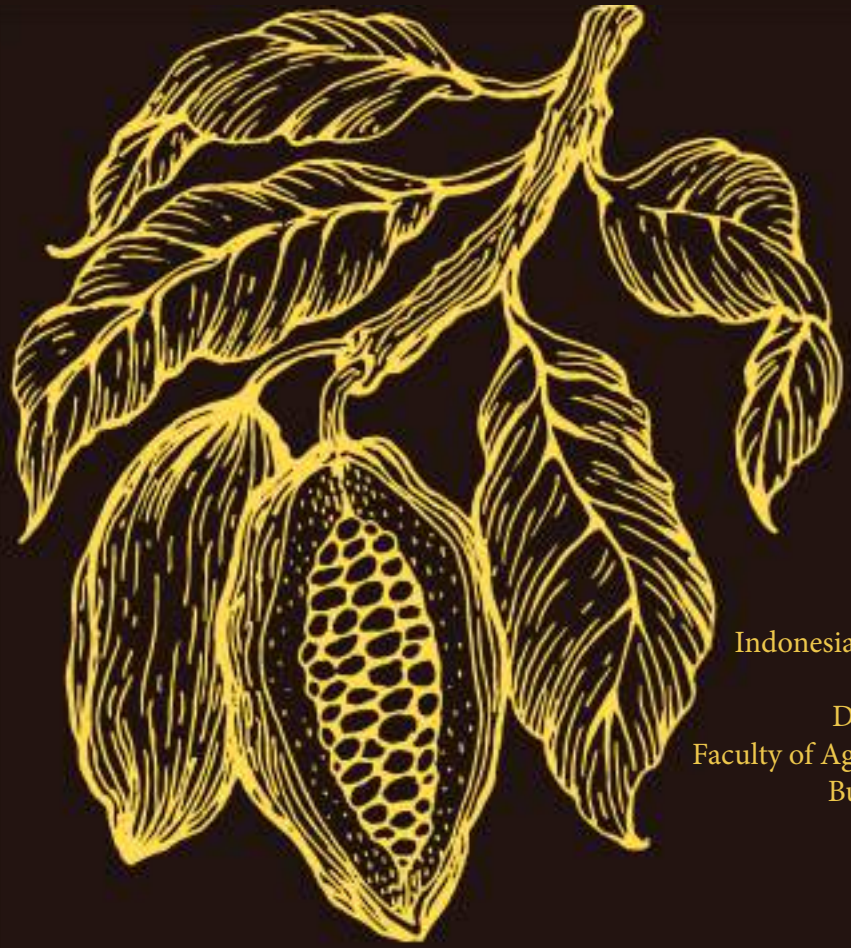
"Death is something inevitable. When a man has done what he considers to be his duty to his people and his country, he can rest in peace" ~ Nelson Mandela

---

For Deden Indra Teja Maya, our friend, our brother.
who had been tirelessly fighting for just causes,
who have flawlessly carried out his duties,
who is true to his words,
a man known for his virtue.

À notre ami, ardent défenseur des justes causes, qu'il repose en paix, après ses nombreux accomplissements.

الله يرحمه ويغفر له ويسكنه فسيح جناته ويلهم أهله
وذويه الصبر والسلوان وانا لله وانا اليه راجعون لاحوله
ولا قوة الا بالله العلي العظيم



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theobroma cacao

etymology

It is believed to be firstly known as cacaua,
which is a Nahuatl (Aztecan) word,
which originated from cacahuatl (bean of the cocoa-tree),
which ultimately derives from the reconstructed
Proto Mije-Sokean word kakawa.
The word cacao itself was brought by the Spanish in the mid
15th century through a long period of expansion and trade.
In Indonesia, we simply called it 'kakao'.

FOREWORD

Cacao is one of the most traded commodities globally. Cacao is not only famous for its unique flavour and aroma that dazzle its consumers, but also contains compounds that have soothing effects and can provide various health benefits to whoever consume it. These facts lead to increasing international and domestic market growth, which created opportunities for all involved actors in Indonesia's cacao supply chain, especially the growers as the main actor. However, this situation has also posed challanges for cacao growers to improve the quality, quantity and continuity of their product to meet the ever-growing market demands.

Unfortunately, the gap of value distribution among the supply chain actors are still too large, making the industries to keep growing, while leaving the growers to passively accept their stagnancy, which creates inequality that hinders their growth. This book provides information about the general situation of cacao agribusiness system in Indonesia. It shows that there are much complexities behind every bar or cup of chocolate that we enjoyed. We hope that this book can inform the society to be more aware of the root of our delicacies.

Jakarta, 2020

Dr. Kasdi Subagyono
Director General of Estate Crops

CONTENT

CACAO

A source of many delicacies that are widely enjoyed by humankind throughout millenias. Did we ever ask where it came from? how did it all begin? who created it? how can it spread globally as today?

01

Cacao
a Brief Intro

classification | *theobroma cacao*

Cacao is one of the *Malvaceae* family, under the genus *Theobroma*, which consists of 17 species. *Theobroma cacao* is physically characterized by alternate, entire and unlobed leaves, producing flowers in clusters directly on the trunk and branches. Cacao flowers are polinated by tiny flies (*Forcipomya midges*). The fruit is called cacao pod, ripening yellow to orange, and weighs around 500 gr. The pod contains 30-60 seeds, embedded in a white pulp. These seeds are the main ingredient of chocolate, while the pulp is used in some countries to prepare juice, smoothies, jelly, and cream. The plantation covers more than 10 million hectares worldwide.

Species

There are 3 types of cacao that are popular enough to be commecially grown today: Criollo, Forastero, and Trinitario. All of them have distinct characteristics, which comprise its plant morphology and environmental suitability to grow, which also determines their fruits and beans characteristics. These also leads to different productivity and even their capacity to resist some pests and disease. Forastero is known for its resistance to diseases and high yiels, making it the most popular to be grown. Cricillio is known for its excelence in taste and its fragileness. Trinitario is known for the mixed characteristics of Forastero and Criollo.

Native Area: Tropical
Ideal Temperature: 18°- 32° C
Light Intensity: Bright, indirect light
Humidity: 70 - 80 %
Soil pH: 5.0 - 7.5
Altitude: 100- 600+ m asl
Soil Type: Coarse
First Productive Age: 2-3 Years
Economic Life Span: 20-25 Years
Known Diseases: Black Pod, Witches Broom, Frosty Pod Rot, Swollen Shoot Virus, Vascular Streak Dieback
Known Pests: Broad Mite, Flower-eating Caterpillars, Helopeltis, Yellow Peach Moth

Forastero

Forastero is the most widely grown variety making up around 85% of the world's cacao production. It literally translate to 'stranger' in Spanish. This variety originated in the Bahia region of Brazil, but is now also grown in Africa and South East Asia. It's popularity came from its characteristics which are more resitant to pests and diseases, robust, and high yields. However, its lack of flavour so some manufacturers combine it with other varieties to enhance the flavour. There are few sub-varieties such as Amelonado, Cundeamor and Calabacillo and each offers slightly different tastes. However, the Amelonado is the most widely cultivated.

Trinitario

Trinitario cultivars apparently came from a hybrid group between Forastero and Criollo types with Criollo characteristics dominant over Forasterocharacteristics. This hybrid strain spread from the Caribbean islands to South America in the 19th and 20th centuries. Being the least pure, the Trinitario has wide range of tastes and profiles inherited from its parents. However, the Criollo profiles greatly influence the complex flavors found in this bean. Trinitario beans make up less than 10% of the total global cacao production.

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Criollo

Native Area: Tropical
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Known Diseases: Black Pod, Witches Broom, Frosty Pod Rot, Swollen Shoot Virus, Vascular Streak Dieback
Known Pests: Broad Mite, Flower-eating Caterpillars, Helopeltis, Yellow Peach Moth

Criollo tree is native to Central and South America, the Caribbean islands and Sri Lanka. This cultivar is very vulnerable to numerous of environmental threats, making it particularly difficult to grow. It is characterised by delicate yet complex flavors, less chocolatey but rich in secondary notes. Due to its complexity, Criollo is considered to be the ingredients of the finest chocolates. This variety only covers 5% of the world's cacao production.

Taste, Flavour & Aroma

The taste and aroma of cacao are determined by its variety. Forastero has more bitterness with full body; Trinitario more balanced flavors. While Criollo has the most complex flavours and aroma.

FORASTERO

Being the most commonly grown, the Forastero sets the global standard for the taste of chocolate. Forastero has purple-coloured beans and is mainly used to give chocolate its full-bodied flavor. Its bitter taste has a short duration and is unsupported by secondary flavors, which is why it is often blended with more superior cacaos. However, its fame came from its strength against pests and diseases that would have easily wiped out other varieties, and also the Forastero yields significantly more than the other two. These features made cacao growing easier for the growers as it can cut down expenses and yields more. Nevertheles, its 'easy to grow' characteristic also lower the selling price for the Forastero, which is compensated by its high yields.

CRIOLLO

Criollo is known as the prince of cacaos, the most valuable among the other cacao varieties. This variety is known for its complex yet delicate flavour, making it suitable to be mixed with the bitter Forastero to make a well balanced flavoured chocolate. The Criollo is not that good in defending itself against environmental threats, including pests and diseases, making the process of plant maintaining difficult for the growers. The difficulty of growing and the complex and rich flavours produced by the Criollo made this variety the most expensive among the other two varieties. In the food industries, the Criollo is famous to be the most prized ingredients for the best chocolates.

TRINITARIO

Trinitario is a natural hybrid between Forastero and Crillio, which is believed to be originated from Trinidad in the 17th century. The flavour profile of this veriety has a mixed characteristics from both parents. Its slightly harsh and strong cacao flavour came from the Forastero, while the refined taste came from the Criollo. However, as other hybrids, the Trinitario could not bring those positive characteristics inherited from its parents to its maximum potential, giving this variety a balanced flavour profile. Nevertheless, in plant characteristics, the Criollo's characteristics are more dominant than the Forastero, making Trinitario more difficult to grow, and yields less than Forastero.

Varieties & Cultivars

VARIETIES

Varieties are the derivation of subspecies, which occured through natural selection, both for wild and cultivated plants. In other words, this mainly generated from the interaction of the plant with its local environment. Some of the varieties are commercially important due to the characteristics ranging from flavors, disease resistance to yields. Due to its natural process, cacao varieties can be found in the wild.

CULTIVARS

Cultivars are the subspecies derived through selective breeding done intentionally by breeders in order to produce unique traits. Some might breed special cultivar to attain higher yield in a shorter period, some others might pursue for unique taste. It is pure experimental, giving flexibility for breeders to produce a cultivar according to their own desired characteristics. Cultivars are not to be normally found in the natural population.

Pests & Diseases

The formation of a focused plant area on one location will attract its natural predators. For example, when we cleared the forest along with its ecological diversity, and replaced it with plantations which are much less diverse, then many of creatures that are attracted to the planted commodity will flourish, in line with the abundant availability of their food source. Unfortunately, for the growers, this leads to distractions.

Disease	Region	Estimated Production Loss (in Tonnes)
Black Pod	Africa, Brazil, Asia	450,000
Witches Broom	Latin America	250,000
Frosty Pod Rot	Latin America	30,000
Swollen Shoot Virus	Africa	50,000
Vascular Streak Dieback	Africa, Asia	30,000

Source: Queensland DOAF, 2013

As in other plants, pests and diseases posed challanges to cacao plantation, threatening its productivity worldwide. In fact, some studies shown that diseases are responsible for the loss of approximately 30% of potential cacao production worldwide (Hebbar, 2008).

The table shows the approximate worldwide cacao production loss caused by various diseases, summing up to 780.000 tonnes of loss. This condition is hampering and limiting the performance of global cacao agro-industry system, which involves millions of workforce, especially the growers who are sitting in the bottom of the chain, directly facing the problems. Left unattended, this situation will threat the global cacao sustainability in the future.

Cacao's Common *Insects Pests*

Mirids

Mirids are the most common insects that attacks cacao plantations accross the globe. Several species of Mirids are responsible for the decrease in cacao production in different areas in the world. *Helopeltis spp.* is common in the South East Asia region; *Distantiella theobroma* and *Sahlbergella singularis* are known to be present in Africa; while the Central and South America is dominated by *Monalonion* species. Left untreated for few years, Mirids attack can have a devastating impact, reducing cacao production up to 75%.

Pod Borer

Conopomorpha cramerella, also known as the Cacao Pod Borer (CPB) is one of the oldest pests known to attack cacao plantations. This particular insect is really common in South East Asia, especially in Indonesia, where it caused around 40 million USD worth of annual lose when it infested approximately 70,000 hectares of cacao plantations in year 2000.

Cacao's Common *Diseases*

Vascular Streak Dieback

picture: plantvillage.psu.edu

This disease can lead to mortality for the infested plant. It is usually started by chlorosis of one leaf on the second or third flush behind the tip, which is caused by the *Oncobasidium theobroma* fungus infection. Once the leaf is dead and fell, the infection spreads from the leaf scar to nearby branches, showed by white coating over the area. This diseases is common in the South East Asia region such as Indonesia, Malaysia, and New Guinea.

Witches Broom

picture: plantvillage.psu.edu

Witches' Broom is caused by the infection of *Moniliophthora perniciosa* fungus which is common in the Central and South America, but not in Indonesia. Witches' Broom attacks the pods, flowers and other active growing parts of the plants. This can be seen as green patches in the pods or malforming in other parts. Left unattended, this disease can lead to inefectiveness in energy flow of the plant, resulting in significat reduced rate of productivity.

Black Pod

picture: plantvillage.psu.edu

This disease is also known as pod rot, which is caused by the infection of *Phytophthora spp.* a fungus that grown in the pod, causing the pod to rot. The parasitic fungus dominates the internal tissues including the beans. What was started from a single tiny dot of dark color in the pod, will soon turned the whole pod to become black within 14 days of initial symptoms. According to the International Cacao and Coffee Organization, this disease causes global yield loss of 20-30% and tree deaths of 10% annually.

Frosty Pod Rot

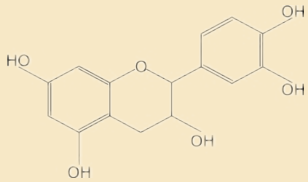
picture: plantvillage.psu.edu

Moniliophthora roreri fungus is responsible for frosty pod rot. Like the Withces' Broom disease, this fungus also infects only actively growing pod tissues, especially young pods. Once infected, the pods' surface will be covered in white fungal mat, causing it to be unproductive. This disease is spread in Central and South America, causing massive loss in production. This disease is not present in Indonesia due to strict quarantine protocols.

Cacao's Known *Benefits*

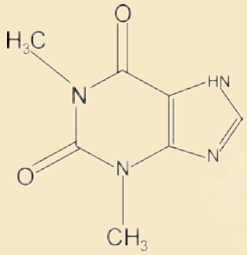
Consuming chocolate does not only give us calories and a good taste, but also provide us with sense of joy and even some health benefits. Ranging from relaxing effects, energy booster, anti-inflammatory, metabolic improvements, respiratory enhancement, to prevention of some serious disease such as cancer. Cocoa contains many substances known to provide provide various health benefits for human.

Polyphenols



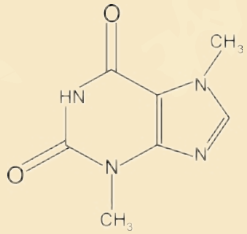
Cacao bean contains polyphenols which has potential benefits for human health. Polyphenol in cacao is known as antioxidant substance that provides various health benefits, especially in relation to inflammatory and cardiovascular diseases, metabolic disorders, and cancer prevention (Anjudar, et al., 2012).

Theophylline



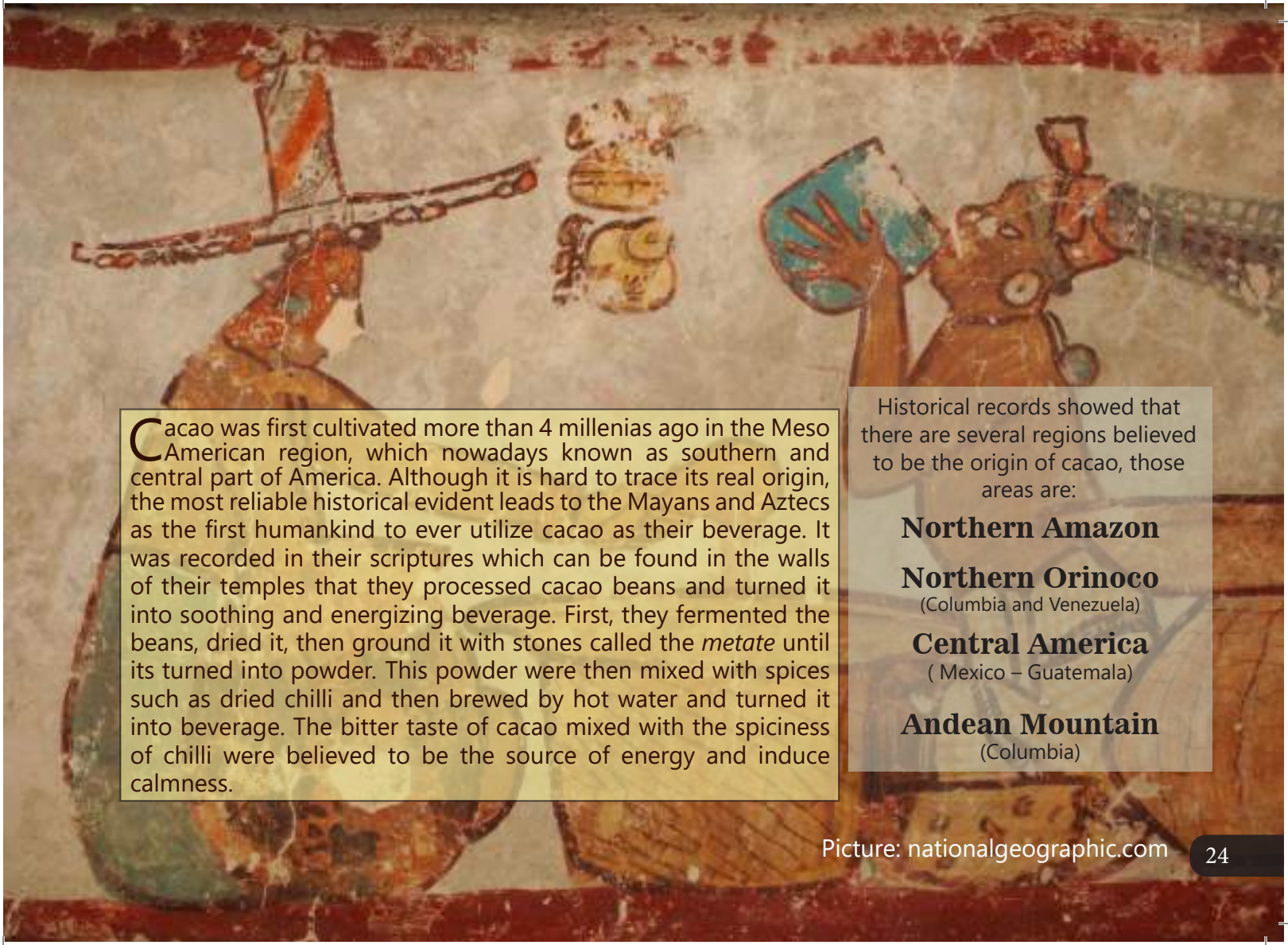
Theophylline is one of the most known Methylxanthines that are naturally found in cacao. The study by Aworte, et al. (2014) shown that Theophylline found in unsweetened cocoa powder has potential anti-asthmatic properties when consumed with the right dose.

Theobromine



Cacao powder is the major natural source of the xanthine base theobromine. The content varies with the type of cacao, and is influenced by the fermentation process (Aworte, et al., 2014). It is due to the abundance of this substance that chocolate is explored as a functional food.

02 *CACAO, the* DRINK OF THE GODS



Cacao was first cultivated more than 4 millenias ago in the Meso American region, which nowadays known as southern and central part of America. Although it is hard to trace its real origin, the most reliable historical evident leads to the Mayans and Aztecs as the first humankind to ever utilize cacao as their beverage. It was recorded in their scriptures which can be found in the walls of their temples that they processed cacao beans and turned it into soothing and energizing beverage. First, they fermented the beans, dried it, then ground it with stones called the *metate* until its turned into powder. This powder were then mixed with spices such as dried chilli and then brewed by hot water and turned it into beverage. The bitter taste of cacao mixed with the spiciness of chilli were believed to be the source of energy and induce calmness.

Historical records showed that there are several regions believed to be the origin of cacao, those areas are:

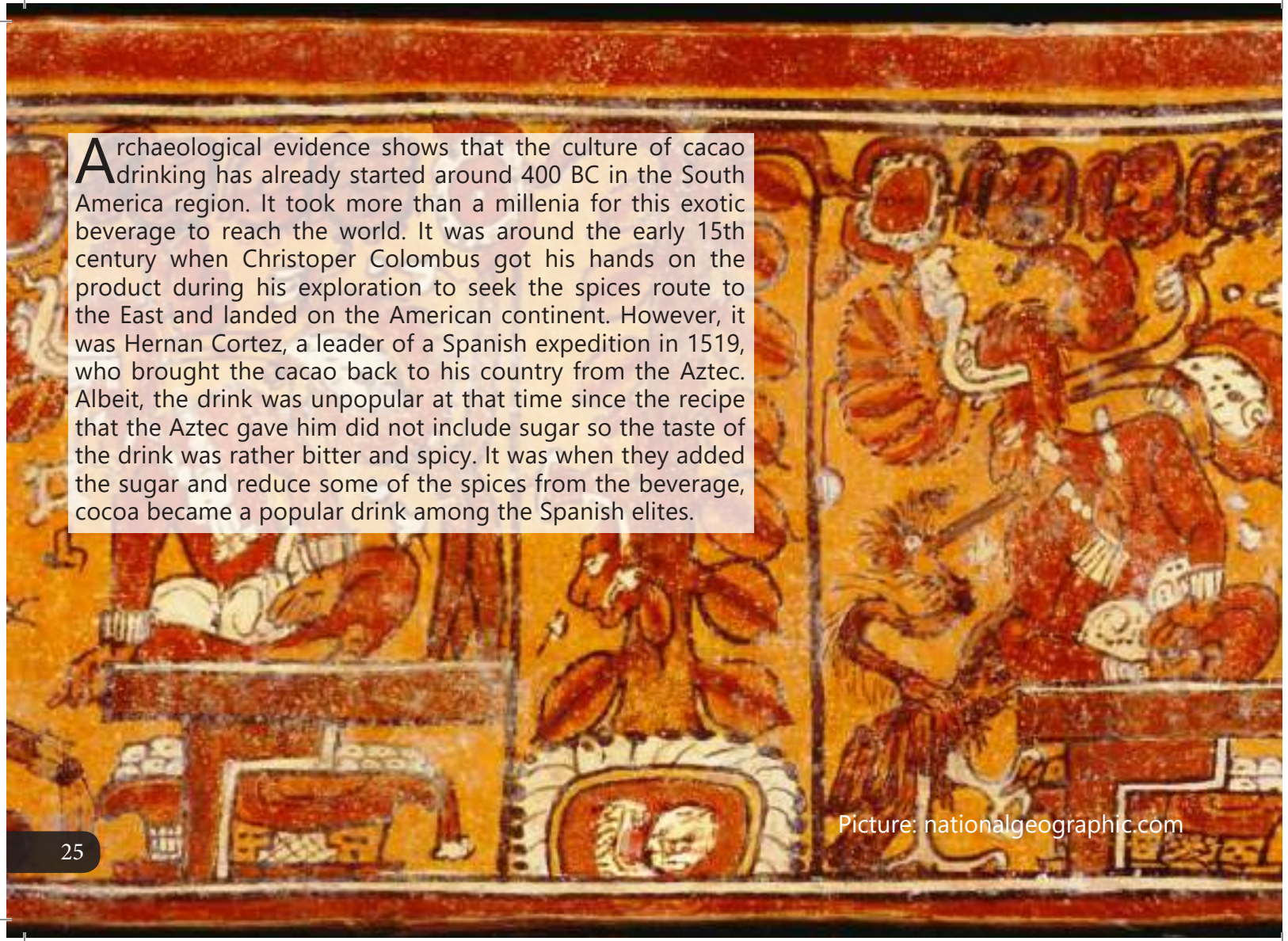
Northern Amazon

Northern Orinoco
(Columbia and Venezuela)

Central America
(Mexico – Guatemala)

Andean Mountain
(Columbia)

Picture: nationalgeographic.com



Archaeological evidence shows that the culture of cacao drinking has already started around 400 BC in the South America region. It took more than a millenia for this exotic beverage to reach the world. It was around the early 15th century when Christoper Colombus got his hands on the product during his exploration to seek the spices route to the East and landed on the American continent. However, it was Hernan Cortez, a leader of a Spanish expedition in 1519, who brought the cacao back to his country from the Aztec. Albeit, the drink was unpopular at that time since the recipe that the Aztec gave him did not include sugar so the taste of the drink was rather bitter and spicy. It was when they added the sugar and reduce some of the spices from the beverage, cocoa became a popular drink among the Spanish elites.

Picture: nationalgeographic.com

When the Spanish Conquistadors arrived in the New World and began the process of colonization, they also discovered the value of the local cacao crop. They then modified cacao to the appropriated drink by adding sugar and spices to sweeten the bitter cocoa.

Chocolate became very popular amongst the Spanish who kept the production method a secret from other Europeans for almost a century after their discovery. However, chocolate appeared in the form of a drink in France, and then England, in royal courts and special 'chocolate houses' that served the social elites.

The exclusivity of chocolate was ultimately diminished by the onset of the industrial revolution, when steam-powered machines made the production of cocoa powder significantly faster and in a larger number, thus, made it more affordable.

4th BC

History records showed that the activity of cacao cultivation was present in Mayan civilization. This is the evidence of the first coffee cultivation ever done in the world.

1508

Christoper Colombus was the first known foreigner to get his hands on cacao. It was from his exploration in the American continent. He then brought cacao to European land.

1528

Hernan Cortez brough cacao beans, equipment, and recipes for preparing chocolate to Spain. It was highly sacred and processed only by monks.

1606 - 1660

Other European countries such as Holland, Italy, France, England, and Germany found their source of cacao and started introducing it to their homeland.

1765

The first chocolate factory in the American colonies had faster production rate of chocolate than anywhere else in the world.

1828

Dutch chocolatier Conrad J. van Houten patented an inexpensive method for pressing the fat from roasted cacao beans to create a fine cocoa powder.

Cacao

Throughout Centuries

1830

British Chocolatier J.S. Fry & Sons developed solid eating chocolate bar. Making the chocolate bars more accessible to larger society.

1875

Swiss chocolatier Daniel Peter added milk powder to chocolate and put the first milk chocolate candy in the market.

1879

The Swiss invented the conching machine which refined chocolate, giving it the smooth texture we know today.

1912

Belgian chocolatier Jean Neuhaus invents the chocolate shell that can be filled with soft centers and nut pastes.

Products of Cacao

Cacao pod can be processed into many derivative products that are useful in various industries ranging from food, cosmetics, chemical, to energy. Its shell and pulp can be processed to produce alcohol, biofuel, organic fertilizer, plastic filler, and others. The beans can be turned into cocoa mass, which will be separated into cocoa cake and cocoa fat. The cake itself can be derived to many substances used in the food, medicine, and chemical industry such as cocoa paste, cocoa powder, concentrate, extract, lechitin and tannin. While the fat is the source of fatty acid, vitamins, cocoa butter, and oleo chemical.

Cacao Pod Husk

Cacao Pod Husk (CPH) is the outer layer of the fruit that protects the inside from external threats. This part constitutes 70% of the cacao fruit and known to be the by-product. CPH is a source of bioactive compounds like dietary fiber, pectin, antioxidant compounds, minerals and theorbomine, justifying their valorization (Campos-Vega, et al., 2018). However, this knowledge is not yet well known in Indonesia, leaving spots for practical innovative ideas to use this inexpensive, renewable and abundant by-product that is needed in chemical and food industries.

Cacao Pulp

This is the part that surrounds the cacao beans, also known as sweatings. The pulp is composed of parenchymatous cells containing cell sap rich in sugars, citric acid, and salts (Lopez, et al., 1984). It contains high grade pectin simillar to those found in lemon and apple that have commercial value. Aside of that, sweatings contain between 10-18% of fermentable sugars (Adomako D., 1975), thus, its fermentation has the potential to led to the production of food grade alcohol that can be applied in beverage products.

Cacao Beans

Cacao bean is the dried seed from the plant, which is the raw material from many of cacao based products. To reach its full potentials, the beans have to go through several stages of processing. Fermentation, cleaning, drying, roasting have to be done to make the beans ready for next phases which will produce several derrivative products such as cocoa paste, powder, and butter. Characteristics of the bean and treatments involved in processing it, determine the quality of the end products, which entails flavours, aromas, and consistencies.

Cocoa Paste

Cocoa paste is also known as cocoa liquor, a product made from grinding the cacao beans. In the beginning of the process, the paste takes the form of thick liquid. However, due to its high fat content, it quickly solidifies in the room temperature. The paste is then usually further processed into cocoa powder and cocoa butter. Nevertheless, there are producers who also sell the product in its original form.

Cocoa Powder

The powder is the star of the product, used as a base in almost all chocolate food and beverage products. Cocoa powder is the powdered form of cocoa solids which is marketed as an end product. The powder contains flavanols antioxidants, which provides several health benefits for its consumer. There are two types of cocoa powder based on its creation process: the Dutch process creates a dark brown colored powder due to the alkalization process, while the natural process creates light brown colored powder. Alkalization process reduces the powder's bitternes and improves solubility, an important feat for beverage product applications.

Cocoa Butter

Also known as theobroma oil, an edible fat extracted from the cacao bean. This product is produced from the separation of their hulls to produce cocoa nibs, which contain raound 56% of cocoa butter. These nibs are then processed into cocoa liquor, which is then pressed to separate the cocoa butter from the non-fatt cocoa solids. Cocoa butter has more versatile uses that are not only limited to food products, but also in ointment, toiletery, and pharmaceutical products. In food products, the butter is a primary ingredient in all types of chocolates. Its moisturizing feature and various benefits for skins also make it suitable to be applied in ointment products.

03

Cacao

Global Trade

Cacao is one of the most traded estate commodities in the world, mobilizing the economy of countless lives spread accross the globe. The commodity is traded in many forms, due to the various producing capabilities and demands of countries. Only countries that lie in the tropical areas, with suitable environment and social cultural conditions that are able to produce the cacao pods; and not all of those countries have the capability nor the capital to produce derrived products. While the higher capital countries mostly located in the area where cacao farming is not possible. Thus, they tend to settle in the processing and marketing part of the cacao agribusiness system.

In general, four cacao derrived products are being traded in the global market: 1) The beans, which is the raw product of cacao fruit; 2) The paste, which contains more fat and has its own suitabilty to be used in certain food products; and 3) The powder, the powdered version of cocoa end product which is used as ingredient in almost all food and beverage product; and the 4) The butter, a fatty substance derived from cacao beans, which is also used in many industries.

TOP 5 CACAO BEANS EXPORTERS (2018)

Cote d'Ivoire 1
1,525,594 tonnes
3.25 billion USD

Ghana 2
843,641 tonnes
2.43 billion USD

Nigeria 3
294,661 tonnes
0.57 billion USD

Ecuador 4
294,063 tonnes
0.66 billion USD

Netherlands 5
237,808 tonnes
0.64 billion USD

CACAO BEANS
IMPORTERS (2018)

TOP 5

1 The Netherlands

1,157,150 tonnes
2.6 billion USD

2 Germany

469,618 tonnes
1.2 billion USD

3 USA

415,272 tonnes
0.99 billion USD

4 Malaysia

345389 tonnes
0.79 billion USD

5 Indonesia

239,377 tonnes
0.53 billion USD

Source: FAOSTAT, 2020

TOP 5 COCOA PASTE EXPORTERS (2019)

1 Cote d'Ivoire
194,651 tonnes
0.56 billion USD

2 Netherlands
147,893 tonnes
0.51 billion USD

3 Germany
84,557 tonnes
0.29 billion USD

4 Ghana
46,439 tonnes
0.13 billion USD

5 France
36,068 tonnes
0.12 billion USD

COCOA PASTE IMPORTERS (2019)

TOP 5

1 **Netherlands**
120,019 tonnes
0.36 billion USD

2 **France**
86,061 tonnes
0.28 billion USD

3 **Belgium**
84,120 tonnes
0.30 billion USD

4 **Germany**
63,112 tonnes
0.22 billion USD

5 **Poland**
49,996 tonnes
0.16 billion USD

Source: FAOSTAT, 2020

TOP 5 COCOA POWDER EXPORTERS (2019)

1 Netherlands
297,419 tonnes
0.71 billion USD

2 Indonesia
154,944 tonnes
0.24 billion USD

3 Malaysia
152,159 tonnes
0.24 billion USD

4 Ghana
136,736 tonnes
0.36 billion USD

5 Germany
124,446 tonnes
0.29 billion USD

COCOA POWDER IMPORTERS (2019)

TOP 5

1 USA
154,333 tonnes
0.36 billion USD

2 Spain
95,045 tonnes
0.12 billion USD

3 Netherlands
88,545 tonnes
0.18 billion USD

4 Germany
75,763 tonnes
0.17 billion USD

5 Russia
57,926 tonnes
0.12 billion USD

Source: FAOSTAT, 2020

TOP 5 COCOA BUTTER EXPORTERS (2019)

1 Netherlands
260,641 tonnes
1.54 billion USD

2 Indonesia
155,025 tonnes
0.82 billion USD

3 Malaysia
89,242 tonnes
0.39 billion USD

4 Cote d'Ivoire
86,964 tonnes
0.39 billion USD

5 Germany
82,467 tonnes
0.49 billion USD

COCOA BUTTER IMPORTERS (2019)

TOP 5

1 USA
154,333 tonnes
0.36 billion USD

2 Spain
95,045 tonnes
0.12 billion USD

3 Netherlands
88,545 tonnes
0.18 billion USD

4 Germany
75,763 tonnes
0.17 billion USD

5 Russia
57,926 tonnes
0.12 billion USD

Source: FAOSTAT, 2020

04

INDONESIA & CACAO

Cacao is one of the main estate commodities in Indonesia. There are various sources which stated how Cacao was first introduced in our country. Wood G.A.R stated that cacao was introduced in the mid 15th Century. While Frederic Durand mentioned in his book that cacao was firstly introduced in the early 17th Century, which is also indicated by Clarence-Smith that cacao was present on the Maluku islands at that period. Our local history said that the Spanish brought cacao in the 15th Century from The Phillipines to Minahasa, which then spread to Maluku. What we can sure of is that cacao was brought to our country during the colonial era for the benefits of the foreign countries, and it has been through many stages of changes until now. There are several attemtpts to introduce the great flavoured and valued Criollo from South America to the island of Java, but those efforts could not be replicated in other parts of Indonesia due to the rising popularity of other varieties to meet the industrial demands. However, some small areas of the old Criollo plantations are still exist in some parts of Java until now. In the late 18th Century, Indonesian cacao was distrupted by the pod borer pest attack which wiped out most of the plantation on the Maluku islands.

Aside from its robustness againts the disease, the Forastero yields better than the Criollo, allowing Indonesian cacao production to skyrocket within a relatively short period. This variety is also suitable to be planted in low altitude areas, which brought other advantages at that time since its plantations are located relatively nearby the ports, cutting off the transportation costs by a considerable amount.

In order to revive the cacao production, which played an important role in the Dutch international trading activities, in the early 19th Century, van Hall did some experiments to grow the best variety of cacao in the island of Java, which was not that successful. The high population density in Java makes it less suitable for growing hard crops such as cacao due to its fastly increasing land price and the dynamics of the society which makes it difficult to stay in the business. However, his efforts were not fully unsucessfull. Javan cacao still manage to maintain its unique flavours in the market due to its high Criollo proportion.

It was the people of Bugis, a tribe originated from the South Sulawesi, who initiated large cacao plantation in their region. The commodity then became popular for many other tribes in the Sulawesi island due to its lucrativeness and less time consuming works required to maintain the plantation. From the 1960's onward, the Indonesian government started to take the potential of cacao as one of the top commodities in the country, by continuously developing the crops in Sulawesi, boosting the national production so that Indonesia always placed in the top cacao producing countries in the world until now.

Indonesia is blessed with geographical advantages which bring numerous posibilities of generating unique taste of cacao. Various interventions brought by the Wests due to their interests in this commodity had also contributed to the production of high quality beans with wide array of characteristics. Although most of Indonesian cacao are produced to meet the industry's demands as a base for producing high quality cacao products, some of our cacao can be considered as hidden gems. It is true that our cacao plantation is dominated by smallholders in the high populated rural areas. Yet, there are also some plantations which are located in the hidden parts of the country, far from the growth center, some even need a week of 'special' motorcycle ride to reach. Albeit, these locations produce the best quality of cacao with high yields due to its pristine environmental condition and supporting local wisdoms. Nevertheless, it requires much efforts in exploring those hidden gems, and much more in developing and improving the current available plantations as they have not reached their optimum potentials.

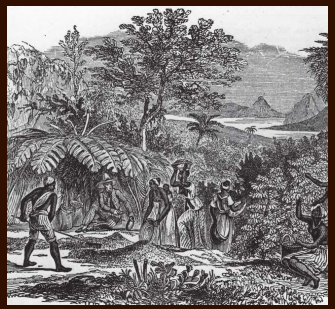
CACAO HISTORY in INDONESIA

15th

Cacao was first introduced in Indonesia during the colonial era by Spanish trader, who brought the seeds from the Philippines to Minahasa, North Sulawesi.

17th

Cacao was spread to the Maluku islands. Some scholars believed this was the first introduction of the commodity to the country.



18th

Dutch scientist started to introduce the Criollo variety to the island of Java, tried to develop the best cultivar to be grown in Indonesia

1825

The first export activity of cacao was done by the colonists who sold cacao from North Sulawesi to the Philippines by the amount of around 90 tonnes in 13 years period.

19th

Indonesian cacao started to become a cash crop in the late 19th century. Development was present in a limited form, plantations were mostly o

1960

Following its independence, Indonesian government started to nationalize cacao plantations under the PTPN. However, at this point, Indonesian cacao still has not seen as potential cash crop, limiting its development

1990

Indonesian government started to develop cacao in the country by various programs of intensification and area expansion. Production level started to climb up, placing Indonesia as one of the top cacao producers in the world, up until today

2010+

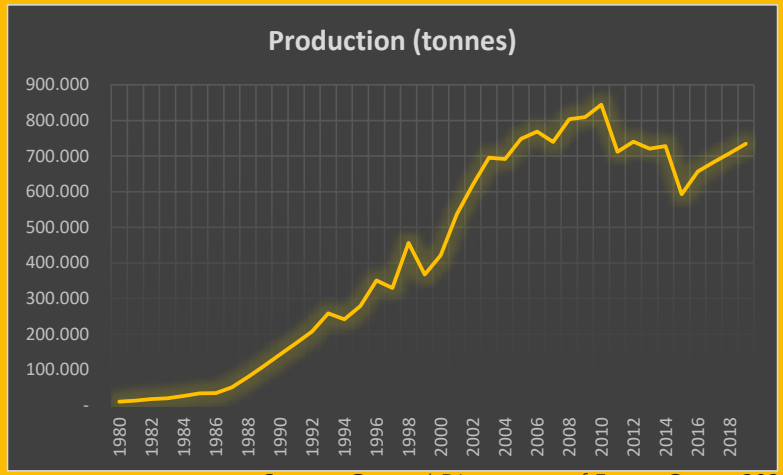
Indonesian government started to shift its concern from raw cacao beans to the production of processed cacao product. This efforts are shown from the production at the farm level to various revisions in trade policies.

Today, Indonesia is the third largest cacao beans producer in the world following Ivory Coast and Ghana (FAO, 2019). The statistics shows that in 2017, Indonesia produced 659 thousand tonnes of cacao beans. However, this was not easy to achieve. Indonesian government played an integral role in improving the commodity throughout many years of continuous development. These efforts ranged from finding the most superior planting material, land expansion, farmers' capacity building, technological improvements and knowledge transfers.

The development of Indonesian cacao started to be stabilised after a few years of the independence, when the country started to stand on its own feet. Former Dutch owned plantations and research centres were nationalised during 1960 - 1990 period. From the 1990s onward, Indonesia started to develop the cacao sector, resulting in significant increase in production for the next 20 years. Post 2010 however, Indonesian cacao production started to decrease due to various factors, especially on-farm related problems.

INDONESIAN CACAO PRODUCTION

Indonesian cacao production is determined by numerous factors from the environmental condition to socio-economics condition of the farmers. In general, the production is driven by the market. Environmental factors include the availability of arable land and agro-climate condition; while the socio-economics condition of farmers determine their capacity to put their knowledge, resources, and networks to optimize the yields of their cacao farm. Unfortunately, Indonesian cacao production areas are mostly located in the eastern part of the country, where the regions are less developed than Java due to limited access to various elements that can enhance their capability.



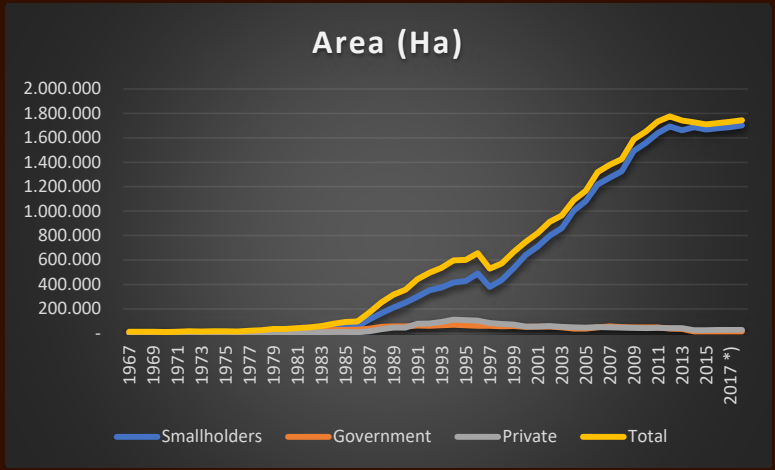
Source: General Directorate of Estate Crops, 2020

Most of Indonesian cacao plantation is owned by smallholder farmers in Sulawesi, Sumatera, Kalimantan and Papua. Those islands are less populated and have more available land for the people, so cacao farmers usually have a quite large of cacao plantation area nearby their houses. However, there are many problems that limit the growth of cacao production. For instance, the Good Agricultural Practice (GAP) is not well disseminated to most Indonesian cacao growers. Low access to informal education and information still limiting their knowledge and capability. Low quality or unavailability of required infrastructures such as road, warehouses, irrigation, post harvest facilities, etc. created ineficiencies in the business. Moreover, low incentives caused by the long market chain created more hindrances for the growers to apply high capital GAP. Considering all of the problems, the production is continuously increasing since 1980s, albeit, it is still far from its potential.

There is no way that the growers are able to handle all of those problems on their own. On the other perspective, this provides promising opportunities for investors to jump in and help out, with some form of partnerships that can build reciprocal relationships.

INDONESIAN
CACAO PLANTATION AREA

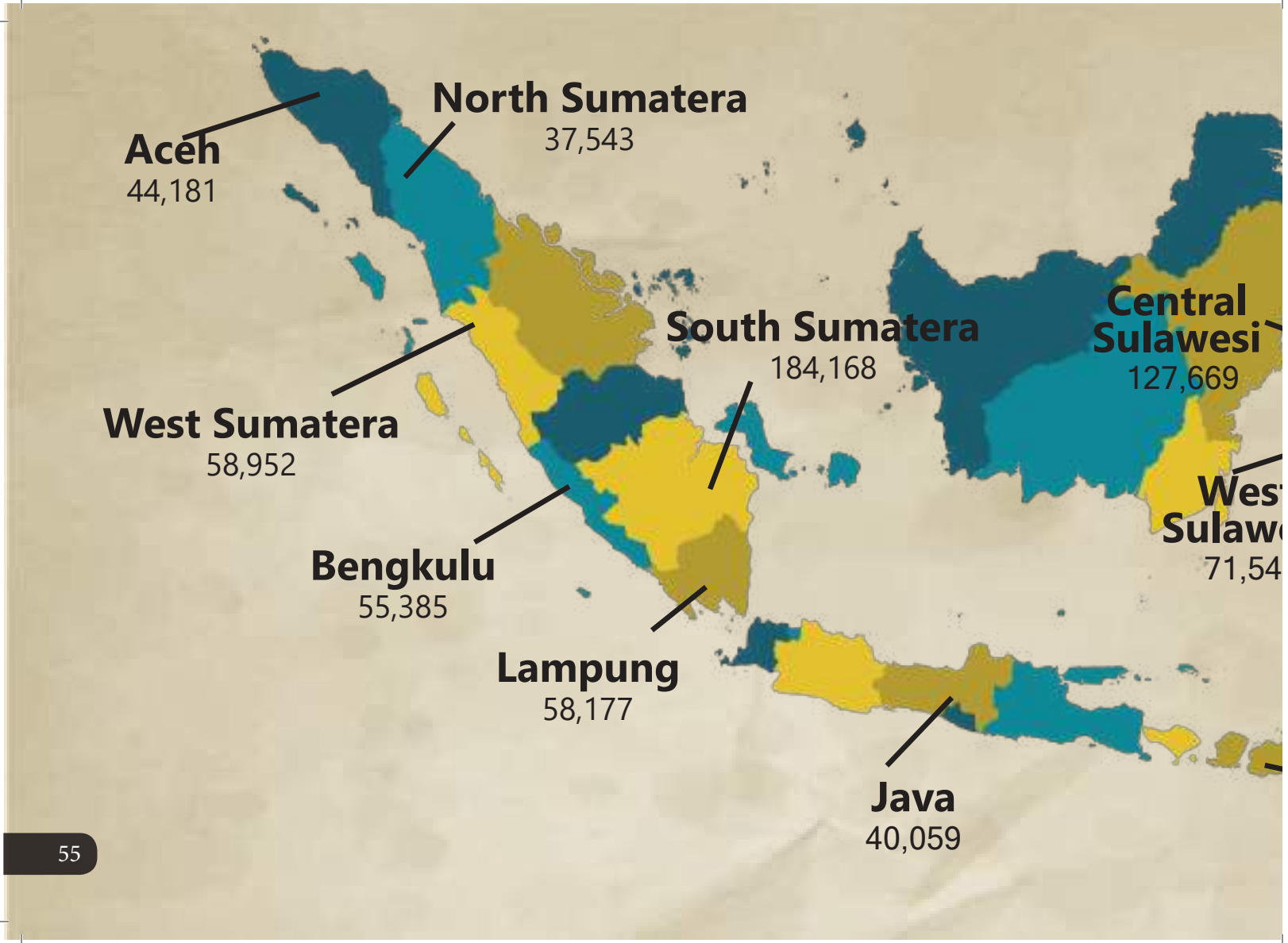
Plantation area is one of the key factors that determine the production level. Indonesia's cacao plantation areas are mostly located at the Eastern part of the country, especially in Sulawesi island, which holds the crown for being the largest cacao producer in the country. Most of Indonesian cacao plantation are located in low altitude areas nearby the villages spread in the producing areas. However, some of the plantations are located in remote areas covered by thick jungle and high mountains such as in the Seko district in North Luwu, South Sulawesi, where its remoteness contribute to the pristine condition of the environment, making it able to produce one of the best cacao in the country.



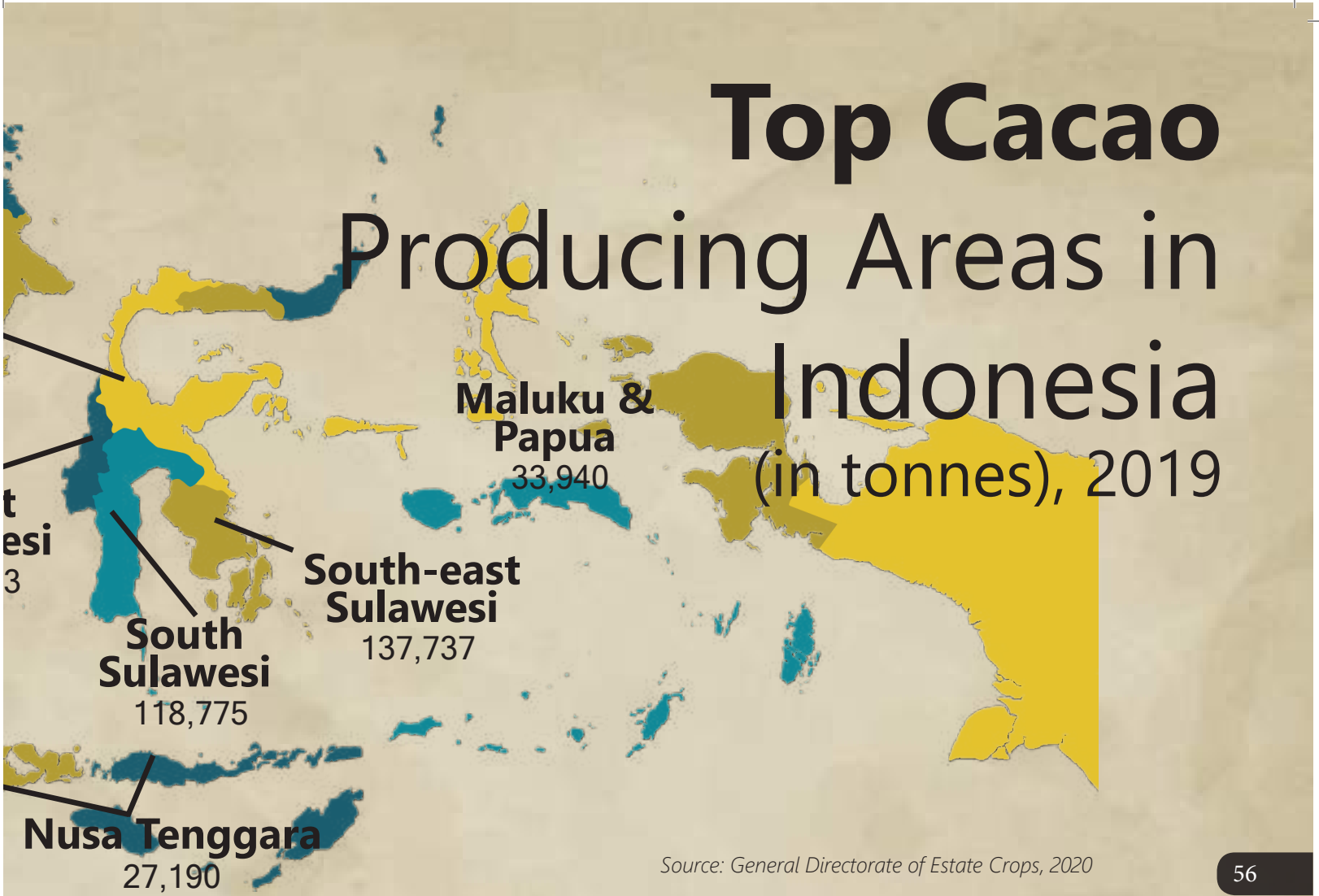
Source: General Directorate of Estate Crops, 2020

The graphic shows that since 1985, Indonesian cacao plantation area is growing with some fluctuation during 1995 to 1998. It is believed that the sharp decline during that time was the effect of 1998's economic recession that followed the chaotic political situation, where Indonesia entered the reformation era. However, agriculture, including cacao is one of the main sectors that saved Indonesia from collapsing in the time of economic recession. Estate crops, such as cacao, were able to provide income for the growers without being affected too much by the global situation. As a result by 1999, the cacao plantation area started to rise again, even after the global recession in 2008. This proved the role of agriculture, especially cacao as one of the estate crops, is important in the social economic condition of Indonesian population.

The table also shows that most of our cacao plantation belongs to the smallholders, who dominates the area by more than 90%. Which means that developing our cacao will directly benefits the commons in terms of increasing their welfare, which will also boost the capacity of our rural areas, which will further strengthen our economy in the macro level.


Aceh
44,181
North Sumatera
37,543
West Sumatera
58,952
South Sumatera
184,168
Bengkulu
55,385
Lampung
58,177
Java
40,059
Central
Sulawesi
127,669
71,54

Top Cacao Producing Areas in Indonesia (in tonnes), 2019



Source: General Directorate of Estate Crops, 2020


Indonesian cacao agribusiness is still lacking in many areas. Hindrances and limitances occured from production to marketing level, limiting the growth of our cacao industry. Despite all those, we managed to compete in the world and still sit in the top percentiles, both for volume and quality. Imagine if we could tackle all of those problems and further develop our cacao industry, the crown will be ours...

Stretching from the island of Sumatra to the island of papua, Indonesia is filled with thousands of islands. Most of them have the potential to produce high quality cacao beans. Thanks to its geographical condition and climate, naturally, Indonesian cacao have a high standard of quality that are preffered by the global consumers.

Indonesia produces one of the world's favourite cacaos. Most of the cacao industries use our cacao as a base in their products, to give the best taste to their consumers globally. Indonesian cacao which is mostly came from the Forastero variety, have high yield and strong chocolate flavor without much complexity, making it suitable to be mixed with other beans which have more complex flavour such as the Trinitario or/and the Criollo.

Some well known cacao producing areas are Sulawesi, Sumatera, Bali, Java, Nusa Tenggara, Papua, and Kalimantan. Each island has their own characteristics, producing their own unique beans. Indonesia has a really huge potential to be the leader of the global cacao industry. With proper and consistent intervetions, this dream is not impossible to reach.

Indonesian Cacao from Seed to Bar

05

We are so used to finding various forms of chocolate almost in every stores, that we often forget that it took years for those products to be available for us. Those products are the result of a long journey trhough many stages of pre-production, production, processing, distribution, and marketing, along with all the complexities that follows each stage. The quality of a product is determined by at least four major stages in chocolate production: planting and plant maintenance, harvesting, post harvest activities, and processing activities. Each stage has a different system and is done by different set of actors. The consistency in quality control in all stages is very important to bring out the best quality of product. Yet, the geographical characteristics and diverse culture covering the nation provide its own opportunities and challenges.

This part will provide short yet resourceful descriptions about the production process of the cacao from planting to producing finished chocolate bar. Although brief, we hope that the readers will be able to grasp general understanding of what it really takes to get their daily mood booster intakes.

It takes at least 2.5 - 6 months for a seed to germinate into a plant. It then takes about 2 - 3 years for a cacao plant to begin bearing fruit that can be harvested for its beans. The plant produce flowers that develop into cacao pod over a period of 6 months.

Planting & Maintenance

Cacao plants grow optimally in low altitude area with the elevation less than 400 m above sea level. In general, it takes 2 years for the cacao plant to reach is early productive stage. Once it starts to produce flowers, it will take approximately 6 months for the flower to grow into ripe cocoa pod. At the farm level, maintenance is very important to ensure that the plants grow to its full potential. This can be done by protecting them from unwanted pests and disease and also giving them needed nutritions (highly recommended to use organic fertilizers) during their maturation phase. The trees will keep producing the fruits annually with the productive life span of 25 years. For industrial market, the farmers are usually use chemical fertilizers and pesticides to boost their production level as the industries prioritize volume over quality. As for small market niche of specialty cacao, farmers usually grown them organically or use low dosage of chemical inputs.

In average, the ideal number of cacao trees per hectar is around 700-800, with 3-4 metres of space between the trees, with covering plants arranged accross the field to protect them from direct sun light and heavy rains, especially during their early stage of development (less than one year of age). The farmers usually plant the covering trees first, when those trees reached certain heights (10-18 months) the cacao seedlings start to be planted.

Maintaining the plantation is the next step that should be taken seriously, as it will determine the quality and quantity of the produced fruits. There are at least five general plant maintenance activities that should be done regularly throughout the year:

1) Fertilization
2) Pruning
3) Weeding
4) Replacing plants
5) Regulating shade

1) Fertilization

Fertilizing the plant is important in making sure that the plants got their nutritions accordingly as they grow up. Fertilization depends on many factors such as the plant age, soil type, and the condition of surrounding bio diversity. Fertilizations are usually done once or twice in a year, starting from the planting period. Manure are usually spread in the planting hole during planting period, then chemical fertilizers are usually spread around the trunk. Nutrition wise, the cacao tree rarely need nitrogen (N), but requires a lot of phosporus (P), potassium (K), and boron (B).

2) Pruning

Pruning is done to make sure that the nutritions are more concentrated for the right part of the tree. Done rightly, pruning can lead to maximizing production through improved flowering. Usually the tree height is capped at approximately 1.5 meters above the ground with a crown of 5 branches, so any branches that grow above that level should be prunned.

3) Weeding

The range between each treen in a cacao plantation is spacious enough for the smaller plants to flourish. With regular fertilization, To maintain there are no competition in nutrition absorption for the cacao tree, any unwanted foliage that gave no benefits to the tree should be removed.

4) Replacing plants

In a controlled plantation, death of plants are inevitable. Starting from unsuccessful germination to failures caused by environmental threats such as pests and disease, or even misshandling done by the grower, can lead to unproductivity or even death of plants. Dead trees should be replaced by new trees. This is done not only to maintain the producitvity of the whole plantation, but also the overall health of the environment. As dead trees can become a source for various diseases that can spread to the surrounding trees.

5) Regulating shade

Cacao yields better under the range of 30% - 60% of full sunlight (Vernon, 1967). Aside of protecting the cacao tree from direct sunlight, the use of shade trees also have the potential to improve the farmers income.

Harvesting

Cacao harvesting is a labour intensive process, due to the characteristics of terrain which makes it too difficult for machinery to operate on. The growers will selectively harvest the pods that are ready. The voluminous characteristics of cacao pod requires versatile tools or vehicles to transport.

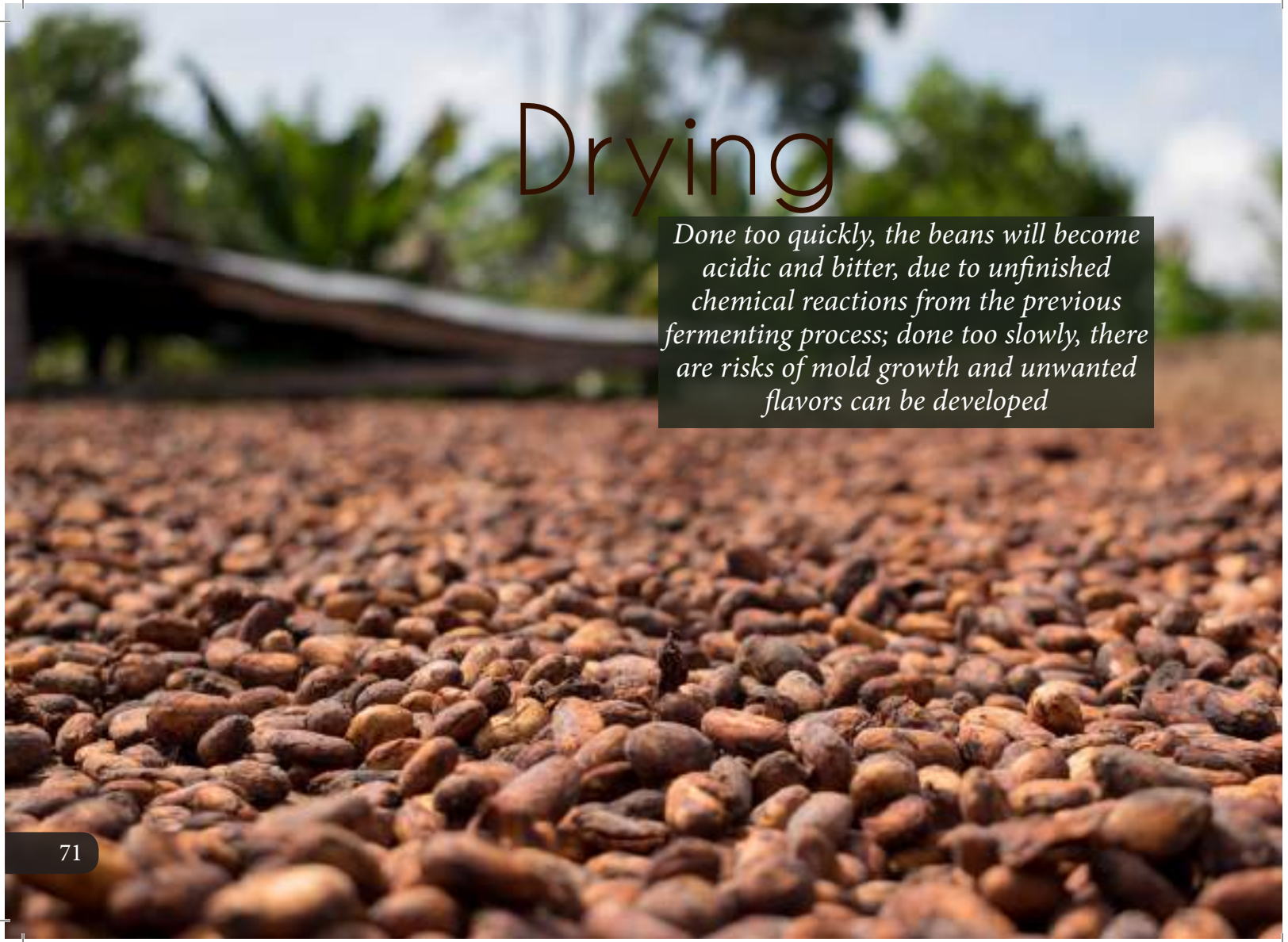
Once the cacao plant reached its productive age, it begin to bear fruits in clusters along its brances, reffered to as cacao pods, which is initially green or red and turns yellowish when it is ready for harvesting. In general, cacao harvesting is done within a period, usually 4-5 weeks. During this period, harvesting was done by only removing the most ripe pods first, and repeating the process in an interval of 1-2 days until the harvest period is over. Traditionally, cacao pod is seletively harvested by hand with the help of pruning tools and a basket. It is very important to maintain the flower cushions undamaged during harvesting as it will produce flowers, which will turn to fruits in the next season. Aside of that, it is also important not to damage the tree as it will be more vulnerable for the tree to be infected by parasitic fungi. Harvesting is a labour intensive process, due to the characteristics of plants which require delicate methods. Moreover, some terrains are also made it impossible for the machineries to operate on.

Fermenting

It is the white pulp that got fermented by the yeast and bacteria, not the beans. The beans are affected by the process of fermentation, getting transformed internally and externally, developing flavour and acidity.

After being harvested, the pods will be opened to remove the beans. This process should be done within one week period after harvest. Some farmers do this step in the field right after the harvest so that they can use the remaining husks as bio fertilizers, to return some of the nutrients to the soil. Best way of opening the pods is to hit them with a club right in the middle to avoid damaging the beans. After the beans which are still covered by pulps, are removed from the pods, it will go through a fermentation process. Fermentation is essential for developing the flavour and acidity of the beans.

There are multitude ways of fermentation, but in general, fermentation is about creating a suitable environment for the microorganisms to grow and start fermenting the pulp. Usually the farmers pile the beans and cover it with banana leaves, the yeast will grow and insects such as the vinegar fly will carry essential micro-organisms to the pile. In the following days, the bacterial activity and increased temperature will break the cell walls and allow for the substances to enter the beans, generating complex chemical processes. The chemical develop the flavour, acidity, and color of cacao beans. This whole process takes around 3 - 6 days to be completed.



Drying

Done too quickly, the beans will become acidic and bitter, due to unfinished chemical reactions from the previous fermenting process; done too slowly, there are risks of mold growth and unwanted flavors can be developed

The firstly seems to be a simple process, drying plays an important role in developing the best quality of cacao beans. Drying is the process that takes out most of the water content from the beans. This process is important since the higher the moisture content, the lower the quality of beans. In a drying process, the optimal moisture has to be taken down from around 60% to just 7%. There are risks involved in drying due to its traditional process of basking the beans under the sun, which often done open in the field. Thus, it is prone to any external threats that could lower the beans quality. Drying process has to be done under a certain amount of time, in a careful way to prevent any unwanted flavour changes. Done too quickly, the beans will become acidic and bitter due to unfinished chemical reactions from the previous fermenting process; if the drying process takes too long, there are risks of mold growth and unwanted flavors can be developed.

In general, there are two methods of drying: first, the sun drying, where the beans are usually spread on a mat or other medium under the sunlight, which is common to be done in tropical countries such as Indonesia; and the second is artificial drying, where the beans are put in a container to be exposed by indirect heat from any source, usually done by burning woods.

Standard Quality

The classification of terms and grade standards used in cacao beans are defined by ISO 2451. These standards are based on the cut test which allows certain gross flavour defects to be identified (CAOBISCO/ECA/FCC, 2015).

The standard specifies that cacao beans shall be:

- Fermented, then dried until their moisture content no longer exceeds 7.5% mass fraction.
- Free from odour contamination
- Within the standard for violet or purple beans, typical of the specified grade or origin.
- Free from any evidence of adulteration.
- Virtually free from any foreign matter.
- Reasonably uniform in size, fit for production of a foodstuff
- Virtually free from living insects and other infestation.
- Reasonably free from broken beans, fragments and pieces of shell.
- Reasonably free from bean clusters, flat beans, germinated beans, residue and sievings.

Many would not notice that just like coffee, different quality, variety and origins of cacao determine their characteristics of flavours. Some studies shown there are indications that in addition to the effects of genetic background and post-harvest practices, the climate and soil may also contribute to flavour differences, referred to as the 'terroir' effect as in wine production (Sukha, et al., 2014). However, post harvest handling is still one of the most determining factors in flavour development, as one mistake can lead to various unwanted flavors development as summarized in the table below:

Mouldy Flavor	Acidic Flavor
• Prolonged fermentation • Slow or inadequate drying • Storage under highly humid conditions • Germinated beans and damaged beans	• Deep box fermentation • Inappropriate turning • Too Rapid Drying
Smoky Flavor	**Excessive bitterness and astringency**
• Contamination by smoke during drying due to inappropriate fuel, bad design, faulty operation or poor maintenance of dryer • By exposure of dried beans in store to smoke contamination	• Certain planting materials • Lack of fermentation

Source: CAOBISCO/ECA/FCC, 2015

Processing

The next phase in the chocolate production is the processing, which entails several steps to be completed. In this phase, the beans are processed into several substances that have economical values and needed in many industrial sectors. This phase involves cleaning, roasting, winnowing, alkalization, and conching. This phase is usually done in a single location, a factory equiped with machineries and tools to do all those steps. Only after going through all these phases, the beans from the cacao fruit will be turned into various products which are used as ingredients in the food industries, chemistry, pharmaceuticals, and other manufacturing activities. Each phase is equally important in producing high quality products. In other words, a mistake in one of the proccesses will affect the the performance of the next process, which in the end, it will reduce the overall quality of the product.

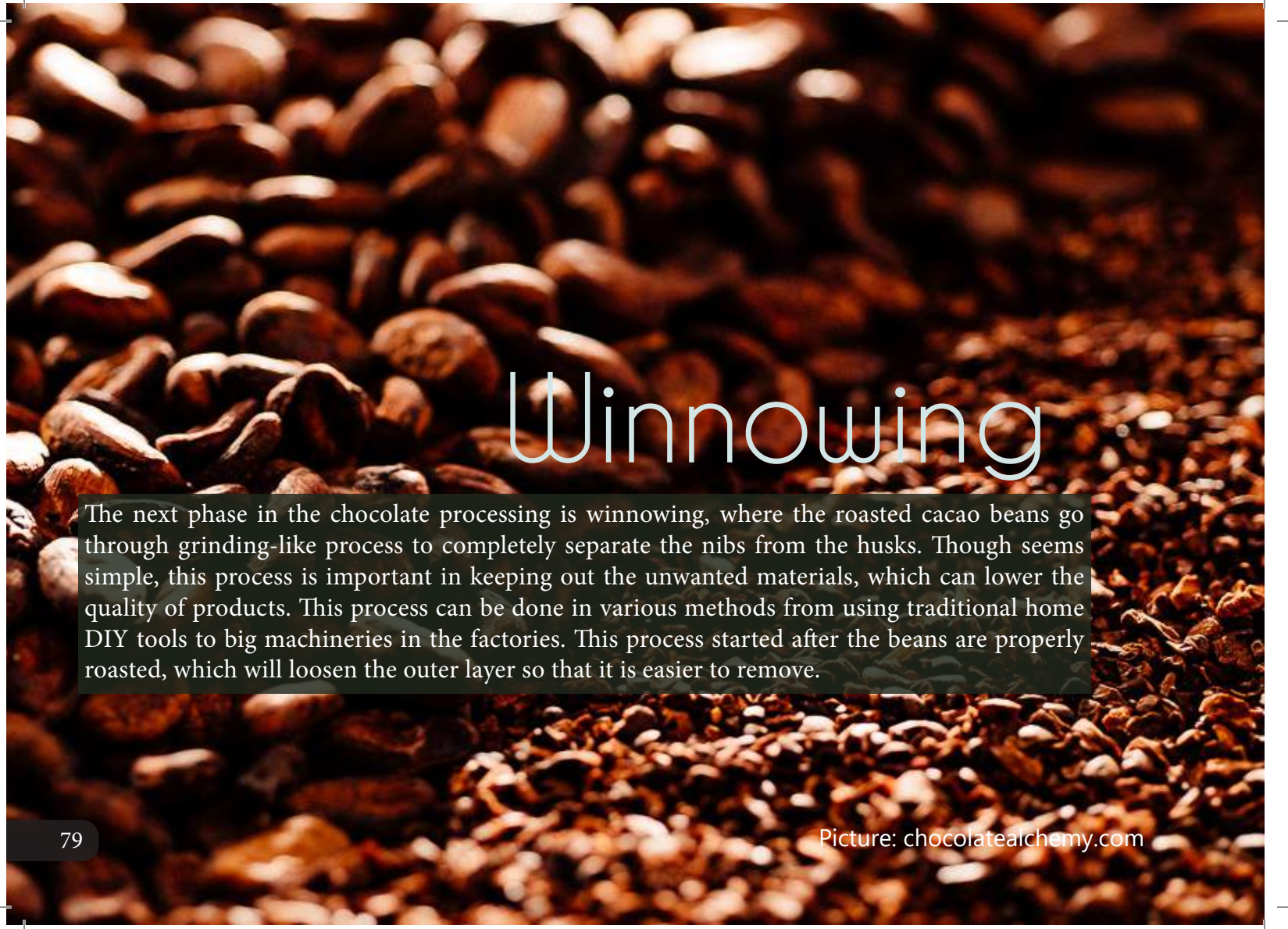
This part will provide a brief yet concise information regarding cacao processing from beans to bar.

Cleaning

Cleaning plays an important role in the pre-processing step of cacao beans. Unclean beans can lead to various problems ranging from the development of unwanted taste and aroma, to failure in the creation of cacao products. Cacao beans processed in the processing factory mostly came from the fields far away if not foreign countries. It usually contains various external materials such as husks, dirts, dusts, branches, stones, even sometimes metals. Removing these materials from the beans is very important not only to maintain the quality of the beans, but also in maintaining the condition of processing machineries.

Roasting

Roasting contributes in multiple ways to the development of cacao beans. From cooking the beans, removing unwanted germs, reducing moisture, developing the texture and flavours of the beans, to separating the husks from the nibs, making it easier for the next process. However, the main objectives of roasting were flavour development and moisture control. During roasting, several chemical processes occur inside the beans where acids gained from the fermenting process and natural sugars are converted into flavour compounds that also brings favourable chocolatey aroma. Cacao roasting process should be handled with a slower and gentle treatment, under a temperature of 120 - 170 °C for about 60-90 minutes. Flavour development during this process is, however, affected by many other factors such as the starting point and temperature adjusments during the process, beans characteristics, and the particular style of the roaster.



Winnowing

The next phase in the chocolate processing is winnowing, where the roasted cacao beans go through grinding-like process to completely separate the nibs from the husks. Though seems simple, this process is important in keeping out the unwanted materials, which can lower the quality of products. This process can be done in various methods from using traditional home DIY tools to big machineries in the factories. This process started after the beans are properly roasted, which will loosen the outer layer so that it is easier to remove.

Picture: chocolatealchemy.com

Grinding

The next phase in the chocolate processing is grinding or milling the cacao nibs to produce cocoa paste or also known as cocoa liquor. Although it can be done through various methods, depending on the quantity and purpose of production, this phase is usually done in a single location, a factory equiped with machineries and tools to do all those steps.

Quality of the cocoa liquor is determined by the temperature and degree of milling, which varies depend on the type of nib used and the product required. The produced liquor will then used in producing cocoa butter and cocoa cake.

Alkalization

Alkalization is the process that treats the cacao nibs with a food-grade alkali solution to raise the pH producing darker colors and stronger flavours (Kamphuis, 2017). Not only the consumers, the producers also have their own preference of flavours that they want to portray in their products. Those who prefer their cocoa product to have a strong flavour with darker color, are willing to put extra costs that are needed for the alkalization process. While those who prefer lighter version both for flavour and color, will skip this phase and go straight to the next one.

Conching

Picture: chocolatedisorder.com

This process describes the final stage of bulk chocolate production, which is considered an important phase for texture and flavour development in chocolate. In this process, the refined cocoa mass is mixed, ground and kneaded inside the chonche at temperatures of 60-80 °C. Several ingredients such as cocoa butter, emulsifiers, and flavor enhancers are generally used in this process. The quality of final product is determined by the temperature and conching times, which can vary from a few hours to few days (Winkler, 2014).

Complexes between polyphenols, amino acids, peptides, and proteins are formed during this process. This is one of the reasons why conching affects chocolate flavor and reduces astringency (Afoakwa, et al., 2008).

Through this book, we tried to deliver some illustrations of the complexities that lies in the world of cacao, in the simplest possible way, so that our readers will gain some useful information that will further enhance their curiosity about Indonesian cacao. We hope that this book will give sparks to the curious minds, inspiring them to do more studies, explore more of our cacao producing areas, and even maybe interested to invest and contribute to the development of our cacao. This book is open for any critiques as we plan to continuously revising it in the future, adding more concise information with updated way of communicating it.

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