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ACCELERATION STRATEGY OF COFFEE AGROFORESTRY AND AGROINDUSTRY IN ACHIEVING SUSTAINABLE DEVELOPMENT GOALS (SDGs): INDONESIA COFFEE REVIEW

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ABSTRACT:
Indonesia is the fourth largest coffee-producing and exporting country in the world after Brazil, Vietnam, and Colombia, and become one of the agricultural commodities that contribute to the Indonesian economy. Four types of coffee species are grown in Indonesian coffee plantations, namely Arabica, Robusta, Liberica, and Excelsa. However, it's considered necessary to find the contribution of agroforestry and agroindustry of coffee in Indonesia in achieving the Sustainable Development Goals (SDGs). Therefore, several things need to be identified in the scope of agroforestry and agroindustry of coffee, namely: (1) Total coffee production at the village level, against total coffee production at sub-district, district, province, country, and world levels; (2) Quality of coffee at village level against quality of coffee at sub-district, district, province, country, and world levels; and (3) Contribution of coffee in 17 goals of SDGs at village level against contribution of coffee at sub-district, district, province, country, and world levels. A significant contribution of this study is the ability to carry out further tests to determine the accelerating strategy of agroforestry and agroindustry of coffee in Indonesia in promoting the SDGs targets.

Keywords: Accelerating strategy, coffee agroforestry, coffee agroindustry, Indonesian coffee, SDGs

1. Introduction

The Sustainable Development Goals (SDGs) or "Global Goals" were approved by 193 states of the United Nations (UN) member in September 2015 to end povert, protecting the planet, and ensuring that by 2030 everyone enjoys peace and prosperity (FAO, 2016); (Fonseca et al., 2020). There are 17 goals in the SDGs that are integrated and interconnected with each other, and maintain a balance between environmental, social, and economic in achieving sustainability (Fonseca et al., 2020). Each of the 17 goals has several more goal-defining targets (Spencer, 2021). The SDGs replaced the Millennium Development Goals (MDGs) which ended in

2015 and were implemented for 15 years. The MDGs underscore the importance of data management to achieve the goals. Data management is an important indicator that must be monitored to achieve the SDGs at local, national, regional and global levels. Good indicators can make the SDGs and their targets an instrument that helps countries highlight in manage the strengths and weaknesses of each country and monitor the country's progress after policy implementation (Gigliotti et al., 2018).

Trade-offs in supporting economic growth over social welfare and ecological sustainability can affect the achievement of the SDGs. On the other hand, the inclusive concept of development emphasizes the social, ecological and political dimensions of development (Gupta & Vegelin, 2016). The SDGs are a step toward change to improve the welfare of the world community (Pogge & Sengupta, 2016). Food and agriculture are the core issues of the 17 SDGs as stated by the Food and Agriculture Organization (FAO), which shows the agricultural sector has a multidimensional role in achieving the SDGs (FAO, 2016); (Maass Wolfenson, 2013); (FAO, 2015). Therefore, every commodity that belongs to the agricultural sector should conduct a sustainability study to find out how big the level of sustainability is, one of which is coffee plantations.

Coffee is one of the most traded agricultural commodities in the world. However, only about 30% of the world's coffee is consumed in coffee-producing countries, the rest is exported to consumer countries such as Norway, Finland, Germany, the Netherlands, and America. In recent years, the total world coffee production has remained relatively constant while the demand for coffee has increased significantly (Panggabean et al., 2021). Currently, Indonesia is one of the top five coffee producers and exporters in the world's. The two types of coffee commonly grown are Arabica and Robusta (Syafaruddin et al., 2020) and have been named one of the best coffees in the world by the National Coffee Association (NCA) (AICE, 2021); (NCA, 2021). In addition, coffee is also one of the leading plantation commodities in Indonesia that have an important role in economic growth, one of which is as a contributor to state income due to the high number of exports (Karim et al., 2019).

Based on plantation statistical data, in a period of 3 years (2015 – 2018), coffee production in Indonesia increased by 18.25% from the total production of 639,355 tons in 2015 increasing to 756,051 tons in 2018. However, it decreased by 0.47 % to 752,511 tons in 2019, although it is predicted to increase to 765,415 tons in 2021 (Direktorat Jenderal Perkebunan, 2021). In addition, Indonesia has a coffee plantation area of 1,230,001 ha in 2015 and increased to 1,249,615 ha in 2021 (Direktorat Jenderal Perkebunan, 2021). Based on these data, the development of coffee production in Indonesia is considered very good when compared to coffee production in 1980, which amounted of 294,973 tons with a plantation area of 707,464 ha (Direktorat Jenderal Perkebunan, 2021).

The strategic role of coffee in the Indonesian economy can be seen from the contribution of the plantation sub-sector to Indonesia's Gross Domestic Product (GDP), where coffee is one of the leading commodities (BPS, 2021). Based on statistical data, total coffee exports in Indonesia decreased by 48.73% in 2019 (359.053 tons) when compared to 2013 (534.023 tons)

(Direktorat Jenderal Perkebunan, 2021). In addition, total import of coffee in Indonesia increased by 103.18% in 2019 (32.102 tons) when compared to 2013 (15,800 tons) (Direktorat Jenderal Perkebunan, 2021). However, the total export and import of coffee in Indonesia shows fluctuating data, where in 2018, the total coffee exports in Indonesia decreased drastically (279,961 tons) and the total import of coffee in Indonesia increased drastically (78,847 tons) (Direktorat Jenderal Perkebunan, 2021). Although total coffee exports in Indonesia fluctuate, domestic demand shows an increasing trend in 2019 (Widyantini, 2019), but in 2021, coffee consumption in Indonesia is low (3.3 million sacks of green green coffee per year) (Panggabean et al., 2021).

According to Widyantini (Widyantini, 2019), Relatively small companies dominate the global value chain for coffee commodities and most of them come from foreign companies. As a result, the stakeholders involved in the coffee industry do not show maximum results to expand the overall value generated. Currently, Indonesia has a trend of low coffee productivity when compared to the other four major exporting countries (Widyantini, 2019).

Based on the information above, several things need to be identified in the scope of agroforestry and coffee agroindustry, namely: (1) Total coffee production at village level, against total coffee production at sub-district, district, province, country, and world levels; (2) Quality of coffee at village level against quality of coffee at sub-district, district, province, country, and world levels; and (3) Contribution of coffee in 17 goals of SDGs at village level against contribution of coffee at sub-district, district, province, country, and world levels. A significant contribution of this study is the ability to carry out further tests to determine the accelerating strategy of agroforestry and agroindustry of coffee in Indonesia in promoting the SDGs targets. On a broader level, this study contributes to the development of knowledge about sustainable development in which Indonesian agroforestry and coffee agroindustry can play a role.

2. Sustainable development and SDGs

Sustainable development is conceptualized as development that meets the needs of the present generation without compromising the needs of future generations. The implementation of sustainable development based on a new approach to how to regulate and organize the economy must become an important and natural part of everyday practice (Bebbington & Unerman, 2018); (Cîrstea et al., 2019). Sustainable development has attracted wide attention compared to other development concepts. Furthermore, sustainable development has also become a public discourse in various countries and businesses at the local, national, regional, and global levels (Pitelis, 2009); (Walker, 2021); (Hanedar et al., 2021). In an effort to measure, track and monitor development worldwide, the United Nations (UN) produced a universal framework that is used as a guide that should be adopted and incorporated into national development planning by all member states (Fonseca et al., 2020); (Government of Ireland, 2020). This blueprint consists of 17 goals called SDGs (Figure 1) (Fonseca et al., 2020) which aim to create a balance between three aspects of sustainability: economic, social and environmental (Fonseca et al., 2020); (Önder & Ağca, 2019); (Roseland & Spiliotopoulou, 2017); (Rao et al., 2018); (Bali Swain & Yang-Wallentin, 2020).

Measuring sustainability is very important because it helps in assessing whether a country or company is making progress or otherwise under a certain period (E. Afful-Dadzie et al., 2014). The main characteristic of the SDGs is that their development goals and targets are inherently interdependent but also interrelated. SDGs require complementarity or synergy as well as trade-offs that have implications for national, regional, and global contexts (Tosun & Leininger, 2017). That is, tackling one goal can help to tackle several other goals at the same time.

The 17 SDGs are interconnected, implying that achieving one goal leads to the attainment of another. Furthermore, the goals in the SDGs also have trade-offs with difficult choices that can result in gains and losses at least in the short term. For example that biodiversity can be threatened if forests are cut down for the purpose of increasing agricultural production for food security (Benton et al., 2021). Food security can be threatened if food crops are eliminated and switch to biofuel production for energy security (Mensah & Enu-Kwesi, 2018). Therefore, it is important to find a balance to achieve a high level of economic growth that contributes to poverty alleviation as well as environmental preservation.

Figure 1. The 17 Points of SDGs. Source: Adapted from (Fonseca et al., 2020).

3. Agroforestry and agroindustry of coffee in Indonesia

3.1. Coffee agroforestry

Coffee agroforestry as one of the important land use categories in biodiversity conservation (Hakim et al., 2019); (Roach et al., 2021). Coffee agroforestry is a forestry system where the area is dominated by coffee plants which are adapted to the plantation system in Indonesia which has good ecological value (Hidayat et al., 2021). Indonesia is a country with a tropical climate (Marganingrum & Santoso, 2019); (Salam et al., 2020); (Novita, 2021); (Sari, 2021) that is likely to produce significant amounts of biomass and may also meet the requirements in the near future (Caramori et al., 2020); (Castanho et al., 2020); (Hiltner et al., 2021); (Muller-Landau et al., 2021). In addition, the tropical climate has advantages in carbon sequestration (Castanho et al., 2020); (Hiltner et al., 2021). Coffee agroforestry in Indonesia is controlled by the tropical climate, causing the quality of the coffee produced to vary (Rahardjo et al., 2020). In addition, the geographical condition consisting of lowlands and mountains causes there are three types of coffee commonly grown, namely Arabica, Robusta, and Liberica (Syafaruddin et al., 2020); (Hendrawan et al., 2021); (Martauli, 2018). Figure 2 show the trend of coffee agroforestry in Indonesia (1980 - 2019) (Direktorat Jenderal Perkebunan, 2021). Coffee production shows an increasing trend even though the area of coffee plantations tends to decrease. In addition, coffee productivity has increased from 0.417 tons/ha in 1980 to 0.604 tons/ha in 2019 (Figure 2).

The most widely produced coffee species in Indonesia is Robusta coffee when compared to Arabica and Liberica coffee (Martauli, 2018). Currently, the total area, production, and productivity of coffee plantations in Indonesia, both from Robusta, Arabica, and Liberica coffee are still dominated by smallholder plantations with an area of 98.06% of the total area of coffee plantations in Indonesia in 2019 (Direktorat Jenderal Perkebunan, 2021). The area of coffee production in Indonesia is estimated at approx 1,245,358 ha, which is spread over Sumatra, Java, and Sulawesi island (Direktorat Jenderal Perkebunan, 2021); (Martauli, 2018). Many farmers in South Sumatra, Lampung and East Java grow Robusta coffee, while Arabica coffee is mostly grown by farmers in Aceh, North Sumatra, South Sulawesi, Bali, and Flores. while liberica coffee is widely grown by farmers in Jambi and Central Kalimantan (Direktorat Jenderal Perkebunan, 2021); (Martauli, 2018). Figure 3 and Table 1 show the trend of coffee agroforestry in Indonesia (Panggabean et al., 2021); (Direktorat Jenderal Perkebunan, 2021); (Martauli, 2018); (Jaya et al., 2021); (Akhir et al., 2021); (Fadri et al., 2021); (Sahfitri et al., 2020); (Ambarini et al., 2020); (Hamdan et al., 2021); (Insanu et al., 2021); (Silmi et al., 2020); (Isnidayu et al., 2020); (Dzakiroh et al., 2021); (Harsono et al., 2021); (Yudhari et al., 2020); (Abdullah et al., 2017); (Pagiu et al., 2020); (Tenriawaru et al., 2020); (Sawalludin et al., 2020); (Edy, 2019); (Priyadi et al., 2021); (Nikmatullah et al., 2021).

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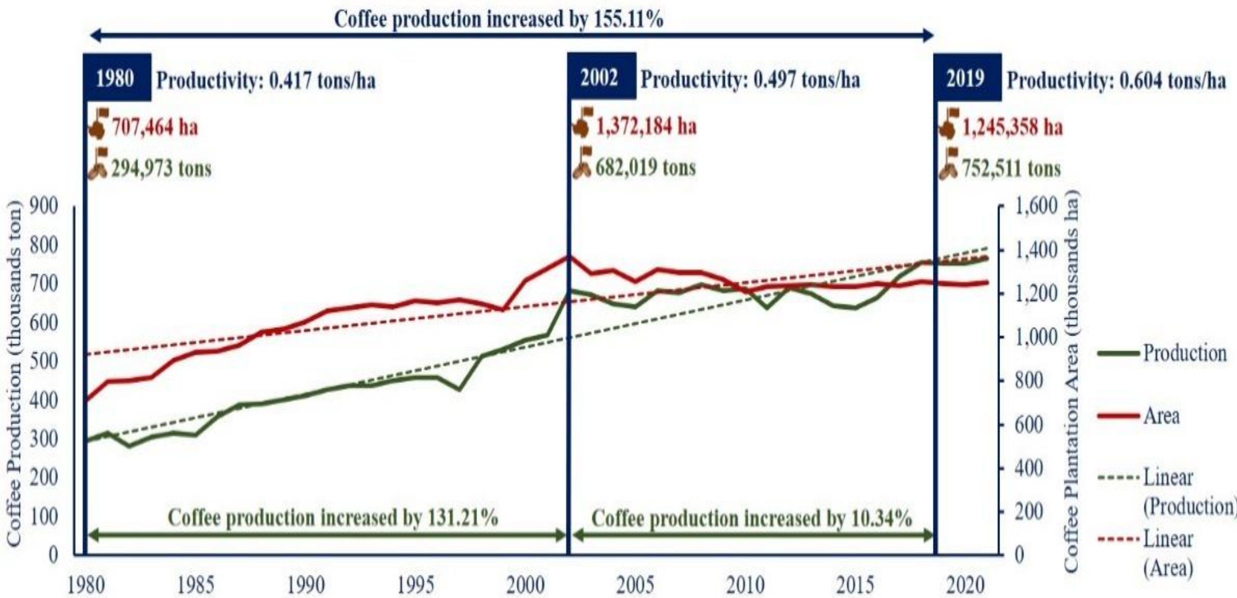

Figure 2. Trend of coffee agroforestry in Indonesia (1980 - 2019). Source: Adapted from (Direktorat Jenderal Perkebunan, 2021).

Table 1. Area, Production, and productivity of coffee by island in Indonesia 2019 adopted from (Direktorat Jenderal Perkebunan, 2021).

Island	Area (ha)	Production (ton)	Productivity (ton/ha)
Sumatera	777,136	552,640	0.71
Java	191,819	97,973	0.51
Nusa Tenggara and Bali	118,674	44,712	0.38
Kalimantan	21,118	5,953	0.28
Sulawesi	122,602	48,019	0,39
Maluku and Papua	14,009	3,215	0.23
Indonesia	1,245,358	752,511	0.60

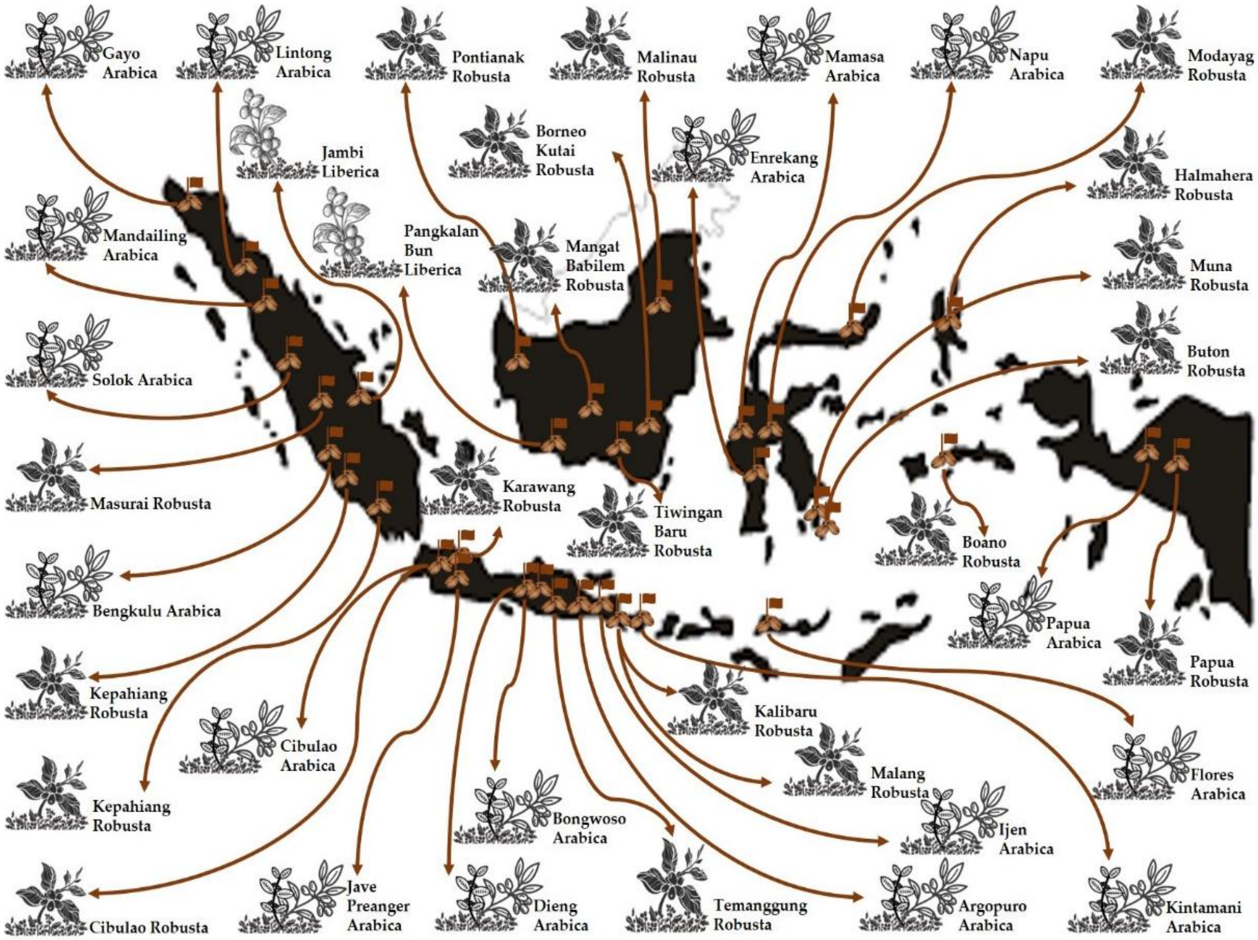

Figure 3. The trend of coffee agroforestry in Indonesia. Source: Author

When compared to world coffee production, Indonesia coffee production is only 7.54% of the total world coffee production and ranks 4th after Brazil, Vietnam, and Colombia (Figure 4). In this condition, Indonesia is in a position below Colombia with a difference of 150,000.15 tons or 22.73% and above Ethiopia with a difference of 275,999.39 tons or 71.87% (World Population Review, 2022). Therefore, Indonesia has the opportunity to increase coffee production in order to reach the 3rd position after Brazil and Vietnam. In addition, the role of coffee agroforestry in Indonesia in achieving the SDGs can be realized. This is a challenge for Indonesia. The role of the government and the consistency of coffee farmers in maintaining and increasing productivity is needed.

Several articles tried to examine the contribution of the agricultural sector to the achievement of the SDGs, but none of the studies quantitatively analyzed the contribution of the agricultural sector. The dual function of smallholders in adopting the SDGs and their socioeconomic limitations make it difficult for them to meet expectations as drivers of sustainable development. One of the problems faced in quantitative analysis of the role of agriculture is the difficulty of finding tools that can be used to identify its contribution. Existing sustainability assessment tools such as life cycle analysis (Schaubroeck & Rugani, 2017) and carbon footprint (Sudarsan et al., 2020); (Wandana et al., 2021) does not adequately consider the social dimensions of sustainable development. This is a challenge going forward, given the importance of the agricultural sector to the achievement of the SDGs, for example, the role of smallholders in relation to the SDGs (Terlau et al., 2019).

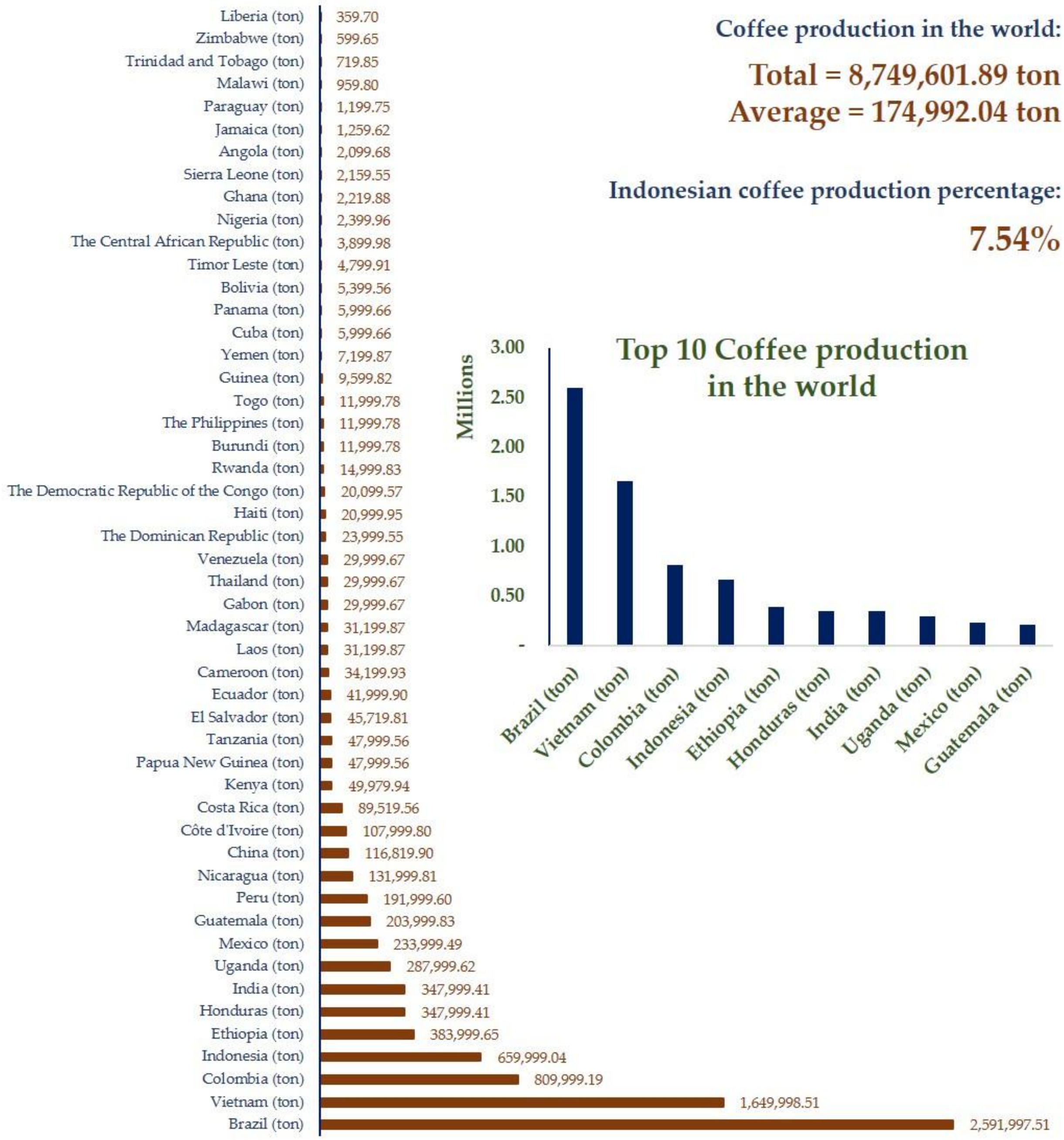

Figure 4. The trend of coffee production in the world. Source: Adapted from (World Population Review, 2022).

3.2. Coffee agroindustry

The existence of coffee agroindustry institutions is one of the most strategic elements in conducting a study of the coffee agro-industry acceleration strategy in achieving the SDGs. This study can be carried out through the identification of post-harvest coffee production process technology, from cherry coffee to green beans and/or roasted beans. Indonesia with its various local cultures serves processed coffee that fulfills the style of local coffee culture, although in processing and serving techniques, the coffee is new to western culture (Purnomo et al., 2021). For example, Starbucks coffee processing and serving techniques from America, which has around 326 outlets in Indonesia, have brought new value to the Indonesian people (Nurhasanah & Dewi, 2020). Therefore, local coffee shops can also provide not only coffee, but also other products that might be of interest to customers. In general, the processing units in the coffee agroindustry in Indonesia, consist of pulping, washing, drying, hulling, and finishing (Pramulya et al., 2019),(Mawardi et al., 2020). Figure 5 show the cultivation stage of coffee in Indonesia (Pramulya et al., 2019),(Mawardi et al., 2020).

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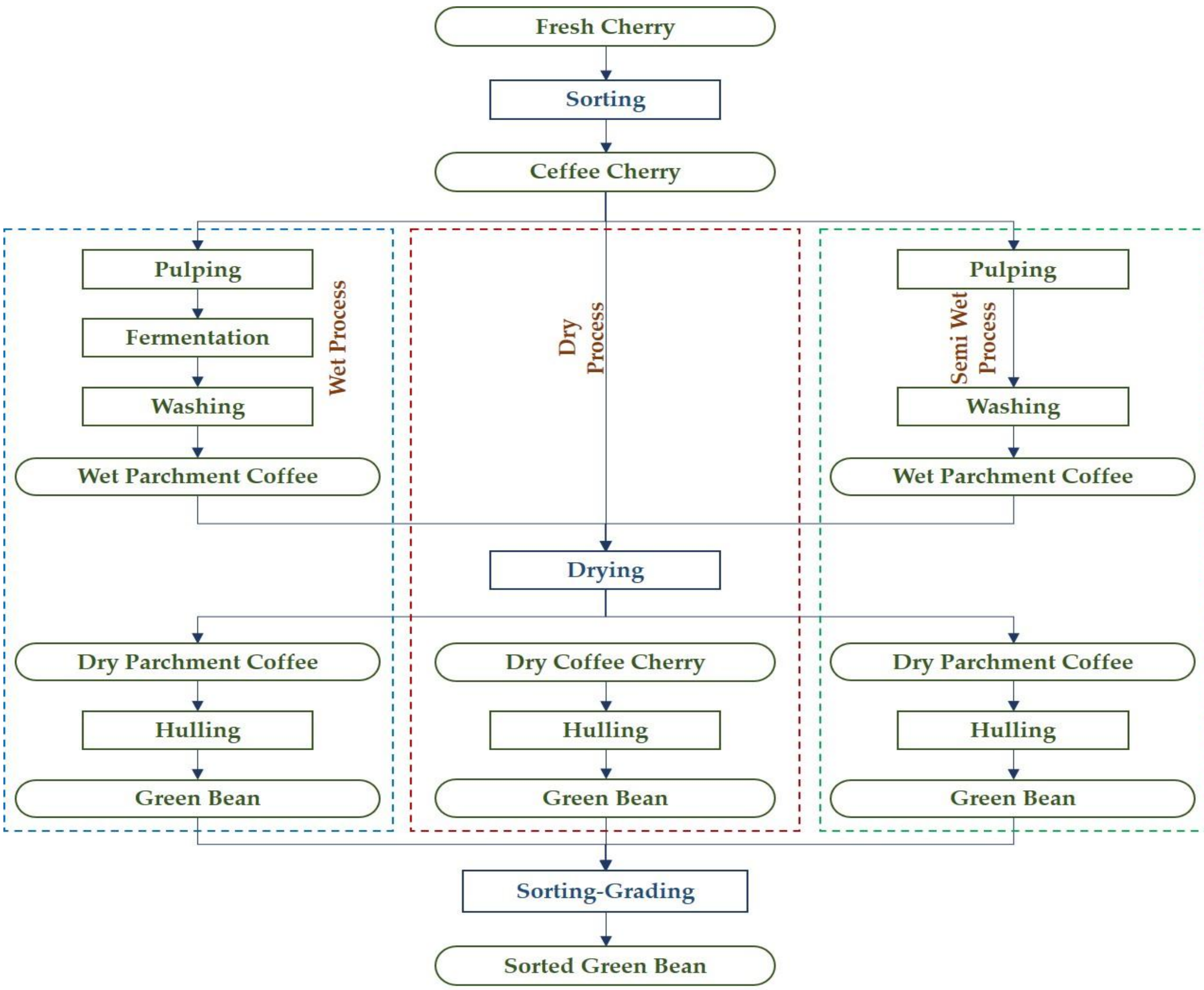

Figure 5. The cultivation stage of coffee in Indonesia. Source: Adapted from (Pramulya et al., 2019; Mawardi et al., 2020).

The right technology in the post-harvest coffee production process is one of the main indicators in improving the quality of the products (green beans and or roasted beans) produced. One of the process technologies that can improve the quality of coffee in general is the alkaline process technology which involves the fermentation stage (Zhang et al., 2019); (Cândido et al., 2019); (Haile & Kang, 2019); (da Mota et al., 2020); (Zhao et al., 2021); (Wiraputra et al., 2021). The application of alkaline process technology in coffee processing can produce green beans with a moisture content of 11.70% which is at a commercial standard green bean water content of 9-12%, while the application of dry process technology in coffee processing can produce green beans with a water content of 12.83% which is above the green bean commercial standard water content (Subedi, 2010). In addition, the caffeine content, antioxidant activity, and taste of the coffee produced are influenced by the applied process technology. One example, the results of research conducted by Supriana et al. (Supriana et al., 2020) it was found that there were differences in the quality of Robusta coffee with respect to the processing technology and roasting temperature (Table 2). Another example has been reported by Maulid et al. (Maulid et al., 2021), regarding the quality of Arabica coffee with respect to the wet processing technology and roasting temperature (Table 3). In general, the Arabica coffee production method in Indonesia uses the wet processing technology method (Sunarharum et al., 2019); (Kembaren & Muchsin, 2021); (Maulid et al., 2021). Based on Maulid et al. research results (Maulid et al., 2021), The caffeine content of Arabica coffee that produces is higher than Brazilian Arabica coffee (0.09%) (Jung et al., 2017), lower than Mayasia Arabica (1.1%) (Mubarak et al., 2019) and Ethiopian arabica coffee var. Yirgachefe, Harar, and Sidama (0.8-1.634 %) (Kim et al., 2020), and are in the vulnerable to caffeine content of El Salvador Bourbon Arabica coffee (0.18-0.76%) (Bolka & Emire, 2020).

Table 2. The difference in the quality of Robusta coffee on the treatment of process technology and roasting temperature.

Treatment	Water content (%)	Caffeine content (%)	Antioxidant activity (%)	Taste	
Process Technology					
- Dry Process	2.66	0.68	82.28	76.00*	81.00**
- Semi Wet Process	2.68	0.60	82.96	75.50*	82.50**
- Wet Process	2.94	0.71	84.42	75.75*	8150**
Roasting Temperature					
- 180^{o}C	3.48	0.61	85.65		
- 210^{o}C	2.04	0.72	80.78		

Description:
*Taste of Steeped Coffee at 180^{o}C Roasting Temperature
**Taste of Steeped Coffee at a Roasting Temperature of 210^{o}C (Cupping test results show that dry, semi-wet, and wet processing methods followed by a roasting temperature of 210^{o}C produce a final score of > 80.00 so that it is included in the Fine Robusta category) (Supriana et al., 2020)

Table 3. The difference in the quality of Arabica coffee on the treatment of process technology and roasting temperature.

Treatment[1]	Water content (%)	Caffeine content (%)	Antioxidant activity (%)	Taste	Quality Category*
Process Technology					

- Wet Process	Arabica Sigarar Utang obtained through a wet process with 36 hours of fermentation				
Roasting Temperature					
- 185°C (Mild-Medium)	2.30	0.60	83.48	85.46	Quality II
- 185°C (Medium-Dark)	1.41	0.46	82.16	85.53	Quality II
- 210°C (Mild-Medium)	2.51	0.62	84.36	86.51	Quality II
- 210°C (Medium-Dark)	1.30	0.55	83.48	85.92	Quality II

Description:
*Quality Category based on SNI 01-3542-2004; Information adapted from (Maulid et al., 2021)

Several articles tried to examine the contribution of the manufacturing sector to the achievement of the SDGs, but none of the studies quantitatively analyzed the contribution of the manufacturing sector. One of the problems faced in quantitative analysis of the role of manufacturing is the difficulty of finding tools that can be used to identify its contribution. In the same case as the agricultural sector, existing sustainability assessment tools such as life cycle analysis (Schaubroeck & Rugani, 2017) and carbon footprint (Sudarsan et al., 2020); (Wandana et al., 2021) do not adequately consider the social dimensions of sustainable development in the manufacturing sector.

3.3. Export-Import Volume and Value of Coffee in Indonesia

Based on data from the Directorate General of Plantations, State of Indonesia in 2021 (Direktorat Jenderal Perkebunan, 2021), conditions for export volume and value of coffee in Indonesia experienced a decrease in export volume in 2018 by 40.15% compared to 2017 and 44.23% compared to 2015. This has the same impact as the value of coffee exports in Indonesia. In the same year, imports volume and value of coffee in Indonesia increased dramatically. Although in 2019 the volume of coffee exports in Indonesia increased by 22.03% compared to 2018, the same thing happened to the value of coffee exports in Indonesia. Meanwhile, the volume of coffee imports in Indonesia in 2019 again decreased by 59.29% compared to 2018, the same thing happened to the value of coffee imports in Indonesia. Figure 6 show the export-import volume and value of coffee in Indonesia (2010-2019).

In addition, according to Figure 6, the export-import value balance of coffee in Indonesia shows that in 2018 the export value of coffee in Indonesia (2.9145 thousand U$$ per ton) was higher than the Indonesian import value (1.9757 thousand U$$ per ton). This condition is better when compared to previous years. However, in 2019 the export value of coffee in Indonesia decreased to 2.4596 thousand U$$ per ton when compared to the Indonesian import value which increased by 2.0617 thousand U$$ per ton.

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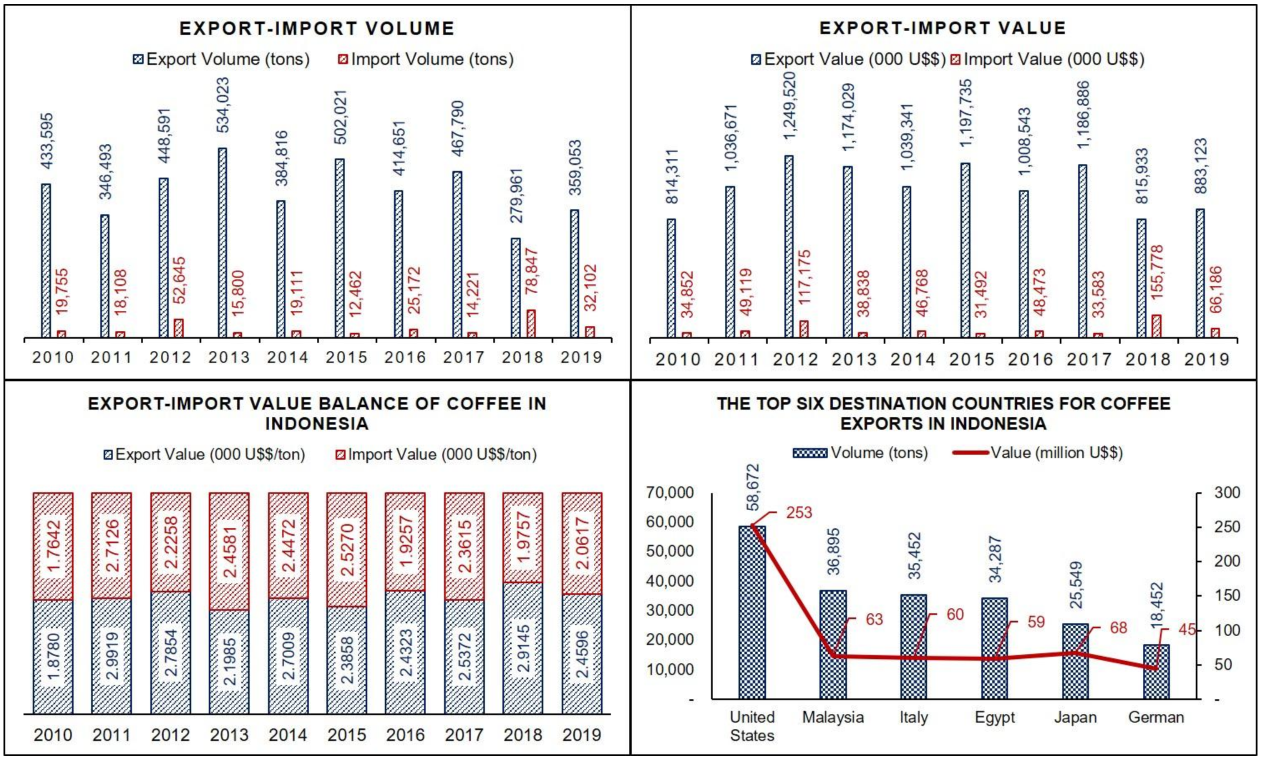

Figure 6. The export-import volume and value of coffee in Indonesia (2010-2019). Source: Adapted from (Direktorat Jenderal Perkebunan, 2021).

In 2019, coffee exports in Indonesia are mostly in the form of dry beans (HS: 09011110) or primary form with a contribution of 98.23%, and the remaining 1.77% is exported in the form of roasted coffee. In the same year, Of the total coffee production in Indonesia, 27.81% is exported to six foreign countries, namely the United States, Malaysia, Italy, Egypt, Japan, and Germany (Figure 6). While the rest is consumed domestically and exported to other foreign countries in a relatively stable amount. Acording to Directorate General of Plantations, State of Indonesia in 2021 (Direktorat Jenderal Perkebunan, 2021), In general, coffee exports in Indonesia have reached five continents, namely Asia, Africa, Australia, Europe and America, with the main market are Europe and America.

3.4. Critical assessment of agroforestry and agroindustry of coffee in Indonesia

Based on the results of the identification of the existing conditions of agroforestry and agroindustry of coffee in Indonesia, there are several problems faced by agroforestry and agroindustry of coffee in Indonesia, namely declining total coffee production and declining coffee export conditions. This is a challenge for Indonesia to make a strategy to improve the stability of agroforestry and agroindustry of coffee in Indonesia so that the sustainability of agroforestry and agroindustry of coffee in Indonesia can be achieved.

When compared with the four other largest coffee producing countries in the world (Blazil, Colombia, Vietnam, and Ethiopia), Indonesia is in a threatened status. Table 4 shows the existing condition of total coffee production from the other four largest coffee producers in the world.

Table 4. The existing condition of total coffee production from the other four largest coffee producers in the world.

Countries	Coffee production conditions	Sources
- Brazil	The Brazilian government says farmers will harvest 55.74 million bags by 2022, 16.8% more than the previous year, but a smaller number than market estimates. Brazilian food supply agency Conab estimates arabica coffee production at 38.78 million bags, 23% more than in 2021.	(Mano & Teixeira, 2022)
- Colombia	Colombia's Agriculture Minister said farmers will harvest 13.2 million bags of coffee by 2022, up 5% from 2021.	(Istoedinheiro, 2022)
- Vietnam	Informasi yang dikutip dari Statista 2022, total Robusta coffee production volume in Vietnam by 30 million bags in 2022, 6.5% more than in 2020-2021.	(Statista, 2022)
- Ethiopia	Coffee production in Ethiopia has grown steadily over the past three years and, with suitable growing conditions, is forecasted to reach to 7.62 million bags (457,200 MT) in 2021-2022.	(USDA, 2021)

Description: 1 bag is equivalent to 60 kg

Based on the results of a survey conducted by the International Coffee Organization (ICO) in 2020, most of the coffee-producing countries experienced a negative impact due to the COVID-19 pandemic, including employment, income, exports and domestic consumption. Farmers' livelihoods are getting depressed as agricultural incomes decline while expenses increase. On the other hand, downstream coffee value chain operations are disrupted as a result of social distancing and lockdowns. Internal logistics as well as export infrastructure were negatively affected. The long-term impact of the Covid-19 crisis on the economic, social and environmental sustainability of the coffee sector needs to be closely monitored (ICO, 2020).

Covid-19 pandemic represents a further challenge to the coffee sector, which was already suffering a prolonged period of low prices. For the coffee sector, the consequent delay or postponement of orders by consumer countries could cause the definitive closure of many farms with the consequent destruction of entire local coffee-based economies. Therefore, the Acceleration strategy of agroforestry and agroindustry of coffee in Indonesia needs to be managed appropriately and consistently in order to achieve the SDGs.

3.5. Methods to estimated contribution of agroforestry and agroindustry of coffee in 17 goals of SDGs

As stated above, the problem faced in quantitative analysis of the contribution of agroforestry and coffee agroindustry in achieving the SDGs is the difficulty of finding the right method. Existing sustainability assessment methods such as life cycle analysis and carbon footprints do not adequately consider the social dimensions of sustainable development. Estimated contribution of coffee in 17 goals of SDGs maybe can be done using several methods that have been used by previous researchers. Table 5 shows several methods of contribution of agroforestry and agroindustry of coffee to the 17 goals of SDGs. Experts also simplify the multidimensional needs of the SDGs. Combining methods from social and sustainability research can produce unique results that aid information dissemination and public engagement and awareness.

Many indices have also been developed and become a key source of information for countries as they can track progress towards realizing the SDGs targets. The Global SDGs Index, for example, is the first world study to assess the position of individual countries regarding the achievement of sustainable development goals. However, this does not mean that this index is without criticism, the SDGs are too broad in scope, therefore making it difficult for countries to successfully implement them (Le Blanc, 2015). In addition, the target ends up as unclear, weak, or meaningless (Holden et al., 2014); (Holden et al., 2017). Therefore, the current SDGs and their targets require a conceptual framework for implementing the SDGs in a cross-sectoral approach (Hassan et al., 2019); (Hassan et al., 2020) and a relevant policy framework and indicator development to avoid ambiguous implementation of the SDGs (Hák et al., 2016).

Table 5. Several methods of contribution of agroforestry and agroindustry of coffee to the 17 goals of SDGs.

No	Methods	Information	Sources
1	Technique for Order Preference by Similarity to Ideal Solution (TOPSIS)	This approach is able to determine the contribution made by each dimension to the combined score, an important aspect that many indices fail to see. As a basic framework in determining the method used to combine the three dimensions of sustainability, namely environmental, social, and economic.	(A. Afful-Dadzie et al., 2016)
2	Handprint Assessment Approach	This approach considers both positive and negative impacts and all dimensions of sustainability consisting of economics, ecology, and social ethics. This approach has 37 indicators that address the five SDG categories into social, health and risk prevention, environmental, economic, and governance dimensions. Using this approach, Kühnen & Hahn found that smallholders contribute to the achievement	(Terlau et al., 2019) (Kühnen & Hahn, 2018) (Kühnen et al., 2019) (Husgafvel, 2021a) (Husgafvel, 2021b)

No	Methods	Information	Sources
		of the SDGs on the social dimension.	
3	Network of Targets	By using network analysis techniques, several thematic areas covered in the SDGs are well connected with each other.	(Le Blanc, 2015)
4	A network analysis framework	A simple and straightforward Venn diagram based on the three pillars of sustainable development can help the success of the SDGs action plan from 2015 to 2030.	(Dalampira & Nastis, 2020a) (Dalampira & Nastis, 2020b)
5	Multidimensional scaling (MDS)	In the sustainability analysis, there are 5 dimensions used, namely the economic, social, environmental, institutional, and technological dimensions.	(Saragih et al., 2020)

Agroforestry and agroindustry of coffee can contribute to several Sustainable Development Goals (SDGs) through various means. Some of the methods to estimate their contribution to the SDGs include: (1) Ecosystem Services: Agroforestry practices in coffee systems can provide important ecosystem services that contribute to meeting the SDGs, such as biodiversity conservation, soil fertility, and climate change mitigation (Wienhold & Goulao, 2023) (Ulya et al., 2023) (Mbow et al., 2014); (2) Socio-Economic Benefits: Coffee agroforestry systems have the potential to contribute to SDGs related to poverty alleviation, food security, and economic growth. For example, a study in Sumatra found that commodity production from coffee agroforestry systems contributed to over 54% of household income (Ulya et al., 2023) (Duffy et al., 2021); (3) Environmental Impact and Green Economy: Coffee agroforestry can be an alternative to the implementation of green economy practices, providing environmental impact, added value, and social equality. It can also contribute to the circular economy and environmental sustainability along the coffee chain (Ulya et al., 2023); (4) Voluntary Sustainability Standards (VSS): Assessing the contribution of VSS in the coffee sector can also help in estimating the sector's contribution to the achievement of the SDGs (Rubio-Jovel et al., 2023) (Rubio-Jovel, 2023); and (5) Intervention Pathways: The coffee sector has been investing in sustainability efforts that align with the SDGs. These interventions form an interconnected system of pathways that contribute to the SDGs, such as sustaining supply, improving livelihoods, conserving nature, and strengthening demand (Bager & Lambin, 2020). By considering these various aspects, it is possible to estimate the contribution of agroforestry and agroindustry of coffee to the 17 goals of the SDGs, encompassing environmental, social, and economic dimensions.

The success of achieving a sustainable coffee sector hinges on our ability to balance responsible consumption and production of farmers and workers, in a way that maintains clean water and conserves life on land. All of this must be done by making concerted efforts to alleviate poverty, achieve food security and promote sustainable agriculture to combat climate change and its impact on coffee production and producers. Standards and certification programs assure the market that coffee agroforestry and agroindustry are applying good social and environmental practices and can improve livelihoods and conserve nature while sustaining the supply of coffee.

3.6. Acceleration strategy of agroforestry and agroindustry of coffee in 17 goals of SDGs

Performance assessment on agroforestry and agroindustry of coffee needs to be done as an early stage in accelerating strategy of agroforestry and agroindustry of coffee in the 17 goals of SDGs. The method used in performance identification can be applied to various performance problems. This is due to industry or organizational awareness of the importance of implementing sustainable practices. The proposed measurement method will help identify performance that meets sustainability targets and ensure improvement over time. Basically, indicators in assessing sustainability do not have a threshold value or standard, an improvement is said to be continuous, so it is difficult to know whether an improvement has met the sustainability standard or not. Therefore, in the selection of the proposed method, the provision of a threshold value or standard for an improvement that is said to be sustainable must be carried out. Figure 7 show the acceleration strategy of agroforestry and agroindustry of coffee in achieving SDGs (A. Afful-Dadzie et al., 2016).

One way to performance assessment of agroforestry and agroindustry of coffee in 17 goals of SDGs is to apply Operational Excellence (OPEX) technique to be Excellence Agroforestry and Excellence Agroindustry. OPEX is considered as a business strategy in order to narrow the discussion and reduce the confusion (Found et al., 2018); (Cahyo, 2019). As a business strategy, it is important to develop a framework to apply it in every level of organization (Cahyo, 2019); (Bogodistov & Moormann, 2019). Six Sigma is a strong and well-established business strategy for achieving OPEX (Sony & Naik, 2019),(Shokri et al., 2020), although previous research has suggested that Six Sigma can have a negative impact on organizational creativity and innovation (Rajamanoharan & Collier, 2006). Therefore, it is possible to apply more than 1 tool to achieve success and accuracy in the analysis. One example is the integration of Six Sigma with CK theory can be done to increase innovation ability in achieving OPEX (Sony & Naik, 2019). C-K theory is one of the most widely used techniques for design reasoning that promotes creativity and innovation. Figure 8 show the structure of OPEX (SantoshK55, 2018).

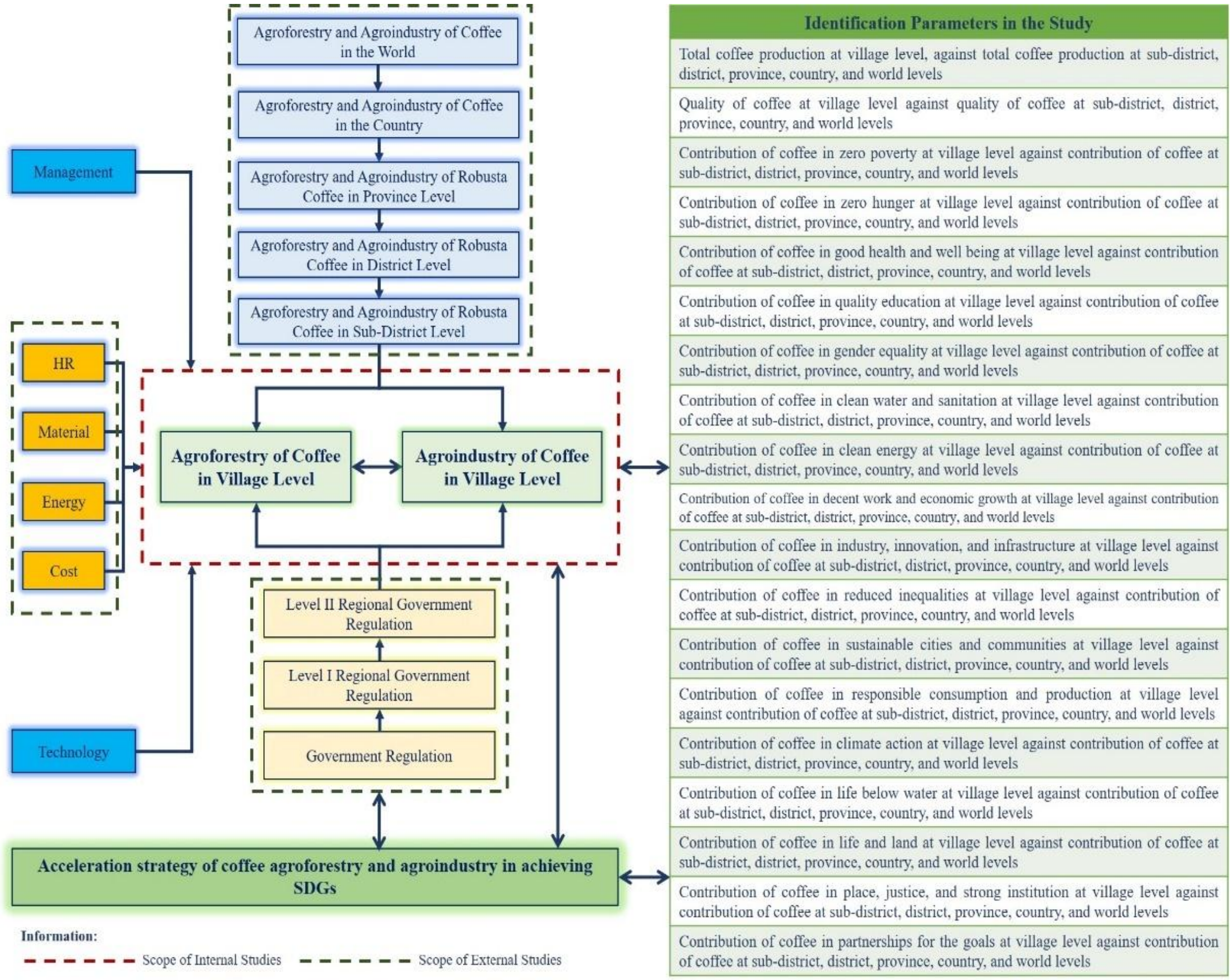

Figure 7. The acceleration strategy of agroforestry and agroindustry of coffee in achieving SDGs.
Source: Author

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Figure 8. The structure of OPEX. Source: Adapted from (SantoshK55, 2018).

Agroforestry and agroindustry play a significant role in achieving the 17 Sustainable Development Goals (SDGs). These goals include addressing issues such as poverty, hunger, climate change, and gender equality, among others (Mbow et al., 2014) (Montagnini & Metzel, 2017) (Sharma et al., 2022). The coffee sector, in particular, contributes to several SDGs, including: (1) No Poverty (SDG 1): By increasing income and production through agroforestry and sustainable practices, poverty reduction can be achieved. (2) Zero Hunger (SDG 2): Agroforestry can contribute to food security and increase biodiversity, helping to alleviate hunger. (3) Climate Action (SDG 13): Agroforestry systems can help combat climate change by sequestering carbon and reducing greenhouse gas emissions. (4) Life on Land (SDG 15): Agroforestry practices can contribute to biodiversity conservation and sustainable land management. (5) Gender Equality (SDG 5): By promoting gender equality in coffee farming households, better family livelihoods and resilience to climate or market shocks can be achieved. (6) Water Quality (SDG 6): Agroforestry can help improve water quality by reducing erosion and maintaining soil moisture. (7) Sustainable Agriculture (SDG 12): Agroindustry can contribute to responsible agricultural production by promoting sustainable practices and reducing environmental impacts.

The coffee sector is investing $350 million annually in various sustainability efforts, focusing on interconnected pathways that lead to common outcomes such as improved livelihoods, conserved nature, and strengthened demand. By adopting sustainable practices and integrating agroforestry into coffee farming, the coffee industry can play a crucial role in achieving the SDGs and creating a more sustainable future (Hinson et al., 2019). The coffee sector, in particular, contributes to several SDGs, including poverty reduction, zero hunger, climate action, life on land, gender equality, water quality, and sustainable agriculture. Agroforestry has the strongest impact potential on poverty reduction, hunger alleviation, climate action, and biodiversity conservation and sustainable land management. By adopting sustainable practices and integrating agroforestry into farming, the agriculture sector can play a crucial role in achieving the SDGs and creating a more sustainable future (Montagnini & Metzel, 2017) (Sharma et al., 2022).

8. Conclusions

Performance assessment on agroforestry and agroindustry of coffee needs to be done as an early stage in accelerating strategy of agroforestry and agroindustry of coffee in the 17 goals of SDGs. Therefore, several things need to be identified in the scope of agroforestry and agroindustry of coffee, namely: (1) Total coffee production at village level, against total coffee production at sub-district, district, province, country, and world levels; (2) Quality of coffee at village level against quality of coffee at sub-district, district, province, country, and world levels; and (3) Contribution of coffee in 17 goals of SDGs at village level against contribution of coffee at sub-district, district, province, country, and world levels. One way to performance assessment of agroforestry and agroindustry of coffee in 17 goals of SDGs is to apply Operational Excellence (OPEX) technique to be Excellence Agroforestry and Excellence Agroindustry. The integration of Six Sigma with CK theory can be done to increase innovation ability in achieving OPEX.

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