase in the supply, due to a higher yield from a sustainable production for example, would not impact the system and mills as well. In fact, Results showed that the mills generally operate way below their maximum capacity where in average for the 4 mills studied for the year 2014, only 56% of the available capacity was used.

In addition to that, this paper showed the suitability of the Mass Balance supply chain model compared to the Book & Claim system where a Downstream Manufacturer would save at least US\$ 0.3 million up to US\$ 1.7 million from a supply base of 100 k mT of FFB in 2014.

Conclusions

This work demonstrated one more time the complexity of the palm oil supply chain in Malaysia in the study of simple dealer model. This provides direction for further analysis of other models for comparison and industry benchmark in Malaysia and other nations. Beside, RSPO certification was demonstrated as a key solution to increase the overall efficiency of the system and help protect the people and environment.

Works Cited

Phillips, Erica E., and Betsy Morris. "Food Companies Scramble to Cut Palm Oil From Supply Chains." *The Wall Street Journal*, April 29, 2015.

Ata et. al. "Sustainable Sourcing for Palm Kernel Oil Supply Chain, The P&G Initiative for Independent Small Holder Farmers & Small Growers." Shah Alam: MISI, 2015.