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Research Article

Small Family Farms, A Review in Indonesian Context

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ABSTRACT

This paper addresses a general description of small family farms in Indonesia. Building on a literature review, it sheds light on the significant role of small family farms in Sustainable Development Goals, family farms in Indonesia and their challenges, as well as on the impact of investments oriented to farmers for food security. The reviews indicate that enabling family farmers to fulfill their roles can affect the acceleration of progress across crucial elements of Sustainable Development Goals. Key challenges faced by the farmers include low technology implementation, limited access to finances, farm size fragmentation, infrastructure and market linkage, the climate factor, and availability and accessibility of fertilizers and seeds. In conclusion, this paper highlights the importance of investment in small family farms for improving access to financial services and public goods, strengthening market linkages, enhancing productivity through research and extension, and investing beyond the farm through a rural non-farm economy and a territorial development perspective.

Keywords: *Food security, Smallholders, Southeast Asia, Sustainable food systems*

Introduction

The achievement of food security is fundamental to the well-being and development of human societies. Although the global food production has remained ahead of global demand over the past half-century, in 2009, statistics indicated that around 1 billion people had insufficient food for consumption, whereas another billion people suffered from malnutrition (Pinstrup-Andersen, 2009). The growing

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population over the next half-century, coupled with other pressing factors, is bound to escalate the global food demand (Foresight, 2011; Godfray *et al.*, 2010). In fact, more recent data indicate that in 2017, the absolute number of undernourished (i.e., chronically food-deprived) people escalated to nearly 821 million (FAO, International Fund for Agriculture Development [IFAD], United Nations International Children's Emergency Fund [UNICEF], World Food Program [WFP] and World Health Organization [WHO], 2018: p. 2), whereas more than 820 million people suffered from hunger globally in 2019 (WHO, 2019).

In the case of Asia, undernourishment appears to be a stable situation in most of its regions (FAO, 2018). The projected Prevalence of Undernourishment (PoU) in 2017 revealed that that 11.4% of the population was undernourished, representing more than 515 million people (the highest number in the world). The Southeast and West Asia regions contribute to this slowdown in the decreasing trend of undernourishment. This is because countries in the Southeast Asia region have been affected by adverse climate conditions that have impacts on food availability and prices, whereas countries in the West Asia region have been affected by prolonged armed conflicts (FAO, 2018). Interestingly, approximately 269 million people or 40.83% of the population of Southeast Asia reside in Indonesia (Worldometers, 2019). The population in Indonesia has been projected to grow up to 288 million in 2050 (Asian Development Bank [ADB], 2011). Within this context, in 2015, Indonesia had already met the Millennium Development Goal (MDG) 1 hunger target by reducing half of its hungry population proportion. Despite the decline in PoU, child chronic malnutrition rates were still high, as 8.4 million children under 5 (37.2%) were stunted (World Bank, 2015).

To address the hunger issue and to attain global food security, the significance of family farmers as the largest food providers across the globe has been largely emphasized in the literature. Essentially, their predominant and indispensable contribution to feeding the world is largely acknowledged (Graeub et al., 2016, FAO and IFAD, 2019). This role will be broader and able to accelerate the key elements of Sustainable Development Goals (SDGs) if supported by sustainable food systems for the farmers. However, farmers seem to be facing the increasingly challenging climatic and environmental conditions, a limited investment that affects the availability of rural infrastructure to support their enterprises, and the prevailing political-economic structures that merely benefit conglomerates within the food systems.

Small farms, also known as small family farms, have a broad range of definitions from multiple stances. Some key features of small family farms are listed as follows: run by a family using mostly (or only) their own labor, rely on agri-activities for a food consumed, and are also engaged in other economic activities (locally or through migration, their resources are considered "small" and scarce, especially for land ownership). Notably, the definition of "small" depends on the context. The most commonly used criterion is land, but it is at times complemented by other productive assets (by livestock) or by measuring the productivity of the land (e.g., irrigation). Land is easier to compare, especially when many sources define "small farms" as those with less than 2 hectares (hereafter, ha) of cropland (World Bank, 2003; Thapa, 2009) or less than 5 ha (Grando *et al.,* 2016; European Union [EU], 2011). In this case, suitable size thresholds, among others, must be adapted to regional and national contexts. For instance, 1 and 2 ha thresholds are relevant in Asia, whereas a small Brazilian farm measure may be as large as 50 ha.

Another study defined "small farms" based on the labor of household members (Lowder, Skoet, & Singh, 2014; Brunori & Bartolini, 2016) or those with subsistence orientation, in which the main aim of the farm is to produce the bulk of the household consumption of staple foods (Hazell et al., 2007). Meanwhile, others define small farms as those with limited resources, including land, capital, skills, and labor (HLPE, 2013), relative to other farmers within the sector (Dixon et al., 2003), relative autonomy from conventional markets and technologies (Ellis, 1993; Van der Ploeg, 2013), and the concept of "simple commodity production" (see Friedmann, 1978).

The definition of a small farmer differs also between researchers across Indonesia. For instance, Sayogyo (1976, cited in Sudaryanto et al., 2009) classified farmers into four groups: peasants with a farm size below 0.25 ha, small farmers with a size at 0.25–1.00 ha, medium farmers with a size of 1.0–2.0 ha, and large farmers with a size above 2.0 ha. This classification is commonly applied for food crops farming. A different concept is applied for horticulture and estate crops because of their large size. Notably, small, medium, and large farms are below 2.0 ha, 2.0–5.0 ha, and above 5.0 ha, respectively (Sudaryanto et al., 2009). The *Badan Pusat Statistik* (BPS) or Central Bureau of Statistics depicted small farmers as farmers with farm sizes below 0.5 ha, whereas family farmers with less than 0.5 ha of land are known as "*Gurem Farmer.*"

State of the art of small farming sustainability

In promoting sustainable food systems, it is crucial to support and give emphasis to the integral role of family farmers. Food systems garnered by family farmers tend to be more sustainable because of the following reasons:

1) Food systems built by family farms significantly contribute to food and nutrition security (FNS). The results of these systems are mostly used for food and nutrition for the world's most populous and food-insecure regions. Family farms are integral for maintaining nutritional diversity, considering that large-scale industrial farming is currently continuously associated with declining diversity of nutrient production (Herrero et al., 2017).
2) Land productivity is often relatively higher in family farms, inclusive of relatively small-scale units—as is the diversity of production—as posited in the vast literature (FAO, 2014a, pp. 16–17; FAO and Organization for Economic Co-operation and Development [OECD], 2012; Larson et al., 2012; Wiggins, 2009; Lipton, 2006; Sen, 1966). This is largely due to the relative efficiency of family members as labor; their dedication to farming associated with self-belonging, family livelihood and food security; their ability to withstand price slumps; and their knowledge of specific characteristics of landscapes on their farms.
3) Small family farms are better at promoting social equity and community well-being. A primary key rationale for promoting small family farms refers to the acknowledgment that these farms contribute to addressing key challenges associated with equity, poverty, and employment. Unsurprisingly, better opportunities for civic and social engagement have been found in communities dominated by family farms, more attachment to local culture and landscapes, and higher levels of trust within the communities (Pretty & Bharucha, 2014; Donham et al., 2007; Lyson et al., 2001; Jackson-Smith & Gillespie, 2005). On the contrary, models of large-scale industrial farming managed by corporate managers place the interests of local communities at risk (MacCannell, 1988; Lobao & Stofferahn, 2008; Lyson, 2004; Crowley & Roscigno, 2004). Additionally, the positive spillover effects of family farming-generated growth on local rural non-farm sectors have been found to be especially strong (Ngqangweni, 1999; Bautista & Thomas, 1998), eventually eradicating poverty at the national level over the long term.
4) Family farms have several advantages in terms of maintaining environmental sustainability and addressing climate change, as they are generally recognized as environment custodians. They have greater attachment to local communities and landscapes, as well as a higher level of interest and care for both the natural environment and climate, on which they heavily depend for agricultural production. Intricate knowledge pertaining to family labor on farmland and local ecosystems shapes them to be more adaptive to sustainable approaches. Hence, key issues related to intergenerational transfer of natural resources, conventional knowledge, and culture are bound up in family farming systems.

The significant roles of family farmers listed above may efficiently serve as accelerators of progress across key elements of Sustainable Development Goals (SDGs). To eradicate hunger, the role of small family farmers is central, as explicitly stipulated in the focus of SDG target 2.3. It states that "by 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, and family farmers." In addition, small family farmers offer particular advantages over other SDG 2 targets, notably in their contribution to feeding all people, especially those trapped in poverty and most vulnerable to hunger (SDG target 2.1).

Then, small family farmers dominate in local and domestic markets, whereby their produce feeds poor rural and urban residents. Meanwhile, larger industrial farms dominate in export markets. This is seen as less important in providing food for those vulnerable to food insecurity and malnutrition but significant for trade and gross domestic product (GDP) figures.

Identifying the role of family farmers is crucial in meeting the SDG targets. Farm families play a role in promoting healthy nutrition while enhancing nutritional diversity (SGD target 2.2), prioritizing sustainable food production systems, as they are the custodians of land and natural resources (SDG target 2.4), and maintaining agricultural biodiversity by promoting diversity of food and nutrition production systems (SDG target 2.5). Farm families are the key protagonists toward achieving SDG 2.

Nevertheless, family farmers themselves are vulnerable to malnourishment, with more than three-quarters of the world's poor living in rural areas and mostly relying on family farming for their livelihood; thus, it is imperative to invest in and enable this group for it to become stronger (FAO and IFAD, 2019). As key transformational actors, the role of family farmers is not restricted to SDG 2. In SDG 1, family farmers make up a large fraction of the poor themselves while simultaneously creating opportunities to alleviate poverty. Since the benefits of improved livelihood among them flow to wider communities and beyond the agriculture sector, many other interlinked goals are associated with the significant role of small family farming (FAO and IFAD, 2019), inclusive of the following: 1) Key environmental sustainability goals are affected by and affect the livelihoods of family farmers; goals linked with water (SDG 6) and terrestrial ecosystems (SDG 15) are related to the ways family farmers are enabled to access, manage, and use these resources. 2) Family farmers are vital actors in addressing climate change (SDG 13); they operate in some of the most climatically vulnerable regions around the world—in tropical regions, on low-lying coastal plains, and in areas vulnerable to extreme and slow onset weather events; their toil heavily relies on the vagaries of climatic and weather conditions. Within the context of SDG 13 (target 13.1: to "strengthen resilience and adaptive capacity…"), adequate investment is required to enable family farmers to adapt to the increasingly adverse impacts on their production systems. 3) In light of equitable growth, employment, and equality goals (SDGs 8 and 10), family farmers are drivers of equitable and sustainable growth to create employment and bridge inequalities, especially upon realizing the rights of family farmers and in enabling their activities.

Based on the explanation above, the research questions of this study are as follows: How are small family farmers in Indonesia? What challenges are faced by them? What kind of investment is needed to support the farmers? Therefore, this study aims to answer the research question on the description of small family farms in Indonesia, their related challenges, and investments accessible to farmers for food security.

Methods

This paper was compiled based on a literature review of a total of 45 pieces of the literature, consisting of 15 reports from FAO, IFAD, UNICEF, WFP, WHO, E.U., ADB, HLPE, World Bank, as well as statistical data belonging to Statistical Agency or *Badan Pusat Statistik* (BPS), and 30 other studies obtained through Google Scholar. The literature was prepared based on this paper's purpose, using a qualitative approach based on descriptive statistics, an approach for studying family farms through the perspective of sustainability, and rural

development beyond farm activity, including economic, environmental, social aspects.

The essential items that guided this review are small family farms, sustainable food systems, and food security. As mentioned in the introduction, a sustainable food system that supports the farmers will lead to food security. Therefore, exploring the explanation of small family farms in Indonesia and then breaking down what challenges they faced will provide information about what investment to be made to help the farmers achieve food security. We have elaborated the sources above to present the results in tables and graphs and description, following the research questions.

Case study presentation: Small family farms in Indonesia

Based on the projection of the population in 2018, the population of Indonesia was 265,015,300 people with 133,136,100 males and 131,879,200 females. Indonesia is composed of 34 provinces (Figure 1), 514 regencies, 7,240 subdistricts, and 83,706 villages. The population growth rate in Indonesia for 2010–2016 was 1.33% per year, which was lower than 1.49% per year recorded for 2000–2010. The male-to-female gender ratio was 101:100. Figure 1 is the map of Indonesia.

Figure 1. Map of Indonesia

Source: (https://phinemo.com/hari-pangan-sedunia-2018/peta-indonesia-lengkap-dengan-provinsinya-1024x635/)

Agricultural, plantation, livestock and fishery sectors. The BPS (2018) reported that wet farmland in Indonesia was approximately 71,051.45 (km^2) from the total area of 1,916,862,20 (sq.km); covering up to 3.71% of the total area. Wet farmland is used to cultivate paddy, wherein rice is the staple food in Indonesia. Other food crops largely produced in Indonesia are maize, soybean, cassava, and sweet potato. Table 1 lists the harvest area, the productivity, and the production of the listed food crops.

The horticulture sector provides data on vegetables, fruits, and biopharmaceutical products. In 2018, chili pepper recorded the highest harvest area, and its yield was at 2,542,358 tons from 308,547 ha, followed by shallot and cabbage with total production amounts of 1,503,438 tons and 1,407,932 tons from 156,779 and 66,110 ha, respectively. Meanwhile, banana, mango, and orange were fruit commodities with the highest annual production in 2018, as they yielded 7,264,383, 2,624,791, and 2,510,442 tons, respectively. Biopharmaka plants are varied in Indonesia. In 2018, the highest production and harvest area of such medical plants was ginger at 207,411 tons from 10,196 ha.

Table 1. Harvest area, productivity, and production of several commodities in Indonesia in 2018

Food crops	Harvest area (ha)	Productivity (qu/ha)	Production (ton)
Paddy 1	10,903,835	51.85	56,537,774
Rice	10,903,835	29.73	32,419,910

Food crops	Harvest area (ha)	Productivity (qu/ha)	Production (ton)
Maize	5,680,360	53.26	30,253,938
Soybean	723,804	13.17	953,571
Cassava	697,384	231.14	16,119,020
Sweet potato	90,707	199.15	1,806,389

Note: 1 The production is in terms of dry unhusked paddy
Sources: BPS (2019) and FAOSTAT (2019)

The main plantations in Indonesia are oil palm, rubber, coconut, cocoa, coffee, tea, and sugarcane. Based on the data retrieved from BPS, the plantations were divided into large estate crops and smallholder estates. Large estate crops were dominated by oil palm, rubber, and sugarcane. The production of crude palm oil and palm kernel in 2018 was 26,576.4 and 5,313.5 thousand tons. By contrast, the production of rubber and sugarcane was 625.3 and 919.9 thousand tons respectively. Smallholder estates were also dominated by oil palm with a total of 5,811.8 thousand ha in 2018. The production recorded 13,999.0 thousand tons of crude palm oil and 2,800.0 thousand tons of kernel. The second crop was to rubber with a total of 3,005.0 thousand tons production from 3,113.4 thousand ha of planted area. In the third place was coconut, which yielded 2,886.6 thousand tons from 3,113.4 thousand ha of planted area.

In the livestock sector, the highest number of livestock was dominated by goats, sheep, and beef cattle, which recorded 18,720.7, 8,542.7, and 17,050.0 thousand heads, respectively (BPS, 2019). The highest number of meat production was beef cattle (496,302 tons) and pigs (327,215 tons). In the same year, broiler produced more meat (among other kind of poultry) at 2,144,013 tons. As for egg production, layer chickens yielded 1,644,460 tons of eggs, followed by duck eggs (332,401 tons) and native chicken eggs (226,911 tons) (see Table 2).

The last sector was fisheries, whose development is directed at expansion efforts of capturing fisheries and aquaculture. Some activities of capturing fisheries include marine and inland open water fisheries (e.g., rivers, lakes, reservoirs, swamps, and puddles). As for aquaculture, it has many kinds of methods and activities. In 2017, fisheries production reached 23,186,443 tons with their total production value exceeding 384 trillion rupiah.

Table 2. Livestock and poultry population, meat production, and eggs and milk production for 2017 and 2018

No.	Livestock and Poultry	Population (thousand heads)		Meat Production (ton)		Eggs and Milk Production (ton)	
		2017	2018	2017	2018	2017	2018
	Livestock					*Cow's Milk*	
1	Dairy Cattle	540,4	550,1	-	-	928,108	909,638
2	Beef Cattle	16,429,1	17,050,0	486,320	496,302	-	-
3	Buffalo	1,321,9	1,356,4	29,380	31,603	-	-
4	Horse	409,1	421,1	2,742	2,458	-	-
5	Goat	18,208,0	18,720,7	70,354	66,859	-	-
6	Sheep	17,142,5	17,397,9	55,112	48,674	-	-
7	Pig	8,260,9	8,542,7	317,402	327,215	-	-
	Poultry					*Eggs*	
1	Native Chicken	299,701,4	310,960,0	300,129	313,807	221,000	226,911
2	Layer	176,936,9	181,752,4	114,900	116,285	1,506,192	1,644,460
3	Broiler	1,848,731,4	1,891,434,6	2,046,794	2,144,013	-	-
4	Duck	57,557,5	60,011,5	42,319	44,059	337,783	332,401

Source: Modified from BPS (2019)

Small family farming in Indonesia. The classification of farmers in Indonesia varies, as described in the introduction section. For food crop farming, the common classification used is as follows: peasant (farm size below 0.25 ha), small (farm size at 0.25–1.00 ha), medium (farm size at 1.0–2.0 ha), and large (farm size beyond 2.0 ha). For horticulture and estate crop farmers, a different concept is used: small farmers (farm size less than 2.0 ha), medium (farm size at 2.0–5.0 ha), and large (farm size beyond 5.0 ha). The lowest classification of farm field held by a farm household, in accordance with BPS, was less than 0.5 ha (Gurem farmer), whereas most farmers had modest plots at around 0.6 ha, which is considered to be for small family farming.

Table 3 presents the classification of farm size and the number of farm households, wherein 58.73% of the total farm households (16,257,430 households) possessed less than 0.5 ha of farming land. The FAO report in 2018 stated that 93% of all farmers in Indonesia were smallholders. This means that the number of smallholders with family farming held farming land from 0.00 to 2.99 ha.

Based on the cultivated subsector, the agricultural households in Indonesia are divided into several categories as listed in Table 4. Most of the households cultivated livestock (13,561,253 households), paddy (13,155,108), and estate crops (12,074,520). Meanwhile, only 780,037 households relied on capturing fish (see Table 4).

The farming activities are managed by the family, thus predominantly relying on family labor including men, women, and their children. The total agricultural household members were 98,311,908 persons, with 49,529,459 males and 48,782,449 females. From the total 27,682,117 farm households, 2,886,408 females were heads of households (see Table 5).

Table 3. Number of farm households by farm size in 2018

Farm size (ha)	Number of farms
<0.50	16,257.430
0.50–0.99	4,498.332
1.00–1.99	3,905.819
2.00–2.99	1,627.602
3.00–3.99	607.908
4.00–4.99	323.695
5.00–9.99	374.272
≥10	87.059
Total	**27,682.117**

Source: Modified from BPS (2019)

Table 4. Number of Agricultural Households by Cultivated Subsector, 2018

No.	Cultivated Subsector	Agricultural Households
1	Paddy	13,155,108
2	Secondary crops	7,129,401
3	Horticulture crops	10,104,682
4	Estate crops	12,074,520
5	Livestock	13,561,253
6	Aqua culture	863,703
7	Fish capture	780,037
8	Forestry	5,575,214
	Total	**27,682,117**

Source: Modified from BPS (2019)

Table 5. Agricultural headed households and household members by gender in 2018

	Male	Female	Total
Agricultural Headed Households	24,795,709	2,886,408	27,682,117
Household Members	49,529,459	48,782,449	98,311,908

Source: Modified from BPS (2019)

Java is predominant in Indonesia's food production of crops, such as rice and maize, although the amount of land owned by each household in Java is smaller than those in the outer islands. The farm size in Java is approximately a quarter of 1 ha or less per farm household, whereas that in outer islands (e.g., Sumatra) is approximately 1 ha or more for each farm household. Referring to Table 6, 50.53% of farm households in 2018 were situated in Java island, and most of them implemented small family farming. Besides, 50% of each total of male and total of female farmers resided in Java island (see Table 7).

Table 6. Distribution of farm households by farm size in Java and Off-Java in 2018 (%)

Farm size (ha)	Percentage of farms		
	Java	Off-Java	Total
<0.50	40.00	18.72	58.72
0.50–0.99	7.03	9.21	16.24
1.00–1.99	2.64	11.46	14.10
2.00–2.99	0.51	5.36	5.87
3.00–3.99	0.15	2.04	2.19
4.00–4.99	0.06	1.10	1.16
5.00–9.99	0.08	1.26	1.34
≥ 10	0.02	0.28	0.30
Total	**50.53**	**49.47**	**100**

Source: Modified from BPS (2019)

Many native people in the outer islands own larger land areas inherited from their ancestors (Septiani, 2015). Those in Kalimantan are allowed to own more than 1 ha per household as the population in Kalimantan is only 6.17% of the total population of Indonesia, but the size of the island is four-fold larger than Java island with 56.46% of the total population (see Table 8).

Table 7. Number of Farmers by Gender in Java and Off-Java in 2018

Location	Male	Female	Total	%
In Java	12,712,761	4,031,858	16,744,619	50
Off-Java	12,723,717	4,019,470	16,743,187	50
Total	**25,436,478**	**8,051,328**	**33,487,806**	**100**

Source: Modified from BPS (2019)

Table 8. The Five Largest Islands in Indonesia and their Population

No	Name of Island	Size (km²)	Population	(%)
1	Kalimantan	544,150.07	16,209,800	6.17
2	Sumatra	480,793.30	54,168,100	20.44
3	Papua	421,991,20	4,260,000	1.61
4	Sulawesi	188,522.36	19,461,600	7.34
5	Java	129,438.28	149,635,600	56.46

Source: Modified from BPS (2019)

Since small family farms refer to farm households with farming land less than 3 ha, information retrieved from BPS and FAO reports indicated that farm-land size above 3 ha is not regarded as a small family farm anymore. Nevertheless, this standard is inapplicable to all regions or islands, particularly the native farms in Kalimantan and Papua islands. Although they possess more than 3 ha of land per household, they are still considered to be small family farms. Besides, most of the land is cultivated with estate crops or both food and estate crops.

Since half of the country's population resides in rural areas, family farming is the predominant activity in these areas, not only to provide food for Indonesia but also to contribute to the socio-economic, environmental, and cultural roles of the country (Septiani, 2015).

Based on the FAO report (2018), on average, on-farm activities contributed only 49% of the annual income, which is one of the lowest shares for smallholders in Asia, with 47% of the total household income generated from crop production. The occurrence of shocks, such as delay in monsoon rains, can adversely affect agricultural production. This has motivated small family farms to diversify their annual income with non-agricultural sources. However, one-fifth of the family farms in Indonesia were trapped below the national poverty line (FAO, 2018).

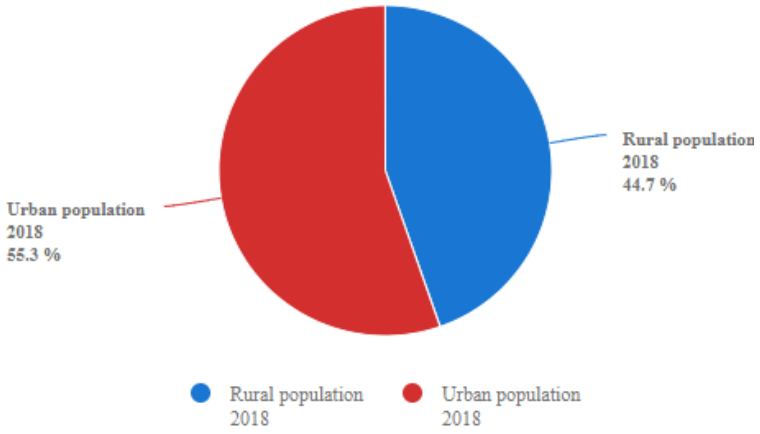

Figure 2. Percentage of the national population (Source: FAOSTAT, 2019)

Table 9 presents the number of family farms based on their main income in 2018. The table indicates that 17,616,298 family farms gained their main income from agriculture, whereas 10,065,819 households generated their main income from non-agricultural sectors.

Table 9. Numbers of agricultural households by main source of income in 2018

No.	Source of Main Income	Number of Agricultural Household
1	Agriculture	17,616,298
2	Non-Agriculture	10,065,819
Total		**27,682,117**

Source: Modified from BPS (2019)

Although the average smallholder farmers partially allocated labor to off-farm activities, agriculture was the most labor-intensive family activity; the share of family labor-days spent on farm (0.78 person days) was higher than that of off-farm income activities (0.24 person days) (FAO, 2018).

Table 10. Smallholder farmer data in Indonesia

Small Family Farms in Indonesia		
Farm Aspects	Average farm size (ha)	0.6
	% of smallholders on total farmers	93
	% of female-headed households	11.3
Income and Poverty	% of income from crops production	47
	% of income from on-farm income	49
	% of income from agricultural wage labor	6
	% of income from non-agricultural and self-employment	30
	% of income from public and private transfers	12
	smallholder poverty rate (national poverty line)	18
Capital and Input	% of household using motorized equipment	9.6
Constraints	% of credit beneficiary households	17
	Distance of household from road (km)	2.3

Source: Modified from FAO (2018)

Results and Discussion

The Challenges of small family farms in Indonesia

Low technology implementation. Despite its vital role in national food production, small family farming faces several difficulties. They often practice without using modern tools or improved seed varieties. Slow technology penetration is one of the many problems. The BPS (2019) revealed that 17.10% of agricultural households used mechanization, and only 10% of smallholders applied high-level mechanization (FAO, 2018). For example, not many farmers in rural areas had access to technology for maize or for rice threshing. Instead, manual threshing was practiced during post-harvest handling, signifying its low efficiency. Threshing machine available in other villages or areas was not sought because of hike in production cost (Septiani, 2015).

Table 11. Percentage of agricultural households by agricultural technology utilization in 2018

No.	Agricultural Technology used	Percentage (%)
1	Mechanization	17.10
2	Non-Mechanization Technology	8.52
3	Both	21.67
4	Not Using Agricultural Technology	52.71
	Total	**100.00**

Source: Modified from BPS (2019)

Access to financial resources. Financing is an integral component in realizing profitable and sustainable agricultural business. However, the accessibility of finance by farmers is a major problem mainly due to lack of information about the wide range of financing schemes that may be accessed by farmers. Besides, financial institutions tend to place the agricultural sector as a less attractive sector because of its high risk stemming from reliance on season and uncertain price guarantees.

The 2016 National Socio-Economic Survey (Susenas) discovered that only 15% of the sample comprising 8,000 farmers had access to bank credit, whereas the majority of 52% relied on their own capital, cooperatives, relatives, and other non-bank financial institutions. Meanwhile, 33% of other farmers depended on credit from the National Community Empowerment Program (PNPM) and people's business credit (KUR). Despite the availability of agricultural business financing schemes, the farming community still faced small-scale control and exploitation of farmers' land, thus limiting the ability of farmers to increase their capital through financing and investment institutions.

The government has provided various financing facilities to ease farmers' access to capital for their farming business. Despite such implementation, targets are still unachieved because it is still difficult for farmers to gain capital assistance. This is noted from the low realization of KUR distribution for the agricultural sector (see Table 12).

Table 12. Realization of KUR of the Agricultural Sector

Year	Realization		
	Amount of KUR	%	Number of debtors
2016	11.90 trillion rupiah	13.99	715,588
2017	17.28 trillion rupiah	17.30	865,552
2018	19.65 trillion rupiah	16.37	894,620
2019	30.40 trillion rupiah	21.71	1,279,058

Source: Modified from Kementan (2019)

The inability of farmers to access formal sources of capital is a result of incomplete credit application procedures and inadequate collateral. The challenge in the future from this condition is collaborating with financing institutions to take sides and be willing to channel their capital to the agricultural sector. Certain programs with simplified access to credit schemes have enhanced the livelihood of farmers. Nevertheless, only 17% of the farmers were the beneficiaries in 2017 and 2018, whereas the figure rose to 21% in 2019. A high share of income spent on food and agricultural inputs can also limit the potential of smallholders to sustainably re-invest their credit amount (FAO, 2018).

Declining farm size. At present, the sustainability of the agricultural-food crop sector is facing a serious threat, as the area of agricultural land continues to shrink because of the massive conversion of productive agricultural land to non-agricultural uses. To date, rice fields are more profitable as real estate, factories, or infrastructure for other industrial activities than for food crops. The paddy fields conversion rate has hit 100 thousand ha per annum, whereas the government produces new paddy fields with a capacity of 40 thousand ha per year. Hence, land conversion is unbalanced with the rate of printing new paddy fields.

Lands once used as paddy fields are now a common sight of housing areas built by developers without proper planning. Such unplanned land conversion is bound to have a direct impact on the low figures of rice production (Septiani, 2015). Approximately 80% of paddy field conversion occurred in the central area of national food production, the Java Island. Its adverse impact on the issue of food security, inevitably, must be addressed with productive land. The Ministry of Agriculture could only support 30 thousand ha of new paddy fields from 2006 to 2013 or an area of 40 thousand ha each year. This indicates that the new paddy fields could not match the rate of conversion of 100 thousand ha of paddy fields per year. One of the reasons is the limited budget the government has. To print 1 ha of a paddy field, at least 30 million rupiah is required. This also depends on the coordination with the regions and other issues, including tenure and land ownership status.

Most of the agricultural lands in Indonesia have experienced a decline in quality, many of which are in the critical category. This is due to excessive use of inorganic chemical fertilizers that causes the soil structure to be dense and decreases the soil bearing capacity for plant growth. Besides, these chemical products, apart from containing materials required by plants, contain harmful chemicals (e.g., chlorine and mercury compounds) for land and living things. In 1992, approximately 18 million ha of land in Indonesia had degraded land quality. In 2002, this area increased to 38.6 million ha (BPS, 2002). If this condition persists, more land will deteriorate and eventually result in decreased productivity of land and crops.

To overcome land degradation, biotechnology products, such as bio-fertilizers and pesticides that contain environment-friendly microbes, should be deployed. The use of

microbes as biological fertilizers offers complete nutrients for plants, increases the activity of soil microorganisms, and enhances soil structure. Meanwhile, the use of biological pesticides can overcome pests and diseases while maintaining a healthy environment.

The total area of national paddy fields in 2018 was 7,105,145 ha or 645,854 ha reduced from the 2013 land area. In 2019, the national paddy field area increased to 7,463,948 ha. Apart from the problem of decreasing land area, another problem related to land is the narrower land ownership possessed by the farmers. The Inter-Census Agricultural Survey (SUTAS) in 2018 reported that the area of agricultural land controlled by agricultural business households less than 0.5 ha had as many as 15.89 million households or 59.07% of the total farmer households. Farm households whose land ownership is less than 0.5 ha increased from 14.62 million households in 2013 to 15.89 million households in 2018. This land ownership condition is caused by (1) increasing conversion of agricultural land to build housing and public facilities, (2) land fragmentation due to inheritance, and (3) sale of paddy land.

Infrastructure and market linkage. One of the agricultural infrastructures that are of great concern is the irrigation network. Limited new reservoirs and irrigation networks, as well as damaged irrigation networks, have greatly decreased irrigation capacity for agricultural purposes. This damage is mainly caused by flooding and erosion, damages to river basins, and lack of maintenance of irrigation to the farm level. Table 13 lists the average land areas held by family farmers by type of land, including irrigation and non-irrigation wetlands.

On top of that, weak infrastructure (e.g., poor access roads and ports) is a major constraint in transporting agricultural products; indicating the missing linkages between input and output markets. Poor linkages prevent vegetable products from being delivered in markets quickly; this refers to market limitation. During the harvest season, farmers face price volatility due to a number of products not absorbable by the limited market. Since the total number of islands in Indonesia exceeds 17,000, as depicted by the Indonesian Naval Hydro-Oceanographic Office (Asian Development Bank [ADB], 2015), it is indeed a challenge to transport food products among the islands.

Table 13. Average of land areas held by agricultural households by type of land (m^2) in 2018

No	Type of Land Area	Land (sq.m)
1	**Agricultural Land**	**7,298.83**
	Wetland	*1,807.97*
	- Irrigation	927,07
	- Non-Irrigation	880,9
	Dryland	*5,490,86*
2	**Non-Agricultural Land**	**492,7**
3	**Average**	**7,791,53**

Source: Modified from BPS (2019)

Briefly, the following amenities are sought: more farm and production roads, ports with air-conditioned warehouses, laboratories and experimental gardens for research, standard and quality-testing service laboratories, quarantine posts and laboratories, seeds and seed breeding gardens, plant health consultation clinics, veterinary services, agricultural information and promotion centers, extension centers, and commodity-specific markets. The challenge here is adequate provision of the entire infrastructure required by farmers to reduce the high costs arising from insufficient transportation and logistics at the production centers of agricultural food crops.

Meanwhile, the problem of livestock distribution is not optimal, as the domestic beef trade system still depends on the inefficient delivery of live cattle. Some noted hindrances are as follows: inadequate number and capacity of transportation means (trucks and ships) and inadequate quality of transportation facilities

(trucks and ships). Besides, not all ports have holding ground for livestock collection and quarantine checks. This condition is further exacerbated by fees imposed during the transportation process starting from the village, subdistrict, district, and province to the destination.

Climate factor. Global climate change is a threat to the agricultural domain as it jeopardizes the sustainability of food security. The impact of climate change is multidimensional (physical and agroecological) on agricultural resources and welfare of farmers. Climate change alters the hydrological cycle in the form of pattern and intensity of rainfall, rising sea levels, and increase in the frequency and intensity of natural disasters that cause flooding and drought. Climate change affects the shifting of planting patterns and calendars, the exploitation of pests and diseases of plants and animals, and the reduction of agricultural yield.

In particular, El Niño (a climate cycle in the Pacific Ocean with a global impact on weather patterns) has an adverse impact on crop yield, especially paddy yield. Increment in temperature by up to 1 °C since 1998 has led to more rainfall with a change of 2%–3% annually. Increased rainfall damages leafy vegetables and enhances the growth of fungi, a pest that damages plants. Agricultural fields along river banks face the threat of flood during the monsoon season. From 2015 to 2019 (see Table 14), the average area of paddy fields affected by flooding and drought was 188,662 ha (52,265 ha were not harvested because of flooding), whereas 255,974 ha were affected by drought (75,246 ha were not harvested because of drought).

Drought and rainy seasons (the rainy season occurs twice a year and lasts for more than a month) typically cause harvest failure. Crop failure in many areas in certain seasons can be due to a wide array of pests and diseases driven by climate change. With accurate monitoring and mitigation, outbreak of certain pests and diseases may be predicted at times, thus the efficient use of tolerant or resistant cultivars. Pesticides and herbicide help to control pests such as fungi. Pest attacks disrupt harvest, limit accessibility to farm input (e.g., seeds), and waste fertilizer.

Table 14. Harvest failure on rice plant due to flood and drought in 2015–2019

Flood and Drought	Year				
	2015 (ha)	2016 (ha)	2017 (ha)	2018 (ha)	2019 (ha)
Flood:					
Affected by flood	129,166	275,004	247,213	153,347	138,632
Failed to harvest	25,496	71,900	72,508	52,175	39,247
Drought:					
Affected by drought	597,202	88,958	78,317	193,130	322,264
Failed to harvest	217,931	8,852	23,714	35,097	90,656

Source: Modified from Kementan, 2019

Some ways of addressing the impacts of global climate change increase the ability of farmers and field officers to forecast climate and take the necessary anticipatory, mitigation, and adaptation measures. Hence, a Climate Field School may be built, a climate information system may be devised, and the planting patterns and calendars may be updated based on characteristics of each region. It is also crucial to create technology that emits low amounts greenhouse gases and is tolerant to heat, drought, flooding/inundation, and salinity.

The vulnerability of paddy farming to climate change has made its production less attractive to smallholders. Encouraging smallholders to diversify, for example, into high-value fruits is imminent to stabilize income and eradicate poverty. In the light of the rapidly increasing population, long-term promotions by the government of Indonesia have fostered the growth of rice production and strengthened the production of other food crops.

Fertilizers and seeds. The increasing rates of fertilizers have boosted production, thus leading to high values of food production per ha

and remarkable productivity per working day when compared to those of other smallholders in Asia, a shift to more intensive crop farming. Nonetheless, the value of annual crop production remains substantially low at USD 573. Smallholder agriculture in Indonesia often lacks improved seed varieties. The availability of fertilizers at affordable prices is vital for the sustainability of small family farming. Despite the fertilizers and seed subsidy programs established by the government, some burdensome regulations caused low impact and even slow to be perceived by farmers. Low assessment of farmer needs is another issue, as farmers receive farming input aid at the wrong time. For instance, some farmers received paddy seed and fertilizer aid during the harvesting period, thus limiting the use of the aid.

Investment for small family farms

Access to financial services, market linkage, and public goods. The investments in small family farms are mostly realized by farmers themselves through, at least, labor investments to improve their resource bases, savings and remittances from family members, to obtain additional resources. Nonetheless, these investments are limited when the farmers face difficulties or when they need to put more priority in some basic expenditure, such as food, health, and education for children. There is a need to reduce or eliminate the constraints faced by small family farms that limit their investment capacity. Thus, they should be first supported to do self-investments, but their capacity to do so depends on other related investments in collective action, private initiatives and public goods. Integrated policies should be implemented, and each policy should support the other. For example, investments in intention or extension for better production should support by appropriate infrastructure and markets. At the same time, simplification of credit or financial support must be in line with the effort of tenure rights investment.

To support small family farm investment, there is an urgent need to improve access to financial services adapted to their needs. This can include facilitating monetary transactions (such as mobile phone-based money transfers), even though this then appears as another challenge in Indonesia, where the government still strives to provide telecommunication network around the country. Safe savings deposit schemes (with incentives to save), low-priced credit (such as through joint-liability group lending), and insurance (such as index-based weather insurance) are also important in the effort to improve farmers' access to financial services. Novel solutions are needed that reduce financial risks, lower transaction costs, and facilitate long-term investments, and, at the same time, liquidity constraints must be relaxed not only on working capital expenditures (fertilizers and seeds) but also on medium- and long-term investments, supported by fair subsidy mechanisms.

Furthermore, small family farms need to get priority in market linkages, domestic, national, and regional markets, as well as direct link between farmers and consumers, and in schemes that rely on small family farms for the procurement of food for school and institutional feeding programs. Investment in SME food processors and small-scale traders at the retail and wholesale levels are also needed in the effort to develop market linkages. As market failures and price volatility are major disincentives for small family farmers' investment, government intervention is important to reduce transaction costs on markets and to stabilize prices and small farmer incomes. Regarding contracting opportunities in value chains, regulatory instruments are needed to bridge the significant gap in economic and political power that exists between small family farmers and their organizations, on the one side, and other contracting organizations, on the other side.

By contrast, to enable their investment efforts, small family farmers need accessible public goods on both the production and consumption sides of the household, where both sides can reinforce each other. On the production side, public investments such as water management facilities and soil conservation are required. At the same time, public investments such as health services, education, water and sanitation, and social protection are needed. By increasing the productivity of labor, these consumption goods strengthen the production side of smallholder operations. To recognize the

differential roles of household members in production, consumption and reproduction of the family unit over time, gender-specific support services are needed, and making sure small family farmers access adequate public goods and services is the responsibility of governments and is essential to securing their well-being and competitiveness.

Improving productivity through research and extension. There is a need to upgrade and finance national research and extension systems targeted at the needs of small family farms, so as to devise viable financial aid mechanisms. Increasing productivity and resilience through diversification of the production system should be the main object, with high nutrition value as a concern for self-provision of diverse foods. Increasing productivity and resilience concurrently demands a certain level of investment in research to develop productive land-use systems. It then should support small family farms to enhance their productivity with minimal ecological risk, where biodiversity may be used productively and conserved. The research and extension have to include and support *in situ* and *ex situ* conservation of agricultural biodiversity in the context of climate change. Small family farmers need proper seeds, appropriate machinery for farming operation, food processing, and other value-adding transformations.

The government should support agricultural extension workers together with the agriculture research center installed in every region to conduct more research in the local context to realize local food security. Besides, wider collaboration and sharing of experiences in technology development for small family farmers in different regencies and provinces or even across countries in certain regions of the world, such as Southeast Asia or Asia Pacific, should be promoted with a strong engagement, if not leadership, of small family farmer organizations.

Investing beyond the farm: rural non-farm economy and territorial development. Small family farmers in Indonesia tend to diversify their crops with food and cash crops for self-consumption and for sales to increase their income. However, they are likely to complement their annual farm income with non-agricultural sources or self-employment. To escape poverty and malnutrition, small family farmers often need access to complementary sources of income in the rural non-farm economy. The non-agricultural activities could derive from local sources, as Asfaw et al. (2017) explained in their research in Ethiopia, such as producing and selling handcrafts of any type, selling fuel-wood, causal daily labor, selling local beverage, and other activities. In their research in India, Chakraborty and Roy (2016) classified non-farm activities as a household industry, non-household industry, construction, trade, transport, and other services. It could also be in an agro-tourism activity, which provides local custom experiences to visitors, including homestay facilities, local ceremonies for visitors, traditional clothes, local foods, local games, and other services.

This calls for innovation investment to create successful rural non-farm employment linked with farm economy that supports on-farm investments. Such effort demands investment to support the rural non-farm economy and the decentralization of economic activity toward rural areas. Investment must be made in the qualifications of young people, to support them in creating or seeking employment either in modernized agriculture or in other related activities and labor markets. Territorial development serves as an effective platform to gather public and private investments in agriculture and in the area of non-farm economy. This eventually increases employment, income, and local food security.

In providing an extensive market for agriculture and small family farmers, as well as the need for harmonious public and private investments and programs in a territorial perspective, appropriate governance is sought. Governance for agriculture and territorial development requires cross-sectoral local government, ministry, and other government agencies to devise solutions tailored to local and national political and institutional contexts. To gain appropriate input for investment in small family farmers, governments need to better document the evolution of small family farms and its contributions to various outcomes. These outcomes include measurement of non-market food production and diversity of diets. National

agricultural statistical data and data collected in other efforts should be harmonized to strengthen the evidence for investment decisions.

Conclusion

Small family farms are the most significant contributor to meeting food needs both nationally and globally. However, they experience many obstacles in farming activities such that even though they are economically active, many of them witness and experience poverty and food insecurity at the same time. In general, they invest independently, but with all the limitations that exist, this self-investment is very far from what is needed; it requires great attention from many parties, both from the government, the private sector, and universities. In other words, investment is necessary to encourage small family farms to contribute appropriately, whether to their families, communities, nations, or regions or to the global economy. Thus, small family farms will also play a role in accelerating various vital elements of the SDGs.

Some points that must be underlined from our case study in Indonesia areas follows: First, the government's role and responsibility for accessibility of finance, market access, and access to public services for farmers are crucial, given the limited investment made by the private sector. Second, there must be broader collaboration at the local, national, and even regional and global levels. Therefore, sharing of information and experiences and increasing skills can be duplicated from one place to another. Third, there must be proper governance, which can accommodate public and private investment so that it does not overlap, and the available investments or programs can be distributed maximally. Next, cross-sectoral cooperation is urgently needed, such as between ministries and other government agencies and between central and regional governments. The last point is the need for harmonious, comprehensive, and evolutive data. Suppose all of these things can be done. In that case, the investment policies/programs that are planned and implemented will undoubtedly be more targeted, fast, and beneficial, both for small family farms and the broader community, in the context of realizing food security.

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