Measurement of Sustainable Agriculture at Household Level: Results of Indonesian Agriculture Integrated Survey (AGRIS) Pilot

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Abstract. This study aims to measure and analyzes the level of agricultural sustainability at the household level using the results of the Integrated Agricultural Survey (AGRIS) pilot conducted by Statistics Indonesia in 2020. Applying descriptive analysis on the computation results of eleven sub-indicators of the SDGs 2.4.1 indicator at the household level, we analyzed the proportion of agricultural households categorized as sustainable and unsustainable for each corresponding sub-indicator of sustainability. We also estimated the average land area managed by agricultural households for each category in each sub-indicators. We found that most agricultural households in West Java, East Java and West Nusa Tenggara are categorized as unsustainable in agricultural practices regarding land productivity. The proportion of households practising unsustainable agriculture are also quite large regarding fertilizer use and decent employment. We also found that less land productivity and poor management of fertilizer use are the phenomena of a relatively large scale farm.

1. Introduction

Sustainable agriculture is one of the strategic issues in the Sustainable Development Goals (SDGs). The population that continues to grow makes the demand for food also increase, posing pressure on the supply side. It was translated into extending measures to boost food production. Sometimes, agricultural development is considered to only focus on increasing output without paying attention to the impact on the environmental ecosystems and soil quality. As a result, it could lead to food scarcity and insecurity in the future, putting the sustainability of food production under threat.

"Sustainable Agriculture" is the development of agricultural systems focused on the goal of developing agricultural technologies and enterprises that: (i) have no adverse effect on the environment (this is because the environment is an important asset for agriculture); (ii) are accessible and effective for farmers; and (iii) lead to increased food productivity and have a positive impact on environmental goods and services. Sustainability in agricultural systems combines the concepts of resilience (system capacity to withstand shocks and pressure) and sustainability (system capacity to continue over a long period of time), and discusses more broadly its impact on the economy, social and environment [1]. In the SDGs, agricultural development is contained in Goal 2: Zero Hunger, namely "Eliminating hunger, achieving food security and good nutrition, and promoting sustainable agriculture". Furthermore, the "Sustainable Agriculture" system is expected to be realized by achieving Target 2.4 in the SDGs, i.e."by 2030 ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for

adaptation to climate change, extreme weather, drought, flooding and other disasters, and that progressively improve land and soil quality" [2].

Measurement of sustainable agriculture through various indicators is needed to monitor the achievement of the target, particularly to see whether the current agricultural system implemented is sustainable or not. Therefore, one can determine whether the existing agricultural practices already reflect sustainable agriculture or further efforts may be necessary to promote sustainable agriculture. They also can equip policymakers in determining policies to be implemented to achieve the target. However, the measurement tools for sustainable agriculture that are currently being developed tend to not include farmers in their interpretation and focus more on measuring at the spatial and temporal levels [3]. At the same time, farmers/agricultural households are a fundamental element in achieving a sustainable agricultural system. Therefore, the measurement of indicators of sustainable agriculture at the farm household level is vital.

Various methods to measure sustainable agriculture have been developed in recent decades. One of the methods developed by FAO is the Sustainability Assessment of Food and Agriculture Systems (SAFA). In the SAFA guidelines, the measurement of sustainable agriculture is carried out based on three or four levels of the hierarchy, with “Dimensions” as the main pillar and the highest level and the most general level to describe sustainability. Furthermore, the universal sustainability goals are translated into “Themes” (and in some cases, made more explicit into “Sub-Themes”). The lowest level of sustainability measurement is an indicator in the form of a measurable variable to evaluate the sustainability performance of the related “Theme” or “Sub-Theme” [4]. The SAFA method uses three main dimensions to measure sustainability at the smallest scale (farmer households), namely Economic, Social, and Environmental.

Another method developed to measure sustainable agriculture at the farmer/household level is the Agricultural Sustainability Indicator (Indicateurs de Durabilité des Exploitations Agricoles/IDEA). The IDEA method defines the concept of sustainable agriculture by (i) involving viability, in the economic concept, namely the efficiency of the production system and securing sources of income in the agricultural production system in the face of market changes and uncertain sources of funding; (ii) livability, focusing on analyzing whether agricultural activities provide a decent life for farmers and their families; and (iii) the environmental reproducibility of ecosystems related to agriculture that can be analyzed using agro-environmental indicators, particularly those that characterize the impact of agricultural practices on the environment [5]. The IDEA method uses three scales, ten components, and 41 indicators to answer 16 objectives that describe sustainable agriculture.

Other methods also used to measure agricultural sustainability at both the macro (country, spatial) and micros (farmer/household) levels are the Public Goods Tool (PG) developed by [6] and Response-Inducing Sustainability Evaluation 2.0 (RISE) set by [7]. These methods use various indicators to measure three main dimensions, namely Economic, Social, and Environmental. In this regard, the FAO developed a method by computing the SDGs 2.4.1 indicator, which contains the three dimensions. The indicator is described more specifically into 11 themes [8]. The measurement of the SDGs 2.4.1 indicator to see the level of agricultural sustainability is carried out on a macro (spatial/area) level, whereas the measurement of the level of agricultural sustainability at the farmer/household level is no less critical.

The SDGs 2.4.1 indicator is designed to measure the extent to which a more productive and sustainable food production system is implemented. It is expected to provide strategic information for policymakers through the three dimensions of sustainability, namely economy, social and environment [9]. On a macro basis, the SDGs 2.4.1 indicator is formulated by proportioning agricultural land managed with a productive and sustainable agricultural system to the total area of agricultural land. The World Food and Agriculture Organization (FAO) recommends primary data collection through a stand-alone agricultural survey or as a part of other surveys to measure these indicators. Currently, in the Indonesian context, there is no survey dedicated to collecting data to compute the SDGs 2.4.1 indicator. Therefore, the Central Statistics Agency (BPS) conducted a pilot of the Integrated Agricultural Survey (AGRIS) in 2020. The survey aims to collect data for the farm-based SDG indicators computation, including the 2.4.1 indicator. The report of the results of the pilot has been disseminated [10]. However, the measurement of agricultural sustainability presented in the report, through the 2.4.1 indicator, is a

macro (regional/spatial) perspective. The results do not provide a micro picture of farm households perspective.

This study aims to measure and analyze the level of agricultural sustainability at the household level. It wants to see to what extent sustainable agriculture has been applied by agricultural households using the results of the AGRIS pilot. This study analyzes the sustainability of agricultural practices at the household level in the three provinces, namely West Java, East Java and West Nusa Tenggara. The three provinces were selected as the pilot location since their agricultural activities variability, and the total number of agricultural households in the three provinces accounted for 33 per cent of the total agricultural households in Indonesia [11].

2. Methodology

The unit of analysis in this study is the agricultural households in West Java, East Java and West Nusa Tenggara, the locations of the pilot. The AGRIS field data collection was carried out in October 2020 by enumerating 1,137 agricultural household samples in the three provinces. The results of the survey were used to compute eleven sub-indicators of the SDGs 2.4.1 indicator at the household level. A descriptive analysis was applied to the computation results of the proportion of agricultural households categorized as sustainable and unsustainable for each corresponding sub-indicator of sustainability. Applying survey weights, we also estimated the average land area managed by agricultural households for each category in each sub-indicators.

The use of household-based survey results in the computation allows us to analyze the sustainable agriculture practices at the household level. The method for 2.4.1 SDG indicator was developed by FAO and consisted of three main dimensions, namely Economic, Environmental, and Social and is more translated explicitly into 11 themes and is measured through 11 sub-indicators that represent each of these themes (Table 1). The measurement of "Sustainable Agriculture" with SDGs 2.4.1 indicator refers to the Sustainable Food and Agriculture (SFA) approach, which is described in five main principles, namely; (i) increased productivity, employment and added value in the food system; (ii) protect and improve the quality of natural resources; (iii) improve livelihoods and promote inclusive economic growth; (iv) increase resilience in communities, communities and ecosystems; and (v) adapting governance to new challenges. This measurement method puts people at the centre, focuses on the efficient use of economic resources and environmental protection.

FAO also describes the criteria and thresholds to assessing the level of agricultural sustainability of the 11 sub-indicators. The sustainability status for the 11 sub-indicators will be presented in three spectrums, namely Desirable, Acceptable, and Unsustainable. These criteria and thresholds are described in Table 1.

Table 1. Dimension, theme, and sub-indicators of sustainability measurement for SDGs 2.4.1indicator

Dimension	Theme	Sub-indicator
Economy	1. Land productivity	Farm output value per hectare
	2. Profitability	Net farm income
	3. Resilience	Risk mitigation mechanisms
Environment	4. Soil health	Prevalence of soil degradation
	5. Water use	Variation in water availability
	6. Fertilizer pollution risk	Management of fertilizers
	7. Pesticide risk	Management of pesticides
	8. Biodiversity	Use of agro-biodiversity-supportive practices
Social	9. Decent employment	Wage rate in agriculture
	10. Food security	Food Insecurity Experience Scale (FIES)
	11. Land tenure	Secure tenure rights to land

Source: FAO, 2019

Following FAO (2019), the definition of each sub-indicators are as follows:

1. **Farm output value per hectare** or agricultural production per hectare is a measure of the level of agricultural productivity per hectare. Production per hectare comes from all agricultural outputs, such as crop production, livestock yields, or a combination of both. Since yields are not always measured in the same unit, the calculation of production per hectare is presented in Local Currency Units (LCU), so it is necessary to multiply it by the average price to obtain production in Rupiah.
2. **Net farm income** refers to the profit earned by farmers over the last three years. The profit is the net profit from agricultural activities, excluding activities outside the agricultural sector carried out by agricultural households (e.g. business activities in the tourism sector, etc.).
3. **Risk mitigation mechanisms** is based on handling agricultural business risks, seen from access to credit and insurance, and agricultural diversification (the share of single agricultural commodities is not greater than 60 per cent of the total production value owned by agricultural business units).
4. **Prevalence of soil degradation** focuses on four main threats that can cause soil degradation: soil erosion, decreased soil fertility, salinization of irrigated land, and soil saturation by water (waterlogging).
5. **Variation in water availability** is seen from the awareness and practice of farmers concerning water scarcity. These awareness and practice are expressed in: (a) whether farmers use water to irrigate at least 10 per cent of the agricultural area and why; (b) whether farmers are aware of the problem of water availability in agricultural land and pay attention to the reduction of water availability from time to time; (c) is there any organization (irrigation agency, others) responsible for allocating water between users and the extent to which the organization is working effectively.
6. **Management of fertilizer** refers to the practice and awareness of farmers in the use of fertilizers and their impact on the environment. The management steps taken are: (i) following the protocol or instructions for use and not exceeding the recommended dose; (ii) using synthetic/mineral fertilizers in combination with organic/compost fertilizers; (iii) using legumes as ground cover or components of multi-crop systems to reduce fertilizer use; (iv) recycling of organic material for use as fertilizer; (v) regulation of the use of fertilizers evenly throughout the growing period of plants; (vi) consider the type of soil and climate in determining the dose and frequency of fertilizer application; (vii) measuring soil nutrients regularly through soil samples, and (viii) undertake site-specific nutrition management or precision agriculture.
7. **Management of pesticide** is guided by several steps, namely steps related to health: (i) Adherence to recommendations for the method and dosage of pesticides use on the packaging label, including the use of personal protective equipment when using pesticides; (ii) dispose of used pesticide waste (packages, bottles, etc.) safely. Environmental measures: (i) Use of pesticides according to the recommended instructions; (ii) implementing good planting patterns (planting time, spacing, crop rotation, etc.) to reduce pest threats; (iii) controlling pests with biopesticides; (iv) apply pasture rotation to suppress livestock pests; (v) systematically remove plant parts that are infested with pests; (vi) use one type of pesticide no more than twice a season, to avoid resistance to pesticides; (vii) cleaning machines and equipment regularly to reduce the spread of pests.
8. **Use of agro-biodiversity-supportive practices** refers to several things, namely: (i) leaving at least 10 per cent of agricultural land for natural vegetation/ecosystems; (ii) farmers produce certified organic agricultural products; (iii) not using synthetic pesticides, not buying more than 50 per cent of animal feed, and not using antimicrobials as growth promoters; (iv) there is agricultural production derived from at least two things from {a) crops/grasslands; b) trees/tree products, c) livestock/animal products, d) fish}; (v) crop rotation/grassland practice involving at least three crops on at least 80 per cent of the farmland; and (vi) livestock have locally adapted breeds or breeds at risk of extinction.
9. **Wage rate in agriculture** is measured by the daily wage rate of unskilled labour in the agricultural sector, which is calculated in LCU (Rupiah).
10. **Food Insecurity Experience Scale (FIES)** is a measure of the severity of food insecurity experienced by individuals or households based on their perceptions.

11. **Secure tenure rights to land** refer to the ownership of formal documents in the name of a person or another person and the matter of selling or bequeathing the agricultural land.

Table 2. Dimension, theme, and sub-indicator measuremnet of sustainability level SDG indicator 2.4.1

Sub-indicator	Desirable	Acceptable	Unsustainable
Farm output value per hectare	Sub-indicator value is ≥ 2/3 of the corresponding 90th percentile	Sub-indicator value is ≥ 1/3 and < 2/3 of the corresponding 90th percentile	Sub-indicator value is < 1/3 of the corresponding 90th percentile
Net farm income	NFI is above zero for the past 3 consecutive years	NFI is above zero for at least 1 of the past 3 consecutive years	below zero for all of the past 3 consecutive years
Risk mitigation mechanisms	Access to or availed at least two of the above-listed mitigation mechanisms	Access to or availed at least one of the above-listed mitigation mechanisms.	No access to the listed mitigation mechanisms.
Prevalence of soil degradation	The combined area affected by any of the four selected threats to soil health is negligible (less than 10 per cent of the total agriculture area of the farm).	The combined area affected by any of the four selected threats to soil health is between 10 per cent and 50 per cent of the total agriculture area of the farm.	The combined area affected by any of the four selected threats to soil health is above 50 per cent of the total agriculture area of the farm.
Variation in water availability	Water availability remains stable over the years, for farms irrigating crops on more than 10 per cent of the agriculture area of the farm. Default result for farms irrigating less than 10 per cent of their agricultural area	The farm uses water to irrigate crops on at least 10 per cent of the agriculture area of the farm, does not know whether water availability remains stable over the years, or experiences reduction on water availability over the years, but there is an organization that effectively allocates water among users.	in all other cases.
Management of fertilizers	The farm takes specific measures to mitigate environmental risks (at least four from the list in FAO (2019)). Default result for farms not using fertilizers	the farm uses fertilizers and takes at least two measures from the list in FAO (2019) to mitigate environmental risks	farmer uses fertilizer and does not take any of the specific measures in FAO (2019) to mitigate environmental risks associated with their use.
Management of pesticides	The farm uses only moderately or slightly hazardous pesticides (WHO Class II or III). In this case, it adheres to all three health-related measures and at least four of the environment-related measures. Default result for farms not using pesticides.	The farm uses only moderately or slightly hazardous pesticides (WHO Class II or III) and takes some measures to mitigate environmental and health risks (at least two from each of the lists above)	The farm uses highly or extremely hazardous pesticides (WHO Class Ia or Ib), illegal pesticides, or uses moderately or slightly hazardous pesticides without taking specific measures to mitigate environmental or health risks associated with their use (fewer than two from any of the two lists above).

Sub-indicator	Desirable	Acceptable	Unsustainable
Use of agro-biodiversity-supportive practices	Farmers applied at least two of the six sustainable agriculture criteria (organic farm) or two form sustainable criteria (non-organic farm) in FAO (2019).	Farmers applied at least two of the six sustainable agriculture criteria (organic farm) or one form sustainable criteria (non-organic farm) in FAO (2019).	farmer uses fertilizer and does not take any of the specific measures in FAO (2019) to mitigate environmental risks associated with their use.
Wage rate in agriculture	If the wage rate paid to unskilled labour is above the minimum national wage rate or minimum agricultural sector wage rate.	if the wage rate paid to unskilled labour is equals to the minimum national wage rate or minimum agricultural sector wage rate.	if the wage rate paid to unskilled labour is below the minimum national wage rate or minimum agricultural sector wage rate.
Food Insecurity Experience Scale (FIES)	Mild food insecurity	Moderate food insecurity	Severe food insecurity
Secure tenure rights to land	has a formal document with the name of the holder/holding on it, or has the right to sell any of the parcel of the holding, or has the right to bequeath any of the parcel of the holding	has a formal document even if the name of the holder/holding is not on it	Has no a formal document with the name of the holder/holding on it, and has no the right to sell any of the parcel of the holding, and has no the right to bequeath any of the parcel of the holding

Source: FAO, 2019

Under SDG 2.4.1 indicator, each sub-indicator evaluates the sustainability equally and independently. It implies that a sub-indicator with the highest proportion of households assigned to unsustainable status will be the reference to draw the conclusion about the proportion of agricultural households that do not meet the standard of productive and sustainable agriculture.

3. Discussion

3.1. Farm output value per hectare

Reagarding sub-indicator 1, most agricultural households in West Java, East Java and West Nusa Tenggara province are unsustainable. The percentage of agricultural households categorized as unsustainable in terms of land productivity for the three provinces are 65.50 per cent, 76.86 per cent, and 82,49 per cent, respectively. Moreover, about 13.31 per cent of agricultural households in West Java and around 16.19 per cent in East Java have agricultural land productivity classified as sustainable. Meanwhile, agricultural households whose agricultural land productivity is sustainable only make up around 3.39 per cent of the total agricultural households in West Nusa Tenggara. Some households were not classified due to partial non-responses on corresponding questions for the computation of sub-indicator 1.

The average agricultural land managed by agricultural households with sustainable agricultural status in terms of land productivity tends to be smaller than those with unsustainable status (Table 3). This condition indicates that agricultural land productivity has not been optimized among farmers with a large scale of farms.

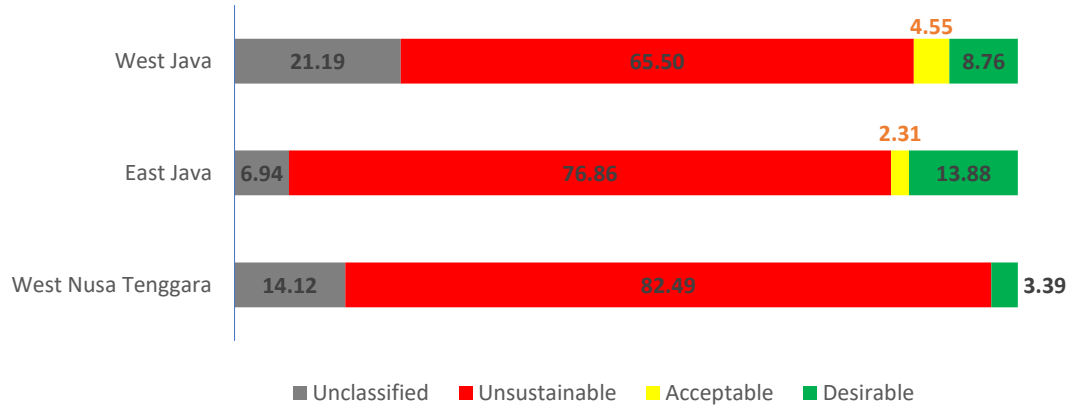

Figure 1. Percentage of agricultural households by agricultural sustainability status (%) – Sub-indicator 1 (farm output value per hectare)

Table 3. Average of agricultural land area hold by agricultural household by sustainability status (m^2) – Sub-indicator 1 (farm output value per hectare)

Province	Desirable	Acceptable	Unsustainable
West Java	3,003.91	2,376.65	3,874.66
East Java	1,548.77	814.33	4,038.67
West Nusa Tenggara	4,666.67	-	12,241.29

The estimation results that most farmers, with unsustainable status, have the highest average of agricultural land area at the same time imply that most agricultural land area in the three provinces are cultivated not under the standards of productive and sustainable agricultural management.

3.2. Net farm income

Based on the net income of agricultural households in the last three years, more than 80 per cent of agricultural households in the three provinces are categorized as sustainable. In more detail, the percentages are 95.97 per cent in West Java, 87.66 per cent in Java East and 90.96 per cent in West Nusa Tenggara. Meanwhile, less than 20 per cent of the rest have unsustainable agricultural status. In West Java, only about 4.03 per cent of agricultural households are classified as unsustainable agriculture in terms of the net income they have received in the last three years. The same applies to West Nusa Tenggara, where about 9.04 per cent of agricultural households are categorized as unsustainable.

The average agricultural land managed by sustainable agricultural households in terms of net income received is relatively larger than that of agricultural households with unsustainable status (Table 4). Agricultural households with narrow lands usually only manage their agricultural land for their consumption, so they are suspected to be less focused on making profits.

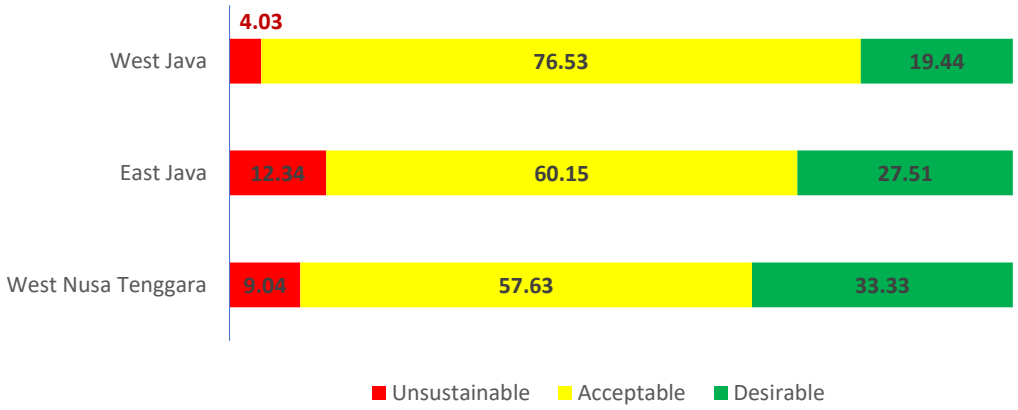

Figure 2. Percentage of agricultural households by sustainability status (%) – Sub-indicator 2 (net income of farmers)

Table 4. Average of agricultural land area hold by agricultural households by sustainability status (m^2) – Sub-indicator 2 (net income of farmers)

Province	Desirable	Acceptable	Unsustainable
West Java	4,806.36	3,667.17	2,557.92
East Java	5,712.25	3,025.91	751.65
West Nusa Tenggara	9,557.58	12,398.76	5,831.25

3.3. Risk mitigation mechanism

Extreme weather and pest attacks usually pose a threat to agricultural households in managing their agricultural land. It is not uncommon for farmers to experience crop failure due to floods, droughts, or severe pest attacks. If this condition occurs, then the agricultural households must have a way to cover the losses experienced. In this case, risk mitigation in the agricultural business is essential. Based on the risk mitigation mechanism implemented by agricultural households, most of them are classified as sustainable agriculture. While the rest, who are 2.45 per cent agricultural households in West Java, 9.51 per cent in East Java, and 18.64 per cent in West Nusa Tenggara, did not apply risk mitigation mechanisms so that they were classified as unsustainable agriculture.

The average area of agricultural land owned by agricultural households with sustainable agricultural status in sub-indicator 3 tends to be larger than unsustainable agricultural households, except in East Java (Table 5). It indicates that farming households in East Java with relatively narrow land areas are more concerned with risk mitigation mechanisms in their agricultural management than agricultural households with larger land areas.

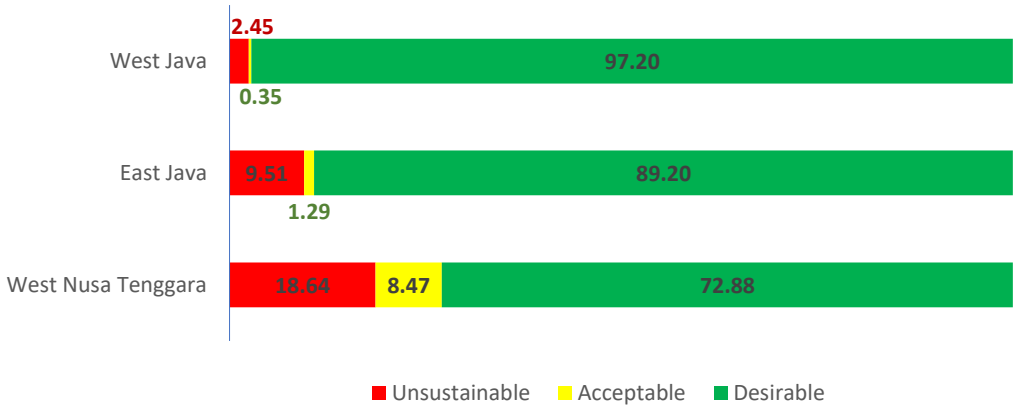

Figure 3. Percentage of agricultural households by sustainability status (%) – Sub-indicator 3 (risk mitigation mechanism)

Table 5. Average agricultural land area by sustainability status (m^2) – Sub-indicator 3 (risk mitigation mechanism)

Province	Desirable	Acceptable	Unsustainable
West Java	3,885.69	1,410.00	2,536.84
East Java	3,433.47	2,077.60	4,150.00
West Nusa Tenggara	10,609.66	18,900.60	8,173.21

3.4. Prevalence of soil degradation

In terms of soil degradation (sub-indicator 4), more than 90 per cent of agricultural households in West Java, East Java, and West Nusa Tenggara are in sustainable agriculture status, as seen from the measurement of the prevalence of degradation of managed agricultural land. Moreover, around 3-9 per cent of agricultural households in East Java and West Nusa Tenggara are classified as unsustainable agriculture. Only 3.68 per cent of agricultural households in West Java are unsustainable agriculture in terms of soil degradation.

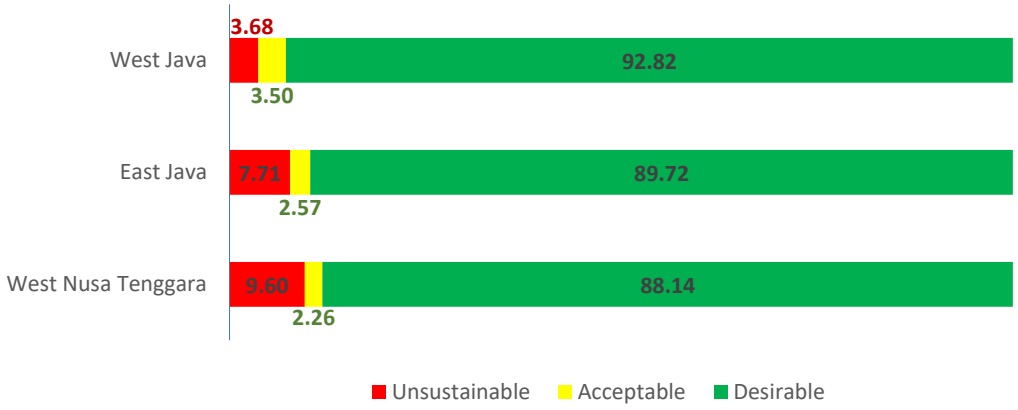

Figure 4. Percentage of agricultural households by sustainability status (%) – Sub-indicator 4 (soil degradation prevalence)

Based on Table 6, agricultural households with sustainable agriculture practices in terms of soil degradation prevalence tend to have a larger area of agricultural land than farm households with unsustainable agricultural status. In other words, it is a strong indication that small-scale agricultural

households are prone to soil degradation. Therefore, knowledge about the causes and preventions of soil degradation needs to be emphasized more to small-scale farming households.

Table 6. Average of agricultural land area by sustainability status (m^2) – Sub-indicator 4 (soil degradation prevalance)

Province	Desirable	Acceptable	Unsustainable
West Java	3,953.60	3,187.55	1,701.62
East Java	3,469.21	4,515.30	3,314.88
West Nusa Tenggara	11,524.17	6,250.00	5,829.41

3.5. Variation in water availiability

Most agricultural households in the three provinces of the AGRIS pilot project are sustainable for water availability. Around 88.44 per cent of agricultural households in West Java, 90.49 per cent in East Java, and 89.27 per cent in West Nusa Tenggara manage agricultural land with sufficient water supply to irrigate at least 10 per cent or more of their agricultural land, and some organizations or institutions manage the distribution of water to users on the agricultural land.

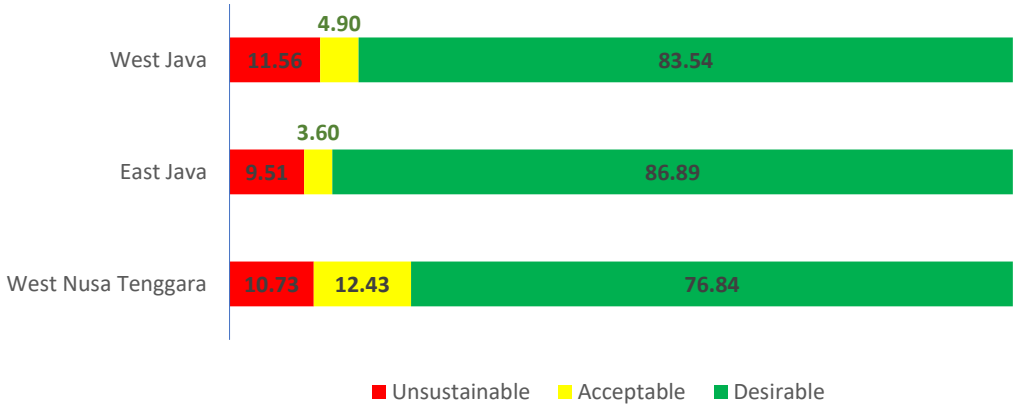

Figure 5. Percentage of agricultural households by sustainability status (%) – Sub-indicator 5 (water availability)

The average area of agricultural land managed by agricultural households in unsustainable agricultural status for sub-indicator of water availability tends to be smaller than agricultural households classified as sustainable agriculture. Therefore, to increase the number of agricultural households with sustainable agriculture status, it is necessary to pay more attention to the water availability for small-scale agriculture. In that regard, regular and fair distribution of irrigation can be one of the solutions. The addition of irrigation canals and other water sources is also considered necessary.

Table 7. Average of agricultural land hold by agricultural houesholds by sustainability status (m^2) – Sub-indicator 5 (water availiability)

Province	Desirable	Acceptable	Unsustainable
West Java	3,971.59	2,896.86	3,323.17
East Java	3,604.27	2,283.43	2,841.64
West Nusa Tenggara	11,280.75	11,980.82	6,532.16

3.6. Managemet of fertilizer

More than 50 per cent of agricultural households in West Java and East Java are unsustainable in terms of fertilizer management. Furthermore, around 70.62 per cent of agricultural households in West Nusa Tenggara are unsustainable. It indicates that the management of fertilizer use by agricultural households in the three provinces is insufficient. Considering that the use of chemical fertilizers has an unfavourable impact on the environment, several management measures to mitigate the risk of the adverse effects of fertilizers on environmental quality need to be emphasized. It could be done through agricultural training to provide knowledge to farm households regarding the negative impact of excessive use of fertilizers and other measures to prevent it.

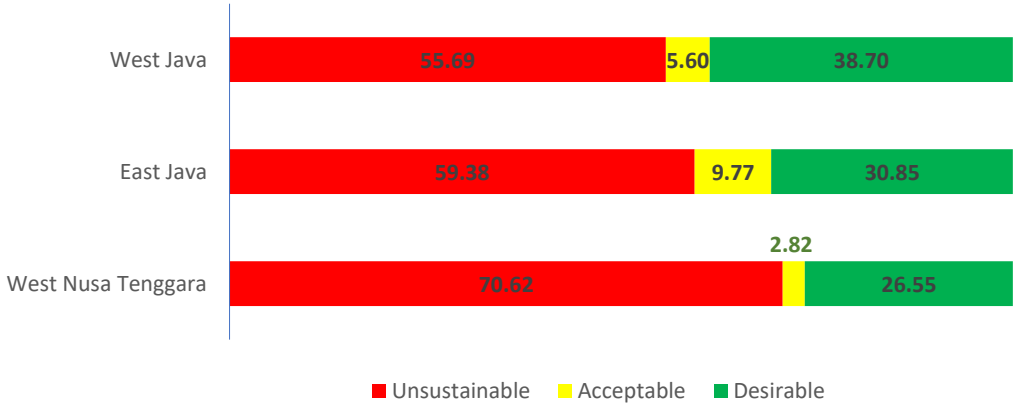

Figure 6. Percentage of agricultural households by sustainability status (%) – Sub-indicator 6 (fertilizer use management)

Table 8 shows that, on average, agricultural households with unsustainable farming status have a larger area of agricultural land than agricultural households classified as sustainable agriculture. It is presumably because agricultural households with a relatively large area of agricultural land focus more on increasing agricultural output but pay less attention to the negative impact of fertilizer use on environmental quality.

Table 8. Average of agricultural land hold by agricultural households by sustainability status (m^2) – Sub-indicator 6 (fertilizer use management)

Province	Desirable	Acceptable	Unsustainable
West Java	3,854.04	3,598.52	3,861.63
East Java	2,143.36	4,293.29	4,047.63
West Nusa Tenggara	15,327.81	8,320.00	9,278.91

3.7. Managemet of pesticide

When it comes to the management of pesticide use, more than 90 per cent of agricultural households in West Java, East Java, and West Nusa Tenggara have used pesticides according to recommendations for proper use for the environment and health are classified in sustainable agriculture. Only 0.26 per cent of agricultural households in East Java are still classified as unsustainable agriculture.

Sustainable agriculture households in the three provinces at the "Desirable" level tend to have a relatively smaller land area than other sustainability statuses. It is presumably because agricultural households with narrow land can manage pest attacks naturally. Therefore, the use of pesticides can be minimized or even not using chemical pesticides at all. For East Java, in addition to the tiny percentage of unsustainable farming households, the agricultural land managed by unsustainable agricultural

households is also minimal. So, it can be concluded that the management of pesticide use by agricultural households in East Java is quite good (Table 9).

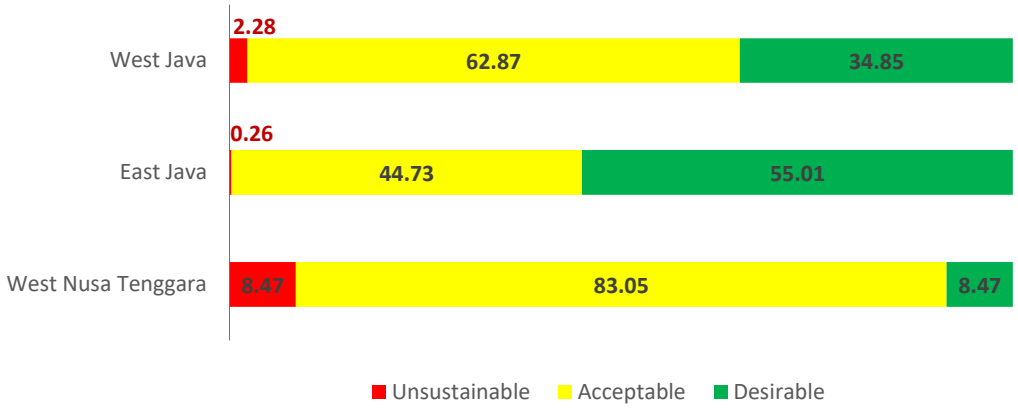

Figure 7. Percentage of agricultural households by sustainability status (%) – Sub-indicator 7 (pesticide use management)

Table 9. Average of agricultural land area hold by agricultural households by sustainability status (m^2) – Sub-indicator 7 (pesticide use management)

Province	Desirable	Acceptable	Unsustainable
West Java	3,500.23	4,049.84	3,419.58
East Java	3,157.40	3,903.62	440.00
West Nusa Tenggara	7,212.53	11,271.31	10,453.33

3.8. Use of agro-biodiversity-supportive practice

Based on the practice of supporting the use of biodiversity, almost all agricultural households in the three provinces of the AGRIS pilot have implemented a biodiversity-based farming system so that they are classified as sustainable. The percentage of agricultural households practicing unsustainable agriculture is relatively tiny. Even in West Java, it is only around 0.18 per cent. Indonesian agricultural households tend to apply crop rotation, use local seeds, carry out agricultural activities in several sub-sectors at once, and apply intercropping cropping patterns. Therefore, in terms of biodiversity, agricultural households in Indonesia tend to be classified as sustainable agriculture.

On average, that relatively small percentage of unsustainable agricultural households manages a relatively larger area of agricultural land than sustainable agricultural households. One reason is that agricultural households that manage large land areas tend to focus on increasing crop production and using more chemical products in crop cultivation practices to obtain greater agricultural output. Meanwhile, small-scale farmers usually apply various patterns and types of crops to get more output.

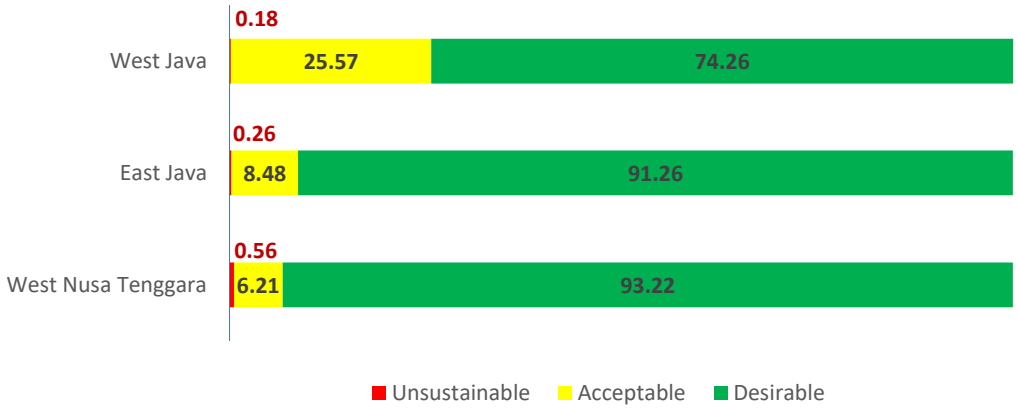

Figure 8. Percentage of agricultural households by sustainability status (%) – Sub-indicator 8 (practice of supporting the use of biodiversity)

Table 10. Average of agricultural land area hold by agricultural households by sustainability status (m^2) – Sub-indicator 8 (practice of supporting the use of biodiversity)

Province	Desirable	Acceptable	Unsustainable
West Java	3,519.48	4,765.28	6,900.00
East Java	3,307.89	5,281.88	6,748.00
West Nusa Tenggara	10,934.37	9,790.91	10,000.00

3.9. Wage rate in agriculture

Most agricultural households in West Java and East Java are classified as sustainable agriculture because the amount of wages paid to untrained workers to manage agricultural land in agricultural households tends to be higher than the minimum wage level in the area. Meanwhile, in West Nusa Tenggara, more than half of agricultural households are in unsustainable agricultural status. It means that untrained workers in the agricultural household are paid below the minimum wage applicable in the area.

The average area of agricultural land managed by sustainable agricultural households is smaller than the area of unsustainable agricultural households, except in West Nusa Tenggara (Table 11). Further studies are needed to find out more in-depth about the relationship between the area of agricultural land managed and the level of wages paid to unskilled workers in agricultural households. It was not covered in this study because of the limited data available.

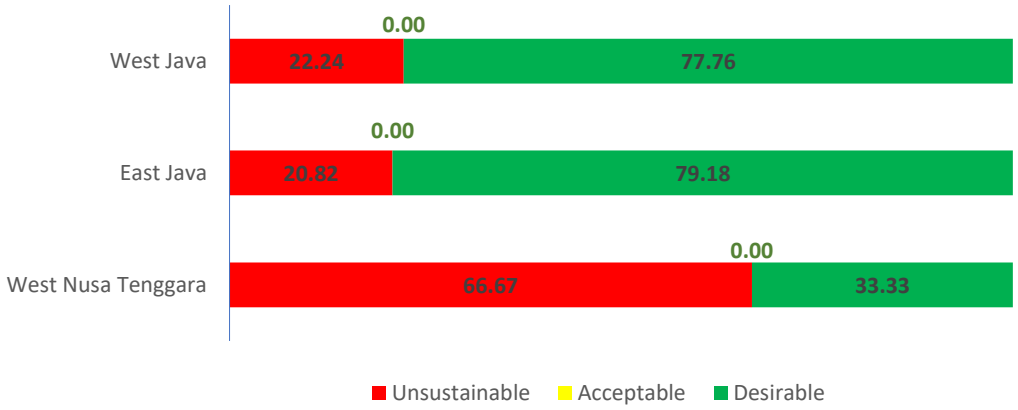

Figure 9. Percentage of agricultural households by sustainability status (per cent) – Sub-indicator 9 (level of wage in agriculture)

Table 11. Average of agricultural land area hold by agricultural households by sustainability status (m^2) – Sub-indicator 9 (level of wage in agriculture)

Province	Desirable	Acceptable	Unsustainable
West Java	3,628.17	-	4,598.31
East Java	2,717.13	-	6,400.92
West Nusa Tenggara	13,194.34	-	9,689.87

3.10. Food Insecurity Experience Scale (FIES)

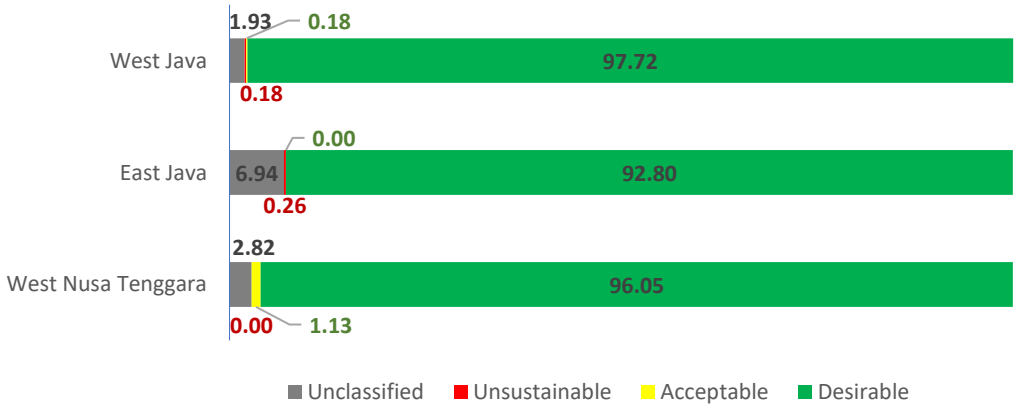

Figure 10. Percentage of agricultural households by sustainability status (per cent) – Sub-indicator 10 (Food Insecurity Experience Index/FIES)

The status of sustainable agriculture is also seen through the Food Insecurity Experience Index (FIES) measurement. This index measures agricultural households' perception regarding their food experience, whether they are experiencing food insecurity or whether food can be appropriately fulfilled. The results of the AGRIS pilot in three provinces show that most of the agricultural households in West Java, East Java, and West Nusa Tenggara are in sustainable agriculture status because they have only experienced moderate to mild food insecurity (perhaps even not experiencing food insecurity). Around 1-6 per cent of agricultural households in the three provinces cannot be assigned to any sustainable agriculture status due to the lack of information to measure the food insecurity experience index.

Table 12. Average of agricultural land area hold by agricultural households by sustainability status (m^2) – Sub-indicator 10 (Food Insecurity Experience Index/FIES)

Province	Desirable	Acceptable	Unsustainable
West Java	3,898.99	1,000.00	2,500.00
East Java	3,624.67	-	5,217.00
West Nusa Tenggara	11,014.54	15,000.00	-

3.11. Secure tenure rights to land

More than 90 per cent of agricultural households in West Java, East Java, and West Nusa Tenggara are in sustainable agriculture status based on land ownership rights. It is shown by official ownership documents provided by agricultural households during field data collection. More than 80 per cent of farmer households in West Java, East Java, and West Nusa Tenggara have official documents in their names. Only less than 2 per cent of agricultural households in these three provinces that have no formal document and have no the right to sell or bequeath any of the parcel of the holding.

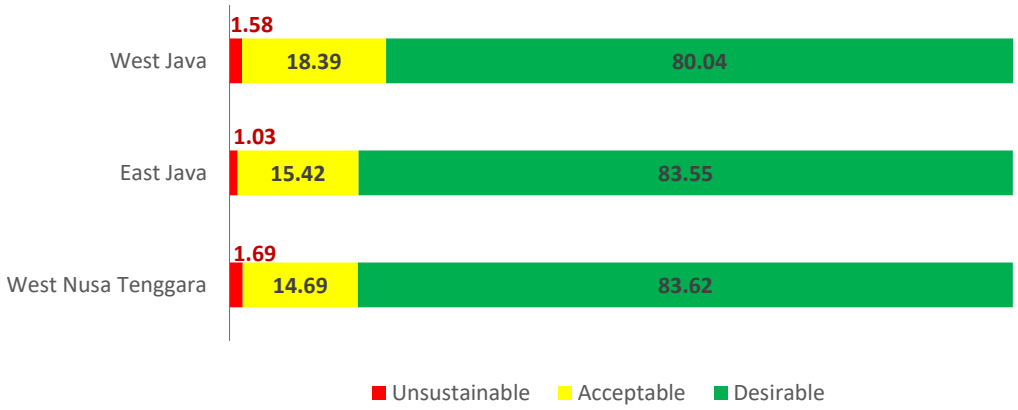

Figure 11. Percentage of agricultural households by sustainability status (%) – Sub-indicator 11 (land tenure right)

On average, sustainable agriculture households for this sub-indicator in West Java and East Java provinces manage a relatively smaller area of agricultural land than unsustainable farming households. It is presumably because unsustainable agricultural households manage more agricultural land that is not owned by themselves (lease and others). They cannot show official ownership documents and are not entitled to sell the agricultural land they cultivate. Unlike agricultural households in West Nusa Tenggara, households with unsustainable agricultural status have a smaller agricultural land area than agricultural households classified in sustainable agriculture.

Table 13. Averege of agricultural land hold by agricultural households by sustainability status (m^2) – Sub-indicator 11 (land tenure right)

Province	Desirable	Acceptable	Unsustainable
West Java	3,915.05	3,352.53	5,966.67
East Java	3,447.27	3,635.04	4,221.75
West Nusa Tenggara	11,379.53	8,526.92	5,333.33

4. Conclusion

The analysis of the computation results of eleven sub-indicators of the SDGs 2.4.1 indicator shows that the sub-indicator 1, with the highest proportion of the unsustainable group, is the reference to draw a

conclusion about the proportion of agricultural households that do not meet the standard of productive and sustainable agriculture. Therefore, it can be concluded that the percentage of agricultural households in West Java that meet the standards of sustainable agricultural practices is 13.31 per cent, and the other 65.50 per cent are below the standards of productive and sustainable agriculture. Meanwhile, the percentage of agricultural households in East Java that meets the standards of productive and sustainable agricultural management is around 16.19 per cent. In comparison, the other 76.86 per cent are below the standard of productive and sustainable agriculture. Only 3.39 per cent of agricultural households in West Nusa Tenggara meet the criteria for productive and sustainable agriculture, and around 82.49 per cent are below the sustainable agriculture standard. These figures also imply that most agricultural land in the three provinces are cultivated below the standards of productive and sustainable agriculture since the average agricultural land for the unstainable group in each province is the highest among other groups.

Increasing agricultural land productivity and good management of fertilizer use are the main concerns for the three provinces to create sustainable agriculture at the household level. For the Province of West Nusa Tenggara, the guarantee of decent work for unskilled workers in the agricultural sector also needs to be considered because the level of wages received by these workers is still mainly below the applicable minimum wage level.

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