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Plantation Crop Productivity: Coffee, Sugarcane and Cocoa

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Policy Paper No. 42

Plantation Crop Productivity: Coffee, Sugarcane, and Cocoa

by Kadir Ruslan & Octavia Rizky Prasetyo

www.cips-indonesia.org

Policy Paper No. 42

Plantation Crop Productivity: Coffee, Sugarcane, and Cocoa

Authors:
Kadir Ruslan
Octavia Rizky Prasetyo

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EXECUTIVE SUMMARY

Plantation sub-sector plays a quite important role in national economy. About a quarter of Gross Domestic Product (GDP) in agriculture sector comes from plantation. It also has a significant contribution to foreign exchange income through export of agricultural crops.

Until today, plantation sub-sector is still faced with structural problem, such as plantation crop productivity by smallholder plantations that is relatively low in compare to large plantations that are run by the government or private sector. It can be clearly seen in commodities like coffee, cocoa, and sugarcane, which are strategic plantation commodities that are mostly cultivated by smallholder plantations. Another problem is the disparity between land and labor productivity is also quite large between regions.

In 2018, the proportion of smallholder plantations area for cocoa, coffee, and sugarcane each is around 96.63 percent, 98.33 percent, and 56.72 percent, respectively, towards the total area of national plantation crops. Unfortunately, throughout 2006-2018, the average productivity of coffee crop from smallholder plantations is lower about 9 percent in compare to large government plantations productivity. Meanwhile, the cocoa crop productivity of smallholder plantations is lower by 11 percent in compare to large private plantations productivity. As for sugarcane, though smallholder plantations productivity is higher than large government plantation, it is still lower by around 26 percent in compare to large private plantations.

Closing the productivity gap is the key to enhance the productivity for all these three commodities. To reduce the productivity disparity between smallholders and large plantations, increasing technical efficiency of smallholder plantations could be the first step, namely by promoting the use of certified seed, enhancement of farmers technical capacity through counseling, and strengthening farmers institution through farmers group membership, farmers association, financial access, and farmers business partnership. Meanwhile, productivity gap between regions can be reduced by increasing productivity in potential areas (plantations with a relatively big area) that still have low productivity.

Cocoa and coffee productivity in several provinces that are not so optimal might be caused by the huge proportion of old plants that are less productive. It is indicated by the relatively big amount of those plants in provinces that are not productive anymore. That is why, plants rejuvenation could be the key to increase coffee and cocoa plants productivity in those provinces.

Labor productivity gap (farmers) between regions is also an important issue that has to be resolved. Provinces with relatively low labor productivity can be the main focus of development as an effort to boost farmers production. Increasing labor productivity can be done by increasing farmers capacity in their cultivation activities. This can be through strengthening the role of field instructor in giving training and guidance to the farmers.

THE ROLE OF PLANTATION COMMODITY FOR NATIONAL ECONOMY

Agriculture sector (including forestries and fisheries) has a very important role in Indonesian economy. It is shown by how big this sector contributed to Gross National Product (GDP), namely around 13.93 percent in 2020 or on the second place after processing industry sector. This is of course supported by the role of plantation sub-sector in it.

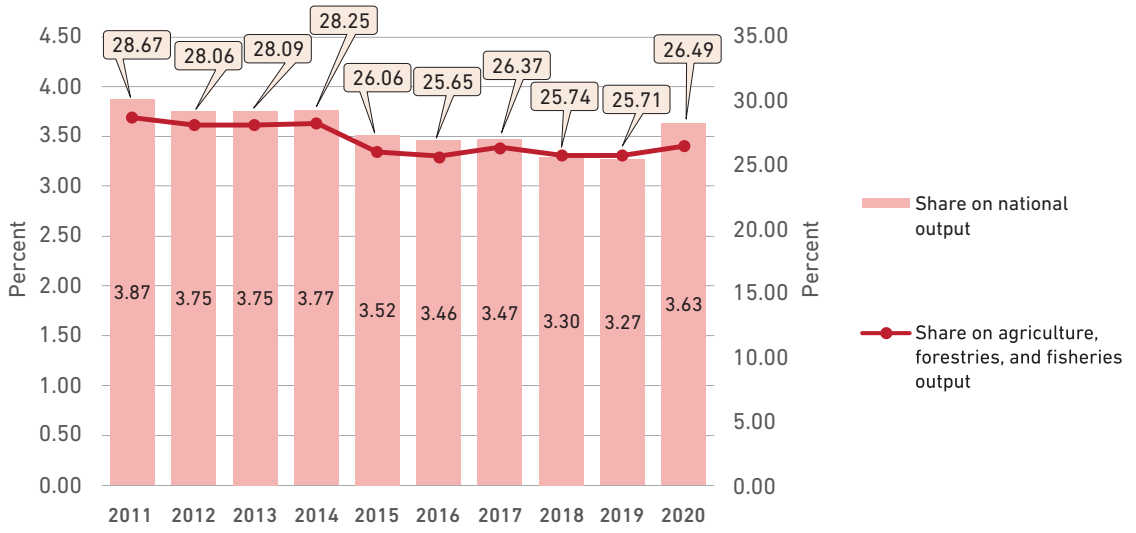
Plantation plays quite an important role in spurring national economy. Not only serve as supplier for food material, this sub-sector has a quite significant contribution towards national output. Figure 1 shows the development of GDP share for plantation[1] throughout 2011 until 2020 on total national GDP, and GDP in agriculture, fisheries, and forestries sector. It can be seen that, although the share for plantation on national output, and agriculture, fisheries, and forestries sector tend to decrease in the last decade, its contribution is still significant.

> In 2011, plantation sub-sector contributed around 3.87 percent to the national economy and decreased to about 3.63 percent in 2020.

In 2011, plantation sub-sector contributed around 3.87 percent to the national economy and decreased to about 3.63 percent in 2020. On the other hand, the average share of plantation sub-sector on agriculture, forestries, and fisheries GDP since 2011 until 2020 has reached 26.91 percent with a decreasing tendency. Plantation GDP share that tends to decline is caused by the fast growing of output in this sub-sector in compare to several other agriculture sub-sectors.

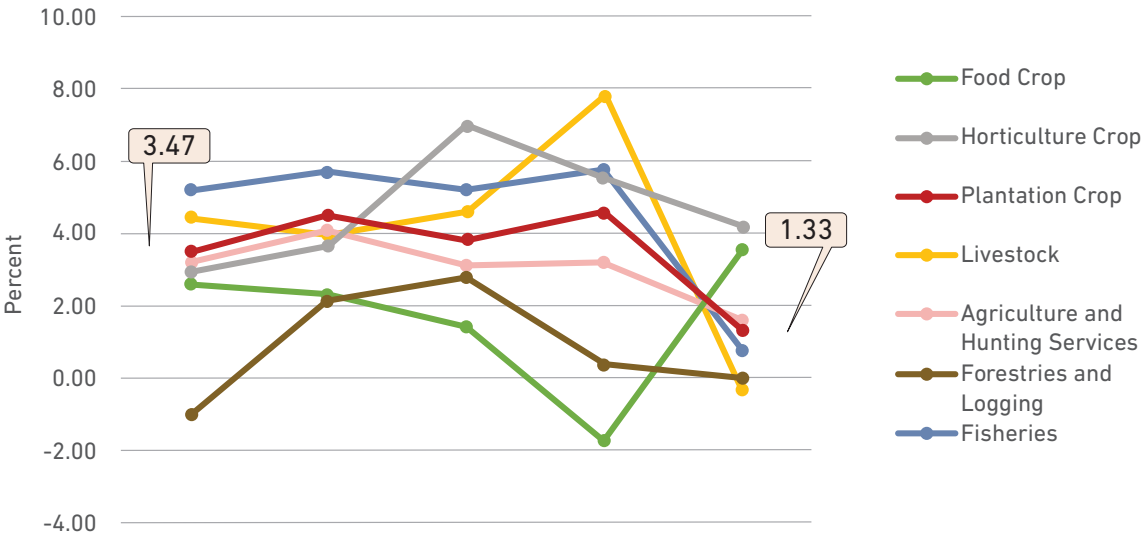
[1] GDP share is calculated by the GDP value based on Current Market Prices in billion rupiah. Share for plantation GDP on total national output is calculated by dividing plantation GDP at Current Market Prices with national GDP at Current Market Prices times 100 percent. Share for plantation GDP on agriculture, forestries, and fisheries output is calculated by dividing plantation GDP at Current Market Prices with agriculture, forestries, and fisheries GDP at Current Market Prices times 100 percent.

Figure 1.
Development of Gross Domestic Product (GDP) Share in Plantation Sub-Sector



Source: Statistics Indonesia, 2021

Figure 2.
Growth of Gross Domestic Product (GDP) in Agriculture, Forestries, and Fisheries According to Sub-Sector, 2016-2020



Source: Statistics Indonesia, 2021

In the last five years, the growth of plantation GDP is fluctuated and lower than several other agriculture sub-sectors, such as horticulture crop, livestock, and fisheries (Figure 2). In 2020, the growth of plantation GDP is even slower to only 1.33 percent from previously 4.56 percent in 2019. It seems that Covid-19 pandemic has a quite significant impact on national economy, including plantation sub-sector.

Despite the slow growth, plantation sub-sector is consistently being the main contributor for agriculture, forestries, and fisheries output in the last five years (Table 1). In 2020, plantation sub-sector contributed around 26.49 percent to the agriculture, forestries, and fisheries output. The important role of plantation is also confirmed in the study by Ministry of Agriculture (2020) which measure the plantation development impact on economic growth[2]. The calculation from regression model shows that the elasticity of plantation share towards the increase of national GDP is around 0.26. That means each 1 percent increase in plantation share will boost national GDP by 0.26 percent from its original value. This outcome has to be further developed. Hence, a better effort needs to take place in order to increase the output in plantation sub-sector, especially through the increase of productivity.

“Despite the slow growth, plantation sub-sector is consistently being the main contributor for agriculture, forestries, and fisheries output in the last five years.”

[2] Ministry of Agriculture (2020) in “Strategic Plan of Plantation Directorate General Ministry of Agriculture Indonesia 2020-2024” estimated the impact of plantation development on economic growth for the period of 2000-2017 using simple linear regression. Plantation development is approaching plantation GDP and economic growth is approaching GDP growth. However, it is important to note that the determination coefficient value from regression model is only 33.1 percent. That is why, the impact of plantation development that can be estimated tend to be overrated, because it also includes other variable impact that can be included in regression model.

Table 1.
Share of Each Sub-Sector on Agriculture, Forestries, and Fisheries Sector GDP, 2016-2020 (percent)

Year	Food crop	Horticulture crop	Plantation crop	Livestock	Agriculture and hunting service	Forestries and logging	Fisheries
2016	25.44	11.21	**25.65**	12.03	1.46	5.24	18.98
2017	24.55	11.04	**26.37**	11.96	1.46	5.12	19.51
2018	23.65	11.51	**25.74**	12.22	1.45	5.12	20.30
2019	22.18	11.87	**25.71**	12.76	1.46	5.17	20.85
2020	22.41	11.84	**26.49**	12.30	1.43	5.14	20.40

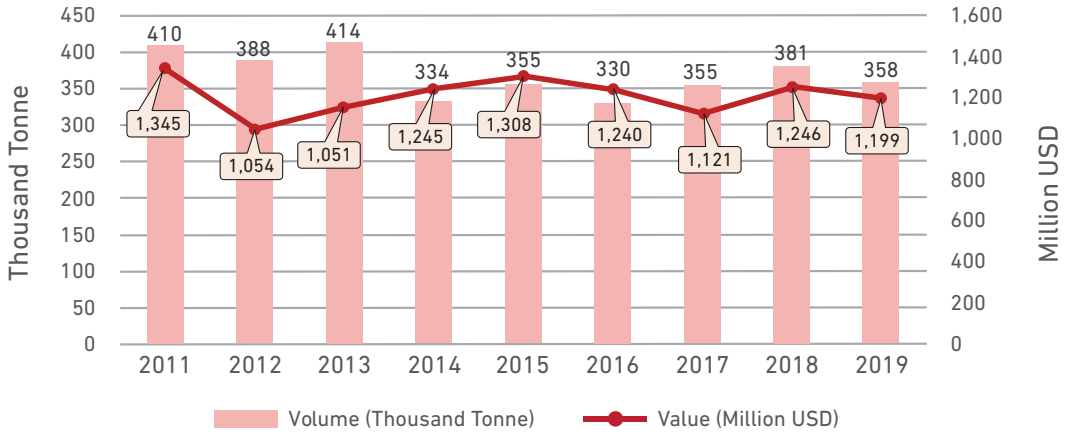
Source: Statistics Indonesia, 2021

The contribution of plantation sub-sector to national economy is also shown by its role in foreign exchange income through export of strategic commodities that is quite large, such as palm oil, rubber, cocoa, coffee, and sugar.

Indonesia is the third largest cocoa producer in the world after Ivory Coast and Ghana. Most of Indonesia's cocoa product is exported, mainly to Malaysia, America, India, People's Republic of China, and the Netherlands (Statistics Indonesia, 2020).

From 2011 until 2019, Indonesia's cocoa export is fluctuated and has decreasing tendency. That is caused by government policy in a form of export duty for cocoa beans which was implemented since 2010. The government issued a policy through Regulation of the Minister of Finance Number 67/PMK.011/2010 regarding Stipulation of Export Goods subject to Export Duties and Export Duty Tariff to support the availability of cocoa beans supplies as domestic industry raw material and enhance its added value, as well as competitiveness of national cocoa processing industry. That has caused cocoa export to slowly decreasing by the average of 0.83 percent export value every year throughout 2011 until 2019. One of the biggest plunges happened in 2012, that was by 21.70 percent in compare to the previous year.

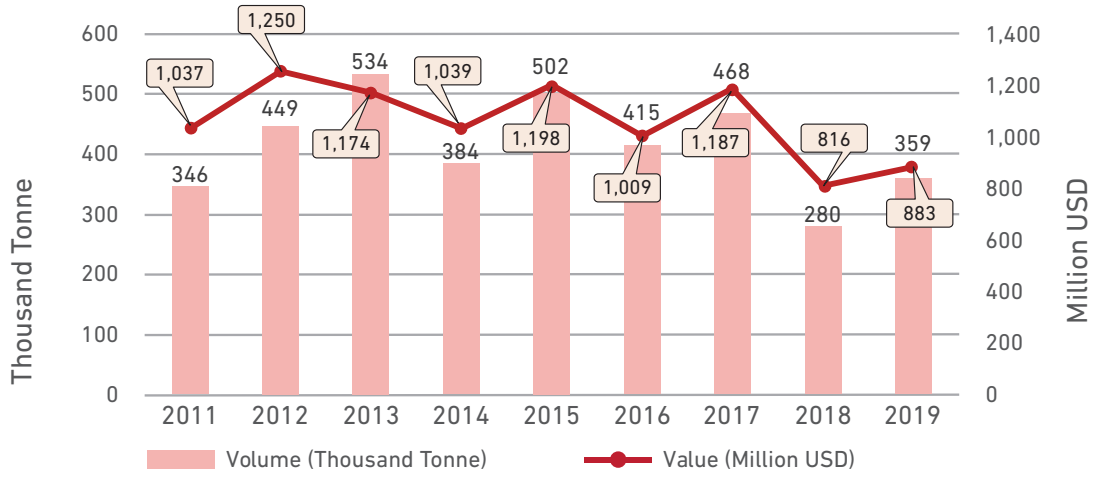
Figure 3.
Cocoa Volume and Export Value, 2011-2019



Source: Statistics Indonesia, 2020

It is also the same case with cocoa, most of Indonesia's coffee production is exported. Figure 4 shows the volume and value development for Indonesia's coffee export from 2011 to 2019. During that period, coffee export volume and value fluctuated and tend to decrease. In 2018 until 2019, Indonesia's coffee export value was under USD 1,000 million. The dynamic of coffee export volume and value is highly influenced by the price in international market. In 2018 for example, there was a quite big decrease in export volume, it reached 40.15 percent in compare to 2017. At the same time, the average price for coffee in international market in 2018 experienced a decrease in compare to the previous year. At that time, the average price of arabica coffee in international market was USD 2.93 per kg or decreasing by 11.75 percent, meanwhile robusta was about USD 1.87 per kg or decreasing by 16.14 percent. That seems to cause most of exporter to switch lane and prefer domestic market instead.

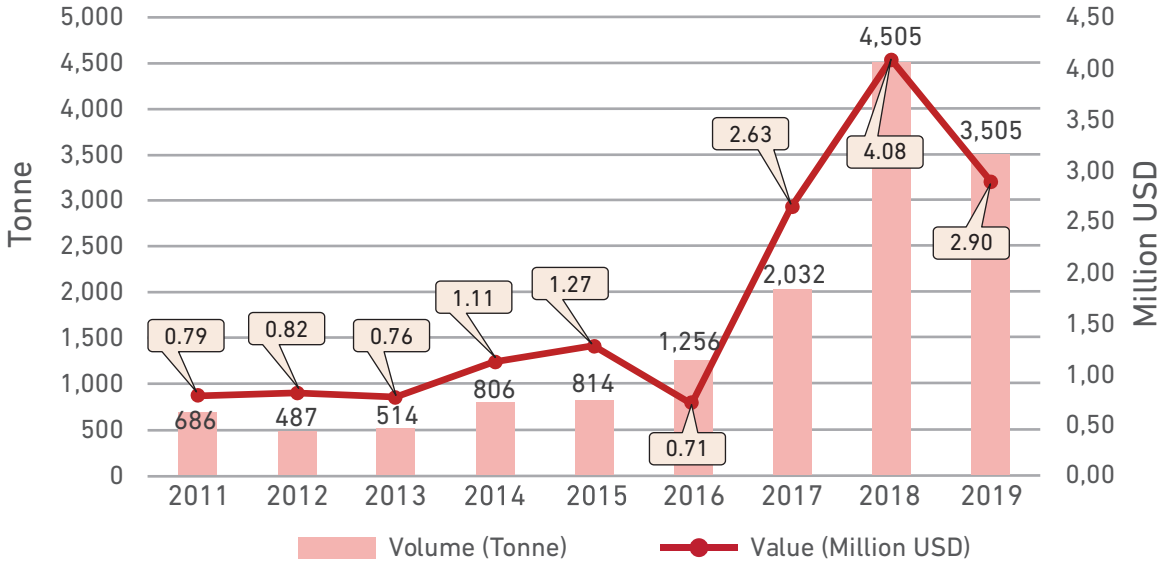
Figure 4.
Coffee Volume and Export Value, 2011-2019



Source: Statistics Indonesia, 2020

Beside coffee and cocoa, sugarcane is also one of Indonesia's main export commodities. Generally, sugarcane export is divided into two types, namely sugar and molasses. Figure 5 and 6 show the volume and value development for Indonesia's sugar[3] and molasses export from 2011 to 2019. Interestingly, though molasses is by product of sugar factory, the export value is far higher than sugar, because molasses as by product from sugar production has not yet fully used domestically. Molasses can actually be used as industry raw material for *monosodium glutamate* (MSG) and ethanol. From 2011 until 2019, sugar export volume was around 487 tonnes to 4,505 tonnes, meanwhile molasses export volume was around 388 thousand tonnes to 643 thousand tonnes. The highest sugar export volume and value throughout 2011 until 2019 happened in 2018. Which was increasing by 121 percent in compare to 2017 where export volume reached 4,505 tonnes or equal to USD 4 million. On the other side, export volume and value for molasses tend to be fluctuated. The highest increase for molasses export volume was in 2014, that was 74.61 percent in compare to the previous year. In 2019, molasses export volume reached 643 thousand tonnes with export value of USD 84 million.

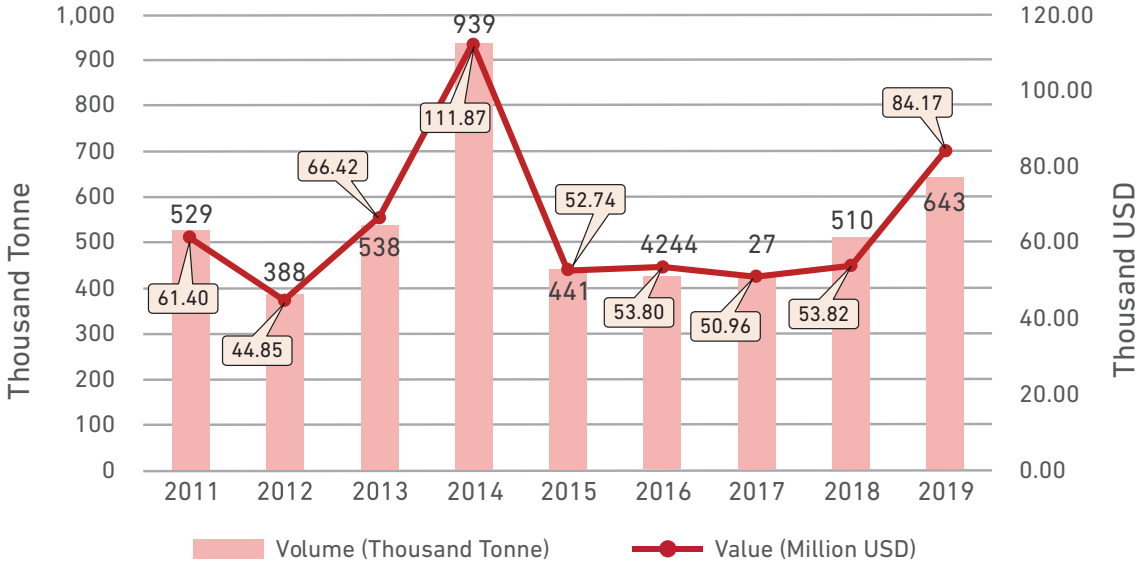
Figure 5.
Sugar Volume and Export Value, 2011-2019



Source: Statistics Indonesia, 2020

[3] Sugar HS code before 2017 included 4 HS code. Since 2017 there was a transition in HS code from HS2012 to HS2017, thus sugar HS code coverage changed to 5 HS code. Sugar HS code since 2017 included Cane Raw Sugar (HS 1701.14.00), other Raw Sugar, containing added flavoring or coloring matter (HS code 1701.91.00), other Raw and Refined Sugar (HS code 1701.9910), and Other Raw Sugar Unrefined (HS code 1701.99.90).

Figure 6.
Sugarcane Volume and Export Value, 2011-2019



Sumber: Badan Pusat Statistik, 2020

AREA AND PRODUCTION DEVELOPMENT OF COFFEE, SUGAR, AND COCOA

Based on business status, the size of the area for cocoa, coffee, and sugarcane plantation is dominated by smallholder plantations instead of big ones by the private sector and the government. In 2018, the contribution of smallholder plantations area to total national area for cocoa, coffee, and sugarcane was each 98.33 percent, 96.63 percent, and 56.72 percent respectively.

Table 2.
Area Size of Cocoa, Coffee and Sugarcane Crops by Commodity and Management, 2018 (ha)

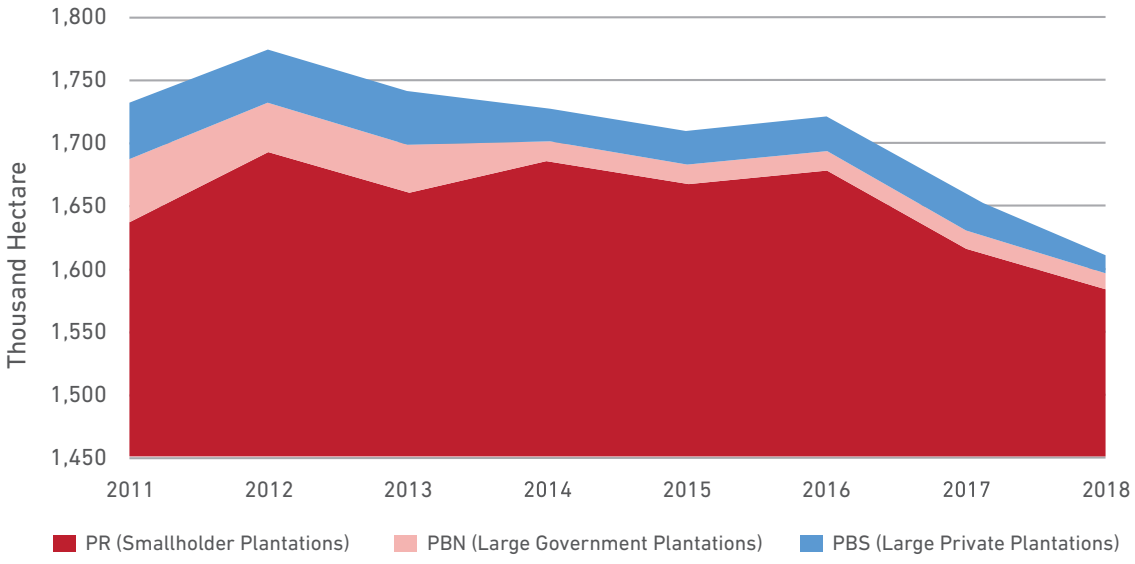
Commodity	Smallholder Plantations (*Perkebunan Rakyat* -PR)		Large Government Plantations (*Perkebunan Besar Negara* - PBN)		Large Private Plantations (*Perkebunan Besar Swasta* - PBS)		Total
	Area size	Share (%)	Area size	Share (%)	Area size	Share (%)	Area size
Cocoa	1,584,133	98.33	12,384	0.77	14,497	0.90	1,611,014
Coffee	1,210,656	96.63	19,923	1.59	22,248	1.78	1,252,827
Sugarcane*	235,758	56.72	68,928	16.58	110,977	26.70	415,663

Source: Outlook for Coffee, Cocoa, and Sugarcane 2020, Directorate General of Plantation
*harvest area.

Figure 7, 8, and 9 show that the domination of smallholder plantations as the main contributor to total area for each commodity nationally tend to be persistent over the last few years. The average size of cocoa crop plantation that is managed by smallholder plantations during 2011-2018 has reached 1.65 million hectare per year or in average contributing around 96.73 percent to national cocoa plantation total area size. Just like coffee, the area size of smallholder plantations is very dominating than large plantations. The average size of coffee crop plantation that is managed by smallholder plantations during 2011-2018 has reached 1.20 million hectare or around 96.73 percent annualy on national coffee plantation total area size. Meanwhile, for sugarcane plantation area, that is managed by smallholder plantations, is 60 percent during the same period. The dominance of smallholder plantations for cocoa, coffee, and sugarcane crop shows how important the role of smallholder plantations is, in determining productivity of the three commodities nationally.

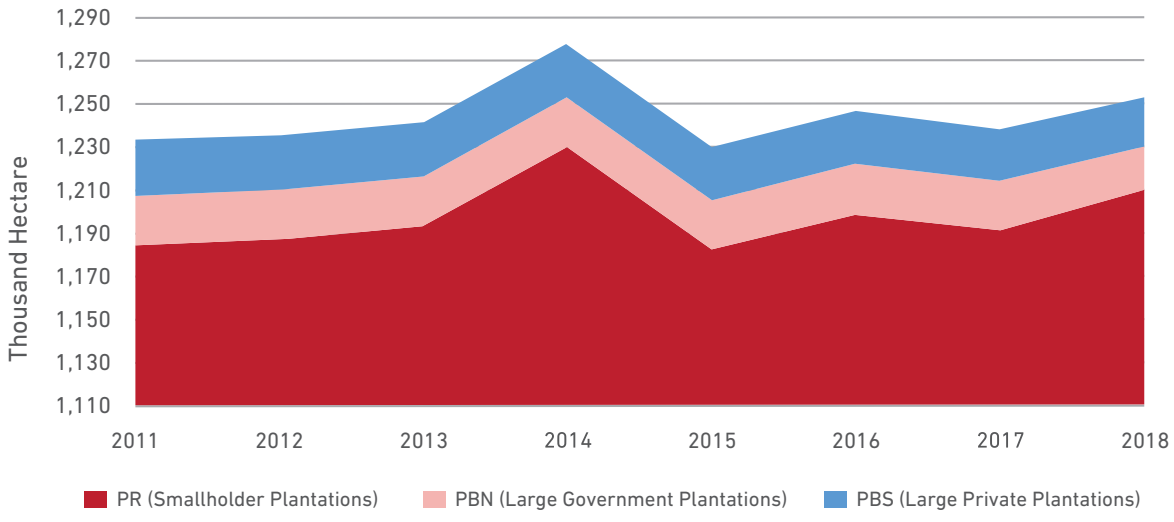
> “The dominance of smallholder plantations for cocoa, coffee, and sugarcane crop shows how important the role of smallholder plantations is, in determining productivity of the three commodities nationally.”

Figure 7.
Area Development of Cocoa in Indonesia by Business Status, 2011-2018



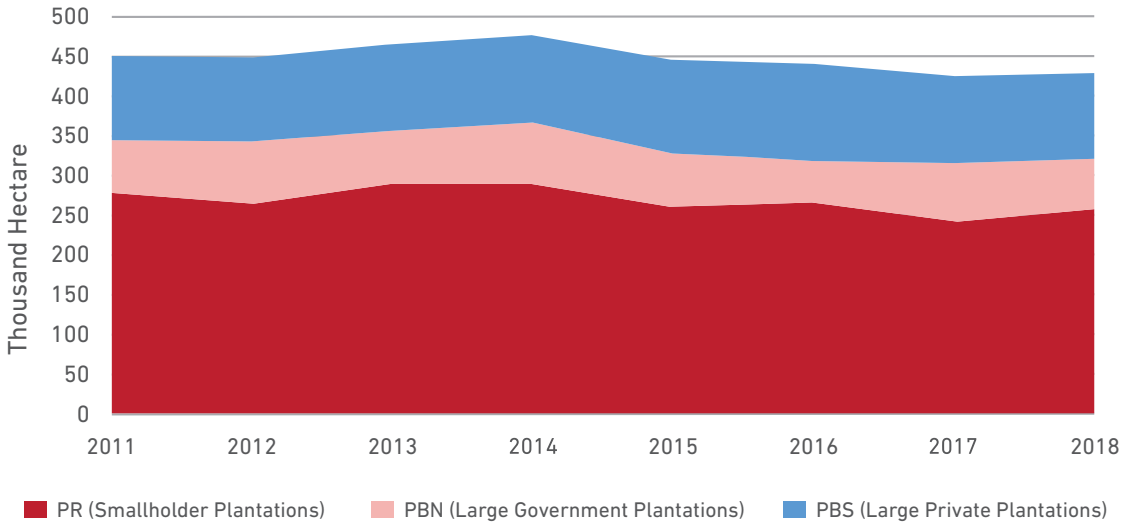
Source: Outlook for Cocoa 2020, Directorate General of Plantation

Figure 8.
Area Development of Coffee in Indonesia by Business Status, 2011-2018



Source: Outlook for Coffee 2020, Directorate General of Plantation

Figure 9.
Area Development of Sugarcane (Harvest Area) in Indonesia by Business Status, 2011-2018



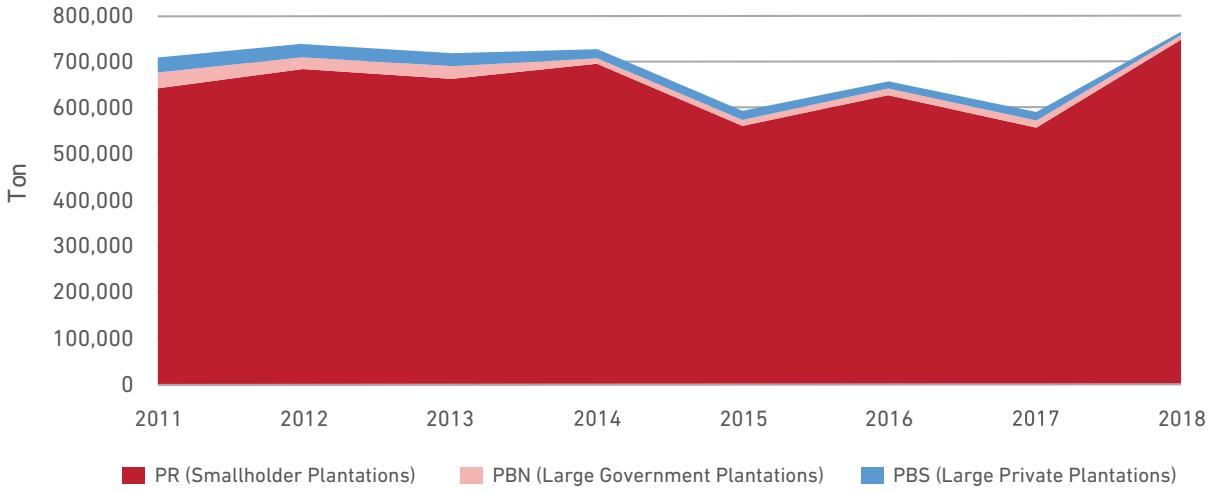
Source: Outlook for Sugarcane 2020, Directorate General of Plantation

In line with the size of the area, cocoa production (dry beans), coffee (dry beans), and sugar[4] that come from smallholder plantations is bigger than the production by large plantations. Figure 10, 11, and 12 show that the production of cocoa, coffee, and sugar from smallholder plantations plays a very significant role for national production. That is of course due to the size of area that is managed by smallholder plantations for the three commodities.

The average cocoa production that comes from smallholder plantations from 2011 until 2018 was 649,807 tonnes annualy or around 94.32 percent of total national production, meanwhile cocoa production from large government plantation and large private plantation each contributed in average of less than four percent from total national production. The same case with cocoa, smallholder plantations contribution for coffee production is quite dominant. Throughout 2011 until 2018, the share for smallholder plantations coffee production on average around 95.52 percent annualy. As well as for sugar, the production from smallholder plantations is bigger than large plantations. Important to note that land conversion seems to be a challenge for cocoa and sugarcane production, if we see it from the size of the area for both commodities, that was decreasing in 2018.

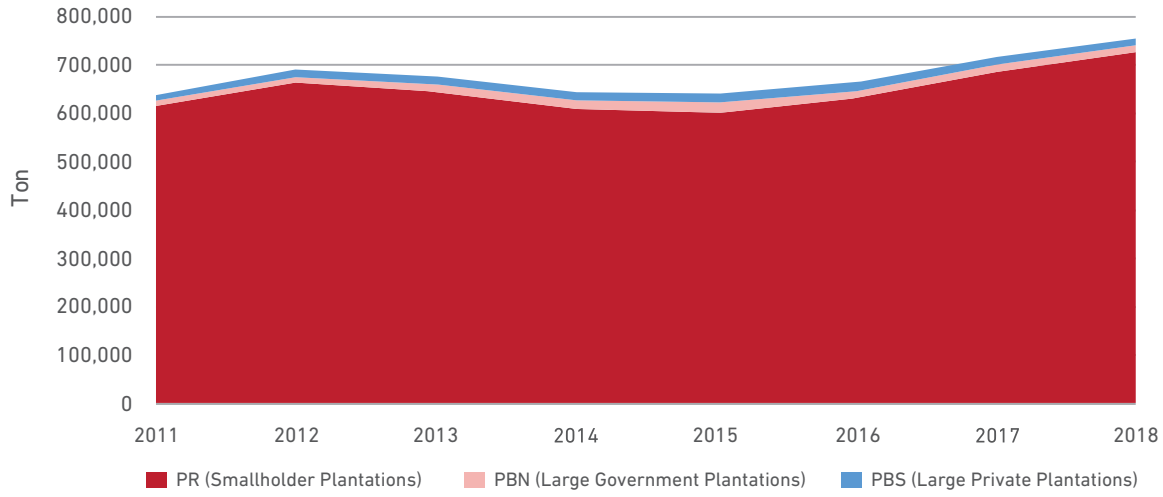
[4] Sugar production included is production of sugar in the form of crystallized sucrose sugar.

Figure 10.
Cocoa (Dry Beans) Production Development by Business Status, 2011-2018



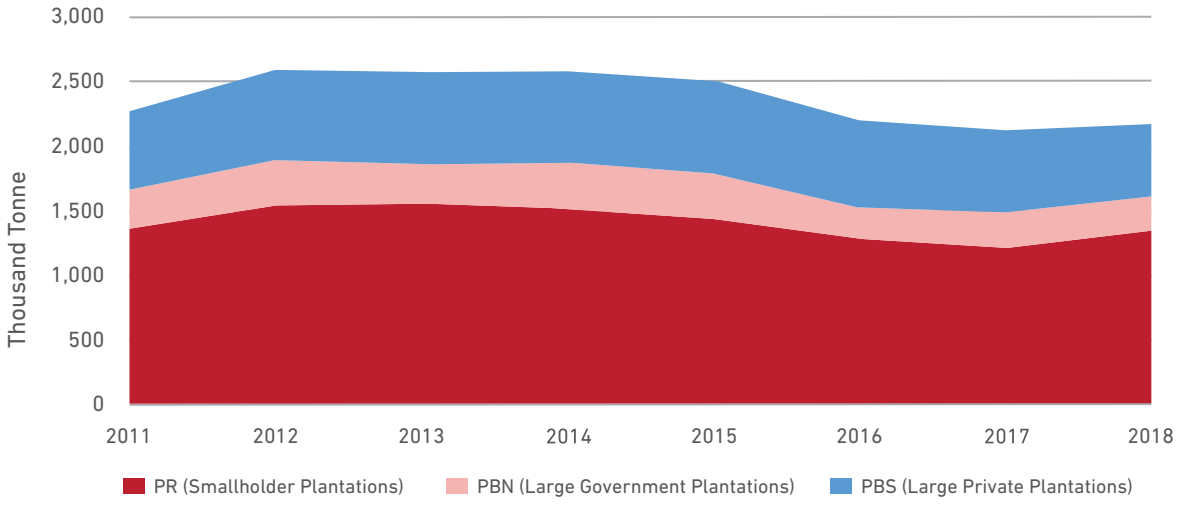
Source: Outlook for Cocoa 2020, Directorate General of Plantation

Figure 11.
Coffee (Dry Beans) Production Development by Business Status, 2011-2018



Source: Outlook for Coffee 2020, Directorate General of Plantation

Figure 12.
Sugar[5] Production Development by Business Status, 2011-2018



Source: Outlook for Sugarcane 2020, Directorate General of Plantation

[5] Sugar production included is production of sugar in the form of crystallized sucrose sugar.

LAND AND LABOR (FARMER) PRODUCTIVITY

Land Productivity

Table 3 gives an overview of Indonesia's rank in terms of cocoa, coffee, and sugarcane production that can be achieved per land unit (land productivity)[6] in compare to several other countries in Southeast Asia. Indonesia's rank as one of the main producers of cocoa, coffee, and sugarcane does not automatically follow by higher productivity in compare to other countries in Southeast Asia. In 2019, for example, Indonesia's cocoa beans productivity was around 490 kg/ha, far less than Thailand with 3,139 kg/ha. The same goes for coffee bean productivity, Indonesia can only produce around 605 kg/ha, ranked number four after Vietnam, Malaysia, and Thailand.

> "Indonesia's rank as one of the main producers of cocoa, coffee, and sugarcane does not automatically follow by higher productivity in compare to other countries in Southeast Asia."

Table 3.
Cocoa, Coffee, and Sugarcane Crop Productivity in 5 ASEAN Countries, 2019 (kg/ha) [7]

Cocoa		Coffee		Sugarcane	
Country	Productivity (kg/hectare)	Country	Productivity (kg/hectare)	Country	Productivity (kg/hectare)
Thailand	3,139	Vietnam	2,705	Thailand	71,388
Indonesia	**490**	Malaysia	2,258	**Indonesia**	**65,604**
The Philippines	281	Thailand	669	Vietnam	65,427
Malaysia	67	**Indonesia**	**605**	The Philippines	54,632
		The Philippines	536	Malaysia	17,805

Source: FAO, 2021

[6] In this paper, the mention of land productivity sometimes shortened to productivity. The mention of land productivity is meant to differentiate it with labor productivity (farmers) or the average production that can be achieved by the farmers in a year.
[7] Data is from FAO. The data for cocoa, coffee, and sugarcane's crop productivity in Indonesia in Table 3 and 4, that is used as reference review on productivity in this paper, is different from official data that was published by Ministry of Agriculture. It is because FAO did some adjustment in production and plant areas data that came from the Ministry of Agriculture. Despite the differences, information in Table 3 and 4 are used in order to use the same data source (apple to apple comparison).

Globally, Indonesia's cocoa productivity performance is quite satisfactory in compare to other cocoa main producers. In 2019, Indonesia's cocoa productivity was higher by 7 percent from cocoa productivity in Ivory Coast (Table 4). Unfortunately, it is not the case for coffee's productivity, among five main coffee beans producers in the world, Indonesia has the lowest productivity. It is the same case with sugarcane productivity, on average Indonesia's productivity is lower than the majority of other sugarcane producers that can produce more than 70,000 kg/hectare or around 70 tonnes per hectare in 2019. It indicated the need of more serious effort to keep boosting cocoa, coffee, and sugarcane crop productivity in Indonesia.

Table 4.
Cocoa, Coffee, and Sugarcane Crop Productivity in 10 Main Producers Countries, 2019 (kg/ha)

Cocoa		Coffee		Sugarcane	
Country	Productivity (kg/hectare)	Country	Productivity (kg/hectare)	Country	Productivity (kg/hectare)
Ivory Coast	456	Brazil	1,650	Brazil	74,683
Ghana	549	Vietnam	2,705	India	80,105
Indonesia	**490**	Colombia	1,037	Thailand	71,388
Nigeria	259	**Indonesia**	**605**	People's Republic of China (PRC)	77,295
Ecuador	540	Ethiopia	636	Pakistan	64,322
Cameroon	416	Honduras	1,132	Mexico	74,542
Brazil	446	Peru	1,011	Colombia	71,350
Peru	1,043	India	767	Australia	74,836
Colombia	867	Uganda	541	**Indonesia**	**65,604**
Dominican Republic	589	Guatemala	730	Guatemala	107,673

Sumber: FAO, 2021

Land Productivity Disparity: Large Plantations Versus Smallholder Plantations

One of the key issues in the effort of increasing plantation productivity, especially coffee, cocoa, and sugarcane in Indonesia, is the productivity disparity between smallholder plantations and large plantations. As explained before, coffee, cocoa, and sugarcane crop productivity that are managed by smallholder plantations really determines the productivity increase on the national level. It is because the area of smallholder plantations is very dominant for those three commodities. Hence, the key to boost national productivity for these three commodities is by boosting smallholder plantations productivity.

> "the key to boost national productivity for these three commodities is by boosting smallholder plantations productivity."

Coffee, cocoa, and sugarcane crop productivity that is managed by smallholder plantations is relatively lower than large plantations. For coffee crop, the average productivity of smallholder plantations from 2006-2018 is lower by around 9 percent in compare to large government plantations productivity. It is also the case for cocoa, where smallholder plantations productivity is lower by about 11 percent than large private plantations productivity. As for sugarcane, though smallholder plantations productivity is higher than large government plantation, it is still lower by around 26 percent in compare to large private plantations.

Smallholder plantations lower productivity is caused by several factors, such as planting technique that is implemented, the use of production facility that is not optimal, type of seeds, plant treatment, as well as the age of the plants. Old issue that is faced by the farmers, like lack of capital to purchase production facilities and infrastructure can also be the factor that caused low productivity for cocoa, coffee, and sugarcane by smallholder plantations. According to Glorya and Nugraha (2019), seeds distribution, machinery, and land expansion that tend to be without ensuring the impact on the profit for the farmers, as well as the lack of consideration for regional differences and farmers education have becoming an obstacle in optimizing the effectiveness of the government program to boost cocoa and coffee productivity.

Productivity disparity between smallholder plantations and large plantations for the three commodities tend to be persistent though it narrowed down lately (Figure 13, 14, 15), especially in 2018 as seen on Table 5. Not only showing productivity disparity between smallholder plantations and large plantations for coffee, cocoa, and sugarcane, the three Figures also show that national productivity for the three commodities is heavily influenced by the productivity fluctuation in smallholder plantations rather than large plantations. This emphasizes the fact that the key to boost productivity performances for the three commodities is by increasing smallholder plantations productivity through intensification.

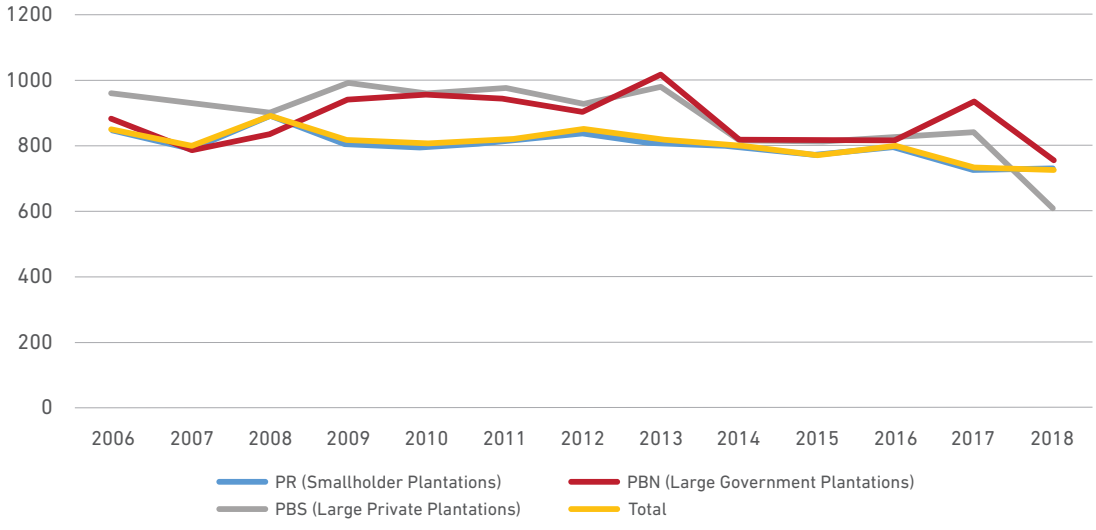
Table 5.
Cocoa, Coffee, and Sugarcane Crop Productivity by Business Status, 2018 (kg/ha)

Commodity	Smallholders Plantation	Large Government Plantation	Large Private Plantation	National
Cocoa	798	849	810	799
Coffee	731	761	612	729
Sugarcane	5,240	4,080	5,170	5,050

Source: Outlook for Coffee, Cocoa, and Sugarcane 2020, Directorate General of Plantation (calculated further)

Productivity in large government plantations for coffee is very dynamic, while in smallholder plantations tend to be stagnant and lower. It is also the case for cocoa productivity. Slightly different for sugarcane, the productivity from smallholder plantations is far higher than large government plantations, however it is still much lower than productivity from large private plantations. We could be suspicious that the relatively low productivity in smallholder plantations for cocoa, coffee, and sugarcane is caused by how relatively low the technical efficiency in farmers business is, in compare to large plantations. That is why, boosting technical efficiency in smallholder plantations is the key to lower the productivity gap between smallholder plantations and large plantations.

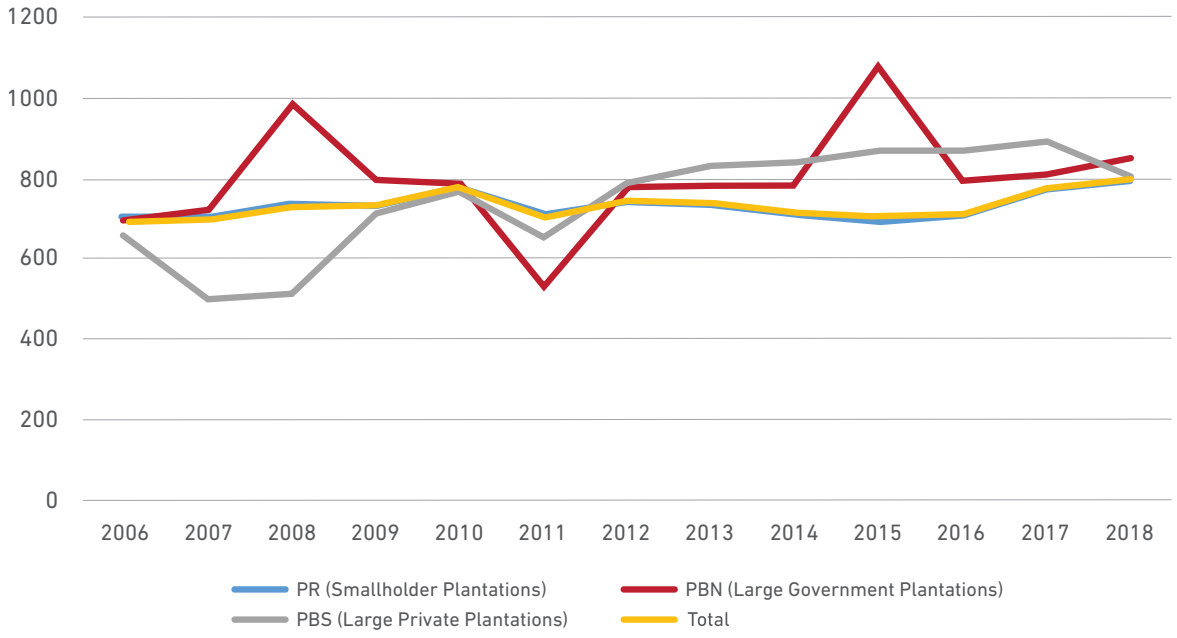
Figure 13.
Cocoa Productivity Development by Business Status, 2006-2018 (kg/hectare)



Source: Outlook for Cocoa 2020, Directorate General of Plantation

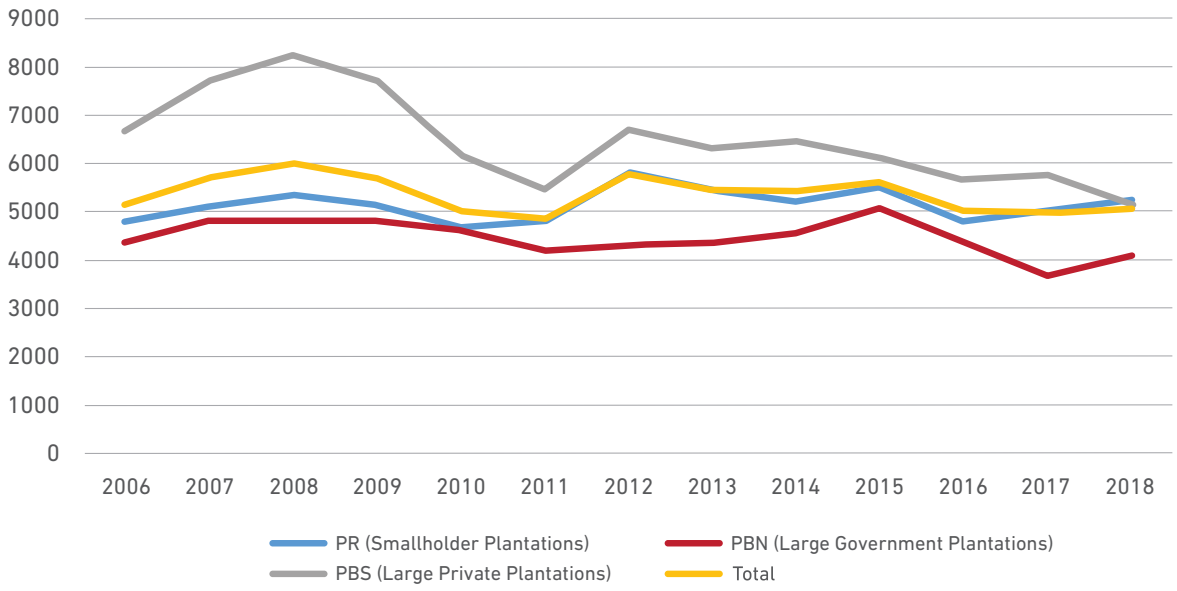
[8] Productivity data included in this analysis came only from production and yield area that can produce white crystal sugar as stated in *Outlook for Sugarcane 2020*, meanwhile FAO productivity data included all sugarcane that was harvested, without seeing the use of it.

Figure 14.
Coffee Productivity Development by Business Status, 2006-2018 (kg/hectare)



Source: Outlook for Coffee 2020, Directorate General of Plantation

Figure 15.
Sugarcane National Productivity Development by Business Status, 2006-2018 (kg/hectare)



Source: Outlook for Sugarcane 2020, Directorate General of Plantation

Table 6.
Percentage of Coffee, Cocoa, and Sugarcane Crops Households by Cultivation Profile, 2014

Karakteristik budidaya	Kopi	Kakao	Tebu
Cara penanaman			
- Teratur	70,07	81,85	98,31
- Tidak teratur	29,93	18,15	7,69
Sistem penanaman			
- Tunggal	48,75	55,98	99,14
- Tumpang sari	14,92	13,07	0,37
- Campuran	36,33	30,95	0,49
Varietas benih			
- Bersertifikat	3,30	11,13	20,78
- Tidak bersertifikat	96,70	88,87	79,22
Cara pengendalian hama			
- Agronomis	20,40	4,37	19,41
- Mekanis	4,11	1,50	4,45
- Hayati	0,72	0,51	0,26
- Kimiawi	46,18	65,55	55,64
- Tidak melakukan pengendalian hama	28,59	28,07	20,24
Penyuluhan/bimbingan			
- Memperoleh	16,21	18,03	15,49
- Tidak memperoleh	83,79	81,97	84,51
Keanggotaan KUD/koperasi perkebunan			
- Anggota	2,02	1,59	12,75
- Bukan anggota	97,98	98,41	87,25
Kelompok tani			
- Anggota kelompok tani	26,19	29,22	22,60
- Bukan anggota kelompok tani	73,81	70,78	77,40
Asosiasi petani			
- Anggota asosiasi petani	1,42	0,61	1,96
- Bukan anggota asosiasi petani	98,58	99,39	98,04
Kemitraan usaha tani			
- Melakukan kemitraan usaha	1,95	0,98	26,99
- Tidak melakukan kemitraan usaha	98,05	99,02	73,01

Source: *Hasil Survei Rumah Tangga Usaha Tanaman Perkebunan*, 2014

Low efficiency in smallholder plantations can be caused by so many things, namely the quality of human resource (farmers), and the old age of the plants (less productive) that needs rejuvenation or replanting. Low quality of human resource is reflected in majority education level (68.32 percent) for farmers in smallholder plantations who are only elementary school graduate (Hasil Survei Rumah Tangga Usaha Tanaman Perkebunan, Statistics Indonesia, 2014). This condition has caused a delay in technology assimilation and adaptation in cultivation activities, such as the use of super seed and mechanization. The result from *Survei Pertanian Antar Sensus* (SUTAS) performed by Statistics Indonesia in 2018 shows that the percentage of plantation crop home industry that don't use machinery and technology other than mechanization in plantation crop reached 87.59 percent. That is the reason why it is important for the government and private sector to be present in order to increase the technical capacity of the farmers in cultivating their crops.

"Low efficiency in smallholder plantations can be caused by so many things, namely the quality of human resource (farmers), and the old age of the plants (less productive) that needs rejuvenation or replanting."

The relatively low level of education impacted farmers' willingness to use good quality and certified seed. Most of home industry for coffee, cocoa, and sugarcane crops are using uncertified seeds. This condition surely affected the commodity productivities (Table 6). Also, the proportion of home industry that are not performing pest control for the three commodities is also still quite high, namely above 20 percent. The provided guidance for coffee, cocoa, and sugarcane crop farmers, as well as its institution, is also low. That condition is reflected in the high numbers of households that have not received counseling/assistance, not becoming members of farmers group, not a member of plantation Village Unit Cooperative (*Koperasi Unit Desa* - KUD), not a member of farmers association, and not involved in farmers business partnership.

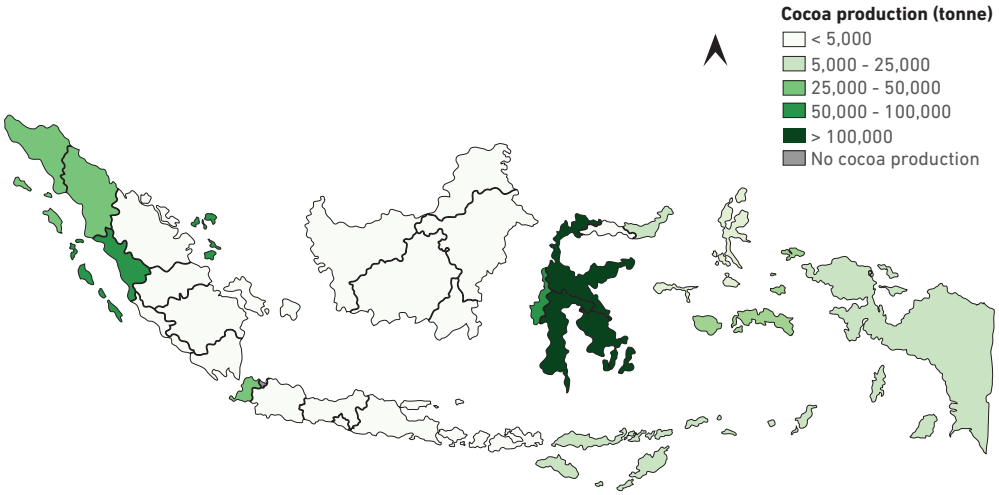
Throughout 2006-2018, cocoa, coffee, and sugarcane crop productivity produced by smallholder plantations is stagnant (Figure 16, 17, and 18). This problem needs to get a serious attention and is an indication that intensified effort of cocoa, coffee, and sugarcane crop cultivation by smallholder plantations is not optimal in the last couple of year. Intensified effort can be done, among others, through rejuvenation of old plants, use of super seed for new plants, production facilities and infrastructure, assistance and counseling, and other intensified efforts.

LAND PRODUCTION AND PRODUCTIVITY BETWEEN REGIONS

Spatially, cocoa production in Indonesia in 2018 was spreading throughout all provinces except DKI Jakarta (Figure 16). The main producer for national cocoa production is Sulawesi. Cocoa total production in four provinces in Sulawesi, namely Central Sulawesi, South Sulawesi, Southeast Sulawesi, West Sulawesi, reach around 58.04 percent from the total of cocoa national production. In 2018, Central Sulawesi ranked the first as main cocoa producer nationally with 125,473 tonne. Two provinces outside Sulawesi that also play a quite big role in national cocoa production is West Sumatera and Riau Islands.

Production capacity increase can be firstly boosted by productivity increase effort, that is land productivity, as well as labor productivity. Productivity increase can focus on regions that are center of production but still have rather low productivity. That has to go together with a better cultivated cocoa bean. Cocoa production tends to be varied, depends on the climate condition of the place[9], Besides that, the effort to boost production capacity can also be developed in other potential region that is still lack of attention, Papua for example.

Figure 16.
Cocoa Production in Indonesia by Province, 2018

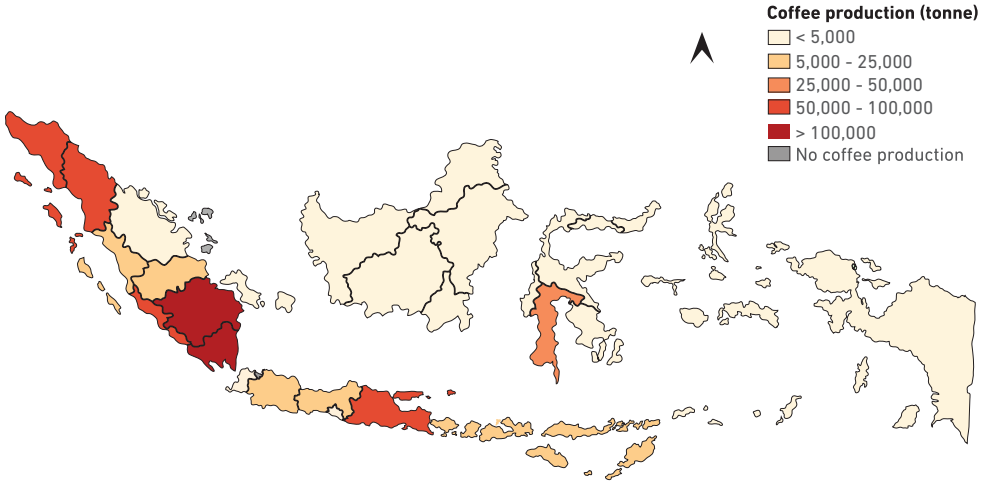


Source: Cocoa Statistics Indonesia 2019, Statistics Indonesia

[9] Cocoa crop development has to pay attention to climate compatibility and other factors, therefore the crops can grow nicely. Cocoa crop can nicely grow in an area of 30-32°C (maximum) and 18-21°C (minimum), annual rainfall of 1.100-3.000 mm, soil acidity (pH) of 6-7,5, and high altitude of 200-700 mdpl. That is why this crop can be rightly cultivated in almost all area in Indonesia.

Figure 17 shows that Sumatera Island seems to dominate national coffee production. In 2018, four provinces of main national coffee producer are South Sumatera, Lampung, North Sumatera, and Aceh. Those four provinces contributed around 58.89 percent to national coffee production. Some other provinces outside Sumatera, like East Java, South Sulawesi, and East Nusa Tenggara, also have pretty big potential to be developed into national coffee production center. The same thing with cocoa, coffee production increase can be boosted by optimizing productivity and production quality, for example by utilizing the right technology. However, coffee crop development has to consider another aspect, such as suitable agroclimate condition[10], and of course the taste of the coffee. In regard to that, not all regions can cultivate specific flavor although it has a suitable agroclimate for coffee crop development.

Figure 17.
Coffee Production in Indonesia by Province, 2018



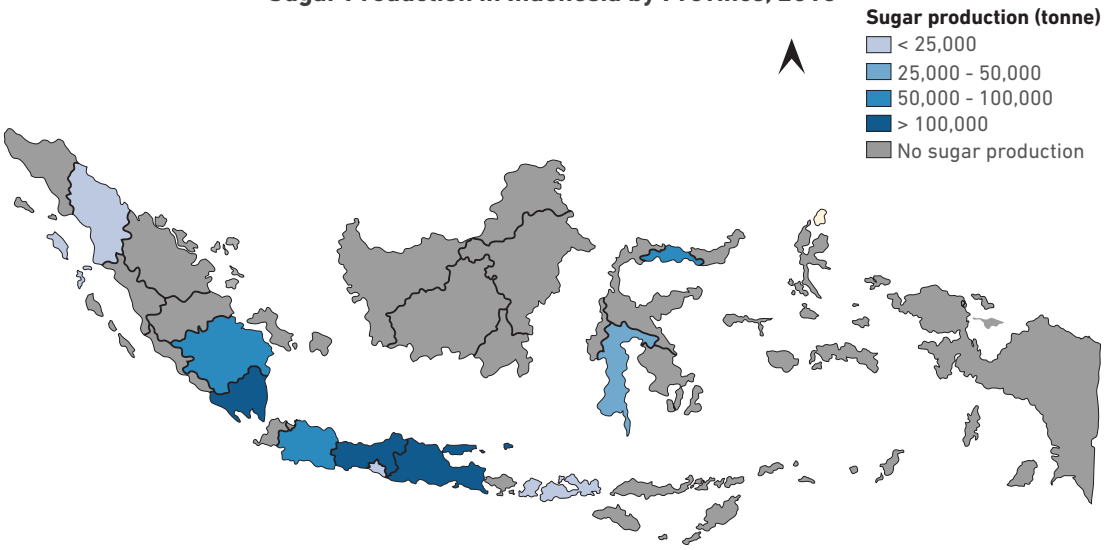
Source: Coffee Statistics 2019, Statistics Indonesia

Figure 18 shows the spread of sugar production in Indonesia based on province. East Java is the biggest sugar producer with around 51.15 percent contribution to national sugar production. Besides East Java, Central Java and West Java are also having their share to national sugar production. That confirms that Java regions are still the main source to suffice national sugar demand. The centralized sugar production in Java indicated that sugarcane cultivation and sugar factory are concentrated in Java. That is despite the fact that land conversion from plantation to non-plantation in Java is massively happening that it threatened the sustainability of plantation cultivation, including sugarcane.

[10] Interaction between climate factor and hydrology, on one side, and plantation on the other side. In regard to that, coffee crop consists of two variety, namely robusta and arabica. Each variety needs a different agroclimate condition. For arabica, the ideal temperature for the plant to grow is around 15-24°C, rainfall of around 2000-4000 mm, soil acidity of around 5.3-6.0, and high latitude of around 700-1400 mdpl. That is the reason why this type of coffee can only be cultivated in some regions in Indonesia that are located in highland. Meanwhile, robusta coffee needs a temperature of around 24-30°C, annual rainfall of 1500-3000 mm or 60 mm monthly, soil acidity of 5.5-6.5, and latitude of around 300-700 mdpl. Robusta coffee can be cultivated in most regions in Indonesia.

The government has to push expansion of sugarcane cultivation and sugar industry outside of Java considering land potential in outside Java is still quite big. The expansion has to go along with the effort to increase farmers capacity, machinery, use of super seed, and connection between cultivation area and sugar industry. In other words, sugarcane cultivation development needs to be in line with the existing and development of sugar factory. In 2018, provinces outside Java that have significant role for national sugar production were only Lampung and South Sumatera, with total production of each 596 thousand tonnes and 97 thousand tonnes, respectively.

Figure 18.
Sugar Production in Indonesia by Province, 2018



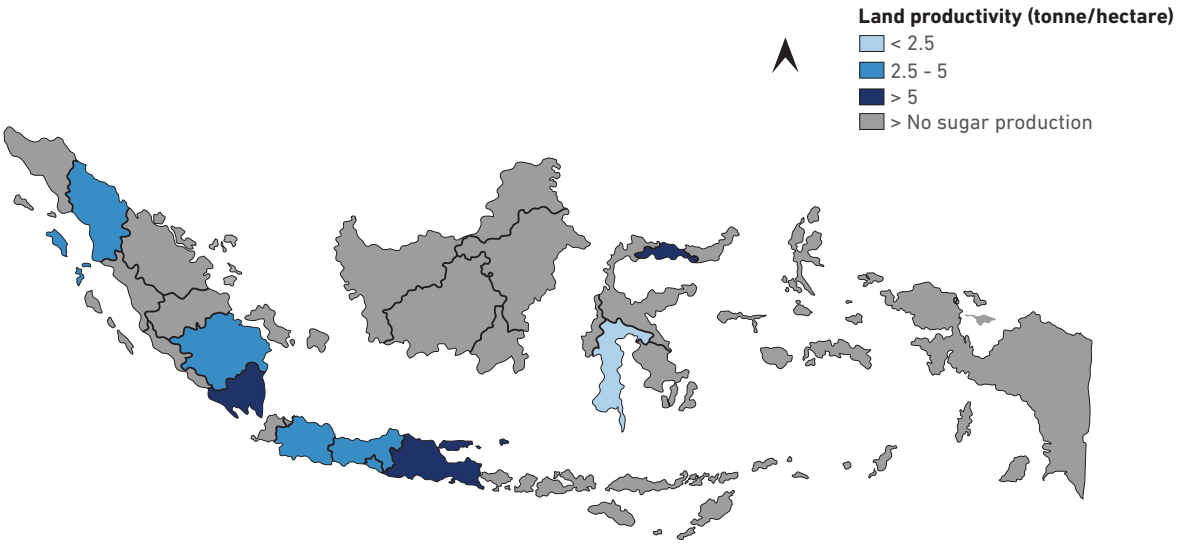
Source: Sugarcane Statistics 2019, Statistics Indonesia

Disparity of Smallholder Plantations Productivity between Regions

Spatially, productivity disparity in smallholder plantations between regions, for coffee, cocoa, and sugarcane crop is a problem that requires serious attention (Figure 20, 21, and 22). Reducing the productivity gap spatially will significantly affecting production of the three commodities nationally. Productivity gap between provinces for sugarcane crop is vivid, especially between sugarcane crop productivity by smallholder plantations in Gorontalo Province, that is 6.77 tonne per hectare (the highest), and in South Sulawesi Province with only 2.27 tonne per hectare (the lowest). Sugarcane crop productivity gap between those two provinces reached 4.5 tonne per hectare, or about three times more.

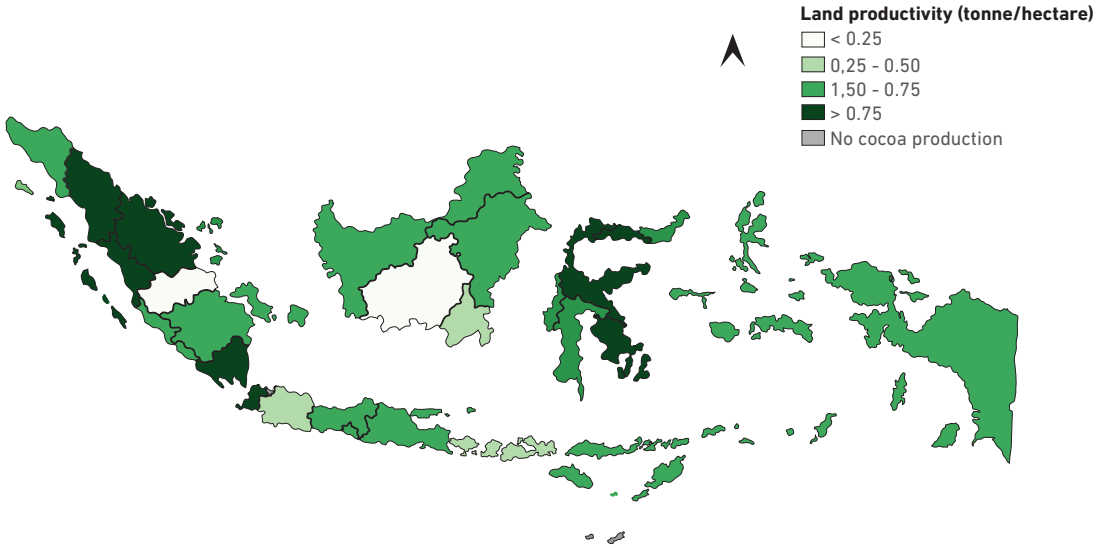
Sugarcane crop productivity in Central Java Province is still lower than Gorontalo Province, Lampung, and East Java, though the largest smallholder plantation area size and home industry for sugarcane crop in Indonesia is in Central Java. Hence, the effort to increase sugarcane productivity in Central Java has to be the main focus of the government.

Figure 19.
Sugarcane Crop Productivity of Smallholder Plantations by Province, 2018 (tonne/hectare)



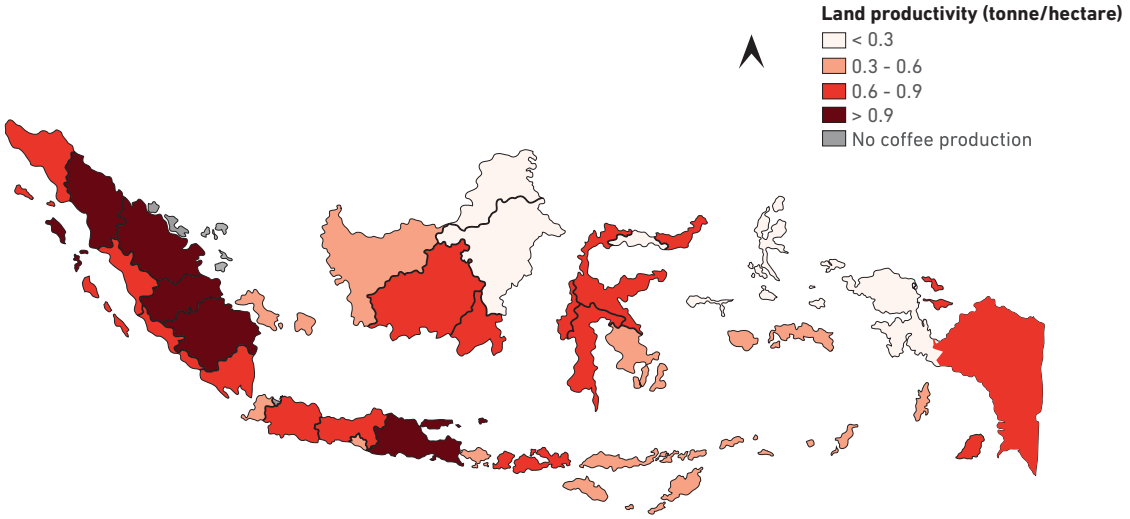
Source: Sugarcane Statistics 2019, Statistics Indonesia (calculated)

Figure 20.
Cocoa Productivity of Smallholder Plantations by Province, 2018 (tonne/hectare)



Source: Cocoa Statistics 2019, Statistics Indonesia (calculated)

Figure 21.
Coffee Productivity of Smallholder Plantations by Province, 2018 (tonne/hectare)



Source: Coffee Statistics 2019, Statistics Indonesia (calculated)

Cocoa crop productivity gap by smallholder plantations is also quite high in 2018 (Figure 20). The highest productivity is in Riau Province with 0.93 tonne per hectare, meanwhile the lowest productivity is in Central Borneo with 0.09 tonne per hectare, thus the gap reached 0.84 tonne per hectare or around nine times. The same thing is also happening for coffee (Figure 21). Productivity gap can be clearly seen by the productivity differences between East Java and North Maluku, reaching 1.12 tonne per hectare or around eight times. It is also seen that most provinces have lower productivity in compare to the productivity average in national smallholder plantations that is reaching 0.83 tonne per hectare.

Identification of Cocoa, Coffee, and Sugarcane Potential Development

Figure 22 shows quadrant analysis that maps each province according to land productivity variable and the size of cocoa crop by smallholder plantations[11]. Numbers in the graphic are provincial code[12]. It can be clearly seen that there is a concentrated provinces spread in quadrant II, namely cocoa productivity is quite high but the crop area is relatively small. These provinces can be the development target for cocoa crop through expansion of planting area, of course by also considering the compatibility and availability of the area. South Sulawesi, Southeast Sulawesi, and West Sulawesi are three provinces that have a relatively high productivity and large plant area according to its position in quadrant I. However, it is important to note, South Sulawesi with the biggest area plan in compare to the other provinces turns out still have productivity around 0.69 tonne/hectare. This productivity level is still relatively low in compare to some ASEAN countries and other main producers as discussed earlier. That is why, intensified effort is still needed for provinces in quadrant I. Provinces in quadrant III are provinces with a relatively low productivity and plant area. They can be the target focus for land intensification and extensification while also paying attention to climate in the respective region.

The important issue that should receive attention is the size of the plant area that doesn't cultivate. For example, the not-so optimal cocoa productivity in South Sulawesi year 2018, might be caused by the relatively large proportion of the old plants with relatively low productivity. That is indicated by the relatively high proportion of unproductive plants. Provinces with a relatively large plant areas but with unproductive plants reached more than 15 percent, namely Gorontalo, Papua, South Sulawesi, West Sumatera, and Banten (Figure 23). That indicates many cocoa crop in those provinces are old and not productive anymore, hence causing unoptimized productivity. The focus of the development in those provinces is through plant rejuvenation.

"Provinces with a relatively large plant areas but with unproductive plants reached more than 15 percent, namely Gorontalo, Papua, South Sulawesi, West Sumatera, and Banten (Figure 23). That indicates many cocoa crop in those provinces are old and not productive anymore, hence causing unoptimized productivity"

[11] This analysis aims to identified provinces that can be the development focus of coffee, cocoa, and sugarcane crop, in terms of increasing productivity as well as expanding plant area. In this case, increasing productivity can be focused in provinces that have a relatively large plant area but with a relatively low productivity level. Meanwhile, expansion of plant area can be focused in provinces with high productivity but have plant area that are not too big and still has potential to be further boosted.
[12] The name of the province for the respective code can be seen in Annex 1.

Figure 22.
Kuadran Analysis of Cocoa Crop Productivity and Plant Areas, 2018

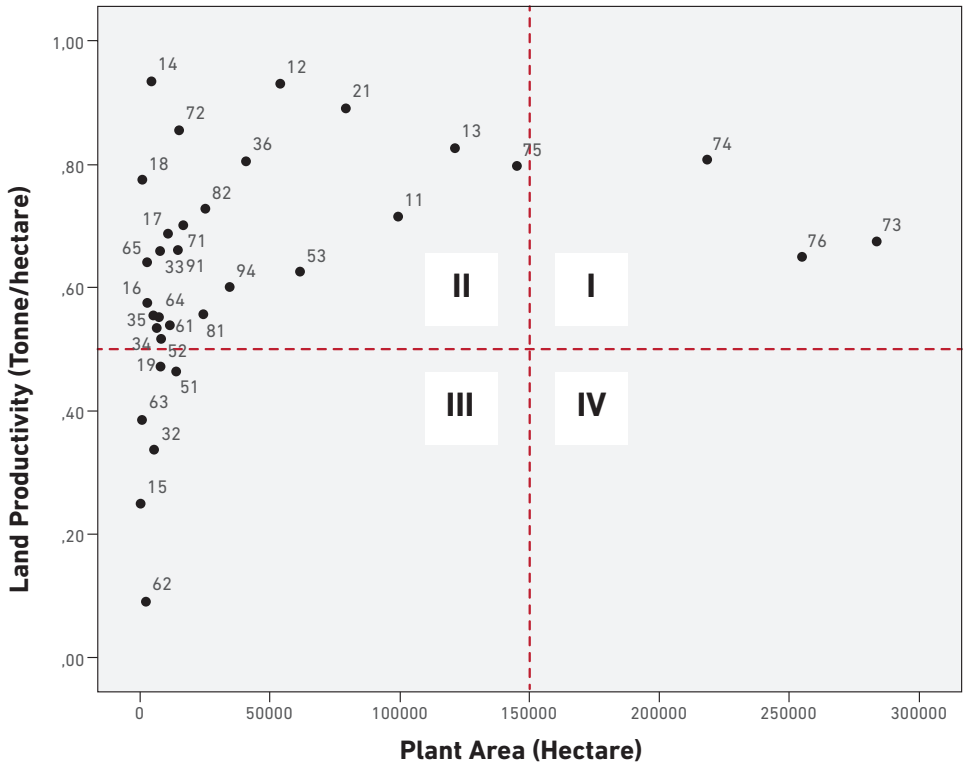
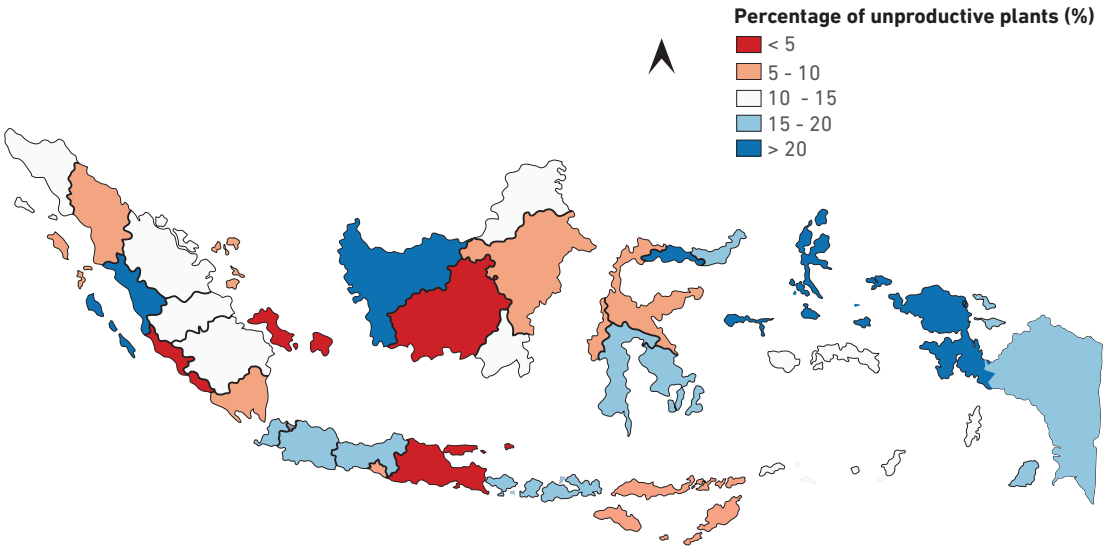


Figure 23.
Distribution of Unproductive Cocoa Crop, 2018



The spread of land productivity and plant area for coffee in Figure 24 shows only two provinces in quadrant I, namely Lampung province and South Sumatera. Meanwhile, other provinces are spread in quadrant II and III. This indicates that there are some provinces that still can be the intensification target as well as extensification for coffee crop cultivation. It is also the case for cocoa, the unproductive plant area in coffee crop cultivation according to province needs to be monitored. Provinces with a relatively large plant area but does not produce more than 15 percent like South Sumatera and South Sulawesi can be the target focus for plant rejuvenation in order to optimizing coffee productivity (Figure 25). West Borneo, Central Borneo, East Borneo, West Sulawesi, Gorontalo, Maluku, and Papua can also be the target for plant rejuvenation, because the unproductive plant percentage that is quite big, namely more than 20 percent.duktivitas kopi yang dihasilkan (Gambar 25). Kalimantan Barat, Kalimantan Tengah, Kalimantan Timur, Sulawesi Barat, Gorontalo, Maluku, dan Papua juga dapat menjadi sasaran peremajaan tanaman karena persentase tanaman tidak menghasilkan yang relatif besar, yakni lebih dari 20 persen.

“West Borneo, Central Borneo, East Borneo, West Sulawesi, Gorontalo, Maluku, and Papua can also be the target for plant rejuvenation, because the unproductive plant percentage that is quite big, namely more than 20 percent.”

Figure 24.
Kuadran Analysis of Coffee Crop Productivity and Plant Area, 2018

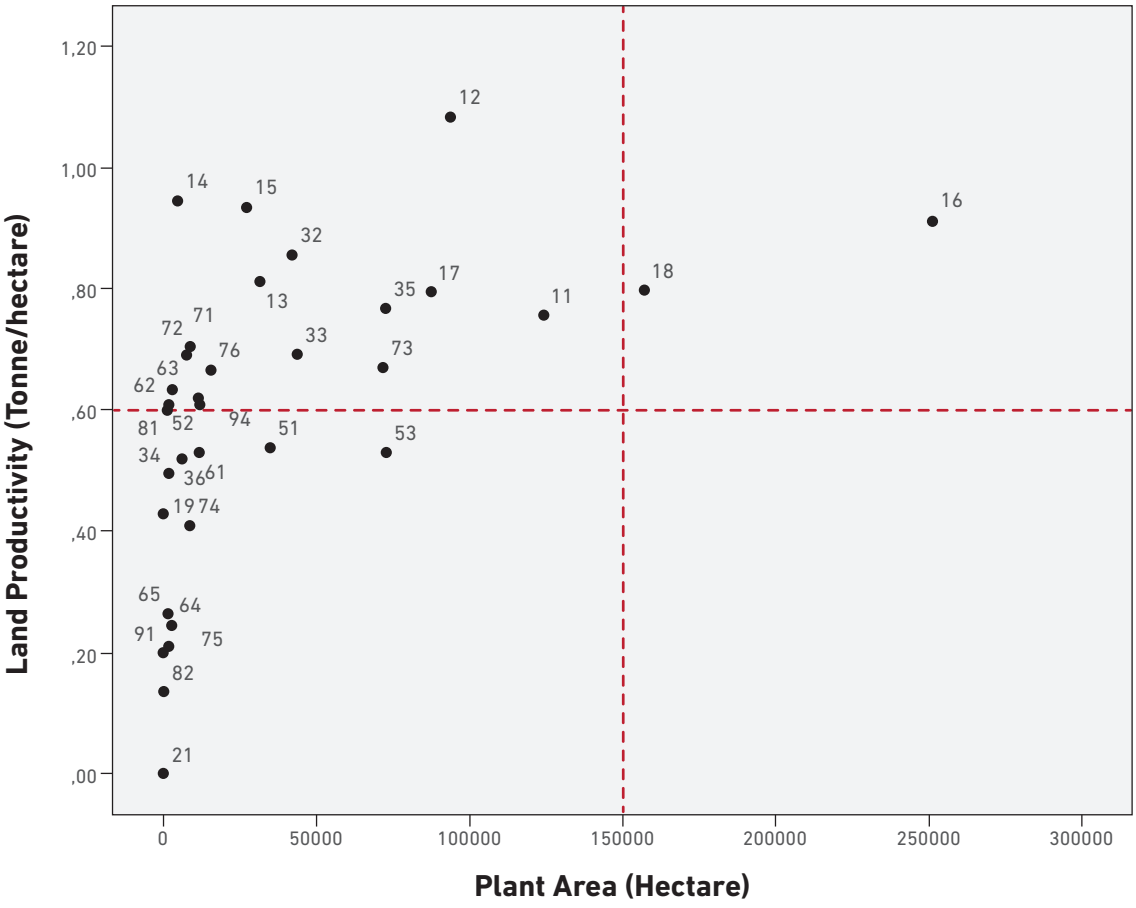


Figure 25.
Distribution of Unproductive Coffee Crop, 2018

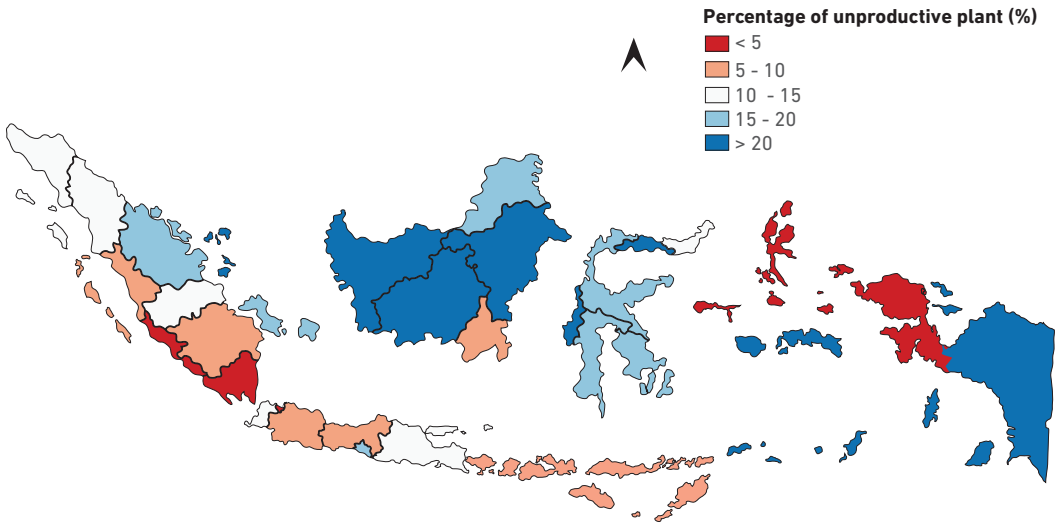


Figure 26.
Kuadran Analysis of Sugarcane Crop Productivity and Plant Area, 2018

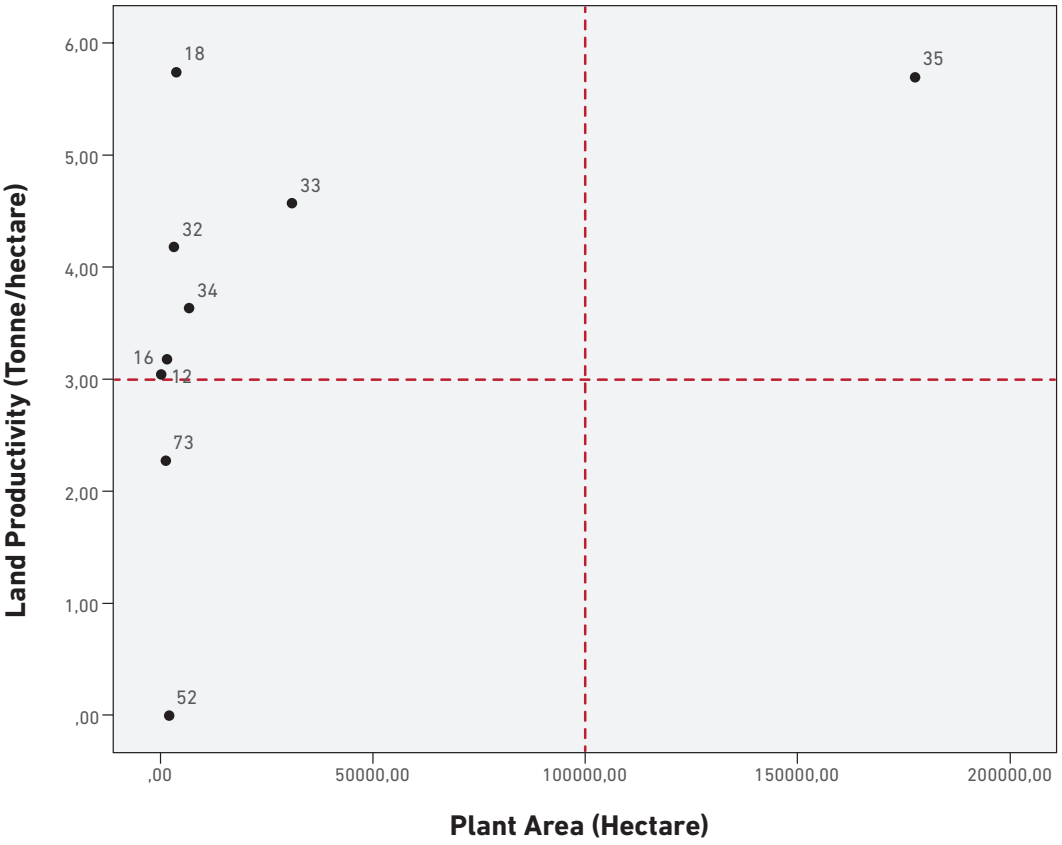
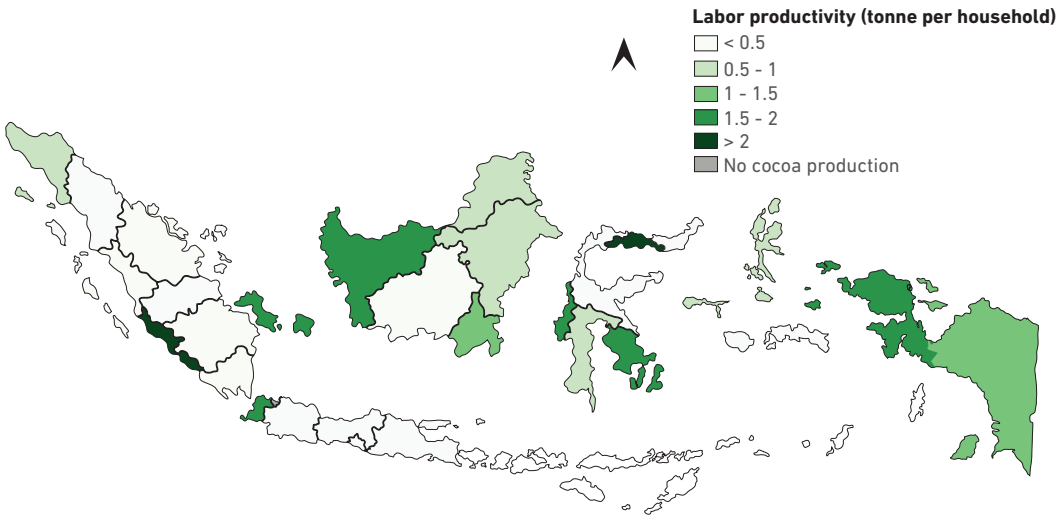


Figure 26 shows that East Java has plant area and sugarcane productivity that are relatively higher than the other provinces that produce sugarcane. Figure 26 also show that the focus of increasing productivity can be done in some provinces with low productivity, like West Nusa Tenggara and South Sulawesi in quadrant III, while also still be mindful about the location of sugar factory. In other words, the development of sugarcane crop in these provinces has to be in line with sugar industry development in order to absorb sugarcane production.

Labor Productivity: Disparity between Regions

Labor productivity in this paper means productivity in each household, because most of the plantation household generally only has family as workers[13]. Labor productivity (farmers) shows the average capacity of each farmer in producing cocoa, coffee, and sugarcane crop in a year, in each province.

Figure 27.
Household Labor Productivity Distribution of Cocoa Cultivation, 2018 (tonne/household)



> Spatially, it is clearly seen that there is a labor productivity gap between regions in the three plantation commodities.

Figure 27, 28, and 29 show labor productivity spatial distribution for cocoa, coffee, and sugarcane crop cultivation. Spatially, it is clearly seen that there is a labor productivity gap between regions in the three plantation commodities. That indicates the technical capacity disparity of farmers between regions. Just as disparity in land productivity, this is also an important issue that needs to be overcome to increase national production of cocoa, coffee, and sugarcane.

[13] Labor productivity is calculated from dividing production of each crop in each plantation throughout 2018 with numbers of household that cultivate each plantation crop in 2018 that was retrieved from SUTAS.

Provinces with a relatively large cocoa labor productivity are Gorontalo, Bengkulu, and Riau Island, with productivity of more than 2 tonnes per household. It shows that farmers in those provinces in average can produce more than 2 tonnes of cocoa annually. Meanwhile for coffee, some provinces have labor productivity above 4 tonnes per household, like Gorontalo, East Borneo, Southeast Sulawesi, South Borneo, Riau, Papua, and Maluku.

For sugarcane cultivation labor productivity, Lampung, DI Yogyakarta, and Gorontalo are three provinces with a relatively high labor productivity, reaching over 20 tonnes per household annually. Household labor productivity increase for sugarcane cultivation can focus in some provinces like Riau, South South Sumatera, and South Sulawesi that have labor productivity under 5 tonnes per household. Increasing labor productivity can be done by increasing farmers capacity in their cultivation activities.

Figure 28.
Household Labor Productivity Distribution of Coffee Cultivation, 2018 (tonne/household)

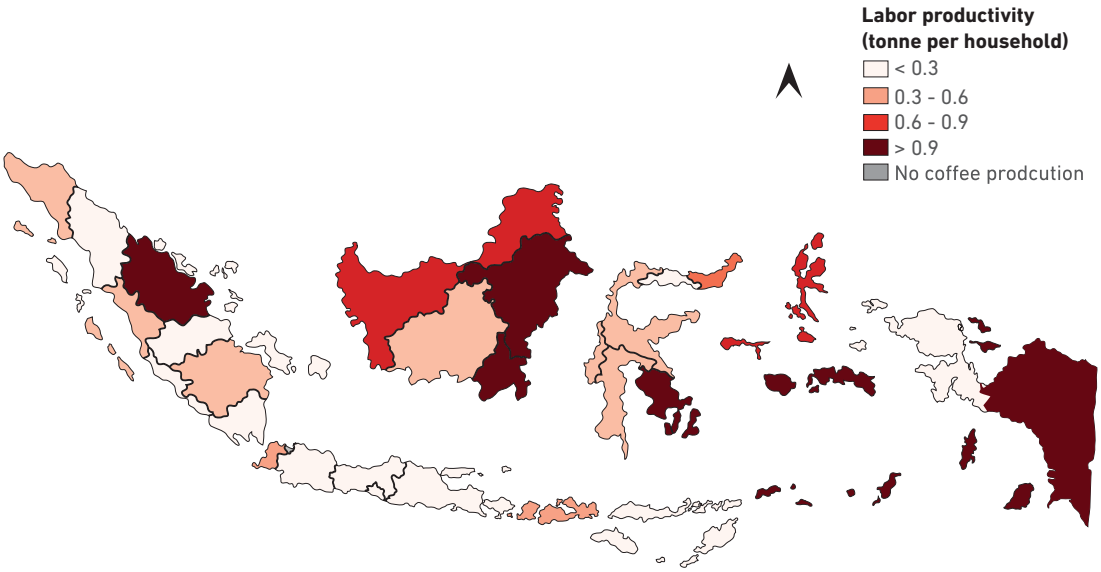
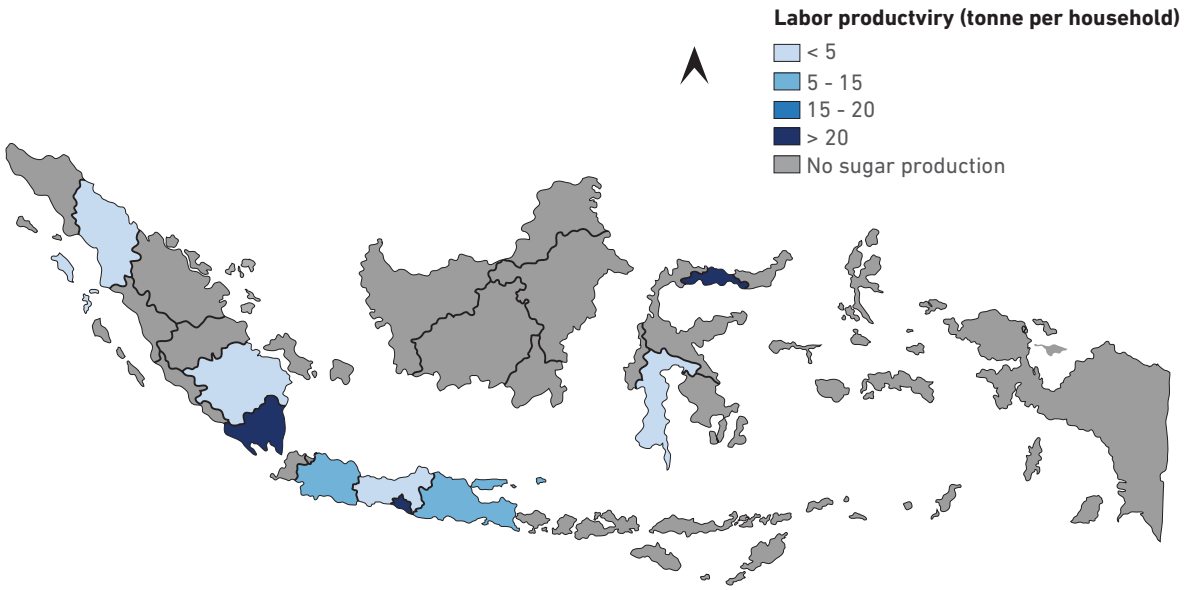


Figure 29.
Household Labor Productivity Distribution of Sugarcane Cultivation, 2018 (tonne/household)



CONCLUSION AND POLICY RECOMMENDATION

Plantation sub-sector has a significant contribution to national economy by shaping GDP and creating foreign exchange income from plantation commodities, such as coffee beans and cocoa beans. That is why, production capacity development through productivity enhancement and planting area expansion are very important to do.

Most of coffee, cocoa, and sugarcane commodities are run by smallholder plantations. Unfortunately, smallholder plantations productivity for the three commodities is relatively lower than large plantations, government and private. It is caused by the technical efficiency level which is lower than the large plantations. Thus, the technical efficiency boost for smallholder plantations of the three commodities needs to be pushed, namely through promoting the use of certified seeds, strengthening planting technical capacity of farmers through counseling, and strengthening farmers institution through membership of farmers group, farmers association, and farmers business partnership.

Disparity between land and labor productivity between regions that is quite big has to be the focus of attention to increase the production of coffee, cocoa, and sugarcane that are run by smallholders productivity in aggregate. Productivity gap between regions can be reduced by increasing productivity in potential areas (plantations with a relatively large area) that still have low productivity. For cocoa and coffee crop, one of the efforts that can be done is to rejuvenate plants that are old and less productive.

Provinces with labor productivity that are relatively low have to be the main focus of development. Farmers' planting capacity in those provinces has to be increased, and that can be done by strengthening the role of farmers group and field instructor in giving training and guidance to the farmers.

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ANNEX 1. PROVINCIAL CODE AND NAME IN QUADRANT ANALYSIS

Provincial Code	Name of Province
11	Aceh
12	North Sumatera
13	West Sumatera
14	Riau
15	Jambi
16	South Sumatera
17	Bengkulu
18	Lampung
19	Bangka Belitung Islands
21	Riau Islands
31	Jakarta
32	West Java
33	Central Java
34	Yogyakarta
35	East Java
36	Banten
51	Bali
52	West Nusa Tenggara
53	East Nusa Tenggara
61	West Borneo
62	Central Borneo
63	South Borneo
64	East Borneo
65	North Borneo
71	North Sulawesi
72	Central Sulawesi
73	South Sulawesi
74	Southeast Sulawesi
75	Gorontalo
76	West Sulawesi
81	Maluku
82	North Maluku
91	West Papua
94	Papua

ABOUT AUTHORS

Kadir Ruslan has been working in official statistics, particularly food and agricultural statistics, for more than a decade. During his career as a statistician, he has been involved in many agricultural surveys and their analysis. Kadir is also an active writer focusing on food and agricultural issues. A number of his writings related to socio-economic issues, especially in the agricultural sector, have been published in national newspapers, such as The Jakarta Post. He obtained his master's degree in Applied Econometrics from Monash University, Australia.

Octavia Rizky Prasetyo is a statistician with an extensive experience in collecting and analyzing data on food crops in Indonesia, and has been working at Statistics Indonesia (BPS) for more than five years. Octavia actively conducts studies in agriculture, and his research articles have been published in a number of journals. Octavia was also a speaker in several international conferences on agricultural statistics. Octavia is an alumnus of the College of Statistical Sciences (STIS), specializing in economic statistics. At the moment, she is a master student in development studies at the International Institute of Social Studies (ISS) in Netherlands, the Hague.

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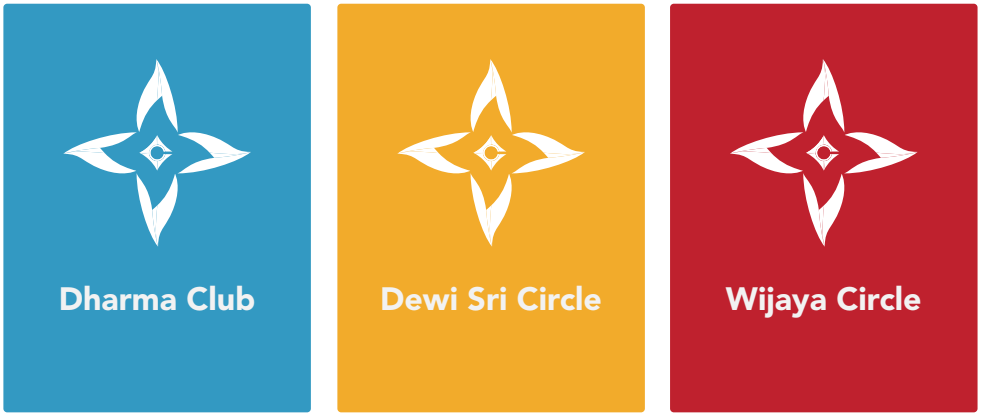

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