

### Access to Finance: The Cocoa Case Cocoa Sector Training for Financial Institutions

Part 1: Cocoa Sector Training

A Short Description of Cocoa Cocoa in Indonesia State of Indonesian Cocoa Farms The Concept of Value Chains Description of Value Chain Actors Key Constraints & Opportunities in the Indonesian Cocoa Sector Cocoa Beans – Quality, Categories and Prices Cocoa Production Certification & Traceability Pictures, Definitions, and Processes

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BI	Bank Indonesia
BPR	Bank Perkreditan Rakyat (People C
BPRS	Bank Perkreditan Rakyat Syariah (I
BRI	Bank Rakyat Indonesia
cm	Centimeter
CPB	Cocoa Pod Borer
CSSV	Cocoa Swollen Shoot Virus
FI	Financial Institution
FOB	Free-On-Board
g	Gram
GAP	Good Agricultural Practice
GFP	Good Financial Practice
GHG	Greenhouse Gas
GIS	Geographic Information System
GNP	Good Nutritional Practice
ha	Hectare (= 10,000 m2 = 2.5 acre)
IDR	Indonesian Rupiah
JFX	Jakarta Future Exchange
К	Potassium
m	Meter
MFI	Microfinance Institution
mm	Millimeter
MIS	Management Information System
MT	Metric Ton (= 1,000 kg)
Ν	Nitrogen
Р	Phosphorus
PsPSP	Panen sering, Pemangkasan, Sanit
	harvesting, pruning, sanitation and
SCPP	Sustainable Cocoa Production Prog
SNI	Standard Nasional Indonesia (Indor
ToT	Training of Trainers
VC	Value Chain
VSD	Vascular-Streak Dieback

### **ABBREVIATIONS**

Credit Bank, rural bank) Islamic People Credit Bank, rural bank)

tasi, Pemupukan (frequent d fertilization) ram onesian National Standard)

Cocoa Sector Training for Financial Institutions

# INTRODUCTION

Indonesia is home to 1.3 million cocoa farmers who are primarily classified as smallholders. As is the case with many smallholders in developing countries, the Indonesian cocoa farmers' lack of Access to Finance (A2F) is inhibiting them from reaching their full production potential. A2F includes access to loans, savings, insurance, and other financial products and services. While the first two topics are very important in the context of this manual, the latter two will only be touched on briefly. It is obvious that not every single cocoa farmer is eligible for a loan, but in absolute numbers there are still a huge number of farmers out there who have potential to become a good loan client. These farmers are concentrated in the several cocoa producing regions throughout the country, making them a promising target group for loan products.

In fact, a loan is nothing more than a future saving. Rather than just promoting loans, savings are encouraged to help ineligible farmers gain access to financial services. This allows farmers to build assets. For financial institutions this is a low-cost refinancing option. Both savings and loans could be used to purchase input material, maintain the farm, and improve production through investment. Cocoa is a very interesting crop since it can be harvested throughout the year. This means that even in the low season, cash flow can be generated. This makes cocoa different from other crops. Professional cocoa farming requires special skills and farmers working in the sector usually have years of experience. This is due to the fact that cocoa is a tree crop and needs time to establish itself before it begins to bear fruit. The economic life of a tree is about 30 years.

To make informed decisions, a financial institution has to become familiar with and understand the cocoa sector (or use an agent who does). Therefore, it is important to answer all the questions a financial institution might have so that they can become confident and positive about giving loans to cocoa farmers. The present manual is an attempt to do so

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and will provide you with the necessary information to understand the cocoa sector and offer insight into financing cocoa in Indonesia. It will explain value chains, risks, farming practices, cash flows, and so forth. In addition, the manual will also suggest feasible financial products to help address the issues of Access to Finance for cocoa farmers. With this understanding, you will be able to assess risks better, minimize them and offer commercially attractive products to the target group. Only then cocoa farmers and financial institutions will benefit from a long-lasting and mutually advantageous relationship.

Many farmers lack experience with loans from commercial institutions or even farmer organizations, although, many have borrowed from/lent to family and friends and/or received financing from traders. They are used to flexible solutions without formal collateral requirements. Basic expectations in working with a bank must be made clear, such as the importance of repaying on time.

The manual is written from a banker's point of view and will be used for a three-day training program. This in-person training program is directed at bank workers from various positions, especially loan officers, and is to be used as a reference for your daily work. In order to keep it short and concise, some technical/agricultural topics are touched on briefly, but are not explained in academic detail. Some references to economics are made to understand the risks. With this, we hope that financial institutions will understand the cocoa sector better and will design appropriate products, but also act in a responsible way to help avoid over-indebtedness of farmers. Swisscontact trusts that financial institutions will use this information to provide better financial services to cocoa farmers.

### 1. A SHORT **DESCRIPTION OF** COCOA

Cacao (Theobroma cacao L.) is a tropical tree crop, growing in the shaded understory of rainforests where it can reach 20 m in height.

The genetic origin of cacao is traced to the so-called Upper Amazon in South America. Thus, the Amazonian region of Peru is the original homeland of cacao<sup>1</sup>. At maturity a cultivated tree tends to be kept to less than 4 m tall. Cacao trees have been recorded to live for up to 200 years in their natural environment, however, the economic life of a cacao tree is about 30 years. The tree is at its most productive for about 25 years, yet smallholder cocoa farmers tend to try and harvest their crops for around 40 years or longer. The lifespan of modern varieties is shorter and the soil around them is depleted after 20-25 years if not maintained through soil productive for about 15 years.

The root system of a mature tree is comprised of a taproot up to 2 m long and a dense system of lateral roots in the top 20 cm of the soil. These roots spread out to lengths of 5-6 m forming a dense surface-feeding mat. The flowers are produced in clusters directly on the trunk (*cauliflory*) and on branches when they are at least two to three years old. The flowers are small, 1–2 cm in diameter, and are pollinated by Forcipomyia midges. These midges are between 1-4 mm and belong biologically to the fly family. They require cool, dark, moist habitats and breed in rotting vegetation. Only 1-5% of flowers are successfully pollinated and form pods. Cacao trees have a fruit thinning mechanism where the young fruit (cherelles) stop growing, turn black and shrivel, but do not fall off the tree (cherelle wilt). The remaining fruit take five to six months to ripen after pollination. The fruit is an ovoid pod, 15-30 cm long, 8-10 cm

<sup>1</sup>Chobachoba.com

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wide, and weighs about 500 g when ripe. The pod contains 20 to 60 seeds, better known as beans, embedded in a white pulp. Each seed contains a significant amount of fat (roughly 40–60%) depending on the genotype, which is extracted to produce cocoa butter. Their most noted active constituent is *theobromine*, a compound similar to caffeine. Once fermented, beans can be processed into cocoa butter and cocoa powder. It takes about 400 beans to make approximately 0.5 kg of chocolate. Traditionally, the cacao tree begins to bear fruit five years after planting, but advances in breeding have produced varieties that can start fruiting in their third year. The pace of decline and shade management. In Indonesia trees are after a period of high production is determined mainly by cultivation practices, but production costs rise steadily. Harvest season depends on the area since it can vary significantly from region to region.

> Hybrid cacao trees are preferred because they are more resistant to known diseases and they yield a higher tonnage per hectare. For example, a cocoa farm that is cultivated under the traditional system with minimal maintenance may typically get a yield of 300 to 500 kg per hectare annually. While newer hybrids cultivated commercially under ideal farming conditions have been known to yield as much as 3,000 kg/ha/year.

The successful cultivation of cocoa requires a special climate. The majority of the world's crop is now grown within 10° North and South of the equator. It will grow from sea level up to a maximum of about 1,000 meters, although most of the world's crop grows at an altitude of less than 300 meters. Temperatures must generally lie within the range of 18° - 30°C, with 10°C as the absolute minimum temperature that the plants can handle. Rainfall must be well distributed across the year, with a minimum of 1,000 mm. Excessive rain affects the bean size negatively; too little rain results in little flowering and thus the tree bears less pods. The trees must be protected from strong winds (the root system is not robust).

Wind can mechanically damage the *pulvinus* at the baseof the leaf leading to leaf-fall anddefoliation. Cacao

likes a soil high in organic material and rich in nutrients. Nutrients found in the decaying cover of leaf litter on the rainforest floor are an important food source for cacao trees. Most of the nutrients in rainforest soils can be found in the topmost layer of decaying vegetation. Pests and diseases must be carefully controlled. Cacao prefers to grow in partial shade, but for full production the crop requires 4.5 to 6.5 hours of sunshine per day.





Figure 1: Cacao Tree and Its Parts

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# 2. COCOA IN **INDONESIA**

Indonesia's Ministry of Agriculture first began recording data on cocoa in 1967. Since then the area where cocoa is planted has expanded, yet the productivity has been declining since 2003.



Figure 2: Indonesian Cocoa Production 1967-2013

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#### (The area in ha and the production in MT use the left axis values and the productivity in kg/ha

The provinces that produced the most cocoa in 2013 are mainly located in Sulawesi and Sumatra:

Province	2010	2011	2012	2013
Sulawesi Tengah	138,306	124,777	144,358	149,071
Sulawesi Tenggara	141,176	114,578	122,960	120,243
Sulawesi Selatan	173,755	142,829	146,840	117,672
Sulawesi Barat	96,011	80,194	76,158	71,823
Sumatera Barat	49,388	44,613	48,113	58,740
Sumatera Utara	63,425	54,515	36,188	31,789
Jawa Timur	24,199	24,788	28,575	30,364
Aceh	27,625	24,596	20,609	28,329
Lampung	26,539	20,721	23,765	25,507
Nusa Tenggara Timur	12,978	8,815	11,190	11,755
Maluku Utara	12,884	9,846	11,021	10,656
Рариа	12,897	9,539	10,305	9,768
Maluku	7,819	9,755	11,706	8,555
Kalimantan Timur	8,063	8,051	7,960	6,927
Bengkulu	5,098	4,102	4,546	4,672
Sulawesi Utara	4,963	3,661	4,231	4,434
Papua Barat	4,665	3,526	4,651	4,277
Bali	6,177	3,668	4,137	3,967

Province 2010 3,669 Gorontalo 3,321 Riau Sumatera Selatan 2,105 2,108 Banten 2,062 Jawa Barat 2,270 Kalimantan Barat 2,678 Jawa Tengah 1,272 Nusa Tenggara Barat 1,199 DI Yogyakarta 841 Jambi Kalimantan Tengah 287 Kepulauan Bangka Belitung 66 72 Kalimantan Selatan 0 Kepulauan Riau DKI Jakarta n.a. Kalimantan Utara n.a. Total 837,918

Aceh



94,075 ha

37,507 ton

Bali

Nusa

Tenggara

Papua

### Sulawesi 984,040 ha 460,024 ton

Source: Indonesian Agricultural Ministry

South-East South Sulawesi Sulawesi

Bali - Nusa Tenggara 70,133 ha 15,682 ton

#### Figure 3: Cocoa Producing Provinces in Indonesia

*Source: Indonesian Agricultural Ministry* 

2011	2012	2013
2,904	3,705	3,826
3,586	3,520	3,631
2,001	2,551	2,837
1,647	2,911	2,586
2,622	2,620	2,427
1,895	2,274	2,032
2,383	2,369	2,012
975	1,303	1,166
845	1,050	853
490	467	512
193	209	205
64	139	151
51	81	74
0	1	1
n.a.	n.a.	n.a.
n.a.	n.a.	n.a.
712,230	740,513	720,862

 Table 1: Indonesian Cocoa Production 2010-2013 by Province (Metric Tons)



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# **3. STATE OF INDONESIAN COCOA FARMS**

11,5%. Old trees (Not yielding anymore)

70.9%.

Figure 4: Cocoa Farm Composition



State of Indonesian Cocoa Farms

### Cocoa Farm Composition (%)



**7,7%** Shade trees, fruit trees & other farm land use





Photo 2: Cacao Trees at Several Life Stages and Shade Trees



Figure 5: Age of Cocoa Farm



Figure 6: Average Farm Age in Selected Provinces

#### State of Indonesian Cocoa Farms

#### 1 Growing and harvesting

The cacao tree only grows in equatorial climates. More than 5 million family farms across West Africa, Southeast Asia and Latin America produce nearly 4 million tonnes of cocoa beans every year. When the

#### 2 Fermenting and drying

days to ferment and develop their flavor, after which they are dried in the sun for

### **3** Collection and shipping

The farmers bring sacks of cocoa beans to collection centers of Intermediaries for weighing and quality checks. The beans are then sold and transported to one of our factoriesfor further processing.



#### 4 From bean to cocoa liquor

The beans are cleaned, dried, blended, and broken to remove the shells. The nibs inside are roasted and ground to a fine can be used as an ingredient for chocolate or further processed into cocoa powder and cocoa butter

#### 5 Making chocolate

Cocoa liquor and other ingredients are mixed and pressed between rollers to form a fine powder. This chocolate powders is kneaded for hours in conches to

### 6 Molding and delivery

The liquid chocolate is stored in large hated tanks so that it can be pumped later on and transported to industrial customers, or it is molded into shape and then packaged for transport and delivery to artisanal customers.



# 4. THE CONCEPT **OF VALUE CHAINS**

In general, a value chain can be defined as the process to bring a product like cocoa through the different phases of production and transforming it to an endconsumer product. It is a system, made of sub-systems, each with inputs, transformation processes and outputs. This involves the acquisition and consumption of resources.<sup>2</sup>

<sup>2</sup> Worldbank, UNIDO

(22)

# **Indonesian Supply Chain Stakeholder**



Source: USAID, adjusted by SCPP

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The Concept of Value Chains

#### 5.1. Agri-input Providers

The major inputs for smallholder cocoa production are seedlings, planting material, tools, fertilizers, and pesticides. Most farmers obtain seedlings and planting material from their own or neighboring farms/nurseries. Cocoa farmers typically buy their tools, fertilizers and pesticides from small retail shops/kiosks in nearby towns. However, there is limited access to inputs for farmers who do not live near towns, especially access to commercial fertilizer and pesticides. There is no subsidized fertilizer specifically made for cocoa. Additionally, during fertilizing seasons, other crops such as rice are claiming a large amount of fertilizer as well. Therefore, the quantity and availability of fertilizer is not always guaranteed which makes it difficult for cocoa farmers to care for their farms properly.



Photo 3: Agri-inputs

#### 5.2. Producers

Smallholders remain the predominant producers of Indonesian cocoa (93%), followed by state plantations (4%) and private estates (3%).

Unfortunately, smallholder farmers' knowledge and implementation of 'best-practice' cocoa farm husbandry techniques is limited as can be seen in the declining average productivity (see figure 2). Smallholders can improve their knowledge through trainings. Trainings are provided by the government, farmer organizations, or other service providers such as Swisscontact's Sustainable Cocoa Production Program (SCPP), which also developed this present manual.

# 5. DESCRIPTION OF VALUE CHAIN STAKEHOLDER

The Indonesian cocoa value chain is long and involves multiple players, with large influence of the international grinders. It has evolved to be quite transparent and efficient with the smallholder farmer receiving up to 80% of the world's market price. Traceability has become more and more important to track the cocoa beans the entire way, from the farmer to the consumer.





Photo 4: Smallholder Farmer



#### Some farmer statistics:<sup>3</sup>

The average age of cocoa farmers participating in SCPP is 44.7 years. The life expectancy in Indonesia is 69 years for men and 73 years for women.<sup>4</sup> 22.99% of the farmers are young.<sup>5</sup>



38.46% of the farmers have completed elementary school, while only 2.70% of the farmers did not go to school at all.<sup>6</sup>



The gender of the registered farmers who are participating in SCPP's Good Agriculture Practices (GAP) training is 81.3% male and 18.7% female.



GAP Participants by Gender

Figure 11: GAP Participants by Gender

<sup>3</sup> Many more information can be found in SCPP's AFF Baseline Report (2016).

<sup>4</sup> WHO, 2012. Life expectancy at birth.

<sup>5</sup> The Age Distribution chart was changed according to the ILO definitions, which regards young people to be under the age of 35.

<sup>6</sup> For 1.85% of the farmers, no information regarding school attendance is available. SCPP tries to work with literate farmers to ensure the best possible understanding of the materials and knowledge taught.

The majority of farmers have either a medium sized farm (44.59%) or small farm (41.79%). Only 13.62% are considered to be large farms. The average farm size is 0.99 hectare per cocoa farmer household. Certified farmers participating in the SCPP have an average of 1.13 ha, 13% more land than uncertified farmers.

12.29% of the farmers are considered professional and 31.43% as progressing. There is a lot of potential to support unprofessional farmers and bring them into the progressing category.

	Unprofessional	Progressing	Professional	Total
Small	22.96%	13.85%	4.97%	41.79%
Medium	26.94%	14.40%	3.25%	44.59%
Large	6.38%	3.17%	4.06%	13.62%
Total	56.28%	31.43%	12.29%	100.00%

Figure 12: Categorization of Farmers by Professionalism and Farm size

By definition professional farmers have higher production per hectare than unprofessional farmers. This results in higher cash flow per hectare and would be preferred over unprofessional farmers for business loans.<sup>7</sup>



#### Figure 13: Yields and Tree of Different Farmer Categories

<sup>7</sup> The limitations of a categorization lay in the categorization criteria. Instead of yield per hectare, yield per tree could also be used.

Compared to unprofessional farmers, professional cocoa farmers have 17.97% more trees per hectare (860 vs. 729) and a 4.05 times higher yield per tree (1.50 kg/tree vs. 0.37 kg/tree), totaling to a 4.8 times higher production per hectare (1,293 kg/ha vs. 267 kg/ha).

On average, the top 10% of the farmers have a much higher annual farm yield of 1,177 kg/ha than the bottom 10% with just 205 kg/ha.



Yield (Kg/Ha)

Figure 14: Yield Differences between Best and Worst Farmers

42.66% of the cocoa farmers have experience with loans from various sources, while 57.34% do not have any loan experience.

From all farmers with loan experience, 13.10% received a loan from a bank.



Figure 15: Loan Experience of Cocoa Farmers

Figure 16: Share of Bank loans on All Loans

#### 5.3 Collectors

There is a strong informal local trader network in the Indonesian cocoa sector. Up to 90% of farmers sell their cocoa directly to local collectors at the farm-gate or to local traders at warehouses.<sup>8</sup>

Local collectors are usually cocoa farmers themselves, farmer groups or rural entrepreneurs who purchase cocoa beans directly from farmers, collecting them by motorbike, pickups or small trucks. The scale of these purchases is usually small with a quick turnover, small margin, and minimal opportunity for speculation.

Typically, collectors and smaller traders do not provide a premium for quality or price discrimination.



Photo 5: Village Collector

<sup>8</sup> The words "trader" and "collectors" are often not distinguished.

Sometimes collectors/traders provide informal loans to farmers. When smallholders are indebted to the traders there is the perception that they have to sell to that particular trader. Usually such loans are highly flexible and do not require collateral.

It is more common for farmers to sell to local collectors at farm gate or directly to local traders. There are only a few examples of cooperative-type grouping or group marketing among smallholder farmers. Most smallholder farmers prefer to deal independently with private collectors and traders.

**Description of Value Chain Stakeholde** 

TRADER WEIGHING COCOA BEANS IN A BUYING STATION



#### 5.4. Middlemen/Traders

Local traders purchase cocoa beans from local collectors and occasionally directly from farmers. Traders are usually engaged in a variety of other businesses, typically trading in other commodities as well. Local middlemen are a source of pre-harvest finance for about 20-50% of cocoa farmers, either in cash or in-kind (agri-inputs).

Traders sell most of their cocoa beans to local exporters although a smaller amount flows to local processors. Collectors do not need licenses or permits to operate, so competition is fierce with few barriers to entry. Traders need a business permit from the local government.

These smaller traders typically deal in a range of commodities depending on the region (clove, cashew, coffee, etc.). Maintaining loyal relationships with individual farmers is key, but proves to be difficult due to high competition among traders seeking cocoa. This results in farmers preferring to side-sell their cocoa to multiple traders so they can get the best price. However, loyalty is often high, although farmers sell to more than one trader.

At buying stations and warehouses the beans are further bulked, cleaned and calibrated before they are traded in to international buyers/processors. Larger international firms establish local or 'up-stream' buying stations to source cocoa locally and directly from the farmers. Based on direct farmer sales to buying stations, 86% of sustainable certified farmers sell directly to buying stations to keep the certification sales channel rather than selling through middlemen.



Photo 6: Buying Station

#### 5.5. Processors

Cocoa processing, or grinding, entails the transformation of dried cocoa beans into a variety of processed products including cocoa paste/liquor, cake, powder and butter. Processors have strict quality standards and expect their suppliers to meet these standards.



Photo 7: Cocoa Factory

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#### 5.6. Exporters / Commodity Traders

Local exporters buy from collectors and traders who deliver beans to their storage facilities. Many of these local exporters have found it increasingly difficult to compete with the large-scale international exporters and have begun to sell to them rather than continue to export independently.

Due to the introduction of an export tax a few years back, cocoa beans are more frequently being processed in Indonesia and only processed products like cocoa powder or butter are exported.

Large multinational companies active in Indonesia are Barry Callebaut, Cargill, Ecom and Olam.







Photo 8: Certified Cocoa in a Warehouse

#### 5.7. International Cocoa

Grinders

Within a short span of time, the grinders have become the most powerful actors in the cocoa value chain. This is mainly due to ongoing horizontal and vertical integration, which refers to the concentration process in the grinding segment and the outsourcing of liquid chocolate respectively.

Cocoa grinders have a highly concentrated market structure. The ongoing concentration process in the grinding segment is very dynamic. Big companies operating in Indonesia are Barry Callebaut and Cargill (both are also active in other commodities and act as traders too).

Photo 9: Vats Containing Liquid Cocoa in a Processing Center

#### 5.8. Farmer **Organizations**

Indonesian cocoa farmers are traditionally organized in village-level groups of 25 to 30 farmers, so they can access extension services and cooperate in laborintensive activities like pruning, weeding and pod sanitation. Formal farmer organization in cooperatives is very low. Less than 10% of the farmers are members of a farmer organization. Farmer organizations will become more important players in the future as they continue to represent the interests of the farmers and provide different kinds of services for farmers, e.g. trainings, trade, fertilizer retail services, support in land registration, etc. Furthermore, farmer organizations have potential to become an intermediary for savings and loans.



Photo 10: Farmers Organized in Groups

#### 5.9. Service Providers

Currently the global cocoa sector oversees several initiatives that focus on increasing production to ensure a stable supply of beans, which also improves the livelihood of smallholder farmers. Part of these efforts is farmer capacity building such as facilitating trainings in Good Agricultural Practices. In addition, attention is also paid to family nutrition, environmental impacts, business practices, community development, and farmers' Access to Finance.

In Indonesia there are a number of service providers active. The implementation of programs through such providers is dynamic. Banks could partner with such organizations to provide better access to finance for cocoa farmer households (e.g. savings) and to identify potential loan clients with sufficient repayment capacity.



Figure 17: Sustainable Cocoa Production Program (SCPP)

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**Description of Value Chain Stakeholde** 



Based on this outlook, and in collaboration with potential key partners, major restrictions potential solutions reflected areas that must be upgraded to ensure greater production and competitiveness of various actors along the cocoa bean value chain.

The major value chain constraints and opportunities in the Indonesian cocoa sector are presented in the table below and give financial institutions an idea of challenges in the sector, but also how to overcome them.

#### CONSTRAINT

#### **Farmer Behavior**

Farmers' mindset and willingness to upgrade production. "Tree crops do not need to be taken care off" is a common perception.

Price differentials alone, however, do not Hold farmer field days as a medium for farmers to appear to be a sufficient incentive for all share their experience regarding their results and farmers to invest in greater farm productivity obstacles. or bean quality

#### **On-Farm Productivity**

Cocoa farm productivity and farmers income is Work closely with the private sector to assist in decreasing due to a number of causes includeducating their trainers who then provide intensive training to their targeted farmers ing:

- Poor adoption of GAP •
- Widespread infestation of pests and diseases (primarily the Cocoa Pod Borer -CPB, Black Pod)
- Age and variety of existing tree stock
  - Poor soil management
- Unstable climatic conditions (drought and flooding)

## **6. KEY CONSTRAINTS & OPPORTUNITIES** IN THE INDONESIAN **COCOA SECTOR**

The cocoa industry believes that the global cocoa market can and will absorb any supply/production increase in the medium term

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#### POTENTIAL OPPORTUNITY

Conduct farmer group development, working together to resolve the problems with leading firms' field staff

Develop a manual standard highlighting good and climate-smart agricultural practices

Establish/scale up cocoa demo plots as a medium for the transfer of technology

Conduct cocoa workshops to transfer knowledge and assist in the implementation of the needed skills, know-how, and information to improve cocoa productivity

CONSTRAINT	POTENTIAL OPPORTUNITY
se of Inputs	
Limited commercial distribution and availabili- ty of improved agricultural inputs and planting materials for smallholder farmers	Coordinate with government research facilities to assist in awareness and distribution of improved tree stock
Farmers lack instruction on the use of appro- priate fertilizers and pesticides, when to use them, and in what amounts	Strengthen and support farmer organizations in functioning as local agri-inputs and services distributors
	Continue farmer group development by providing the groups with the technical skills on how to develop a commercial cocoa nursery
	Link and work with input supply companies to develop and distribute special fertilizer "packag- es" for cocoa, based on soil analysis and provide additional services.
Market Access	
Many smallholder farmers are unable to sell their production in large volumes and there- fore cannot benefit from direct sales with	Improve skills, knowledge and capacity through group development and management training
exporters and processors	Encourage transparent market price signals across the entire value chain
	Promote access to up-country buying stations where smallholders can bring cocoa beans for direct sale to exporters and processors
Access to Finance	
Smallholder farmers lack access to acceptable collateral for financial institutions. As a result, farmers are not able to finance the purchase	Work closely with financial institutions to improve the availability of and access to credit for small- holder farmers to purchase farming inputs
of inputs. Farmers have access to informal loans, but are	Work on a model for off-take agreements or har- vest guarantees as a way of financial collateral
Some Farmers do not have a saving culture,	Develop a saving culture amongst the farmers to purchase smaller inputs themselves and practice a reaular savina/loan repayment
where to save money.	
Post-Harvest Processing	
The production of fermented cocoa beans in Indonesia is limited which reduces potential quality and value-added opportunities for smallholder farmers	Encourage the downstream processors to reward farmers through price incentives and/or other suitable reward mechanisms to assist in the in- creased fermentation of cocoa beans

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#### POTENTIAL OPPORTUNITY

Access lobbying services to expand the legal status options for farmer groups, and rural enterprises in general, to effectively conduct business operations

Provide farmer groups with the necessary tools to recognize their group status, so they are able to make collective strategic plans and improve their group's status

Collaborate with other organizations to strengthen or scale up farmers and farmer groups to conduct sustainability certifications

Provide group empowerment and train group members in effective internal management systems

Work with the various auditing agencies to simplify certification recording and note taking

Work closely with the private sector to assist farmer groups in the implementation of certified bean programs

Coordinate with key stakeholders in establishing buying units and reward systems for farmers/ farmer groups if they have met the certification requirements

Assist in the availability of financial services for exporters, traders, and processors based on alternative sources of collateral (e.g. inventory)

Work closely with private/public sector who have been actively investing in the development and improvement of the Indonesian cocoa sector

Actively work with and contribute to the CSP as the lead cocoa forum

Host in-depth discussions with cocoa stakeholders through CSP to repeal the export tax on cocoa

rtification, AMARTA I survey 2010 and discussions with the private

#### 7.1. Quality

Quality refers to various aspects, e.g. flavor, purity and grade, but also physical characteristics that affect the yield of edible material.

There are some quality aspects that the grower has little influence on and which depend on the quality of the planting material. Primarily these have to do with the fat content of the beans and flavor characteristics. The former is influenced by the variety grown as well as climatic conditions (notably the rainfall level and the stage of pod development at which the rain falls). Flavor characteristics are influenced by the variety grown, but the grower does have some control over whether or not these develop in the post-harvest processing.

A proper assessment of cocoa quality can take up to an hour.



Photo 11: Quality Assessment of Cocoa Beans

#### 7.2. General Quality Characteristics

#### 7.2.1. Flavor & Off-Flavor

Manufacturers need cocoa beans that can be processed into chocolate with a good flavor, so that consumers will enjoy the taste. This is the most important feature of the cocoa bean, but it is one which cannot be closely defined, nor can it be assessed objectively, as flavor has to be assessed by tasting the chocolate made from a sample of beans.

### 7. COCOA BEANS – QUALITY, CATEGORIES AND PRICES

For Indonesian cocoa the flavor is of less importance, since Indonesian beans – because of their fat content – are used as filler together with flavor beans from other producing countries.

Mold is one of the most significant causes of off-flavor. As few as 4% of beans with internal mold can produce an off-flavor in the entire sample. Mold can be avoided through proper, dry storage. Slaty (unfermented) beans have none of the precursors of chocolate flavor and chocolate made from them has a bitter, astringent and thoroughly unpleasant flavor. Another off-flavor is smoke which is usually attributed to contamination by smoke during drying or storage.

#### 7.2.2. Assessment of Fermentation

The degree of fermentation can be divided into four categories:

- Fully fermented
- Partly brown, partly purple
- Fully purple
- Slaty



Photo 12: Fermented beans

#### 7.2.3. Purity

Purity refers to contamination. The main source of contamination is the use of pesticides. Manufacturers are concerned that they affect the flavor, governments are concerned that they leave toxic residues. Contamination is checked during import procedures and contaminated beans are not allowed to be imported in various countries, e.g. Japan.

#### 7.3. Physical Characteristics

A cut test is a standard procedure to assess the quality of the beans. It can identify the quantity of moldy or unfermented beans, but also detect other damages. A random sample is taken (100 – 300 beans) and cut lengthwise. Each bean shall be inspected in full daylight or equivalent artificial light. Any bean with more than one fault shall only be classified in one category of fault. Bean weight, shell percentage and fat content are the major physical characteristics of cocoa beans, all of which are measured objectively. If the characteristics are not fulfilled, it is more difficult to sell the beans and the price is lower.



Photo 13: Waste Sample



Photo 14: Tool to measure moisture

#### 7.3.1. Waste

Little stones, placenta residues or branches do not have any value for the buyer. That kind of waste can unintentionally enter the cocoa bags and increase the weight. If too much waste is discovered, price discounts are applied.

#### 7.3.2. Moisture

Another characteristic that influences the price is moisture, especially if too wet. Water has a weight, and this doesn't have a value for the buyer either. If too wet, the buyer has to spend time and effort to dry the beans before they can be sold to the next off-takers. This reduces the turnover speed and therefore binds working capital. Besides that, beans that are too wet can cause mold, which was described before.



Figure 18: Cocoa Bean Parts

#### 7.3.3. Bean Weight

Average bean weight is expected to be between 1.0 - 1.2 g, although standard contracts accept max. 110 beans per 100 g (= 0.91g/bean). Bean weight is influenced by the type of tree and by the rainfall during the development phases of the cocoa pod.

#### 7.3.4. Shell Percentage

The shell is removed during the manufacturing process and is of very little value. Still, the weight of the shell is included in the price when selling the cocoa beans.

The percentage of the shell weight compared to the overall bean weight depends on the bean size. Smaller beans have a higher percentage of shell than larger beans. The amount of shell is between 10% (larger beans) and 14% (smaller beans). Sometimes the shell can even make up 17% or more of the weight. Therefore, manufacturers prefer larger beans.

#### 7.3.5. Fat Content

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The content of cocoa butter is usually expressed as a percentage of the dry nib (or cotyledon). Fat content is roughly between 40% and 60%, depending on the growing region, genotype of plant material, and the harvesting season.

7.3.6. Definitions regarding quality Moldy bean. A cocoa bean with mold visible to the naked eye on the internal parts. Slaty bean. An under fermented cocoa bean which shows a slaty, purple color over half or more of the surface exposed by a cut made lengthwise through the center.

Insect-damaged bean. A cocoa bean where the internal parts contain insects at any stage of development, or show signs of damage caused thereby, which are visible to the naked eye. Germinated bean. A cocoa bean with a shell that has been pierced, slit, or broken by the growth of the cotyledons. They are considered defect, because the hole provides an easy entrance for insects and mold.

Flat bean. A cocoa bean with cotyledons that are too thin to be cut.

#### 7.4. International Cocoa Standards

International Cocoa Standards were agreed on in Paris in 1969. They define "cocoa of merchantable quality" as:

- 2. It must be reasonably free from living insects.
- pieces of shell, and be virtually free from foreign matter.

Cocoa is graded on a result of a cut test (maximum percentage by count):

	Moldy	Slaty	Insect damaged, germinated and flat
Grade I	3%	3%	3%
Grade II	4%	8%	6%

Table 2: International Cut Test Quality Criteria

#### 7.5. Definitions regarding the International Cocoa Standard

Thoroughly dry. Cocoa which has been evenly dried throughout. The moisture content must not exceed 7.5% as determined at first port of destination or subsequent points of delivery. Smoky bean. A cocoa bean which has a smoky smell or taste or which shows signs of contamination by smoke.

Uniform in size. As a guide no more than 12% of the beans should be outside the range +/- 1/3average weight.

All dry cocoa that fails to reach the standard of Grade II will be marked as sub-standard cocoa and shall only be marketed under special contract.

1. Cocoa of merchantable quality must be fermented, thoroughly dry, free from smoky beans, free from abnormal or foreign odors and free from evidence of adulteration.

3. It must be reasonably uniform in size, reasonably free from broken beans, fragments and

#### 7.6. Indonesian Cocoa Standard

The Standard Nasional Indonesia (SNI) has the following criteria:

#### Classifications

According to its plant genus, cocoa beans are classified into:
1) Fine Cocoa / F) (Criollo and Trinitario species, or its crossbreeds)
2) Bulk Cocoa / B) (cocoa beans from the Forastero cocoa plant)

According to its quality (see criteria below), cocoa beans are classified into:

- 1) Grade I
- 2) Grade II
- 3) Grade III

According to its weight (beans per 100 g), cocoa beans are classified into:

- AA : maximum of 85 beans per hundred grams
- A : 86 100 beans per hundred grams
- B : 101 110 beans per hundred grams
- C : 111 120 beans per hundred grams
- S : over 120 beans per hundred grams

#### **Quality Requirements**

General Requirement

No.	Test Type	Unit	Requirements
1.	Live insects	-	None
2.	Moisture Content	% of mass fraction	Max. 7.5
3.	Smoky, hammy, or other foreign-smelling beans	-	None
4.	Ratio of foreign objects	-	None

Table 3: Indonesian Bean Quality General Requirements (SNI)

Fine Cocoa	Bulk Cocoa	Ratio of moldy beans (%)	Ratio of slaty beans (%)	Ratio of in- sect-damaged beans (%)	Ratio of waste (%)	Ratio of germinat- ed beans (%)
I – F	I – B	Max. 2	Max. 3	Max. 1	Max. 1.5	Max. 2
II – F	II – B	Max. 4	Max. 8	Max. 2	Max. 2.0	Max. 3
III – F	III – B	Max. 4	Max. 10	Max. 2	Max. 3.0	Max. 3

Table 4: Indonesian Bean Quality Specific Requirements



Cocoa Beans – Quality, Categories and Prices

MEASURING Moisture of Cocoa beans in A bag

8.1. The Crop Production Cycle over the Year Production cycles vary for different regions. For example, the North of Sumatra is different from the South of Sulawesi. Therefore, it is important to make an analysis of the production cycle in the respective area(s) to define suitable products. Why disburse a loan to a farmer to buy fertilizer, if he cannot use it because it's the wrong time in the year?





Figure 20: Crop Cycle Sulawesi

#### 8.2. Nursery

A nursery is a place where seedlings and young cacao plants are raised under appropriate and supervised conditions. Seeds, often pre-germinated, are planted into polybags and a cacao plant grows out of it. Many of the seedlings are top-grafted with improved planting material after 3 months. After 4 to 6 months the seedlings are strong enough to be planted on the cocoa farm. Thus, a nursery normally has the capacity for 2 cycles per year. The size/capacity of the nursery can highly vary.

# 8. COCOA PRODUCTION





#### Photo 15: Nursery

Seedlings are sold for prices between IDR 5,000 to 10,000. Production depends on the nursery size and input costs and ranges for a nursery with a capacity of 5,000 seedlings per production cycle from IDR 3,000 to 4,000 per seedling. With a selling price of IDR 7,500 and selling 80% of the first production, there could be already a profit, despite having all investment costs of about IDR 10 million.

The nursery needs shade, water and wind protection. It needs approximately 90 to 115 liter of water for 1,000 seedlings. Watering is recommended every 2-3 days, sometimes even daily. However, overwatering could lead to a fungal attack. Per square meter about 25 to 30 seedlings can be raised. Seedlings need attention every day as they are very sensitive to any damage which spreads fast if not caught in early stage. The survival rate of seedlings in the nursery is about 80-90%.

The nursery also needs to sell seedlings as part of its business model, which means customers are needed and competition can be tough. Usually the input costs are low and therefore the financial risk is limited, especially since some of the seedlings can be used in the owner's own cocoa farm. However, if the seedlings are under pest and/or disease attack, it could take up to 2 hours a day to maintain the nursery. Some farmers raise not only cacao seedlings, but other tree seedlings and vegetables as well. One option is to produce only on order.





Photo 17: Polybags

If a cacao tree grows out of a seedling there is a significant time investment involved. Risk of failure has to be minimized. However, not all trees will be highly productive. Some will have very low productivity. To minimize that risk, top grafts from superior planting material are used to produce high yielding trees. It is accomplished when a graft is performed by cutting off the top of a seedling and attaching a small section of a selected budwood branch to the top of the seedling. The new budwood 'extension' is held to the top of the seedling with plastic tape and covered by a plastic bag. The grafted seedling will be a clone of the mother-tree from which the budwood has been taken, showing the same superior traits. This is usually done in nurseries by specialized cocoa farmers. Budwoods need to be certified. Technically it could be done also on a chupon or already planted seedlings in the farm.



Photo 19: Top-Grafting

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#### **Cocoa Production**





Photo 18: Cacao Seedling

#### Top Grafting:

farmers can graft budwood onto seedlings that have been raised in a nursery. The grafted seedling will be a clone of the mother-tree from which the budwood has been taken, showing the same superior traits. The grafted seedling can be used to replace damaged or diseased cacao trees in the farmer's cocoa farms. Most cacao varieties cross-pollinate, which means that cocoa seeds don't hold the same genetic traits as their mother-tree. It's therefore important to raise a cacao seedling in two stages, initially by planting a seed that will develope into a seedling with a strong root system and, after three months in the nursery, graft budwood harvested from a superior cacao clone onto this seedling.

#### 8.3. Planting Cacao Trees

#### 8.3.1. Planting Material

The most important input in any cropping system is the planting material, which is supposed to definition can be broken down into various components: **agricultural**, **commercial and local**.

characteristics are:

- 1. Vigorous growth
- 2. Early bearing, which is
- 3. Lowered seasonality year long

Commercial characteristics are: Desirable local characteristics 1. Good values for bean

- content. 93 beans per 100g should have a relatively uniform bean weight, shell content no less than 55% fat content in the dry nib
- 2. High weight of beans per
- 1. A degree of resistance or tolerance to local pests and diseases 2. Adaption to withstand
- specific local conditions

possible (but not recommended) to raise plants out of the seedling at the place the tree should

Through top-grafting, the statistical, normal distributed production probability (as to be expected from seedlings raised from a seed) is shifted to an asymmetric, negative skew. That means that



Figure 21: Yield Distribution of Non-grafted and Top-grafted Cacao Trees

Related to planting material, there can be so called hybrids and clones. A hybrid is a tree raised from seeds that were cross-pollinated from a certain number of varieties (clones) in a controlled environment. The full genetics of the tree is then unknown and each tree is different. A clone is identical planting material because the original tree is reproduced vegetatively and it is usually top-grafted. As stated before, top-grafted trees should be preferred as their origin and potential is known.

In Indonesia, there are mainly local clones, as well as S2 and S1 planted. The advantages and disadvantages of planting them are:

Clone	%	Good Characteristics	Bad Characteristics
Local	69.17%	Good adaptation on climate pres- sure	Low production
52	16.91%	High productivity, tolerant to pest (CPB) and disease (Black pods)	Small size of beans, need high inputs in order to keep better performance
S1	10.13%	High productivity	Intolerant to disease (black pods)
45/MCC 02	2.26%	High productivity, and tolerant to pest and disease	Big canopy and need more efforts on pruning
Other	1.53%		

#### Table 5: Cacao Clones Used in Indonesia

Farmers can have their own nursery to raise seedlings or buy the cacao seedlings from a nearby nursery.

#### Planting material distribution strongly regulated by the government



Figure 22: Planting Material Distribution Source: CSP Roadmap



8.3.2. Preparing the Land New cacao trees can be planted on the existing land.





Photo 22: Planting the tree

#### **Cocoa Production**

#### **Cocoa Production**

Obviously, it is faster to burn down the forest to make "new land" farming ready. However, every single farmer who does this should be excluded from any loan, since this harms the environment to an unacceptable extent and bears high reputational risk for a financial institution.

#### An explanation:

During the burning, large amounts of carbon are released into the air, thus creating GHG emissions. This has an impact on climate change as well as human health. Nevertheless, ashes created during the burning increase the amount of soil carbon and micronutrients, which are valuable for the plant's growth. That's why soil after slash and burn farming methodology is very rich and fertile. The disadvantages are:

- It's quickly absorbed by the plants and washed away by the erosion so the fertility generally doesn't last more than 3 years. That's not a good pre-condition for a farm that should last 30 years or more.
- The amount of pollution released during its production doesn't balance the benefits. It harms the environment and human health.
- It can only be sustainable if there is enough time for the ecosystem (micro and macro organisms) to recover. In humid tropics this is around 30 years. This means that the local ecosystem is completely imbalanced after burning down the forest.

#### 8.4. Growing Cocoa

Cacao trees need regular attention while growing, which will be explained further in the following chapters. This includes pruning to influence the desired shape and height, pest and disease control, sanitation and others.



Photo 23: Cocoa Flowers Growing Directly on the Trunk





Photo 25: Tree with Pods

#### **Cocoa Production**



#### 8.5. Maintenance & Good Agricultural Practices

8.5.1. Good Agricultural Practices

Good Agricultural Practices (GAP) are farming practices that positively affect yield and quality, reduce pests and diseases, maintain the soil and are ecologically responsible. Post-harvest practices like fermentation are included as well. Whether a farm is financially viable or not



Good Agricultural Practices include tree and integrated pets and disease management. use of inputs, crop diversification, farm rehabilitation, grafting, and basic business skills.

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depends on a variety of factors such as farm management, the age of plantation, weather conditions, etc. Above all else, cocoa requires a high level skillset to deliver financially viable yields. With a large share of annual cocoa yields lost due to pests and diseases, the most widespread GAP among Indonesian cocoa farmers are integrated pest management practices. For this purpose, a great majority of stakeholders in the Indonesian cocoa sector promote the following agricultural practices, collectively referred to as PsPSP:

- Frequent harvesting (Panen sering);
- Pruning (Pemangkasan);
- Sanitation (Sanitasi);
- Fertilization (Pemupukan) and soil/plant health;
- Pest and diseases management

A yield increase will be reflected after one year of proper management. A majority of farmers (93%) claim to apply PsPSP to some extent, although not strictly based on the guidelines. The advanced GAP are:

- Nursery management
- Replanting & rehabilitation
- Integrated pest & disease management
- Shade tree management, intercropping
- Demo plot management
- Livestock integration

The modules selection are based on previous farm evaluation and partner's preference. The uptake of better agricultural practices and the use of agri-inputs tend to be higher for those cocoa farmers that rely on cocoa as their main source of income. For farmers growing cocoa as a secondary crop, adoption rates are generally lower.

#### 8.5.2 Pruning

Pruning involves trimming, cutting back, plants, ant nests, and diseased, rodent removal of low or diseased branches. The purpose of pruning is to form the tree and make it a manageable height to simplify harvest and other field operations. It gives streak dieback (VSD) disease happen. The a shape to the tree/graft and removes unnecessary branches so that the plant can of thread-blights. direct energy to several strong branches and improve pod production/size. Another purpose Trees should be structurally pruned as they of pruning is the creation of stress for the tree, grow to control both the height (3 to 4 m is resulting in higher intake of nutrients that leads ideal) and shape of the tree, which makes to larger pods. maintenance and harvesting easier.

Sanitary pruning is used to maintain the health As can be seen in the figure below, it is and vigor of the tree. This includes the removal obviously easier to harvest from smaller trees of all unnecessary chupons, dead and diseased



Figure 23: Tree Size

branches, mistletoes, epiphytes, climbing damaged, or over-ripe pods. The removal of chupons reduces the number of unhardened leaves, through which infections of vascularremoval of dead material reduces the infection

than from taller ones:



Figure 24: Pruning



Photo 26: Pruning

Both pruning and phytosanitation help to reduce pest infestations on cacao trees and pods. While there is no effective way to remove all pests from cocoa farms, it is possible to greatly reduce incidence of pests with these two steps. Pruning should be as vertical and clean as possible to avoid water, insects or fungus entering the wound, thus damaging the stem/wood. An infection could happen as well, but could be avoided by applying wound dressing and sanitized tools.

Pruning is accomplished by using shearers to remove leaves, which increases the productivity of a tree by supporting pollination and letting the appropriate amount of sunlight in for photosynthesis activity. Trees should be pruned in the center to increase sunlight exposure and reduce humidity. This allows new leaves and pods to form quickly as well as decrease Cocoa Pod Borer (CPB) incidence as sunlight disrupts their reproductive cycle.

#### 8.5.3 Side-Grafting

Grafting is a technique used to both regenerate usually after nine months, the farmer must and increase production of older trees. cut the canopy of the mother-tree to direct the flow of nutrients towards the young graft. Additionally, it also ensures that farmers are aware of what seedling clones are used. Side-grafting can lead to improved yields Budwood is a branch taken from a cacao within two years. tree and therefore holds the same genetic traits and attributes as the tree it has been Side-grafting costs are estimated at IDR 2,000 per tree if the farmer side-grafts himself taken from. Budwood is used for vegetative and IDR 5,000/tree if hiring a specialized propagation of cacao clones with desirable traits, where the budwood is grafted onto a cocoa farmer to apply the grafts. Some trees seedling or mature tree. When the cambium are too old to graft and will need to be (plant tissue) of the budwood is fused with replaced. Experienced grafters can side-graft the cambium of the tree or seedling, they will about 150 trees per day. Success rates vary grow together and become one plant. highly, depending on the experience of the grafter. It could be nearly 100% success rate, Budwood can be grafted onto the side of while in some cases the rate is below 50%. healthy and strong trunks of older or low-Unsuccessful attempts can be seen in cocoa yielding cacao trees. When the emerging farms.

superior graft has unfolded its first branches,



Photo 27: Budwood



Photo 29: Unsuccessful Side-grafting

Photo 28: Side-Grafting

#### 8.5.4. Fertilizing & Soil Conditions Through production of agricultural products, minerals are withdrawn from the soil. The influenced by the soil condition. Lack of proper soil maintenance and fertilization leads to a gradual decline in the soil's structure and nutrient value.

Fertilizer is defined as organic or inorganic material added to a soil to supply essential plant nutrients.

In order to increase the productivity of cocoa farms beyond the progressing level, the Fertilizer supplies appropriate and sufficient nutrients to the soil, improves the soil texture and its ability to absorb and retain water. This helps to reduce vulnerability towards pests higher production.

However, if fertilizer is not applied correctly or if it is of poor quality, its yield-increasing effect will be severely limited. This could be because the fertilizer is washed away from rain or blown away by the wind.

For young cacao plants, fertilizers should be applied frequently in small doses. During the first and second year of growth in the field, 3 or 4 applications should be made per year. For mature cacao plants, fertilizer should be fertilizer should be applied at the beginning of the rainy season and 4-5 months later, when the plant has the greatest demand for nutrients during the crop development.

Inorganic and organic fertilizer can be

All plants need Nitrogen (N). It's mostly used for the green parts and intensive growing so for young trees and grasses it's perfect. However, grasses are not desirable in the area around the cacao plants (see weeding). NPK

### **Inorganic fertilizers**

contain one or a mix of these primary macronutrients (sometimes enriches with others) :



Figure 25: Inorganic Fertilizer

mixes contain the three main macro-elements the cacao tree needs to grow, especially pod growth.

fertilizer is essential and must be combined with GAP. If using NPK, between 250 – 500 g should be applied per tree. In addition to be applied for its micronutrients, which can improve the chemical and physical soil quality.

Quantity of fertilizer needed per hectare varies a lot and depends on soil type and condition. In the case of cocoa, 35 kg of Nitrogen (N), 6 kg of Phosphorus (P) and 60 kg Potassium of (K) is depleted per ton of dried cocoa beans/

ha/year. Based on an average production of 1,000 kg/ha/year, over a period of 35 years the following minerals are taken out of the soil per hectare: 1,230 kg Nitrogen (=2,700 kg urea), 210 kg Phosphorus (=1,000 kg TSP) and 2,100 kg Potassium (K) (=4,200 kg KCl).

Organic fertilizer is made of organic material (e.g. animal manure, green manure, empty cocoa husks, compost). It is important to add organic material to the soil before applying chemical fertilizer because chemical fertilizer cannot replace the lost organic material or improve the soil structure. The basic rule is to use as much organic material as possible and balance the outputs (cocoa beans, sometimes with pod husks, sanitation) and inputs (empty pod husks, leaves, pruned branches, manure, compost). The amount of organic material in the soil is especially crucial in dry areas, where healthy soil can retain water for much longer.

need some sugar. What you do? You drink a Coca Cola to get your sugar level back to normal As you know, too much sugar is not good for your body (e.g. diabetes) and sugar doesn't

After applying fertilizer, the increased production as effect doesn't come immediately. The effects are mid and long term. Both, organic and inorganic fertilizers are needed to maintain production. Organic fertilizer leaves a smaller ecological footprint.

59.5% of the farmers in SCPP use chemical fertilizer, 7.4% use organic fertilizer.

Indonesia has a large market of subsidized fertilizer, receiving 28% of national agriculture spending. A schematic overview of the subsidized market is shown below. The system knows several flaws that result in: Scarcity of (affordable) guality fertilizer at cocoa farm-level • Farmers use the subsidized (mainly inorganic single) fertilizer incorrectly due to lack of knowledge. The added value to cocoa yield is therefore very limited



Figure 26: Fertilizer Distribution CSP Roadmap based on Susila (2010)

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#### Fertilizer Distribution

#### **Cocoa Production**

Fertilizer cannot be applied directly beside the stem. The reason why the fertilizer is used in such and drop into the same zone where the fertilizer is applied. The roots that absorb water and



Photo 30: Fertilizer Application in the Drop Zone



Photo 31: Inorganic Fertilizer

#### 8.5.5. Phytosanitation

Cocoa farms should be well maintained to allow optimal production. Part of that is and dead plants, diseased pods, etc.



Photo 32: Sanitation

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### phytosanitation, e.g. moats, so that water can drain and circulate, but also remove dying

**Cocoa Production** Photo 33: Pesticide Application 68

proper sanitation and pruning, managing

and perennial broadleaf weeds, woody plants and climbers. Weeds compete with cacao trees for

Accordingly, a farm with a complete cocoa canopy and good shade management system rarely



Photo 34: Weed-free zone around the tree and small trench in the drop zone to apply fertilizer

76.6% of the farmers in SCPP use herbicides, 65.8% use insecticides and

Pest control on farms is essential, but is even be destructive.

#### 8.5.8. Shade Tree Management

Shade is needed, especially for immature cacao trees. Shade should be reduced gradually as the cacao plants age. Too little shade will result in bushy growth and more time needed to form a canopy, which also leads to slower growth and weaker branches. When young plants without sufficient hardened leaves are grown in full sunlight, all leaves are exposed to high radiation. This reduces the effectiveness of photosynthesis. Young plants require shade to reduce light intensity and buffer the micro-environment so that excessive moisture stress is avoided. Older trees with a canopy provide some self-shading.

Producing/older trees without shade have a higher pod production and a larger leaf area due to the higher photosynthesis activity. This can only be maintained if nutrients are well provided. However, shade removal shortens the economic life of cacao trees considerably because shade is an effective instrument to control conditions which lead to premature decline of yields.

Moreover, shade trees provide more benefits to the farm and the farmer. Besides adding more organic material to the soil and protecting it from direct sunlight and rain, they capture carbon and might serve as an extra source of income, food, wood or fodder.

The use of shade is generally mandatory to successfully establish cacao trees. Older trees need about 25% additional shade from shade trees.



Figure 27: Effect of Fertiliser Application on Yield of Cocoa Grown at Different Light Levels Source: Murray (1975)



Figure 28: Diversification of Shade Trees on a Cocoa Farm

#### 8.5.9. Intercropping

Cocoa is often grown together with shade trees or intercropped. Intercropping means that there are other plants planted in the area (trees, vegetable, etc.). In Indonesia, shade trees take up more than 7% of cocoa farms and could consist of non-cocoa estate plants (e.g. rubber, coconut), hard woods (e.g. teak, mahogany), fruit trees (e.g. mango, lime, durian), Leguminosae (e.g. Gliricidia, Lamtoro, tamarind) or others. Other crops such as pepper can be planted on the farm as well and contribute to the farmer's income.

#### 8.5.10. Compost Production

Compost (or other organic fertilizer such as farm manure) adds necessary nutrients and organic material for good soil structure and water absorption. A minimum of 3 kg of fertilizer per tree (around 3 ton/ha) should be applied at least once per year; preferably 5 kg should be applied. It can be applied at the same time as chemical fertilizers to save the time and labor. Producing quality compost usually takes around two to three months and its preparation and transport requires a certain amount of time and labor. However, the cost of compost is nearly free if using only resources from the own farm such as farm and kitchen waste, animal manure, fire ashes and natural activators from available fruits.



Photo 35: Empty Pods

Photo 36: Compost Making Machine



#### Photo 37: Compost Storage

#### 8.5.11. Replanting

Yield exam- ples	Year 3	Year 4	Year 5	Year 6
Farm 1	66	883	1278	1885
Farm 2	117	234	430	736
Farm 3	173	328	822	834
Farm 4	112	335	805	1438
Farm 5	1328	2231	1300	2384
Farm 6	250	708	824	1287
Farm 7	453	735	843	1342
Farm 8	300	1400	2000	2500
Average	350	857	1038	1551

### Table 6: Yield Examples After Planting Cacao Trees Source: Wood/Lass

When trees are old and/or unproductive, they negatively affecting farm productivity. In order to maintain farm productivity trees have to be replanted. The majority of tree losses happen through physical damage, e.g. falling branches from shade trees, insect damage, drought or waterlogging. In the first few years, new trees do not produce much and some might even die. The survival rate of newly planted is between 90% and 95%.

The production of 100% replanted farms were studied with the following results and average yield (in kg) per hectare (see table below). This is a good indication for financial institutions to predict production levels after replanting cacao trees. It shows that in year 3 (first column) production is still low and could not be used for loan installments yet. This changes later. As mentioned before, modern varieties start producing earlier.

It should be noted that the replanting occurs gradually to keep production and ensure the farmer income. Only in cases where the farmer has sufficient income to cover the period till the new production, the entire farm is replanted. It is recommended to replace 5-10% of the trees per year through replanting. This cumulates during the first 3 years (0, 1, 2) to 18% (if replacing 6%) of the total farm which is not producing yet. Many farmers are reluctant to cut trees as long as they are still bearing pods, even though they produce very few. However, there is considerable doubt about the plant's longevity under a high yielding cultivation regime.

#### 8.5.12. Spacing

The optimum spacing between cacao trees is the distance which will give the best economic return of cocoa per unit area. It usually varies from 2.5 to 4 m and is affected by several factors: the vigor of the trees, type of planting material, shade conditions, cropping system, and soil and climate. Too much space means that the farm productivity could be increased by planting more trees. That would be a low-cost option to increase production.

#### 8.5.13. Harvesting

Harvesting involves removing ripe cocoa pods from the trees and opening them to extract the wet beans. As they ripen, the pods change color. The unripe pods can be harvested too; pods that are not fully ripe will ferment satisfactorily. Ripe pods should be collected immediately as there is a possibility of unwanted germination of the beans. There is a



Figure 29: How Pods Should Be Harvested

considerable period of time, 2-3 weeks, during which a pod is ready for harvesting. It's recommended that harvesting be done every week, although longer periods are possible. Studies have shown that with weekly harvests the yield is at its highest, especially because of lower pests and diseases incidence or other losses on the tree. The peak harvest season depends highly on the region.

The pod opening processes can vary considerably. Pods can be collected in the field and opened at a "gathering point". They also could be transported, e.g. to the fermentation place. Unopened pods weight about 4 times more than just the wet beans after removing them from the pod. Pods can be opened by cracking on a stone or with a wooden billet. A knife can be used, but this is not recommended as it could damage the beans inside.

A farmer can harvest 1,500 pods/day or open 1,500 pods/day. They can harvest and open about 900 pods in the same day. Both activities together take about 33 days per ton of dry beans.

Pods that have not been harvested are a major source of infestation. They do not fall off the tree like other crops such as mangoes. Climbing on the tree for whatever reason (harvest, pruning, etc.) sh ould be avoids as it can damage the branches and flower cushions.





Photo 38: Cutting the Pod



Photo 39: Collecting Pods



Photo 40: Opening Process



Photo 41: Open Cocoa Pod with Seeds and Pulp

#### **Cocoa Production**

#### 8.6. Post-harvest Processes

#### 8.6.1. Processing for Cocoa Commodities

Processing cocoa beans begins right on the farm, in the village or on the plantation. In the smallholder system, efficiency is currently by no means optimal and a significant wastage of beans can happen in the fermentation or drying process. These two processes are important for developing distinct flavors in the cocoa, but all processes, not just these two, impact the final character and quality of the finished product. The major processors and brand owners seek to influence as many of these processes as possible in order to achieve a product quality that meets their brand promises. Beans and cocoa that are consistently produced with quality standards will achieve a premium over beans that have been produced under variable and unaudited conditions.

Chocolate flavor is developed in two stages: during the curing process by the grower and roasting by the manufacturer. Good flavor cannot be obtained by one of these processes alone. The curing process is divided into two parts: fermentation followed by drying.

#### 8.6.2. Fermentation

Fermentation of cocoa beans is a process that releases the familiar chocolate flavor which is well-known throughout the world. It is a biological process that is crucial for the development of the cocoa aroma. It takes about 5 days to complete and reduces the weight of cocoa beans by 7 to 8%. Fermenting the beans enhances the flavor as the process reduces the tannin content which is responsible for the bitter taste of raw beans. When farmers ferment their beans, they can receive a potential premium price up to IDR 2,000/kg.

Fermentation is a stage in the processing of cocoa beans that typically happens on the farm or in the producer village. In a fragmented smallholder system outcomes cannot be expected to be uniform.

During fermentation the wet beans heat up as a result of exothermic chemical reactions in the pulp. Much of the pulp drains away as sweating. After 36 and 72 hours from the start of fermentation the beans are killed and thereafter chemical reactions take place inside the bean. Important among these are oxidation reactions which continue during the drying process. There are two methods used for fermentation: the box and heap method. The box method uses strong wooden boxes with some holes to provide drainage and air ventilation. In the heap method beans are laid on plantain or banana leaves and are covered with more leaves. Ideally, fermentation should be started within 4 to 6 hours (or at most within 2 days) after harvest.

Properly fermented beans are brown or dark red while partially fermented beans are purple, overfermented beans are very dark in color. Underfermentation will produce beans with a bitter taste and astringency will be expected in the final product. Over-fermentation will produce beans with little chocolate flavor. The purpose of turning the beans during fermentation is to ensure uniformity.

Fermentation boxes measure typically 1.2 x 1.2 m, with a depth of 0.9 m, and will hold about 1 ton of wet beans when loaded to a depth of 0.75 m.

A minimum weight of about 50 kg of wet beans is needed for satisfactory fermentation. A fermentation box costs about IDR 750,000 to 1,000,000.



Photo 42: Wooden Fermentation Box

#### 8.6.3. Drying

The main objective of the 3-5 day drying process is to reduce the moisture content of the beans from about 60% to 7.5%. A moisture content of around 7.5% means the beans are safe for storage and shipment.

Wet beans are because of their water content approximately 3 times heavier than dry beans. If the moisture content of cocoa beans is above 8% there is risk of molds developing within the beans. Below 5% the beans will be very brittle.

Another objective is the continuation of the oxidative stage of fermentation. This plays an important role in reducing bitterness and astringency and develops the chocolate brown color of well-fermented beans. Faulty or rapid drying has to be avoided as it can lead to an 'off-flavor' and excessive acidity being present in the cocoa product.

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#### **Cocoa Production**

Drying also takes place at or near the place of production. Beans may be heaped on leaves, in boxes or baskets, or spread out on trays or mats. After drying the beans are packed into bags and delivered for sale.

The weight of dried beans is 37-40% of the weight of wet beans.

8.6.4. Drying without fermentation Beans which are dried without being fermented at all have been killed by drying instead of by the heat and acid arising during fermentation. Therefore, none of the changes which take place as a result of the breakdown of the internal cell structure have occurred. Taste and smell do not evolve, so the cocoa is of low quality.



Photo 43: Cocoa Beans Dried in a Solar Dryer

#### 8.6.5. Sorting/grading

As outlined in the quality section, there are price discounts or price premiums if certain characteristics are present. Too much waste such as stones and sticks results in a price discount. Appropriate removal of waste can result in higher prices. Some farmer organizations have a sorting machine, where waste is removed through a mechanical process. Beans that are too small could reduce the average weight, but they could be sorted out.



Photo 44: Waste Sorting Machine

#### 8.6.6. Storage

Typically, beans are bagged in jute sacks which can hold approximately 62.5 kg per bag. Storing beans in the tropics presents two potential problems: the development of mold and the spread of pests. It is safe to store cocoa beans for 2-3 months, but if stored longer, special precautions must be taken to ensure that quality does not deteriorate from either one of these causes.

Jute bags should be preferred over plastic bags, since the beans can "breath" and do not sweat in jute bags.

The cocoa storage building should have a cement floor or concrete blocks. Doors and windows should provide sufficient ventilation, and temperature variation within the storage should be minimized. The relative humidity in cocoa storages should not exceed 80%, because beans could absorb moisture to a level higher than 8%. Most farmers store the beans in their house. Traders store the beans in their shops and warehouses until they are delivered to an off-taker.



Photo 45: Cocoa Beans in a Bag

#### 8.7. Sale

Beans can be sold wet, fermented and dried.

Larger traders/warehouses have standard procedures for setting the daily price for standard quality beans and how to calculate positive or negative differences based on quality. There are several ways how to determine the price of the beans:

- Standard price for standard quality. Deductions for higher moisture, excessive waste in the bags, infestations, off-flavors, etc.
- Price premium for certified beans and better quality, e.g. less moisture or fermented beans. The premium price is either given to the farmers after inspection or at a later stage.
- Price difference between wet beans and dried beans. Due to the weight difference (100 kg wet beans become between 37 to 40 kg dried beans, because they lose water content during the drying process), prices are calculated accordingly.
- Using New York price fixing per ton in USD, minus a discount of USD 500 for Indonesian cocoa, then applying the current exchange rate between IDR and USD.

Approximately 80% of smallholders sell to local collectors and traders with whom they have long trusted relationships. About a third of sales transactions take place at the smallholder's home, and half of the sales takes place at a collection facility. The number of sales transactions per smallholder varies between 13 and 24 times per year with an average value of IDR 500,000 per sale. About 20% sell directly to exporters or manufacturers, particularly smallholders who sell fermented or certified beans. Only a quarter of smallholders negotiate cocoa bean prices with the purchaser, but this may be due to transparency in pricing as they receive daily pricing via text message from both local collectors and major trade companies. Margins are small for both collectors (reported at IDR 800-1,200 per kg) and traders, as they must deal with daily fluctuations in exchange rates.

In many cases, collectors are farmers that are better off than others and can afford to buy a motorbike and have access to cash working capital. Collectors sell to traders at village, subdistrict or even district level, who sell on to the next level.

Shortage of working capital stimulates traders and collectors to buy and sell as much and as quickly as possible rather than maximize profit percentages. This leads to high competition and relatively high farm gate prices between 70-80% of FOB (free-on-board) price levels and sometimes even more. On the other hand, the rush and time pressure in peak seasons and the use of outdated processing machinery leads to loss of quality in the end product.

Quality assessment during the sale occur as described above, e.g. bean counts, assessment of defective/faulty beans, or test for offflavors. Traceability must be ensured during the entire process.

#### 8.8. Transport

Transport from farms to traders often takes place by motorbike, obviously in small quantities. Transportation from traders to larger traders, processors or exporters usually happens with smaller or larger trucks, either owned by the trader or rented. If the truck is rented, the cost very largely between the regions and can be between IDR 350 and 2,000.

During overseas transport, cocoa is stored in closed containers, most likely lacking ventilation. A dropping temperature could cause condensation in the container, leading to some damage of the beans in the top layer. The same applies for infestation during the storage or transport period. In Indonesia, processing capacity was established in previous years so this problem is not as dominant and many beans are processed in the country.

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# 9. CERTIFICATION & TRACEABILITY

Certification is a process whereby smallholders are evaluated and accredited based on sustainable GAP, protection of the local ecosystem, and safe working conditions. The certificate needs to be renewed on an annual basis.

### Yusrian

731200788 Kelompok Tan Nurul Amanah Demand for certified cocoa comes from importing nations, not from producer countries. Certification requires smallholders to document their activities and make changes to their farm management practices if necessary. Some buyers pay a price premium for certified and traceable cocoa. This can be up to USD 200/MT.

Requirements for certification include implementing GAP, establishing farmer group internal control systems, respecting human rights, banning child labor, addressing environmental issues, recording farm inputs and small holder income, having farm management plans, and training. Environmental issues may include addressing pest management, limiting which pesticides are used, maintaining soil fertility, protecting biodiversity, safe water management, practice to reduce greenhouse gas (GHG) emissions and increase carbon sequestration. Compliance is determined by independent audits on the outset of certification and on regular time intervals.



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The purchaser of certified cocoa beans must be able to trace the product back to the producer by keeping records (name, date, volume, and price) that show the flow of cocoa beans from the smallholder to a processing factory. Auditors would evaluate if an organization sells more certified products than its purchase records indicate. While it may add transparency and sustainability to the supply chain, it burdens smallholders with additional costs.

The most well-known certification organizations working in Indonesia are UTZ, Rainforest Alliance and Fairtrade International.

One of the most important advantages for financial institutions is that certification requires documentation. Those documents can be analyzed during a loan application process if needed. It does not mean that a certified farmer is automatically a better loan client, but at least the financial institution can get an idea of the farmer's situation.



Figure 30: Traceability Process

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TRANSPARENCY AND TRACEABILITY IN THE COCOA SUPPLY CHAIN ARE BECOMING INCREASINGLY IMPORTANT FOR THE CONSUMERS



### CocoaTrace



### MANGNGOY

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### 10. PICTURES, DEFINITIONS, AND PROCESSES

The following chapter contains some additional information on cocoa processing, pests and diseases, etc. in order to get a well-rounded picture of the cocoa sector.

#### **10.1. End Products**

The most well-known cocoa end product is chocolate in all its forms and cocoa powder for beverages or the baking industry. From an industrial perspective, cocoa products are distinguished between cocoa liquor (mass), cocoa butter and cocoa powder.



Photo 46: Dark Chocolate

#### 10.2. Raw Products

#### 10.2.1. Cocoa Nibs

Cocoa beans that have their shells removed before roasting are called nibs. They are perfectly roasted cocoa beans separated from their husks and broken into small pieces. They are the essence of chocolate. Nibs add crunchiness and subtle chocolate flavor to baked goods and savory dishes. They make a great substitute for roasted nuts or chocolate chips, without added sweetness.



Photo 47: Cocoa Nibs



#### 10.2.2. Cocoa Liquor

The roasted nibs are ground to produce cocoa liquor. Cocoa liquor contains the cocoa solids and cocoa butter in whatever proportion they were present in the preceding cocoa nibs. The winnowed nibs are simply crushed and heated to create cocoa liquor. Cocoa Liquor contains 50-58% cocoa butter, most of which can be extracted by hydraulic pressure. The solids that remain are referred to as press cake (or 'cocoa cake'). This can then be broken down to make cocoa powder.



Photo 48: Cocoa Liquor

#### 10.2.3. Cocoa Cake

Cocoa cake or press cake is the result of the cocoa butter extraction process after the cocoa liquor has been pressed. The solids left over are referred to as the cake, which is then refined to a very small particle size.

The fat content of the cake can vary. Some high fat cake (22%) is produced for grinding

into cocoa powder for drinking chocolate, etc. Most cake produced is low fat (11%). These cakes are used to produce cocoa beverages, but also used by the baking industry and for the manufacturing. When used for industry purposes the cake is reconstituted with other vegetable fats of chocolate flavored or compound coatings.

#### 10.2.4. Cocoa Butter

Pure Prime Pressed Butter (PPP Butter) is obtained from cocoa liquor by mechanical pressing. It is filtered and deodorized to eliminate any remaining cocoa solids. It is then cooled and packed.

Cocoa butter is by far the most expensive ingredient in dark and milk chocolate.



Photo 49: Cocoa Butter

- 10.2.5. Cocoa Powder
  - Cocoa powder has the widest spectrum of all cocoa products. It is produced with diverse characteristics
  - It is influenced by the early stages of roasting and processing, with the blend of beans chosen for each round of grinding
  - During pressing, the processor can choose the percentage of butter fat (10-12%) to leave in the powder
  - After being pressed, alkalization or the 'Dutch Process' allows for a diversity of



Photo 50: Cocoa Powder

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colors, flavors and applications
Finally, the powder is typically packed in 1 MT bulk sacks made of woven polyethylene, or 25 kg bags with three layers of Kraft paper that each have an internal polyethylene coating that acts as a moisture barrier

Natural cocoa powder is primarily used in the baking and confectionery industry and often forms the flavor base for compound coatings.

Cocoa Sector Training for Financial Institutions

#### 10.3. Pests and Diseases



Photo 51: Black Pod



10.3.2. Vascular-Streak Dieback Vascular-streak dieback (VSD) is a disease impacting leaves by slowing or stopping the photosynthesis process. It can have physiological or pathological reasons, such as environment, nutrition, fungal invasion, pest attacks or a combination of any of these reasons. For instance, wood boring insects could pave the way for pest/diseases by giving an entry point for fungal infection or wound parasites. Losses could be from 25% up to 40%.

10.3.1. Black Pod

ripeness.

Black pod, also known as pod rot or

which causes pods to shrivel and die.

The fungus infects pods of all ages. If left untreated, a farmer could face losses between 30-60% of their cocoa pod production. The most important method to overcome black pod is regular sanitation of the trees and diseased pods. Using a copper

fungicide also reduces the infection.

Phytophtora, is a fungal cocoa pod disease,

Major economic loss occurs from infection,

especially in the 2 months before pods reach

10.3.3. Other Diseases

#### 10.3.4. Cocoa Pod Borer (CPB)

In Indonesia, the Cocoa Pod Borer (CPB) is a major pest. The CPB is a moth who lays larva on the surface of cocoa pods which tunnel into the pods and eat the cocoa beans. It is sometimes still possible to harvest some beans from an infected pod; but there are fewer beans, and they are of poor quality and should not be fermented. Sanitation and proper shade management is the most important practice to reduce infestation of CPB.



Photo 53: Cocoa Pod Borer

#### 10.3.5. Other Pests

As a group, mirids (capsids) are the most important and widely represented insect pests of cocoa. Their feeding inflicts severe damage, especially to the extent to which they attack stem tissue. They also fall into the pathological category since fungal infections can take hold in feeding lesions on the stems. In Indonesia, helopeltis, a genus of the mired family, cause serious losses if not treated properly.

Other pests are present, but have a lower impact on production. One example is the stem borer, but also other bugs such as leaf hoppers and other leaf eating insects. While pests cannot be eliminated, they can be reduced by pruning, phytosanitation, frequent harvesting, and pesticides. Trees suffering from water stress will succumb more easily from attacks by fungi and pests.

Tall shade trees (like rubber, forest trees or coconut trees) are associated with lower pest infections.

Rats, monkeys and squirrels can also cause some physical damage to cacao trees and cocoa pods, especially on farms in forested areas.

Photo 52: Vascular-Streak Dieback

In Indonesia, other fungal and virus diseases are of less importance from an economic point of view. Root diseases cause losses of only 1-2% of the trees.

The life cycles of all cocoa mirids are similar. The eggs are first buried in the epidermal layer der, sub-equal terminal filaments on the egg protrude above the plant surface. There are five successive juvenile stages (nymphs), in total taking up 18-30 days. In the last stage, the insects molt to produce the winged adult insects. The adults are medium-sized (7-12 mm long).

#### 10.4. Processing

The industry differentiates between cocoa processing and chocolate manufacturing. Cocoa processing normally covers the activity of converting the beans into nib, liquor, butter, cake and powder. Chocolate manufacturing covers the blending and refining of cocoa liguor, cocoa butter and various optional ingredients, such as milk and sugar. All cocoa products start with cocoa liquor, although the liquor required in the manufacturing of chocolate has a different texture from the liquor required to make cocoa butter, cake and powder.

#### 10.4.1. Roasting

Beans should be roasted within a couple of months after fermenting and drying to reduce the chance of moisture build up; this means that the period from harvesting to processing may be less than 13 weeks. Industry stocks tend to be measured by the products of processing: cocoa butter and cocoa powder. After the cocoa beans have been received at the processing location, they are inspected and thoroughly cleaned of all extraneous matter, such as sticks, stones, metal fragments, as well as broken beans. This process involves sorters, which remove items that are lighter or heavier than cocoa beans. Sieves are also used to eliminate items that are too small or too biq.

- The roasting process is designed to bring out all the rich aromas and flavors in the beans and reduce any remaining moisture content to 1.5-2.0%
- Roasting can be done on the whole bean before shelling or on the nib after shelling.
- However, it is known that the roasting process makes it easier to de-hull the beans
- The time and temperature allowed for the roasting are important influences on flavor: a "low roast" produces a more acidic, aromatic flavor, while a "high roast" gives a more intense, 'bitter chocolate' taste
- In this process the acids and other agents likely to produce bitterness in the cocoa should be removed including any agents or remaining pathogens that might cause the beans to degrade
- Roasting occurs in large rotating ovens at temperatures between 100°C and 140°C (210-280°F) and should follow a precise curve
- If the temperature is too high, starches caramelize and the beans loose fat content, resulting in loss of desired taste
- Roasting can last anywhere from 20 minutes to 2 hours, depending on the unique characteristics of the beans (variety, bean size, moisture, plumpness, etc.).

Generally speaking, chocolate manufacturers prefer to roast the beans before hulling them, while cocoa processors favor the nib-roasting process. Bean roasting allows for more variety in the degree of roast and development of flavor, but requires beans of a uniform size. Nib roasting is more even and does not require uniform bean size. Removing the shell before roasting prevents migration of cocoa butter from the bean into the shell during the roasting process. This migration is an important yield factor.

#### 10.4.2. Cocoa Processing

- After roasting, the beans are crushed to release the nib from the shell and then winnowed (blown) through a tunnel to separate the nib and shell
- The roasted nibs are ground to produce cocoa liguor and cocoa mass (cocoa particles
- powder will retain between 10-12% fat content
- The cocoa liquor is then fed into hydraulic presses that remove a predetermined cocoa cake market, or it is ground into a fine powder
- cartons. It is sold as 'pure, prime pressed, natural' cocoa butter.

Virtually all the cocoa butter produced by the international cocoa processing industry is used in the manufacturing of chocolate, where it must be added to the liquor to achieve the desired result. The pharmaceutical and cosmetics industries, which also use cocoa butter, may obtain their requirements from sources using solvent extraction or other methods besides pressing cocoa butter from cocoa shells. Some may use cocoa beans that are not suitable to be made into a food item.

#### 10.4.3. Chocolate Manufacturing

In the chocolate manufacturing process, cocoa liquor is mixed with cocoa butter and sugar. In the case of milk chocolate, fresh, sweetened condensed or roller-dry low-heat powdered whole milk is added. What milk product gets used depends on the individual manufacturer's formulae and manufacturing methods. In the crumb or flake process, liquor is blended with sugar and precondensed milk, or sweetened condensed milk.

It is then dried on heated rollers to produce the 'caramel' flavor more common for European chocolate, or mixed with slightly acidified milk to produce the typical American 'cheesy' flavor. These distinctions are a matter of taste and not of quality. After the mixing process, the blend is further refined to bring the particle size of the added milk and sugar down to the desired fineness. The mixture is then placed into conches, i.e. large agitators which stir it under heat. Normally, cocoa butter is added at this stage, although some manufacturers add it during the original blending process. Conching eliminates unpleasant and undesirable odors and further smoothens the particles. Generally speaking, the longer chocolate is conched, the smoother it will be.

The process may last for a few hours to three full days, and in the case of expensive coatings, even longer. After the conching process the liquid chocolate is either stored at the processing factory or delivered in tanks to the confectionery industry. At the processing factory, the liquid chocolate can be tempered and poured into block molds for sale to the confectionery, dairy and baking industries. It may also be converted into proprietary bars for direct sale to the consumer market.

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suspended in cocoa butter) resulting from the high temperatures during grinding. The grinding process generates approximately 80 kg of cocoa liquor / mass for every 100 kg of cocoa beans. Manufacturers generally use more than one type of bean in their products and therefore the different beans have to be blended together to get the required formula 80 kg of liquor will yield approximately 40 kg of butter and 40 kg of powder, but cocoa

percentage of the cocoa butter, leaving behind a solid material called cocoa cake which, according to the processor's requirements, may contain anything from 6-24% of cocoa butter. The cocoa cake is either broken into smaller pieces (kibbled) and sold to the generic

The extracted cocoa butter is then filtered and stored in tanks in liquid form until it is ready to be turned over to the chocolate operation, if at the same location. Otherwise, it is shipped to its final destination either in liquid form in tank trucks or in molded form in

#### 10.4.4. Cocoa Processing Chain







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**Pictures, Definitions, and Processes** 

10.4.6. How chocolate should be stored

There are three essential factors: temperature, air and light.

it is absolutely necessary to keep it away from other products with intense odors such as cheese,

disintegrates, the flavor changes and the chocolate develops an unpleasant smell. White chocolate is especially sensitive to oxidation since it doesn't contain any anti-oxidants. Dark and You should therefore choose a dry and dark environment with constant temperature (between 15 and 18 degrees Celsius). Keep your chocolate in an airtight container and avoid strong odors, humidity and strong light. If you have to store it in the fridge, make sure to take it out at least one hour before consumption.

#### **10.5. Cocoa Dictionary**

#### Adulteration

Adulteration of the composition of graded cocoa by any means whatsoever so that the grade prescribed, or affects injuriously the quality of flavor, or alters the bulk or weight.

#### Bittersweet

Bittersweet, also known as dark chocolate or chocolate liquor with varying amounts of sweeteners and cocoa butter. The amount of

#### Broken Bean

A cocoa bean of which a fragment is missing, the missing part being equivalent to less than half the bean.

#### Chocolate Butter Equivalents (CBEs)

performance, simplify use and save money. They were created to complement and enhance Fat free dry cocoa solids, i.e. moisture free, fat the performance of cocoa butter while at the

#### Chocolate Liquor (Cocoa Mass)

(center) to a smooth, liquid state. Cocoa butter content of 50-58% and fine grind gives chocolate liquor a rich, smooth consistency. Also known as cocoa mass or unsweetened baking chocolate.

#### Clone

characteristics as the original tree. Clones are bred from hybrids in controlled environment to bear certain characteristics, such as high productivity potential, flavor, pest and disease tolerance, and drought and flooding resistance.

#### Cocoa Beans

The seed of the cacao tree (Theobroma cacao

#### Cocoa Butter

A natural fat that is present in cocoa beans. It is obtained by pressing chocolate liquor.

#### Cocoa Powder

The result of grinding or pulverizing press cake, which is available in different fat levels. May be natural or Dutched process.

#### Cocoa Solids

free cocoa material.

#### Compound

A confectionery product where vegetable oil is substituted for cocoa butter.

#### Dark Chocolate

Dark chocolate, also known as bittersweet or semi-sweet chocolate, is prepared by blending chocolate liquor with varying amounts of

sweeteners and cocoa butter. The amount of

#### **Dutching Process**

An alkaline treatment of the nib prior to arinding, or the liquor prior to pressing. This or cocoa and modifies the chocolate flavor.

#### Emulsifier

formation and stabilization of an emulsion. ammonium phosphatide and PGPR are used to influence the flowing properties of chocolate.

#### Enrobing

The act of coating a biscuit/candy center by covering it with chocolate. Usually done by mechanical means.

#### Fat Bloom

The white cast and soft texture that is the result Also known as a cross-bred is a tree raised of poor tempering or exposure of the chocolate from seeds that were cross-pollinated from to high temperatures or migration of fats into the chocolate. While visually undesirable, the

#### Fermentation

interaction naturally modifies the composition of the cocoa bean so that when the beans are roasted, they yield characteristic chocolate

#### Fineness

The measurement of the average particle size of the cocoa or chocolate solids. Fineness is in microns. It may be measured as largest particles present in the product by a sieve residue, a grindometer or a micrometer, or by measuring the particle size distribution with

#### Flat Bean

to be cut.

#### Foreign Matter

Any substance other than cocoa beans, broken beans, fragments, and pieces of shell.

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#### Fragment

A piece of cocoa bean equal to or less than half the original bean.

#### Germinated Bean

A cocoa bean, the shell of which has been pierced, slit or broken by the growth of the

#### Grinding

A mechanical process of reducing the roasted cocoa bean nib to a smooth liquid known as chocolate liquor.

#### Hard Butter

A class of specialty fats with physical properties to semi-solid at ambient temperatures and depending upon application.

#### Hybrid

certain number of varieties (clones) in a controlled environment. Hybrids are then a result of mixture of characteristics among the different parents. As clones, they are bred to be highly productive, tolerant to resistant to pests and diseases and weather instability.

#### Insect-Damaged Bean

are found to contain insects at any stage of development, or to show signs of damage caused thereby, which are visible to the naked

#### Lecithin

A natural food additive that acts as an emulsifier and surface active agent. Most commercial lecithin products are derived from Typical usage levels range from 0.1 to 0.7%.

#### Milk Chocolate

Milk chocolate is made by combining milk and 12% milk with cocoa butter, sweeteners and sometimes flavorings.

#### Moldy Bean

A cocoa bean on the internal parts of which mold is visible to the naked eye.

#### Natural Process

Non-alkalized chocolate liquor or cocoa

#### Nibs

Nibs are the "meat" or center of the cocoa bean. Roasted or unroasted cocoa beans are mechanically cracked, allowing the separation of the cocoa bean shell from the cocoa nib.

#### Piece of Shell

#### Press Cake

Product that remains after most of the cocoa butter has been pressed from the chocolate liquor. Press cake is pulverized to make cocoa

#### Pressing

from the cocoa liquor by means of hydraulic presses. The two products of pressing are cocoa White-Cocoa-Butter-Based Confectionery butter, which is filtered and stored in tanks, and **Coating/White Chocolate** 

#### Roasting

A cooking or heating process using high chocolate flavor of cocoa beans.

#### Semi-Sweet

#### Slate

The formation of stratified layers in a bar of chocolate. This is usually caused by the outer surface of the stream of chocolate filling a mold being colder than the center of the stream.

#### Slaty Bean

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A cocoa bean which shows a slaty color on half or more of the surface exposed by a cut made

#### Smoky Bean

A cocoa bean which has a smoky smell or taste or which shows signs of contamination by

#### Tempering

tempering, when followed by good cooling, provides contraction from molds and optimum surface gloss. Tempering is required for

#### Thoroughly Dry Cocoa

Cocoa which has been evenly dried exceed 7.5%.

#### Viscosity

A measure of a coating's resistance to flow in melted form, which determines its ability to ice cream. Viscosity is affected by process and formulation varieties.

A blend of sugar, cocoa butter, milk solids (whole/skimmed milk) and flavorings. This product cannot be called "chocolate" in the United States since it does not contain cocoa

#### Winnowing

See "bittersweet," another name for semi-sweet. cocoa bean shell, revealing the inner part of the bean (the nib).

All definitons are sourced from ADM.<sup>9</sup>





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Cover	: A well-maintained cacao tree yielding large green cocoa pods.
Photos	: Swisscontact Indonesia
Layout	: Swisscontact Indonesia

**Swiss NPO-Code:** The structure and management of Swisscontact conforms to the Corporate Governance Regulations for Non-Profit Organisations in Switzerland (Swiss NPO-Code) issued by the presidents of large relief organisations. An audit conducted on behalf of this organisation showed that the principles of the Swiss NPO-Code are adhered to.

**ZEWO-Gütesiegel:** Swisscontact was awarded the Seal of Approval from ZEWO. It is awarded to nonprofit organisations for the conscientious handling of money entrusted to them, proves appropriate, economical and effective allocation of donations and stands for transparent and trustworthy organisations with functioning control structures that uphold ethics in the procurement of funds and communication.

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