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UNDERSTANDING THE LANDSCAPE OF AGRIFOOD SMALLHOLDERS IN MALAYSIA

CLIMATE RISKS, SUSTAINABLE STANDARDS, AND GENDER GAP

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Understanding the Landscape of Agrifood Smallholders in Malaysia: Climate Risks, Sustainable Standards, and Gender Gap. – Kuala Lumpur, Malaysia: Khazanah Research Institute

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EXECUTIVE SUMMARY

Background

This report analysed the smallholder survey (SEMAI) data, which Khazanah Nasional Berhad (KNB) funded and conducted in collaboration with KRI and Think City. A nationwide study of the smallholders of Malaysia has not been reported before this survey. Thus, this report provided insights into the landscape of food producers in Malaysia. Contrary to the perception that farmers are predominantly ageing, this survey demonstrated a shift to a younger and more educated cohort among agrifood smallholders (excluding paddy smallholders). Nevertheless, this survey indicated that educated smallholders were more inclined to pursue alternative employment opportunities (Figure 1.3). This outcome suggests that offering opportunities for non-farm side income could be attractive if the government wanted to promote a younger, agropreneur-centric sector. The smallholders in Sabah and Sarawak were also found to be the least competitive. This observation was attributed to the high climate risk, wider gender gap, and lower adoption of good agricultural practices among agrifood smallholders in Sabah and Sarawak. Therefore, these smallholders require substantial policy initiatives to help uplift their socio-economic status and food production capacity, which are crucial in improving the food security status of the nation.

Chapter 2, titled **Measuring Climate Risk and Perception of Malaysian Smallholders** showed that while Malaysia could not avoid the incidence of extreme weather impacts, the impact of crop loss could be minimised by improving the adaptation capacity of the smallholders. This chapter highlights several findings as follows:

1. The respondents ranked climate change as one of their top three challenges impacting food production.
2. Sarikei, Sibu, Belaga, and Bintulu (Sarawak), Semporna, Kota Belud and Beaufort (Sabah), Gua Musang and Pasir Mas (Kelantan), Hulu Perak, Kuala Kangsar and Perak Tengah (Perak), Kuantan, Temerloh, Lipis, Cameron Highlands, Bera, Pekan, and Jerantut (Pahang), are examples of districts considered very high risk to extreme weather events. At the state level, Kelantan, Pahang, and Sarawak are categorised as very high risk, followed by Sabah and Perak. These areas require urgent policy actions, such as income diversification, better information access, improved farm technologies, and improved flood mitigation facilities with better-adapted smallholders at the national level.
3. The smallholders in the crop sub-sector were the most concerned regarding extreme precipitation and flooding. This observation emphasised the necessity for alternative solutions, including Controlled Environment Agriculture (CEA), climate-resilient varieties, and better-adapted smallholders.

Chapter 3, titled **Empowering Smallholders in Malaysia through MyGAP** emphasised the importance of agricultural standards in promoting sustainability practices among smallholders in Malaysia. This chapter demonstrates several findings as follows:

1. There are positive correlations in adopting Malaysia Good Agricultural Practices (MyGAP), including improved perceived financial literacy and security, increased stability of smallholders' marketing channel, as well as higher likelihood of receiving farming support (e.g., agricultural-related training, participation in agricultural associations/cooperatives, access to technology).

2. The demographic composition from the SEMAI survey shows that there is a lower proportion of MyGAP certified smallholders among those with lower education attainment, shorter farming experience as well as smallholders from Sabah and Sarawak. This result warranted the targeted intervention requirement for smallholders with specific demographic characteristics to improve the overall certification rate.
3. There is also a need for improvements in several mechanisms of MyGAP adoption which include improving the application process and minimising bureaucracy to ease the certification process. Additionally, exploring options such as group certification and monetary incentives might be a feasible option to make certification more appealing for smallholders.

Chapter 4, titled **Understanding the Gender Gap Among Agrifood Smallholders** examined agricultural practices, experiences, and support among agrifood smallholders in Malaysia using a gender perspective. This chapter presents several findings as follows:

1. Gender gaps exist among agrifood smallholders with a wider presence in Sabah and Sarawak. Women smallholders are more likely to fall behind in machinery or equipment adoption, training attendance, and contract farming participation. They also tend to face sales irregularity, which is potentially attributed to their greater reliance on direct-to-consumer sales.
2. Group training on topics such as sales and marketing with a casual approach, fit-for-purpose machinery and equipment support, and tailored support for contract participation can be undertaken to reduce the observed gender gaps. Establishing a sales platform connecting women smallholders to regular buyers through contract farming and public-private-partnership (PPP) can be considered. These initiatives may need to prioritise women smallholders in Sabah and Sarawak.
3. A multi-ministerial collaboration between the Ministry of Agriculture and Food Security (KPKM), Ministry of Women, Family, and Community Development (KPWKM), Ministry of Rural and Regional Development (KKDW), Ministry of Economy (EPU), and state governments is crucial for implementing gender-responsive agricultural policies. Additionally, it is recommended to conduct gender-sensitive impact assessments of agricultural policies and programmes to determine their true equity.


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Source: KNB

CHAPTER

01

CHAPTER 1

Report Overview, Methodology, and General Findings

By Dr Mohd Amirul Rafiq Abu Rahim, Lai Cai Xuan, Nik Syafiah Anis Nik Sharifulden and Dr Sarena Che Omar

1.1 Report Overview and Relevance

This report analysed smallholder survey data (SEMAI) conducted by KNB in collaboration with KRI and Think City. The survey was fully funded by KNB and was performed between 2022 and 2023 in 13 states and federal territories.

1.1.1 Relevance to the National Agriculture Policy

This KRI study complemented and supported the six core objectives outlined in the *Dasar Agromakanan Negara* 2021–2030 (DAN 2.0) (see Table 1.1).

Table 1.1: The DAN 2.0 Core Objectives* and KRI Report Contribution

Main Objective	SEMAI Report Relevance
Objective 1: Increase income growth and quality of life for food producers	This objective is directly relevant to Chapters 2, 3, and 4, which focus on climate adaptation, sustainability standard adoption, and gender gap reduction to safeguard and improve smallholder income.
Objective 2: Increase production output and harvest quality through productivity improvements	This objective is directly relevant to Chapters 2 and 3, which discuss climate adaptation and sustainability standards to safeguard food supply and ensure safe, quality food for consumers.
Objective 3: Develop a more resilient value chain with value-added activities	This objective is irrelevant as value-added activities are not focused in this report. Nonetheless, the survey elucidates particular insights regarding the supply chain and fixed buyers, which the authors believe could strengthen the food supply.
Objective 4: Improve food security and nutrition for the citizens	This objective is directly relevant to Chapters 2 and 3, which describe climate adaptation and sustainability standards for food security resilience and ensuring safe, quality food for consumers, respectively.
Objective 5: Promote economic, social, and inclusivity growth	This objective is directly relevant to Chapter 4, which covers the gender gap and the corresponding gap reduction strategies (specifically for women smallholders) to improve rural household income security and socio-economic factors.
Objective 6: Encourage sustainable food consumption and production	This objective is directly relevant to Chapter 3, which focuses on sustainability, climate adaptation, and the positive outcomes of the MyGAP programme in aiding the government achieve its 6th objective.

Source: DAN 2.0
Note: *translated from Bahasa Malaysia

1.1.2 Research Questions and Policy Objectives

The primary research questions of this report involve highly detailed research questions outlined in each Chapter as follows:

1. What is the most recent demographic structure of Malaysian smallholders?

   Described in Chapter 1

2. What are the key themes or challenges the surveyed smallholders encounter and their correlation to the observed demographics?

   Described in Chapter 1, leading to focused themes for Chapters 2, 3, and 4

This report could support the country in achieving the six objectives outlined in DAN 2.0 by answering these research questions. Consequently, this information could improve the consumers' national food security and producers' socio-economic status.

1.2 Methodology

Project SEMAI is a research initiative focused on investigating the challenges encountered by smallholders in various Malaysian agricultural sectors. This project is one of the Dana Impak (DI) initiatives by KNB under the Food and Energy Security theme, **which comprehends Malaysian smallholders' challenges**[1]. The project conducted primary data collection by surveying 3,300 smallholders across three agricultural sectors (crops, livestock, and aquaculture) in five regions: Sabah and Sarawak, Northern *Semenanjung*, Central *Semenanjung*, Southern *Semenanjung*, and Eastern *Semenanjung*. This project comprehended the challenges encountered by various Malaysian agricultural sectors, aligning with the vision of DI. Notably, the KRI functioned in an advisory role in supporting this research initiative and subsequently analysed the surveyed data.

Project SEMAI emphasised qualitative inquiry in establishing the foundation for its methodology, prioritising in-depth understanding through multiple rounds of engagement and interviews with related industry leaders before executing the nationwide survey. This approach was further supported by the insights gathered during the desk research and literature review in the initial stages of research exploration, which were essential in ensuring that Project SEMAI could successfully achieve its intended research objectives.

[1] The DI is as an important foundation within the overarching strategy of Khazanah (Advancing Malaysia Strategy). This strategy is designed to elevate the economic competitiveness of Malaysia and reinforce national resilience across various fronts. The portfolio addresses prevalent issues and challenges confronting the nation within six distinct themes, encompassing Digital Society and Technology, Quality Health and Education for all, Decent Work and Social Mobility, Food and Energy Security, Building Climate Resilience, and Competing in Global Markets. Source: https://www.khazanah.com.my/how-we-invest/dana-impak/

1.2.1 Scope and Coverage

Project SEMAI extended its scope to cover all 13 states (covering urban and rural areas), including three federal territories in Malaysia: Kuala Lumpur, Putrajaya, and Labuan. This project focused on three key agricultural sub-sectors: crops, livestock, and aquaculture. Table 1.2 tabulates the definitions of smallholders according to their sector and segment. These definitions were based on the guidance by KPKM for crop-based smallholders, the Department of Veterinary Services for livestock-related activities, and the Tenth Malaysia Plan (RMK10) for aquaculture. Subsequently, these definitions were further refined through valuable insights provided by industry experts and adjusted accordingly based on the Regional Coordinators' (RC) experience, ensuring a comprehensive and accurate definition of smallholders within Project SEMAI.

Table 1.2: The Definitions of Smallholders under Project SEMAI

Sector	Segment	Definition
Crops	Vegetables	Less than 5 Ha
	Fruits	Less than 2 Ha
Livestock	Chicken	Less than 30,000 chickens
	Cow	Less than 50 cows
	Goat	Less than 100 goats
Aquaculture	Pond	Less than 1 acre
	Cage	Less than 0.25 acres

Source: KPKM, Department of Veterinary Services (DVS), RMK10 via KNB

1.2.2 Development of The Survey Instrument

Project SEMAI applied a questionnaire as its survey instrument, which was developed to align with its research objectives. The questionnaire development of this project began by identifying essential aspects and issues related to challenges experienced by agricultural smallholders. This questionnaire contained several dimensions as the foundation for the questionnaire development, which was derived from insights obtained during the literature search and qualitative inquiry (including stakeholder engagements). The dimensions considered included crop productivity, labour, dependence on inputs, concerns related to research and development, supply chain dynamics, financing mechanisms, fragmented governance with policy, and the impact of climate change.

The questionnaire development of Project SEMAI involved an iterative process, incorporating valuable input from relevant stakeholders, insights from smallholders, pilot testing, and expert reviews to ensure its effectiveness and relevance in capturing essential information for this report. Table 1.3 presents the questionnaire that (see Appendix A) contains a structured set of questions divided into eight sections addressing various topics within the identified critical dimensions identified.

Table 1.3: The Key Dimensions of the Project SEMAI Questionnaire

Key Dimension	Detail
Section A: Demography	This section contained vital information regarding smallholders' demographic characteristics, capturing personal attributes and professional engagements within the agricultural landscape. The information encompassed the agriculture sector, land ownership, age, gender, citizenship status, ethnicity, and the highest education level. This section also explored the smallholders' involvement in industry organisations, MyGAP certification ownership, and accumulated experience in the sector.
Section B: Productivity	This section collected information regarding the smallholders' productivity landscape, encompassing input and output dimensions while providing insights into their agricultural practices. The focus was on obtaining multiple details, including agricultural produce, cultivation or number of livestock, and annual yields with sales. This section also enquired about the input sources, primary use and buyers of outputs, labour size and composition, and the challenges encountered in the agriculture sector.
Section C: Financial	This section comprehended the financing sources of smallholders to support their farm operations and how they managed their financial resources. The information included questions on their financing sources, financial health, practices, and received assistance types.
Section D: Skills	This section investigated the skill development aspects relevant to smallholders. The questionnaire explored the training landscape of smallholders' past and future training opportunities.
Section E: Technology	This section addressed the technology landscape of smallholders by exploring current practices, identifying gaps, and researching agricultural activity-related specific technology applications. The questionnaire inquired smallholders regarding their utilised technology types to determine any existing technological gaps while assessing the impact of smartphones in their farming activities.
Section F: Research & development	This section assessed the smallholders' engagement in local research and their participation in agriculture-related research activities. The questionnaire identified the activity level and smallholders' involvement in local research initiatives.
Section G: Climate	This section primarily evaluated the smallholders' perspectives on climate change. The main question probed the agreement level (from strongly disagree to strongly agree) regarding climate change and its influence on agricultural output. Additionally, the questionnaire comprehended the broader impact, awareness levels, and smallholders' sentiments concerning climate change.
Section H: Future	This final section followed a similar structure to Section G, gauging the smallholders' sentiments (from strongly disagree to strongly agree). The questionnaire explored the perceived agreement regarding farming activities and the agriculture industry. Specific questions involved assessing the farmers' intentions to continue and expand farming activities over the next 5 to 20 years. These questions also evaluated if the government assistance fulfilled the smallholders' requirements.

Source: KNB (2023)

Several measures were implemented before conducting the fieldwork survey to ensure the reliability of the developed questionnaire. These measures comprise several aspects as follows:

i. **Pilot survey:** A preliminary survey involving 381 smallholders was performed to assess the questionnaire and collect the respondents' feedback. The feedback from the pilot survey was crucial in refining and adapting the questionnaire for the survey. This iterative step also identified areas for modifications to improve clarity in addressing the objective of Project SEMAI.
ii. **Engagement with industry leaders:** Table 1.4 lists the active engagements with key industry players in the agricultural sector. This process included a roundtable discussion held in May 2022, in which various stakeholders (government agencies, startups, associations, and academics) and conglomerates participated. Follow-up meetings were also held with KPKM, Farmers' Organisation Authority (LPP), and National Farmers Organization (NAFAS) to understand the challenges encountered within each agricultural sector.

Table 1.4: The List of Stakeholders Engaged in the Survey Development of Project SEMAI

Stakeholder	Name
Government agencies	Malaysian Fisheries Development Authority (LKIM) Federal Agricultural Marketing Authority (FAMA) Department of Agriculture (DOA)
Startups	Bioloop Aerodyne GK Aqua Green World Genetics (GWG)
Accelerators	Malaysian Research Accelerator for Technology & Innovation (MRANTI) Sunway iLabs
Associations	Kuala Lumpur Vegetable Wholesalers Association National Association of Smallholders Malaysia (NASH) The Lost Food Project Federation of Livestock Farmers' Association of Malaysia
Universities	UPM Universiti Malaysia Terengganu (UMT) Universiti Malaysia Sarawak (UNIMAS)

Source: KNB (2023)

1.2.3 Fieldwork Survey

The fieldwork survey was conducted with Think City through six appointed local regional coordinators (RCs). These RCs were responsible for overseeing the fieldwork survey in their respective regions. Table 1.5 summarises the RC list and its corresponding regions. The fieldwork survey lasted five months (October 2022–March 2023) involving the crop, livestock, and aquaculture sectors. Initially, the questionnaire was prepared in Bahasa Malaysia and translated into English, Mandarin, and Tamil to foster inclusivity among diverse ethnic groups. The RCs were then responsible for recruiting field enumerators, conducting training sessions for enumerators, and overseeing the data entry process. Local enumerators were also appointed to facilitate interview sessions in different languages and local dialects to enhance effective communication and ensure clear transmission of survey questions to respondents.

Table 1.5: The RC List and its Respective Regions

Region	RC
Sabah and Sarawak	
• Sabah	AgriData Portal
• Sarawak	Owl & Badger Research
	UNIMAS
Northern *Semenanjung*	Penang Institute
Central and Southern *Semenanjung*	UPM
Eastern *Semenanjung*	Universiti Sultan Zainal Abidin (UniSZA)

Source: KNB (2023)

1.2.4 Sampling Design

Considering that the random sampling conditions were challenging without a sample frame for Project SEMAI, a non-random sampling method was used for the sample design[2]. This survey adopted a non-probability[3] sampling approach to enhance the reliability of the sample. Two distinct sampling approaches were applied during the sample selection stage: quota and convenient samplings. The smallholders' sample design was carefully structured using quota sampling to ensure proportional representation from the three subsectors. These subsectors were based on the available information regarding the respective population estimates. Convenience sampling was then employed to achieve the desired number of respondents.

[2] A sample frame is a comprehensive list or database used to randomly select potential participants or elements for a study or survey. This frame is the population or universe from which the sample is drawn. Essentially, the sample frame provides a structured and organised basis for selecting a representative sample for research purposes.

[3] Project SEMAI employed a non-random sampling technique due to the lack of a comprehensive smallholder list in certain Malaysian agricultural sectors. The logistical difficulties concerning smallholder access in diverse regions and time constraints were also key factors in opting for this non-random approach.

Although the two sampling methods employed in the Project SEMAI survey could introduce biases, they could be practical when an established sample frame was difficult to obtain. This project applied a non-random sample, and the findings remained valuable due to the sufficiently large sample sizes. Several precautions were also performed when interpreting the information to acknowledge the limitations of the chosen sampling method. Table 1.6 presents the sample selection steps.

The SEMAI survey implements comprehensive approaches to mitigate potential biases arising from its non-random nature as follows:

i. The enumerators appointed by the respective RCs and local experts were trained to reach respondents based on pre-determined criteria, such as demographic characteristics (gender and urban or rural distributions). These individuals utilised multiple sources to enhance the representativeness of the selected smallholders.
ii. The SEMAI survey defined its target population based on various characteristics through quota setting to ensure representation proportionately to estimated population sizes. Therefore, the total sample size was determined proportionally for each smallholder type while considering the desired margin of error in each subsector.
iii. Project SEMAI fostered collaboration with diverse stakeholders (public and private sectors), ranging from federal to state-level entities. This collaboration also involved government agencies, such as DOA, DVS, and Department of Fisheries (DOF), private players, Non-Governmental Organisation (NGOs), and local associations.

Table 1.6: The Sample Selection Steps for Project SEMAI

Sampling Method	Detail
Quota sampling	The samples in this phase were selected from distinct subgroups within the population of interest based on the predetermined quota sizes for each region. Project SEMAI grouped agricultural smallholders into three subsectors (crops, livestock, and aquaculture)., while quotas were assigned based on estimated population proportions in each subsector (subgroups). This method used quotas to ensure that each subgroup was adequately represented in the sample, providing a certain degree of representativeness despite the non-random nature of the sampling method. The estimated population number of smallholders in each subsector was sourced independently from multiple sources, including KPKM, DOA, DVS, and DOF. Participants were selected within each subgroup until the predetermined quota for that subgroup was met. This process involved purposefully choosing smallholders who fulfil the specified criteria for each subgroup.
Convenient sampling	This phase supplemented the practicality of the quota sampling method, which entailed selecting respondents based on their proximity, availability, and willingness to participate in the survey.

1.2.5 Sample Size Determination

The intended sample size for Project SEMAI was 4,662, which was adjusted to accommodate potential non-response within each subsector. The distribution for each subsector was 2,356 for crops (50.5%), 1,436 for livestock (30.8%), and 870 for aquaculture (18.7%). These figures were determined using data collected from the pilot survey using Cochran's formula[4]. The effective sample size was then adjusted based on the response rate gathered from the pilot survey. This parameter was important in determining the minimum number of respondents required to achieve the desired precision level or accommodate the specific sampling design[5].

The overall response rate for the pilot survey was 50%. Specifically, the livestock sector demonstrated a lower response rate of 25% due to accessibility, logistic, and communication challenges. These challenges were then considered in the sample size design for the actual survey. Meanwhile, the response rate for aquaculture was 50%. The actual survey in Project SEMAI received 2,100, 816, and 702 responses for crops, livestock, and aquaculture, respectively. Consequently, the final response rates exceeded expectations, reaching 89% for crops, 57% for livestock, and 81% for aquaculture. Table 1.7 tabulates both the effective and actual sample size of Project SEMAI.

Table 1.7: The Effective and Actual Sample Sizes of the Surveyed Smallholders in Project SEMAI

Details	Crops	Livestock	Aquaculture	Total
Population size (estimation) of smallholders in Malaysia[1]	14,228	29,551	4,139	47,918
Prevalence[2]	0.30	0.62	0.09	1.00
Desired margin of error[3]	2.5%	5.0%	2.5%	-
Total effective sample size	1,178	359	435	1,972
Expected response rate[4]	50%	25%	50%	-
Intended sample size, adjusted for non-response rate	2,356	1,436	870	4,662
Actual sample collected from the actual survey[5]	2,100	816	702	3,618
Actual response rate	89%	57%	81%	78%

Source: KNB (2023)

Notes:

1) The population size of smallholders was sourced from KPKM, DOA, DVS, and DOF.
2) The proportion of the smallholder population size determined the prevalence of each subsector.
3) A margin of error of 2.5% was established for the crop and aquaculture sectors when the response rate was considered. Conversely, a higher margin of error of 5.0% was applied for the livestock sector, which was attributed to the survey challenges regarding accessibility, logistics, and communication issues.
4) The expected response rate was the response rate of each subsector during the pilot survey. This rate for nationwide surveys was estimated based on pilot survey experience.
5) Certain smallholders engaged in farming across multiple sectors. Each smallholder participating in various sectors was considered separately for each subsector in the SEMAI analysis. Thus, the same smallholder could be counted more than once, contributing to crops, livestock, and aquaculture sample sizes. This process rendered the sum of sample sizes for crops, livestock, and aquaculture (*3*,618) (observations of the dataset) to exceed the number of unique surveyed smallholders (*N* = 3,300).

[4] Cochran's formula ($n = \frac{n_0}{1+\frac{n_0}{N}}$) assumes that the samples drawn are from an infinite population. This assumption denotes that the population size is significantly larger than the total sample size (N). Meanwhile, n represents the new and adjusted sample size, with n_0 representing Cochran's sample size recommendation. The n_0 value is typically 385. Cited from Woolson, Bean, and Rojas (1986)

[5] A. S. Singh and Masuku (2014)

Furthermore, there are two important factors to consider when explaining the discrepancies between the actual and intended sample size for the Project SEMAI survey, which utilised a non-random sampling selection methodology:

i. A notable difference appeared between the actual and the intended sample sizes, which was attributed to an intentional oversampling strategy aimed at smallholder respondents from different subsectors. Generally, the oversampling method is supported by established survey methodologies[6] to ensure a certain degree of representation across the various investigated sectors.
ii. The nuanced interpretation of the response rate within non-random sampling should be highlighted, distinguishing it from the conventional understanding in random sampling settings. Traditionally, the response rate in random sampling is a key metric for assessing survey representativeness and gauging the potential for non-response bias. On the contrary, a paradigm shift occurs when dealing with non-random sampling. Despite the response rate offering insights into sample participation, its direct applicability to representativeness became nuanced. This observation was held when the sampling methodology did not adhere to the random selection principles.

1.2.6 Limitations and Caveats

The non-random nature of the Project SEMAI survey should be recognised to understand its limitations fully. These limitations provided the necessary context for interpreting the survey findings. Hence, the limitations are as follows:

i. **Non-random sampling method:** The significance of the non-random sampling method employed in Project SEMAI should be acknowledged. This sampling approach limited the application capacity of the survey findings to the entire Malaysian smallholder population. Therefore, this method was necessitated by inadequate comprehensive smallholder data across Malaysian agricultural sub-sectors. The logistical challenges posed by geographic constraints and time limitations also influenced the decision to opt for a non-random approach. Thus, understanding these limitations was vital for interpreting the data accurately within the scope defined by the survey design.
ii. **Scope of Project SEMAI:** Project SEMAI only focused on addressing challenges encountered by smallholders. Even though this focus offered in-depth insights into smallholder concerns, the process essentially limited the capacity of the survey to capture the complexities of the entire agricultural sector comprehensively. For example, supply chain management-related issues were not extensively addressed within the scope of the survey.
iii. **Self-reported data:** The survey relied on self-reported information, which could be subjected to reporting bias and errors. Smallholders' perceptions and personal experiences could influence responses by complicating the generalisation of findings.

[6] R. P. Singh, Petroni, and Allen (1994)

iv. **Limited sector coverage:** The survey does not include all sectors within agriculture, excluding several significant sectors such as the paddy sector and other industrial crops such as palm oil and cocoa. Hence, the findings of this survey will not be deduced to these excluded sectors.

1.2.7 Data Management and Method of Analysis

Think City led the data coordination process, which involved several steps to ensure data consistency and logic, such as data validation, cleaning, and basic tabulations. The internal team of KNB then further processed and analysed the datasets. This procedure involved an initial exploratory data analysis phase, which aimed at uncovering patterns, outliers, and irregularities within the dataset using summary statistics and graphical representations of data points. Subsequently, KRI conducted a deeper analysis of the datasets, culminating in Chapters 2, 3, and 4 of this report. The analysis method in this report for the Project SEMAI data was primarily descriptive, aiming to provide a comprehensive overview of critical aspects related to issues encountered by Malaysian smallholders.

The analytical process involved thorough exploratory steps, leading to three key themes in the subsequent chapters. This information addressed the primary research questions about the key challenges experienced by the surveyed smallholders and their correlation to the observed demographics. The three key themes are as follows:

i. **Chapter 2:** Measuring climate risk and perception of smallholders
ii. **Chapter 3:** Empowering agrifood smallholders through MyGAP
iii. **Chapter 4:** Understanding the gender gap among agrifood smallholders

This report utilised descriptive analyses involving basic statistical measures to discover patterns, characteristics, and correlations of the variables. Notably, the basic tabulation was presented in frequency and percentages to interpret the distribution and prevalence of various factors in the analyses. Chapter 2 also used composite indicators to measure climate risk among Malaysian smallholders. Similarly, Chapter 3 applied a random forest algorithm to identify the most influential variables related to MyGAP certification by employing an advanced machine learning technique involving a controlled randomisation process and creating several decision trees[7]. Consequently, the analytical methods in this report addressed the research questions and provided informed policy recommendations with targeted interventions to resolve the specific needs of Malaysian smallholders.

[7] The details of these analytical techniques were presented in its respective chapter.

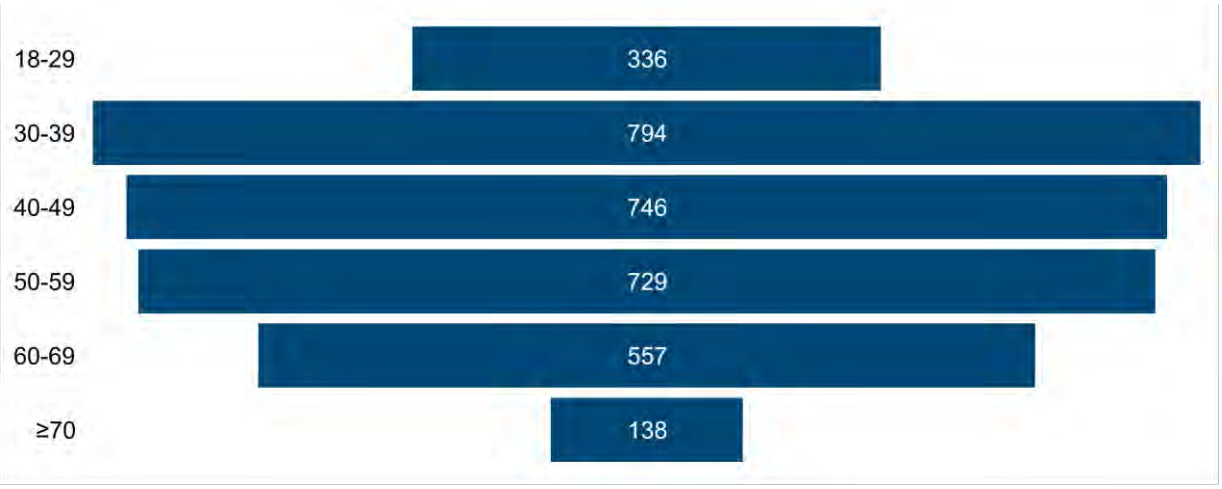
1.3 General Findings

1.3.1 Overview: Smallholders' Characteristics in the SEMAI Survey

Contrary to common perception, the age group of the surveyed smallholders surveyed seemed to skew towards the younger age group. Out of 3,300 smallholders, 57% were below 50 years old. Meanwhile, those aged between 30 and 39 acquired the most representation (see Figure 1.1). Note that paddy farmers[8] were also excluded from this SEMAI survey. Other studies documented that the paddy farmer demographic profile (particularly in the Northern states of the Peninsula) was ageing, with an average age exceeding 50[9]. These studies on paddy farmers in the Northern states of the Peninsula suggested that Malaysian smallholders were ageing. However, with the group of paddy farmers being excluded, such as in this SEMAI survey, data showed that smallholder farmers are indeed skewed towards being younger.

A demographic shift to younger smallholders (concentrating on the middle age) was a good indicator in this report. This finding was due to the insufficient experience of the very young farmers (20s). Simultaneously, farmers above 60 were deemed physically and technologically less competitive. A study on United States (US) farmers revealed that 35 to 44-year-old farmers were 3% more productive than the younger group. In contrast, farmers above 65 were 10% less productive than the youngest[10]. This study supports Tauer's early studies in the 1980s and 1990s that suggest middle-aged farmers (30-40s) tend to be the most productive[11].

Figure 1.1: The SEMAI Smallholder Distribution by Age Group

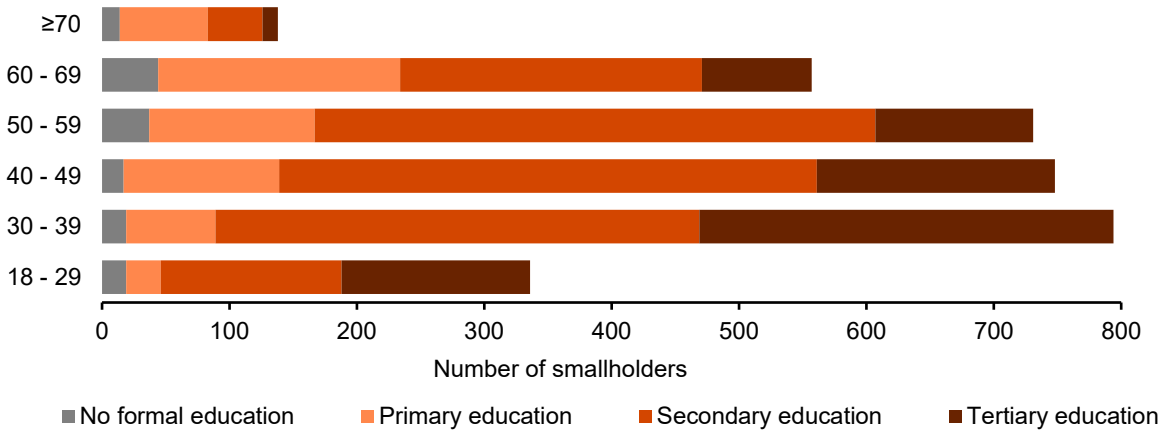


Source: KNB (2023)

[8] These paddy farmers only performed paddy farming cultivation, and not any other farming activities.
[9] Rabu and Mohd Shah (2013); Che Omar, Shaharudin, and Tumin (2019)
[10] Fried and Tauer (2016)
[11] L. W. Tauer (1984); L. Tauer (1995)

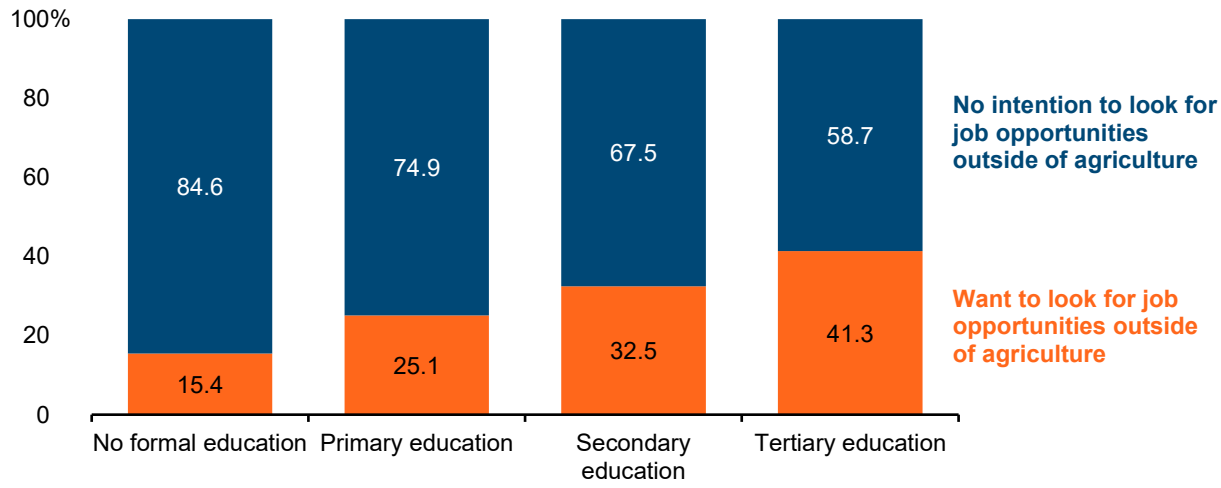
Malaysian smallholders are skewed to the younger, middle-aged group. The SEMAI data also highlighted that younger farmers were associated with higher education levels (Figure 1.2). This outcome indicated a changing demography among Malaysian smallholders from older and less educated individuals to younger and more educated ones, the SEMAI survey also showed that these educated smallholders intended to seek other jobs (Figure 1.3). This observation indicated that if the government wanted to promote a young agropreneur-centric sector, offering opportunities for non-farm side income could be attractive.

Figure 1.2: The SEMAI Smallholder Distribution by Age Group and Education Level



Source: KNB (2023)

Figure 1.3: Distribution of Smallholders by Education Level and Intention to Look for Job Opportunities Outside of Agriculture (%)

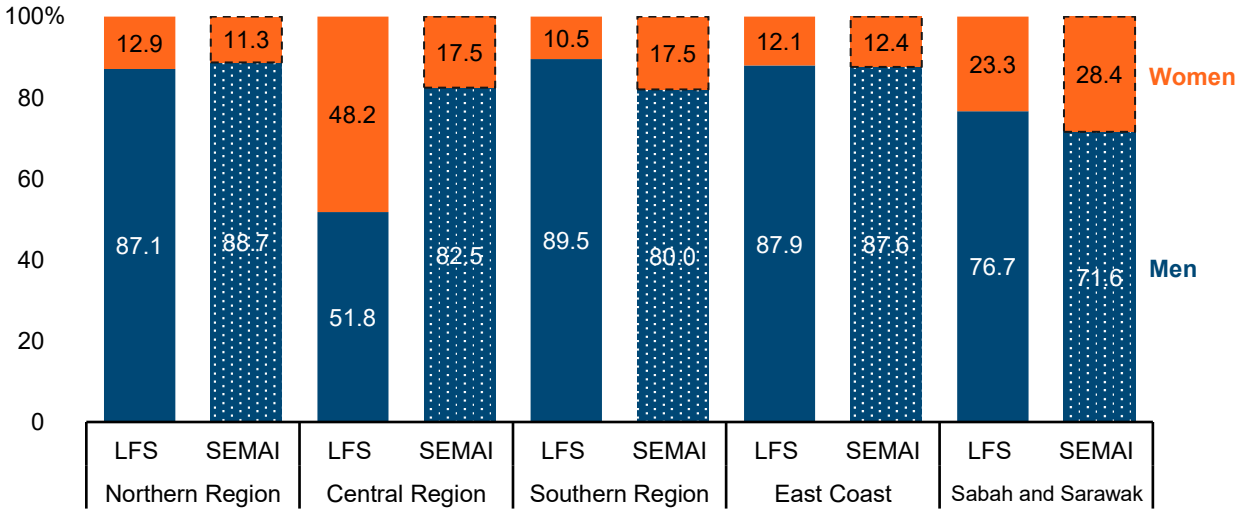


Source: KNB (2023)

The gender distribution of this survey was consistent with the Labour Force Survey (LFS) and varied by region. Approximately 20.6% of women were reported to be in the agriculture, forestry, and livestock industries[12] and 38.9% were in the overall labour force based on the LFS data for the year 2022. This result suggested that males dominated agriculture, forestry, and livestock industries. Similarly, the SEMAI survey denoted that 23.0% of the smallholders were women. Despite that this survey was not statistically representative and was conducted using purposive sampling, the large sample size exhibited statistical similarities to a statistically representative survey (such as the LFS). Both LFS and SEMAI statistics presented that men were the predominant group in this industry.

Compared to other regions, Sabah and Sarawak exhibited a higher ratio of women to men smallholders (Figure 1.4). A consistent trend was also observed compared to the LFS data involving the ratio of women to men for the agriculture, forestry, and livestock categories (a higher ratio of women in Sabah and Sarawak and a lower ratio in the Northern, East Coast, and Southern Peninsula). The only difference was recorded in the Central region, where the percentage of women workers was significantly higher for LFS in 2022. This difference could be decisively explained in this report. Nevertheless, the lack of distinction between smallholders and large-scale farmers in the LFS data was a potential cause of the larger share of non-smallholder females in the Central region. Meanwhile, the higher women-to-men ratio of smallholders in Sabah and Sarawak was interesting and warranted further investigation. This observation was particularly true when considering the presence of a gender gap and varied needs between women and men smallholders. Chapter 4 expanded further on this segment.

Figure 1.4: Distribution of Male and Female Respondents from the LFS* 2022 and SEMAI Survey, by Region (%)



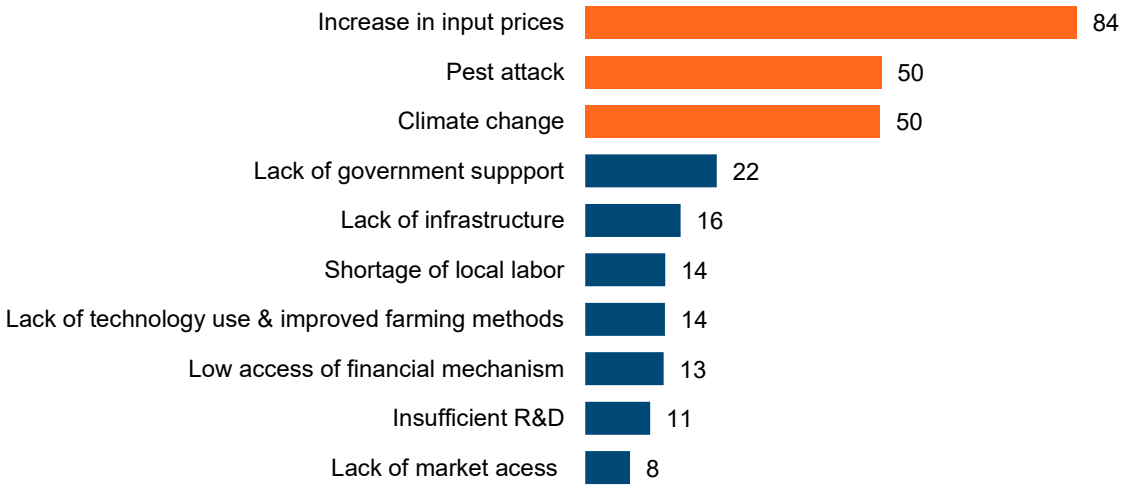
Source: DOS (2023), KNB (2023)
Note: *LFS 2022 Category of agriculture, forestry, and livestock.

[12] DOS (2023c)

When the respondents were asked what the main challenges are impacting their farm production, the top three challenges were increasing input prices, pest attacks, and climate change (Figure 1.5). Surprisingly, these issues were consistent across different sub-sectors, indicating that these challenges persisted regardless of sector type. Considering that the SEMAI survey interviewed non-paddy smallholders, an increase in input prices was not surprising. Paddy smallholders also received input subsidies, increasing input prices but not impacting them. In contrast, this process demonstrated a more significant impact on other smallholders. This increase was due to the higher global input prices between 2020 and 2023, such as fertilisers[13] and animal feed sources (maize)[14]. Another worrying trend observed was frequent pest and climate change incidents, which were closely related[15].

This report suggested that smallholders were undeniably highly concerned about climate change. Over 75% of the respondents agreed or strongly agreed that rainfall pattern changes could impact their farm output (Figure 1.6). While perception studies were essential to provide insights into the smallholders' concerns, data validation was also important. This observation required a more thorough analysis. Chapter 2 further examined this issue and elucidated the vulnerability of Malaysian smallholders to extreme weather events using actual historical weather data, the exact Global Positioning System (GPS) locations of the respondents' farms, and the respondents' survey answers.

Figure 1.5: Ranking of Challenges Faced by Smallholders Surveyed (%)

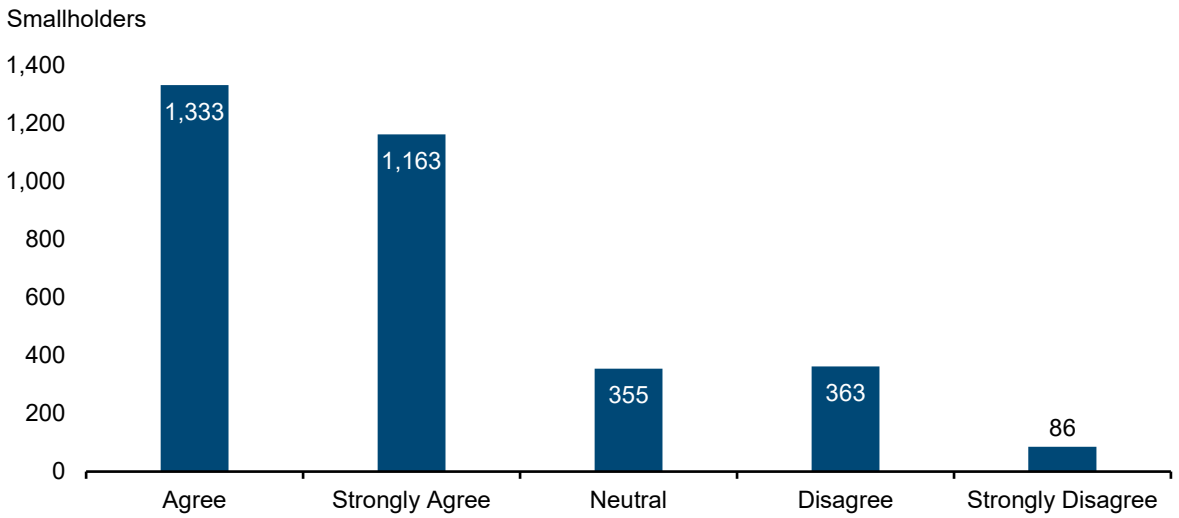


Source: KNB (2023)

[13] IndexMundi (2023b)
[14] IndexMundi (2023a)
[15] Bebber, Ramotowski, and Gurr (2013)

Another interesting observation involved the smallholders participating in the MyGAP certification scheme. Preliminary analysis revealed patterns between MyGAP participating smallholders with their education level, sub-sectors, and region. For example, a positive correlation was observed between the education level and MyGAP participation among smallholders (r = 0.153), suggesting a slight adoption tendency for MyGAP practices as the education level increased. When the data was analysed based on regions and subsectors, more MyGAP participating smallholders were recorded in Peninsular Malaysia and within the crop subsector (Table 1.8 and Figure 1.7).

Figure 1.6: Responses from the Smallholders Regarding the Impact of Rainfall Changes over the Last Five Years on Their Farm Production



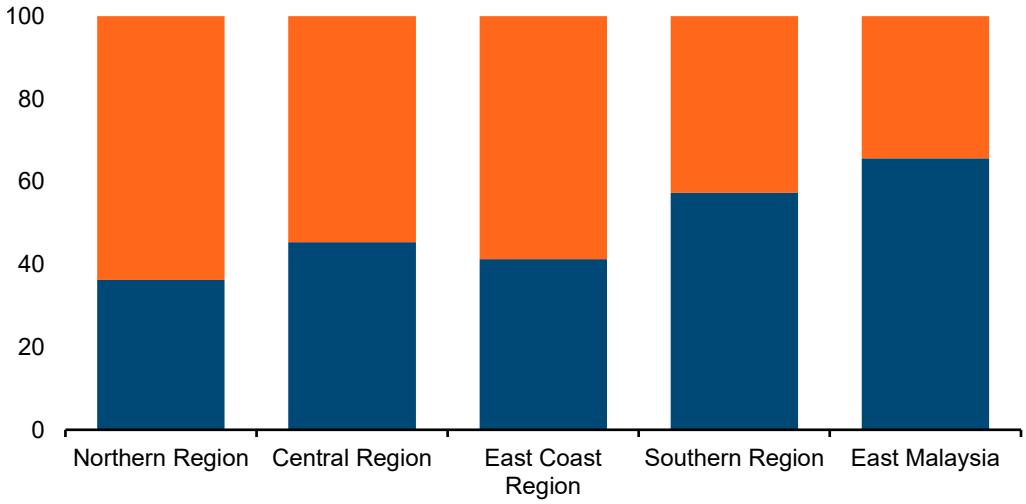
Source: KNB (2023)

Table 1.8: The Smallholder Participation in MyGAP Programme by Subsector Type

MyGAP status	Crops		Livestock		Aquaculture	
	Total	Percentage (%)	Total	Percentage (%)	Total	Percentage (%)
Non-MyGAP	1,795	85.5	769	94.2	653	93.0
MyGAP	305	14.5	47	5.8	49	7.0
Total	**2,100**	**100.0**	**816**	**100.0**	**702**	**100.0**

Source: KNB (2023)

Figure 1.7: The Participation of Smallholders in the MyGAP Programme by Region Type (%)



Source: KNB (2023)

The patterns and associations of the data warrant further investigation. Given that Malaysia aims to be a higher-income country, farming practices must improve by adopting better agricultural practices. This process ensured long-term sustainable agriculture and safer, better-quality food for consumers. Good farming practices, sustainability standards, and integrated pest management systems can positively impact food safety, environmental sustainability, and worker's rights[16]. If the MyGAP programme encourages these positive association types regarding farmer demography, the government should further support this programme. Chapter 3 expanded on this matter and provided relevant policy recommendations.

[16] Kharel, Dahal, and Raut (2022)

1.4 References

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Source: Piyaset, Shutterstock

CHAPTER

02

CHAPTER 2

Measuring Climate Risk and Perception of Malaysian Smallholders

By Chooi Je Qin and Dr Sarena Che Omar

2.1 Introduction

2.1.1 Food Security – Definition and Measurement

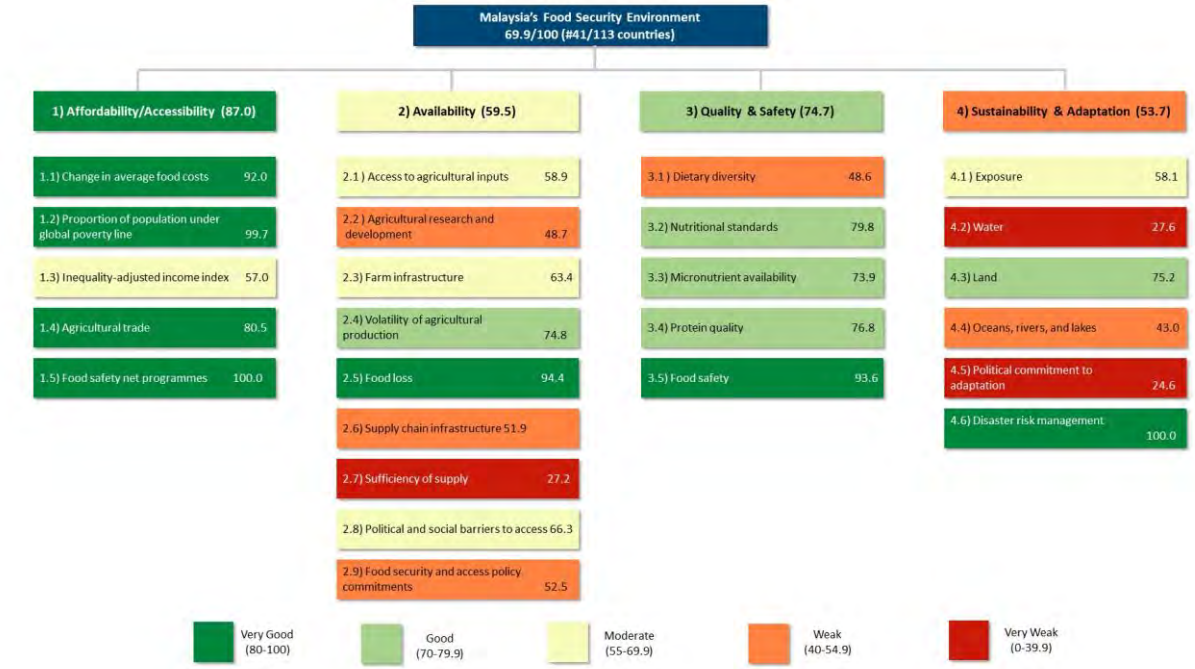
The Food and Agriculture Organization (FAO) denotes that "food security exists when all people, at all times, have physical, social, and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO 1996[17]). Typically, food security consists of four main pillars or dimensions: Food Availability, Food Accessibility, Food Utilisation (Quality and Safety), and Stability or Sustainability with Adaptation[18]. Detailed explanations and discussions on these dimensions have been discussed elsewhere, including recent KRI publications (see footnote below)[19] and various FAO resources. The Economist has taken the initiative to capture the progress of these dimensions by attributing meaningful indicators. These dimensions rank 113 countries annually based on their food security performance[20]. A total of 68 unique indicators were recorded for the assessment year 2022. The fourth dimension (Sustainability and Adaptation) is the focus of this discussion.

Sustainability and Adaptation represent the ability to secure a stable food supply over a long period. This dimension involves topics such as environmental sustainability and climate change, and addressing these factors is crucial in ensuring a steady food supply for generations to come. Specifically, the Global Food Security Index (GFSI) dimension "assesses a country's exposure to the impacts of climate change; its susceptibility to natural resource risks; and how the country adapts to these risks". Overall, 20 specific indicators have been utilised for this fourth dimension, covering output-based while capturing the climate resilience of a country. These indicators include, among others, climate exposure, water resources, land conditions, conditions of natural water bodies (rivers, lakes, and oceans), political commitment to adaptation, and disaster risk management.

This chapter focused on Stability and Adaptation, which has been attributed to the lowest-scored dimension for Malaysia (see Figure 2.1). Malaysia scored the highest in Affordability at 87.0/100, followed by Quality and Safety at 74.7/100, Availability at 59.5/100, and Sustainability with Adaptation at 53.7/100. Specifically, the 'supply' in the availability dimension scored the lowest. When this value is coupled with the lowest scored dimension of Malaysia at 53.7 for Sustainability and Adaptation (global sub-category ranking of 57th), these factors underscore the importance of addressing the food security of Malaysia through its weakness: **climate change (especially on climate adaptation)**. If this issue is not addressed, this concern can jeopardise the food supply and the availability dimension.

[17] FAO (1996)
[18] Simon (2012); Economist Impact (2022a)
[19] Che Omar (2022)
[20] Economist Impact (2022a)

Figure 2.1: The 2023 Malaysian Food Security Performance Based on the GFSI Assessment



Source: Adapted from GFSI country ranking 2022, Malaysia

2.1.2 Climate Change Impact on Food Security and Smallholders[21]

Climate Definitions

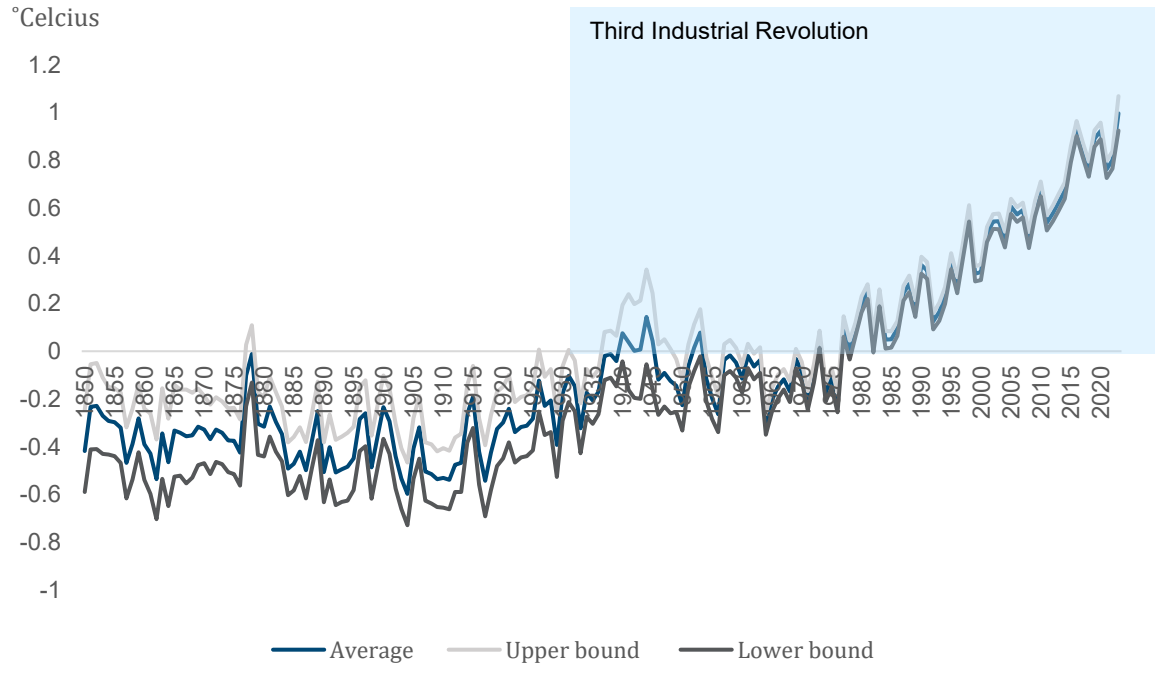
The National Aeronautics and Space Administration (NASA) defines **weather** as "the more local changes in the climate we see around us, on short timescales from minutes to hours, to days to weeks. Examples are familiar – rain, snow, clouds, winds, thunderstorms, sleet, and hail"[22]. Meanwhile, the United Nations Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (AR6) report denotes **climate** as the "… average weather… over a period of time ranging from months to thousands or millions of years. The classical period for averaging these variables is 30 years"[23]. In terms of **extreme weather events**, the definition is taken from the United States Agriculture Department states that "**extreme events** are occurrences of unusually severe weather or climate conditions that can cause devastating impacts on communities and agricultural and natural ecosystems. Weather-related extreme events are often short-lived and include heat waves, freezes, heavy downpours, tornadoes, tropical cyclones, and floods"[24].

[21] For this study, *smallholders* are defined in Chapter 1.
[22] NASA (2023)
[23] Al Khourdajie et al. (2022)
[24] United States Department of Agriculture (2023)

Climate Change

Climate change and global warming have been widely discussed across various sectors in recent years, from agriculture to financial sector as well as manufacturing. Throughout the history of the Earth, climate changes are not out of the ordinary. Nonetheless, what makes the occurrence of climate change different this time is the contribution of humanity. An impactful study published in the Science journal revealed 66 million years of climatic data trends, which were mainly driven by orbital variations of the Earth[25]. The study highlighted four temperature periods, namely Hothouse (where the global temperature was 10 degree Celsius [˚C] higher), Warmhouse, Coolhouse, and Icehouse. The emission of Green House Gases (GHGs) while can be found naturally, are accelerated due to human activities, and is predicted that human-led GHG emissions can cause further warming of the earth as quoted: "The IPCC projections for 2300 in the 'business-as-usual' scenario will potentially bring the global temperature to a level the planet has not seen in 50 million years,"[26]. The Our World in Data statistic findings further supported this statement: "Global average temperatures have increased by more than 1°C since pre-industrial times" [27]. Furthermore, temperatures have risen particularly during the Third Industrial Revolution (see Figure 2.2), coinciding with the increase in global GHG emissions (see Figure 2.3).

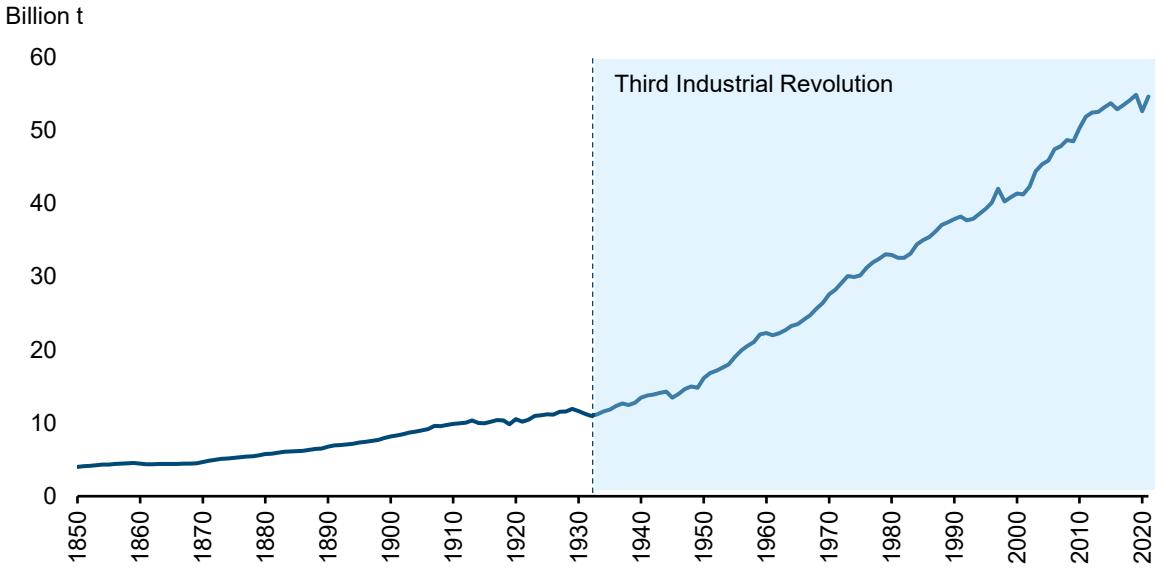
Figure 2.2: Average Global Temperature Anomaly, 1850 – 2023 (℃)



Source: Met Office Hadley Centre (2023), *CO_2 and Greenhouse Gas Emissions - Our World in Data* and Our World In Data & World Economic Forum. Note: The global average land-sea temperature anomalies relative to the 1961–1990 average temperatures. The grey lines represent the upper and lower bounds of the 95% confidence intervals.

[25] Westerhold *et al.* (2020)
[26] University of California (2020)
[27] Ritchie and Roser (2020)

Figure 2.3: The Annual GHG Emissions in CO2 Equivalents between 1850 and 2021



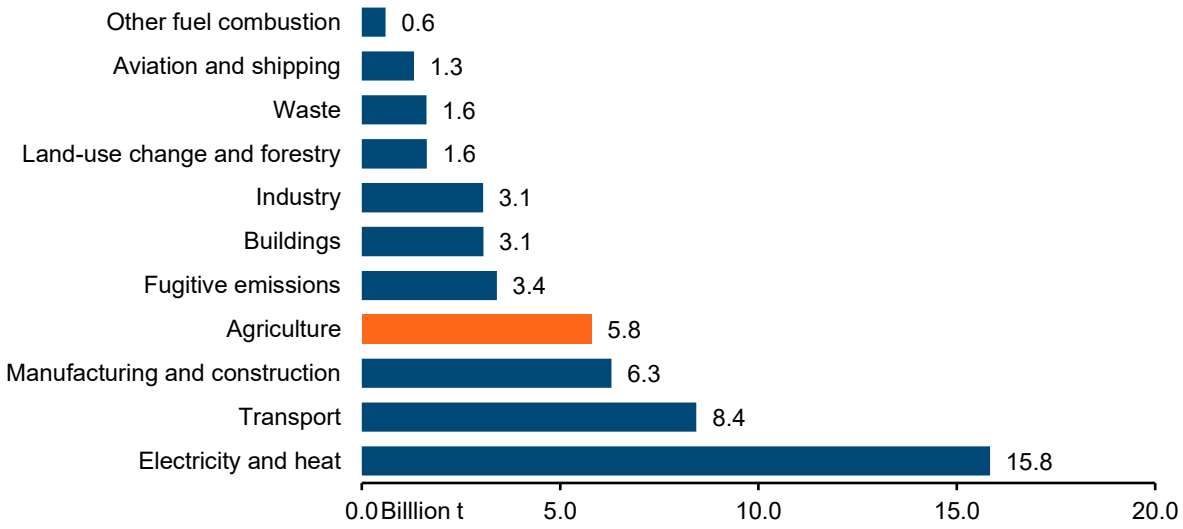
Source: Our World in Data & World Economic Forum[28]

Agriculture and Climate Change

Agriculture and food production are significant contributors to global GHG emissions, and agriculture was the fourth largest GHG emitter in 2019 by sector at 5.8 billion tonnes (see Figure 2.4). Hence, efforts should be promoted to mitigate and reduce this emission. The global human population should aim to reduce GHG emissions (specifically in agriculture) through better practices and alternative solutions (such as cellular agriculture[29]). However, within the context of Malaysia, our overall GHG contributions are minimal, and they are even lower in agriculture. A KRI publication (*National Climate Strategy: A Balanced Approach*)[30] reported that the Malaysian all-time accumulated GHG contribution from 1751 to 2020 only came up to 0.37%, in contrast to USA at 25.21% and China at 14.27%. Furthermore, global warming is expected to surpass the 1.5°C threshold[31]. This means that **for Malaysia, a more pressing focus with regards to climate change, should be towards accelerating adaptation measures**. Meaning, how well can Malaysia adapt and be resilient to the unavoidable changes of climatic conditions. This paper focuses on the need for climate adaptation among our vulnerable smallholders who are the main producers of Malaysia's domestic food. This will be expanded more in subsequent sections.

[28] Ibid.
[29] Brown (2021)
[30] Loong (2022)

Figure 2.4: Global GHGs Emissions by Sector in 2019



Source: Emissions by sector – Our World in Data

Climate Change Vulnerability Among Farmers

According to the AR6 IPCC report, there are several ways how climate change can be a risk to food security[32]. Among these are climate impacts which could be direct or indirect. With regards to direct climate impacts, it can include climate hazards including drought, flooding, and extreme temperatures. If the area affected involve food producing areas, then not only does this leads to a loss in food supply, but also economic loss. For example, in March 2023 there was a major flood in the state of Johor in Malaysia, which damaged a lot of the agricultural lands, costing a loss of up to Ringgit Malaysia (RM) 35.5 million[33]. Besides local incidences captured by the local media, Scientists have also conducted complex modelling work to show the global impact of climate change.

Published in a Nature paper, a group of Scientists tracked the projected yield changes of 12 major crops over the twenty-first century[34]. As temperatures begin to be warmer, both yields and incidence of pests are expected to increase at higher latitudes (places that used to be colder). In contrast, the tropics will see little to no productivity gains. This finding is a concern for Malaysia, being on the equator. In other studies, temperature warming has reduced wheat yields by up to 5.2% from 1981 to 2009 in India[35].

[32] Al Khourdajie et al. (2022); Andy Reisinger et al. (2020).
[33] Yee (2023)
[34] Chaloner, Gurr, and Bebber (2021)
[35] Gupta, Somanathan, and Dey (2017)

Climate impacts to food security can also be indirect such as through pest and pathogen outbreaks triggered by changes in weather conditions. According to Chaloner et al. (2021), changes in climate meant that there are alterations in pest outbreaks. Temperature is often a major factor in disease onset[36]. Due to this, global distributions of pathogens have moved in line with historical global warming[37]. Meaning, pathogens are now moving poleward. This means that our smallholders not only need to be prepared for natural disasters, but also the onset of more frequent/unexpected disease outbreaks or new diseases. This comes to the next area of discussion: adaptation.

An important concept to understand is that extreme weather events are nearly impossible to avoid. Nonetheless, vulnerabilities can still be addressed and mitigated among Malaysian food producers, providing a more resilient food system through effective adaptation strategies. But what is adaptation?

According to the IPCC, adaptation is "the process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities "[38]. Adaptation is how individuals react, maintain, or build resilience against current or future change[39]. **A farmer's resilience or adaptive capacity in food production refers to their ability to withstand natural disasters affecting their crops or to anticipate and prepare for changes in an optimal farming environment**.

For example, an educated, large-scale farmer can be well-financed (good bookkeeping skills) and tech-savvy. This farmer uses weather detection sensors and accesses satellite imagery data to detect early signs of a drought or disease onset (leaf colour or soil moisture changes). The farmer also identifies the upcoming storm through excellent information and communications technology (ICT) connections. These upgrades suggest they can respond quickly and appropriately to minimise crop losses. Even under an unexpected natural disaster causing the loss of all crops, owning insurance or significant capital implies that the farmer can resume operations in the next season. Unfortunately, this ideal scenario is not a reflection of the largely poor and uneducated smallholders that lacks these climate resilience characteristics and tools.

Smallholders around the world have been shown to be relatively vulnerable to climate change. This is especially true since they lacked economies of scale, lacking in the adoption of climate-resilient technologies, mostly depend on rain-fed agriculture, and lack financial support[40]. These smallholders, makes up a large part of our global food producers. A recent study predicted that there are more than 475 million farms (less than 2 Ha) globally, covering 80% of all farms[41]. Importantly, the cited study also showed that these farms are mostly found in South Asia, Southeast Asia, and sub-Saharan Africa and were found to be responsible for more than half of the calories consumed within the region. The matter here is, how well can smallholders adapt to changes in the climate?

[36] Delgado-Baquerizo *et al.* (2020)
[37] Bebber, Ramotowski, and Gurr (2013)
[38] Pachauri *et al*. (2014)
[39] Smit and Wandel (2006)
[40] Morton (2007); Donatti *et al*. (2019)
[41] Lowder, Skoet, and Raney (2016)

Cohn et al (2017) mapped and did literature review to compare the climate situation of smallholder systems against other agricultural systems. The authors discovered that the future adaptive capacity of these smallholders was uncertain and depended on the severity of climate change and the socioeconomic factors within the respective regions[42].

In Malaysia, agriculture land use is split between commodities at 7.5 million Ha[43], and food production, at 5.4 million Ha[44] in 2020. Contrary to commodities, for domestic food production, Malaysia relies mostly on smallholders. In total, there are about 466,124 fruit and rice producers[45], 20,295 aquaculturists[46], and 41,257 livestock growers[47]. The precise number of smallholders are uncertain because while statistical records of farmers are available, their status as smallholders can be confusing or inconsistent. Thus, we can only make assumptions based on limited available data. The best estimate is that there are no less than 50,000 smallholders for fruits, vegetables, aquaculture, and livestock[48], and no less than 150,000 paddy smallholders[49] within Malaysia.

So, how vulnerable is Malaysia's food production system, especially smallholders, to extreme weather events? Additionally, since they are our main producers of food, how does that make our domestic food supply resilient to climate change? A recent study by Alam *et al*. (2017) established that climate change-related incidences (drought, flood, disease outbreaks, and changing crop cycles) negatively impacted 198 paddy farmers in Northwest Selangor[50]. The study revealed that approximately 64% of the respondents agreed that climatic changes within their planting areas affected their paddy production. Likewise, Solaymani (2018) analysed the responses of different rainfall and temperature scenarios using a computable general equilibrium (CGE) model. The study discovered that the productivity of primary food sources (paddy, vegetable, fruit, and livestock outputs) in Malaysia declined due to excessive precipitation and temperature anomalies[51].

Literature review showed that there are climate-related studies on specific areas or weather models for Malaysia on food production as elucidated in the previous paragraphs. **However, there is no nationwide study measuring the climate risk of smallholders in Malaysia. Knowing the climate risk and its contributing factors for smallholders nationwide can help policymakers craft targeted adaptation strategies by prioritising areas at highest risk and being able to discern the risk due to climatic exposure or vulnerabilities related to socio-economic factors.**

[42] Cohn *et al*. (2017)
[43] Ministry of Plantation Industries and Commodities (2020)
[44] Ministry of Agriculture and Food Security (2022)
[45] Department of Agriculture (2022)
[46] Department of Fisheries (2022)
[47] Ministry of Agriculture and Food Security (2022)
[48] Data obtained from the Ministry of Agriculture and Food Security and its Departments. The definition of a 'smallholder' was explained in Chapter 1. This data was an estimated exercise, and the numbers might not be accurate.
[49] Note that this value was the total number of paddy farmers according to *Booklet Statistik Tanaman (sub sektor tanaman makanan) 2022*. Although large-scale were recorded, most Malaysian paddy farmers work on land less than 2 Ha.
[50] Alam *et al*. (2017)
[51] Solaymani (2018)

This report measured the risk posed by extreme weather events to Malaysian smallholders (food producers). Extreme weather events (extreme precipitations, drought, and floods) were demonstrated to deviate from optimal growing conditions that impacted crop productivity or livestock. This report also defined optimal growing conditions as a combination of environmental factors [percentage humidity, temperature range, soil potential of hydrogen (pH)] enabling a particular plant or animal species to cultivate at maximum potential.

The survey data was analysed from the SEMAI survey of 3,300 Malaysian smallholders with actual weather data to elucidate smallholder climate vulnerability insights by measuring climate risk. Subsequently, the climate risk of Malaysian smallholders was measured using the recommendations made by the IPCC AR6 report and the methods used by Yusuf and Francisco (2009)[52]. The following sections describe the various related frameworks for measuring climate risk comprehensively.

2.1.3 Defining Climate Risk

The Oxford English Dictionary defines risk as "the exposure to the possibility of loss, injury, or other adverse or unwelcome circumstance"[53]. Meanwhile, the IPCC AR6[54] Working Group II report denotes risk: **"In the context of climate change impacts, risks result from dynamic interactions between climate-related hazards with the exposure and vulnerability of the affected human or ecological system"**.

The AR6 by the IPCC decomposes climate risk into hazards, exposure, and vulnerability and their corresponding definitions as follows:

i. **Hazard**: "The potential occurrence of a natural or human-induced physical event or trend that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems, and environmental resource"[55]. Examples of hazards include flooding, wildfires, and extreme heat impacting crops, livestock, and farmers.
ii. **Exposure**: "The presence of people; livelihoods; species or ecosystems; environmental functions, services, and resources; infrastructure; or economic, social, or cultural assets in places and settings that could be adversely affected"[56]. For example, a dense coastal city is more exposed than an uninhabited island to the same coastal flooding hazard.
iii. **Vulnerability**: "The propensity or predisposition to be adversely affected". Vulnerability encompasses a variety of concepts and elements, including sensitivity or susceptibility to harm and lack of capacity to cope and adapt"[57]. For example, how can a farmer respond and recover from crop damage in the event of an extreme weather event?

[52] Yusuf and Francisco (2009)
[53] Oxford English Dictionary (2023)
[54] IPCC (2022)
[55] Al Khourdajie *et al*. (2022)
[56]Ibid.
[57] Ibid.

In a similar intention, in trying to capture climate risk in Southeast Asia, Yusuf and Francisco (2009) mapped vulnerability (at the time of publication, *risk* is called vulnerability) across seven countries, including Malaysia. In this study, the authors overlayed climate hazard maps, sensitivity maps, and adaptive capacity maps in according with the 2001 IPCC vulnerability recommendations with the following illustration:

$$\text{Vulnerability} = f(\text{exposure, sensitivity, adaptive capacity})$$

exposure "the nature and degree to which a system is exposed to significant climatic variations" e.g. weather patterns

sensitivity "the degree to which a system is affected, either adversely or beneficially, by climate-related stimuli" e.g. population density

Adaptive capacity "the ability of a system to adjust to climate change (including climate variability and extremes), to moderate the potential damage from it, to take advantage of its opportunities, or to cope with its consequences".

With this, Yusuf and Franscisco (2009) showed that the drivers of vulnerability (now termed *risk*) differ between countries. The authors discovered that Indonesia's high vulnerability is related to its high population density (sensitivity), while the vulnerability in the Philippines is mainly due to climate hazards (exposure). For Malaysia, in general, the adaptive capacity is higher than the neighbouring countries. However, within Malaysia, the state with the highest vulnerability is Sabah at a score of 0.22 with exposure being the highest contributor. The Yusuf and Franscisco (2009) study investigated vulnerability generally, using the overall population of Malaysia and is limited to the state level.

Similar mappings were produced in Malaysia on a smaller scale at the sub-district geospatial resolution for several localities, including a case study in Terengganu and Pahang[58] However, **no work has been done to measure the climate risk of food producers nationwide, down to the district level. This in turn, makes it difficult to introduce effective and targeted adaptation policies to help improve Malaysia's food security against climatic incidences.** Therefore, this report assessed this exercise by referring to and adapting the studies by AR6 and Yusuf and Francisco (2009).

[58] Abd Majid *et al*. (2019); Nor Diana *et al*. (2019); Bagheri *et al*. (2021)

2.2 Methodology with Results and Discussions

2.2.1 SEMAI Survey Analysis

Methodology

Between 2022 to 2023, KNB under the DI initiative, conducted a nationwide survey of 3,300 smallholders (SEMAI). Among others, this survey included data regarding their demography, specific farm locations, and questions relevant to climate risks. The respondents can be categorised into three sectors: crop (2,100 respondents); livestock (816 respondents); or aquaculture (702 respondents) smallholders and comprise of smallholders from 13 states in Malaysia, (excluding the federal territories). The survey generated a total of 135,300 data points, of which key findings relevant to climate change, are shared in the following sections.

For a complete survey methodology, statistical details including calculations for sample representativeness, as well as general overall findings, refer to Chapter 1 of this report.

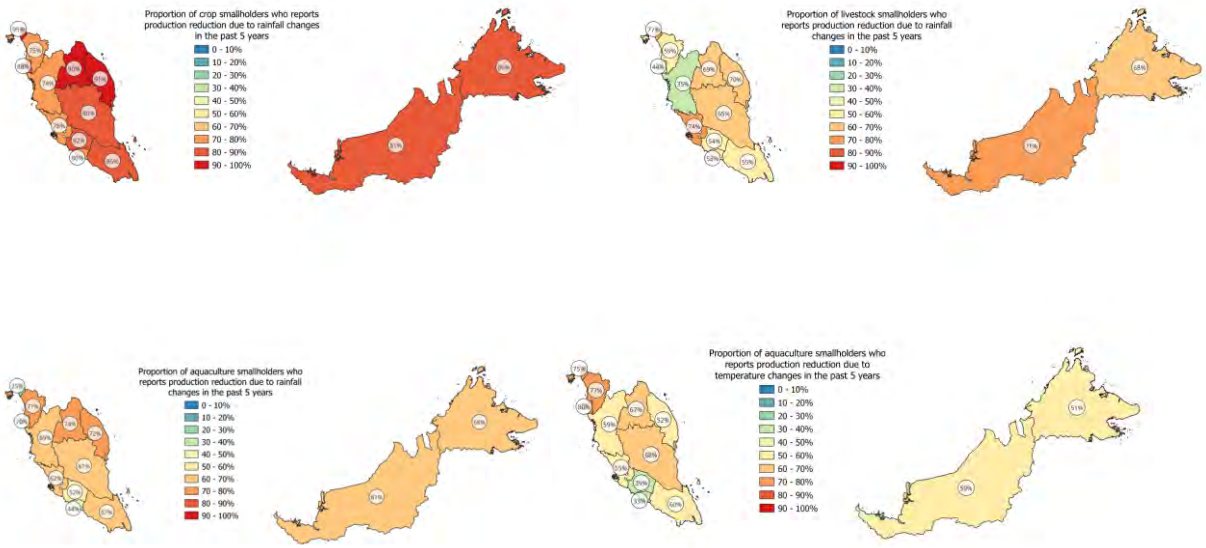
Results

According to the SEMAI survey questionnaire, concerns over climate change were among the top three challenges encountered by smallholders nationwide [59]. This observation was further supported by another survey question, in which 75.7% of the respondents either agree or strongly agree that rainfall changes affected their farm production.

When compared between agricultural industries, this survey discovered that the level of concern for certain types of extreme weather events depends on the sub-sector type (livestock, crops, or aquaculture). For example, crop growers were more concerned about rainfall patterns (Figure 2.5). More than 70% of the respondents nationwide who are in the crops sector, claimed that their production has reduced over the last five years, due to changes in the rainfall pattern. On the contrary, fewer percentage of respondents from the aquaculture and livestock sector seem to make this claim. A similar outcome is seen when asked if their production was impacted by changing temperatures, whereby crop growers are most impacted, but it is less drastic than changing rainfall patterns (Figure 2.6). This is an expected observation as crops that are grown outdoors are expected to be more exposed and sensitive to the climate, especially with regards to rain[60], as compared to a sheltered poultry farm or a shrimp aquaculture farm. Furthermore, most of Malaysia's vegetables are grown in the highlands such as Cameron Highlands and Kundasang, locations vulnerable to landslides and crop loss due to excess rain. The respondent's surveyed answers are consistent with this. Therefore, Malaysia may want to explore alternative locations/systems of growing vegetables such as controlled environment agriculture[61] in addition to improving climate adaptation factors for the smallholders within these regions.

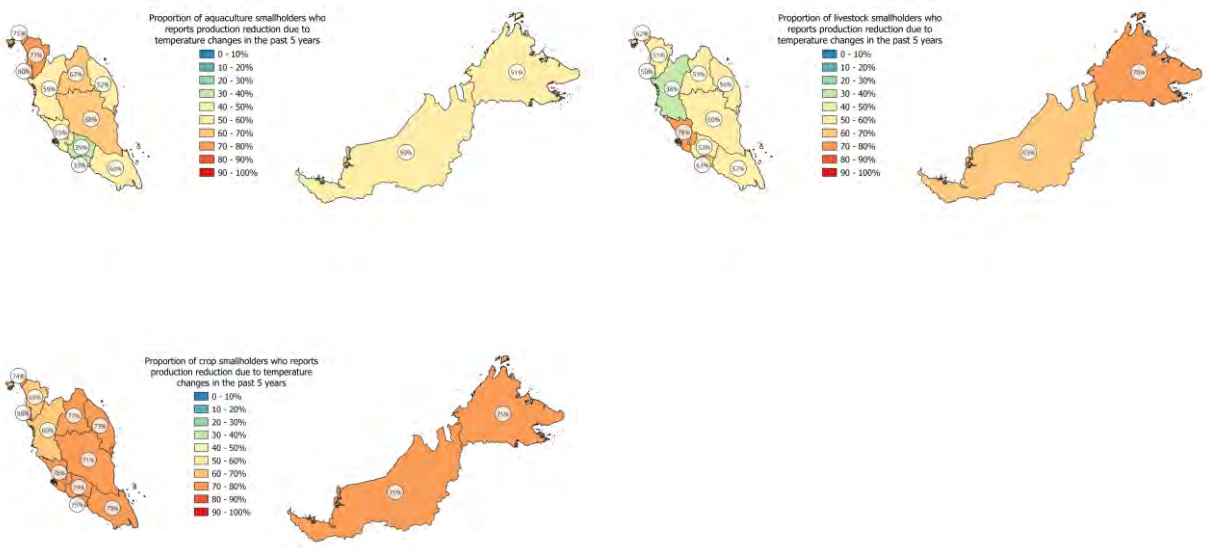
[59] Semai (khazanah.com.my)
[60] Suppiah (2020)
[61] Benke and Tomkins (2017)

Figure 2.5: Percentage of Respondents by State that Claimed Changes in Rainfall Patterns had an Effect on their Farm Production Over the Last Five Years



Source: KNB (2023), KRI Illustrations

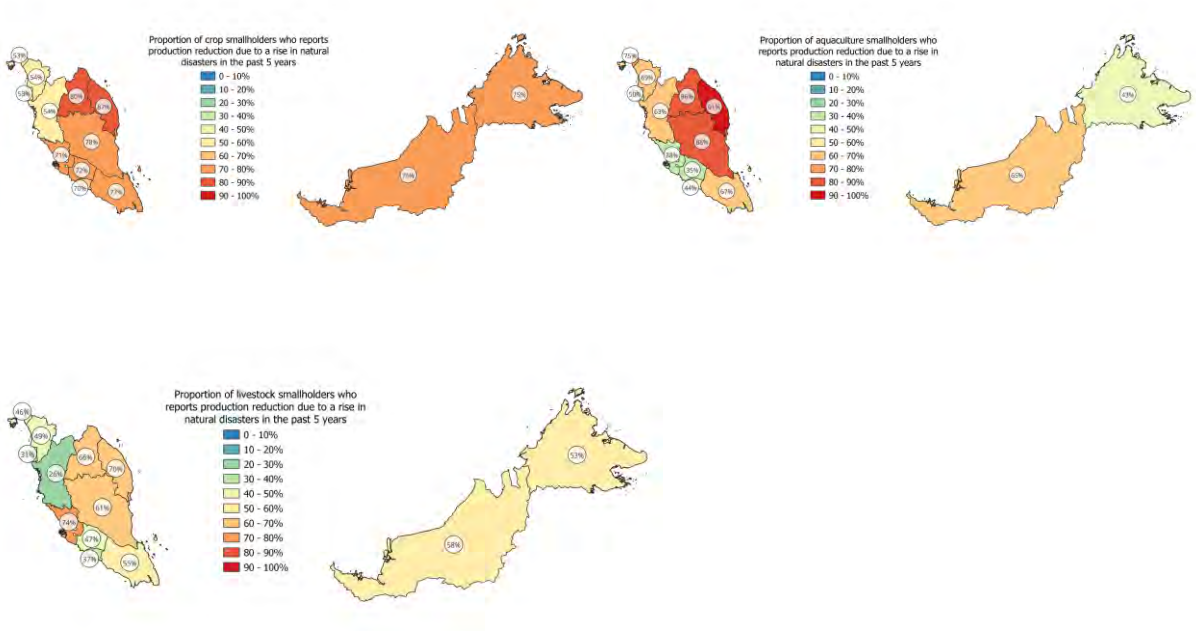
Figure 2.6: Percentage of Respondents by State that Claimed Changes in Temperature had an Effect on their Farm Production Over the Last Five Years



Source: KNB (2023), KRI Illustrations

In contrast with rainfall and temperature, the sentiment on natural disasters (floods and droughts) was more consistent across locations than sectors, whereby the top 2 states are Kelantan and Terengganu for all three sectors (Figure 2.7). This is seen to supersede the sector type as floods in Kelantan and Terengganu are severe enough to also impact livestock including sheltered farms as well as aquaculture ponds and the livelihoods of the overall population on the East Coast[62].

Figure 2.7: Percentage of Respondents by State, that Claimed to Experience Production Reduction due to Natural Disasters Over the Last Five Years



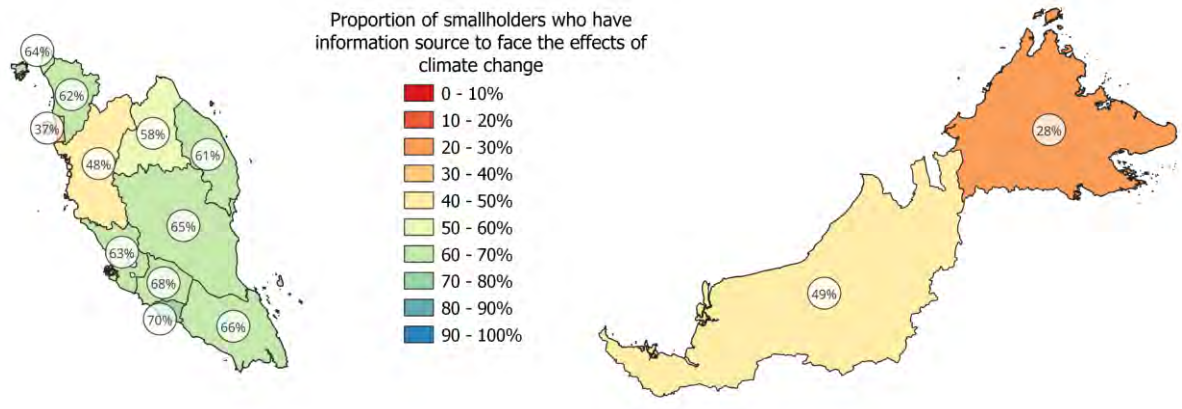
Source: KNB (2023), KRI Illustrations

In addition to capturing the respondent's perception regarding changes to the climate, the questionnaire also tries to capture the resilience of these smallholders against climatic incidences. This resilience depends on having quick and easy access to weather information, the use of ICT technologies, financial capacity to recover from damaged crops as well as income risk (sole reliance on farm for income), to name a few. For example, this survey revealed that smallholders in Peninsular Malaysia claimed to be better informed about climate change compared to Sabah and Sarawak (Figure 2.8). This suggests that raising awareness and information sharing among smallholders in Sabah and Sarawak may need to be improved if we want to improve the resilience of our food producers.

[62] Mayowa *et al*. (2015); Hashim (2019)

These preliminary statistics suggests that the impact of extreme weather events is indeed of concern among smallholders but may vary according to locations and sector type. Literature review revealed that no studies have been conducted at the nationwide level to unravel the climate risk of Malaysia's smallholders. In subsequent sections, the authors of this study used actual weather data mapped together with the locations of the smallholders surveyed and together with selected questionnaire answers, to measure the climate risk of Malaysia's smallholders.

Figure 2.8: Percentage of Respondents by State that Claims to Have Sufficient Information to Address the Impact of Climate Change on Their Farm



Source: KNB (2023), KRI Illustration

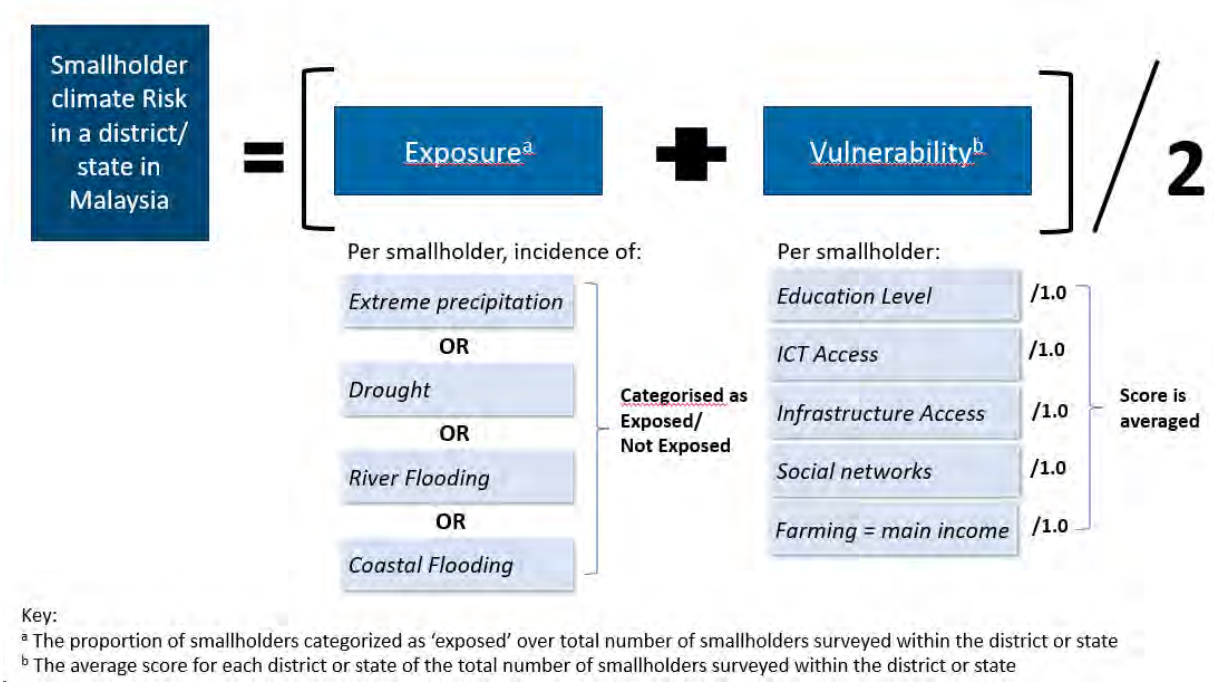
2.2.2 Measuring Climate Risk

Methodology: Measuring Risk

By referring to both frameworks of IPCC AR6 and Yusuf and Francisco (2009), we have developed and adapted a similar approach to measure the climate risks of smallholders surveyed across Malaysia using the SEMAI survey data. By incorporating learnings from both literatures, we aim to study at the national and sub-national level, the climate risk of smallholders in Malaysia. This, thus far, has not been conducted at the nationwide level. Being able to measure climate risk among smallholders at the national level was critical to understanding and developing targeted adaptation initiatives and policies.

The updated definitions for measuring climate risks were utilised, and vulnerability was a subset of climate risk. Particularly, the overall risk score as a factor of the Exposure[63] and Vulnerability dimensions was measured across Malaysia (see Figure 2.9). The smallholders' exposure to climate hazards was estimated using satellite data and available forecasting models, while smallholder vulnerability was measured using the SEMAI survey dataset. Further methodology is explained in subsequent sections.

Figure 2.9: An Illustration of the Framework Used for this Study



Methodology: (A) Measuring Exposure

A set of indicators to measure the Exposure of climate hazards has been proposed by Organisation for Economic Co-operation and Development (OECD) to standardise international and subnational comparisons[64]. The climate hazards identified in this report relevant to smallholders were extreme precipitation, drought, river flooding, and coastal flooding.

[63] According to AR6 IPPC, Hazard and Exposure are two main factors of climate risk. In this study, we measured both by quantifying the exposure *to* hazards by considering the sampled smallholder size and proportions. When referring to the indicators, the first alphabet is capitalised, example: Exposure scores and Vulnerability scores. But is not capitalized when explaining the meaning of being exposed or vulnerable.
[64] Maes *et al.* (2022)

Table 2.1: List of Exposure Indicators for Identified Climate Hazards

Hazard	Exposure indicator	Data source	Resolution
Extreme precipitation	The total number of days in 2017-2021 where the total daily precipitation amount exceeds the 99th percentile of daily precipitation values over the whole reference period of 1981-2010	Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS)[65]. Link.	0.05° (~5 km)
Drought	Average volumetric surface soil moisture anomaly[66] (the water content in a 0 to 7 cm-depth layer of soil) in 2017-2021 compared to 1981-2010	Copernicus Climate Data Source (CDS) ERA5L and monthly averaged data[67]. Link.	0.1° (~10 km)
River flooding	River flood levels with a 10-year return period	Joint Research Centre (JRC)JRC flood hazard maps at the global scale[68]. Link.	0.01° (~1 km)
Coastal flooding	Coastal flood levels with a 10-year return period	Global coastal flood hazard maps[69]. Link.	0.01° (~1 km)

In order to measure climate Exposure, several data sources that are used, as per Table 2.1. The data sources provided climate information in raster (grid cell) format. In this grid cell format, the world is divided up into little squares, each a few kilometres wide, and they are each assigned a value for the related climate phenomena. For example, the CHIRPS dataset provided the precipitation in millimetres for each of the 5km wide squares for each day in a year. A grid cell is classified as '**exposed'** when one of the following criteria is met.

a) The grid cell has more than 18 days of extreme precipitation in 2017-2021.
b) The grid cell's average soil moisture anomaly in 2017-2021 is more negative than -5%.
c) The grid cell has more than 10 cm of river flooding with a 10-year return period.
d) The grid cell has more than 10 cm of coastal flooding with a 10-year return period.

[65] Funk et al. (2015)
[66] An anomaly here is defined as the percentage deviation from the reference value.
[67] Muñoz Sabater (2019)
[68] Dottori (2016)
[69] Muis et al. (2016)

The following are justifications for the criteria set: It is expected that number of days with precipitation in the top 99th percentile to be around 4 days per year, or around 18 days for 5 years. Therefore, smallholders who are exposed to more than 18 days of extreme precipitation in 2017-2021 face a higher exposure to the effects of extreme bursts of rainfall, which can reduce yield through direct physical damage to the crops or disruptions in planting and harvesting schedules[70]. For drought, a soil moisture anomaly within 5% is considered near normal[71]. In drier conditions, the heat stress from droughts is shown to be detrimental towards crops and livestock[72]. Flooding can cause direct damage to crop and livestock, and its threat is dependent on depth, velocity, inundation duration and seasonality of the flood[73]. A 10cm flood level is chosen as a starting point for exposure monitoring.

The grids for each criteria (a) – (d) that are identified as 'exposed' areas, were then geographically mapped.

The coordinates of the smallholders are obtained by passing the collected addresses through the Maps Geocoding Application Programming Interface (API) provided by Google. These coordinates were then overlayed with areas classified as Exposed to determine whether a smallholder was exposed. Subsequently, the calculation for Exposure scores at the State level is calculated as such: Each smallholder was assigned a TRUE or FALSE status for each of the four hazards (a) – (d) if the location of the smallholder overlaps with a grid that is categorized as 'exposed'. TRUE if it is exposed, and FALSE if it is not exposed. A smallholder was 'exposed' if there were more than 1 hazard that is TRUE. The score for each state, is therefore, the proportion of the Exposed smallholders over the total number of smallholders surveyed within the state. Similarly, the same calculation was conducted for Exposure scores at the district level.

Methodology: (B) Measuring Vulnerability

In contrast with physical measurements like rainfall, vulnerability is an abstract concept that does not have a universal objective measure or unit. Previous studies have also indicated that there is no unified framework to measure vulnerability[74]. However, several such indexes have been constructed to attempt to capture the multi-dimensionality of vulnerability. The Notre Dame-Global Adaptation Initiative (ND-GAIN) Country Index measures the vulnerability of countries in the context of climate change across the six sectors of Health, Food, Ecosystems, Habitat, Water, and Infrastructure[75]. Furthermore, each sector has six indicators, two each for the three components of "Exposure", "Sensitivity" and "Adaptive Capacity". These three components are reminiscent of the framework used by the Fifth Assessment Report (AR5) of the IPCC.

[70] Y. Li *et al*. (2019)
[71] Wu *et al.* (2011)
[72] FAO (2021)
[73] Bremond, Grelot, and Agenais (2013)
[74] X. Xu *et al*. (2020)
[75] Chen *et al*. (2015)

Here is a non-exhaustive list of indicators selected from the "Adaptive Capacity" component across the sectors:

i) Access to reliable drinking water (Water)
ii) Access to improved sanitation facilities (Health)
iii) Quality of trade and transport-related infrastructure (Human Habitat)
iv) Paved roads (Human Habitat)
v) Electricity access (Infrastructure)

In addition to vulnerability, University of Notre Dame Global Adaptation Initiative (ND-GAIN) also measure "readiness" through the three components of Economics Readiness, Governance Readiness and Social Readiness. Information and communications technology (ICT) infrastructure and education are two such indicators under Social Readiness.

Another vulnerability index in the context of climate change is the Livelihood Vulnerability Index (LVI) constructed under the guidelines of the Fourth Assessment Report (AR4), abbreviated as LVI-IPCC[76]. The seven major components used in this index are Natural Disasters and Climate Variability, Socio-demographic Profile, Livelihood Strategies, Social Networks, Health, Food, and Water. Percent of households dependent solely on agriculture as a source of income is one such indicator under Livelihood Strategies.

Referring to the SEMAI survey of smallholders, several questions within the questionnaire were identified to be suitable for quantifying smallholder vulnerability with relevance or similarity to the ND-Gain and other literatures. Five sub-indicators were developed, each having a score from zero to one (Table 2.2). These sub-indicators consider not just their adaptive capacity in the face of climate change from a food security perspective, but also how susceptibility of their livelihoods towards climate change.

In this paper, the simple average of these five indicators is termed the smallholder vulnerability index, which was calculated for each smallholder. The average score across all smallholders were then calculated for each subnational unit, e.g., districts or states.

[76] Hahn, Riederer, and Foster (2009)

Table 2.2: Five Sub-indicators Used to Measure Smallholder Vulnerability to Climate Change

Sub-indicator	SEMAI Question No.	Condition	Assigned Vulnerability Score	Research papers indicating that this sub-indicator is important for measuring vulnerability
Highest level of education	A7	No formal schooling	1	Xu et al (2020), Chen et al. (2015)
		Primary school	2/3	
		Secondary school	1/3	
		Post-secondary (including diploma, bachelor's degree, master's degree, or PhD)	0	
ICT access	E1	Has neither smartphone nor internet access	1	Yusuf and Francisco (2009), Cohn et al (2017), Xu et al (2020), Chen et al. (2015)
		Has either smartphone or internet access but not both	1/2	
		Has both smartphone and internet access	0	
Infrastructure access	B9	Lack of infrastructure (including roads and irrigation systems) is a major challenge	1	Yusuf and Francisco (2009)
		Lack of infrastructure is not a major challenge	0	
Social networks	A10	Does not participate in any farming associations	1	Cohn et al (2017), Xu et al (2020)
		Participates in community, district, state, or national farming associations	0	
Farming as main income	A8	Main income is from farming	1	Xu et al (2020), Shaffril et al (2020)
		Main income is not from farming	0	

Source: KRI

Methodology: Measuring Risk (A) + (B)

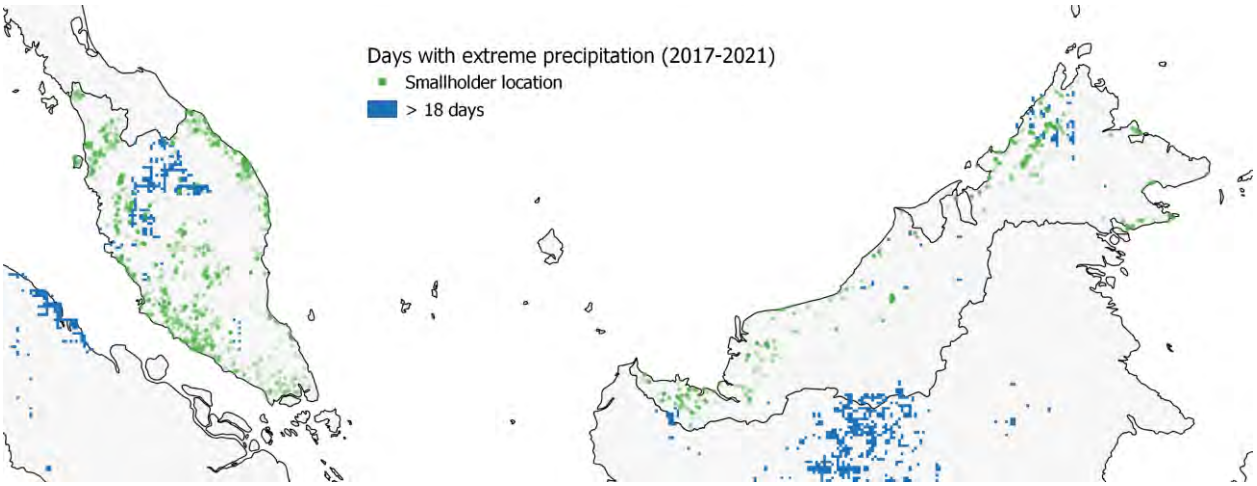
To elucidate more meaningful data, firstly the authors of this work mapped both Exposure and Vulnerability scores prior to combining it into a final Risk score. This was done by calculating the proportion of Exposed smallholders and the average score of smallholder climate Vulnerability, for each state. To highlight states/districts that are relatively higher in Exposure, a state/district was classified as Exposed when the proportion of Exposed smallholders exceeded the mean across all states. Similarly, a state was then classified as Vulnerable when the average score of smallholder climate Vulnerability exceeded the mean across all states. A similar step was also performed for the district level (Figure 2.18 and Figure 2.19). The objective of this is to be able to understand which areas are more exposed to extreme weather events, were vulnerable to climate change but were not exposed to extreme weather events or were Exposed and Vulnerable. This process allowed for more informative data before generating an overall Risk score for targeted policy actions.

The calculated composite indicators for Exposure and Vulnerability were then combined using a simple additive aggregation method[77] (Figure 2.20) and then divided by the number of composite indicators: two (Exposure and Vulnerability) to get a maximum score of 1.0 for climate Risk. This was done to provide an overall picture of climate resilience among Malaysian smallholders surveyed (but it may not provide more granular insights than the method mentioned in the previous paragraph).

Results: (A) Exposure

As shown in Figure 2.10, the northernmost side of the Peninsula that is part of Kelantan and Perak, as well as parts of northwest Sabah are exposed to extreme precipitation. The maps for 2021 and for the 10-year period of 2011 – 2021 are available in the Appendix D.

Figure 2.10: Areas with Extreme Precipitation (>18 days) Over a Five-year Period

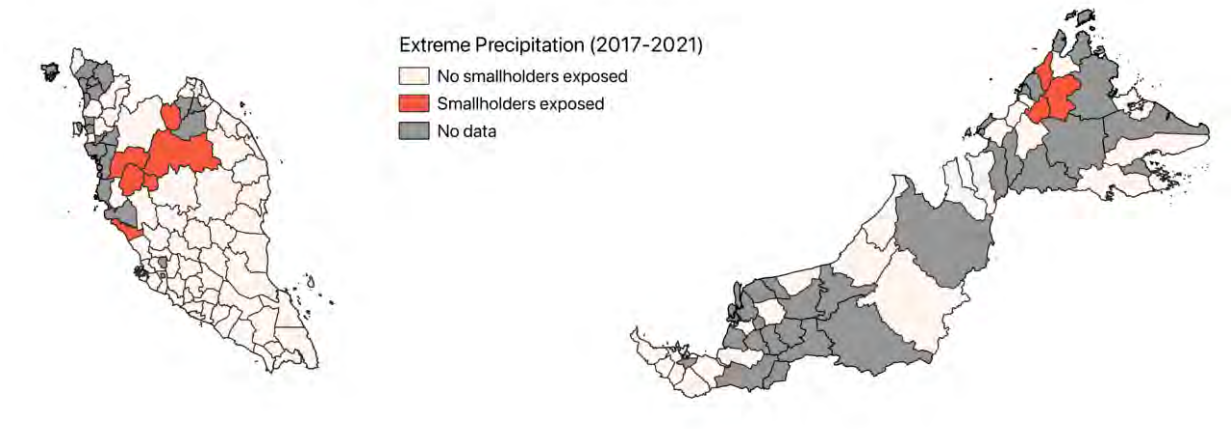


Source: KR Illustration

For visual clarity purposes, the data were then simplified according to districts. According to Figure 2.11 districts with smallholders exposed to extreme precipitation include Sabak Bernam (Selangor), Kinta and Kuala Kangsar (Perak), Gua Musang and Jeli (Kelantan), Cameron Highlands (Pahang), Tambunan, Ranau and Kota Belud (Sabah). Among exposed districts, the mean of the proportion of smallholders affected is 19% with a standard deviation of 27%. The quartiles 3%, 11%, 23%. The minimum is 0.7% (Ranau) while the maximum is 91% (Cameron Highlands). Note that some districts have no survey respondents, and districts with less than 10 respondents are also eliminated from this exercise because it is deemed unable to provide meaningful insights. This applies to all subsequent district-level maps.

[77] Joint Research Centre-European Commission (2008); European Commission (2020)

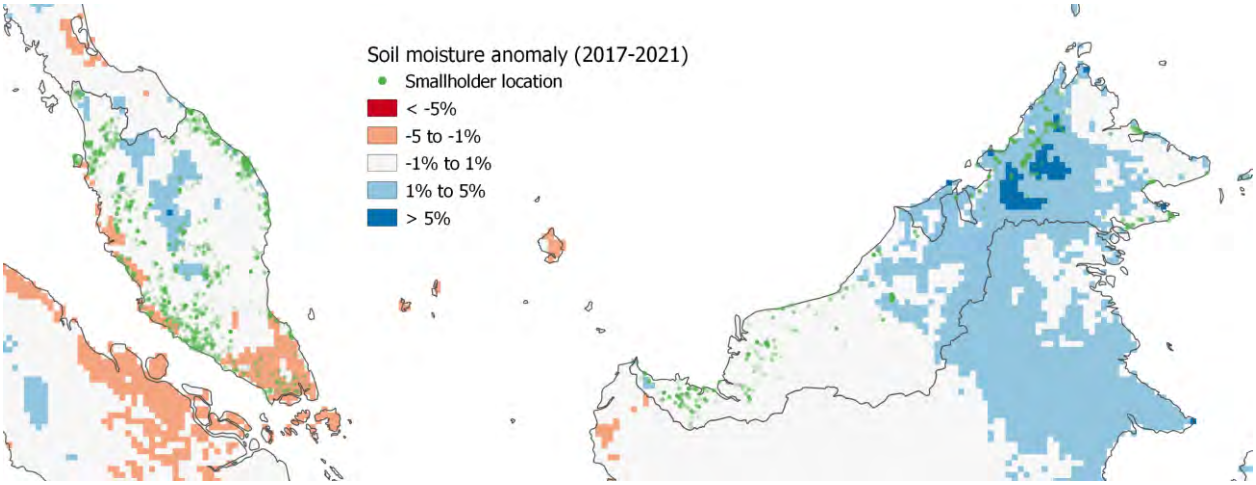
Figure 2.11: Exposure to Extreme Precipitation (>18 days) Among Surveyed Smallholders, by District



Source: KR Illustration

Referring to Figure 2.12, although some parts along the west coast of the Peninsula and the southern parts are slightly dry, they did not cross the -5% threshold to be considered as a drought. Sabah and Sarawak are relatively moist, with increased soil moisture in the region between Sarawak and Sabah. **Therefore, no smallholders were classified as exposed to drought within this paper's classification of soils moisture anomaly (b) in the methodology section**.

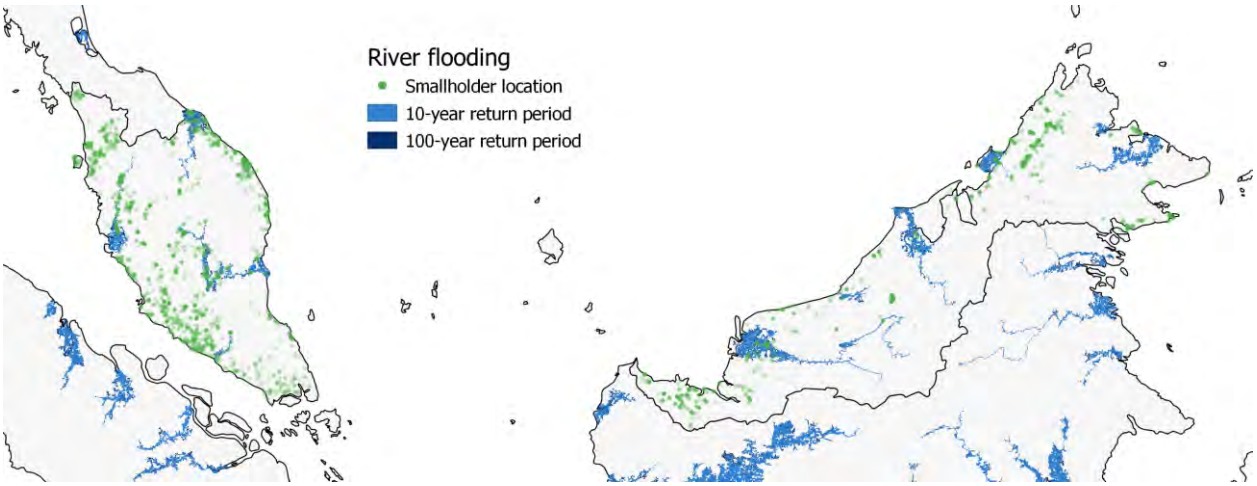
Figure 2.12: Areas with Soil Moisture Anomalies Based on Grid Cell Condition Over a Five-year Period



Source: KR Illustration

In the Peninsula, areas near the Perak River, Kelantan River, Pahang River, and Muar River were exposed to river flooding with a 10-year return period (Figure 2.13). In Sarawak, the Baram River and the mouth of the Rajang River are exposed. In Sabah, the areas around Padas River and Kinabatangan River are exposed. River flooding with a 100-year return period is mapped here to demonstrate that it does not differ significantly from those locations which are exposed to 10-year return period river flooding.

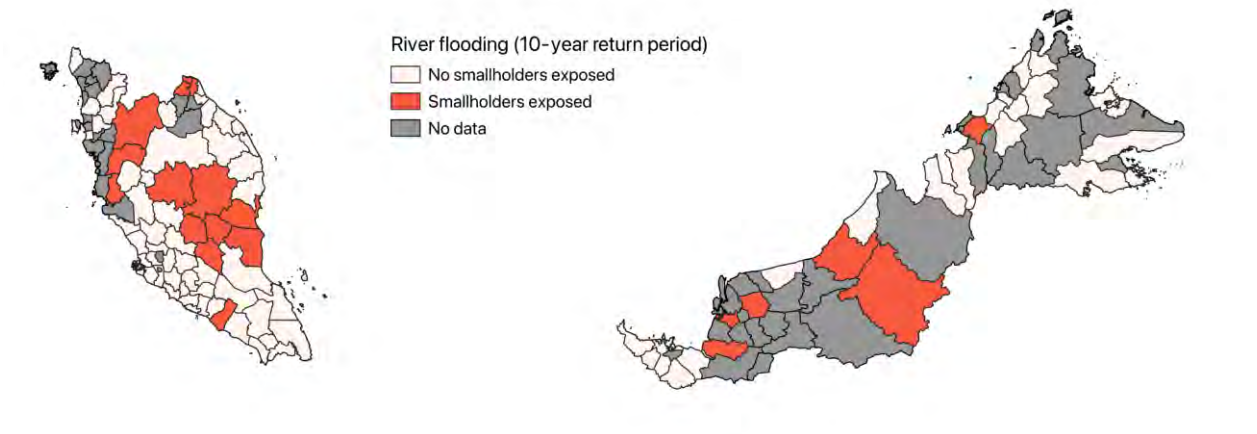
Figure 2.13: Areas with River Flooding



Source: KR Illustration

According to Figure 2.14, districts with smallholders exposed to river flooding include Muar (Johor), Hulu Perak, Kuala Kangsar and Perak Tengah (Perak), Pasir Mas, Tumpat and Kota Bharu (Kelantan), Lipis, Jerantut, Kuantan, Temerloh, Maran, Pekan and Bera (Pahang), Betong, Sarikei, Sibu, Bintulu and Belaga (Sarawak), and Beaufort (Sabah). Among exposed districts, the mean of the proportion of smallholders affected is 46% with standard deviation 25%. The quartiles are 23%, 44%, 66%. Specifically, the minimum and the maximum proportions of smallholders affected were 8% (Betong) and 90% (Pekan), respectively.

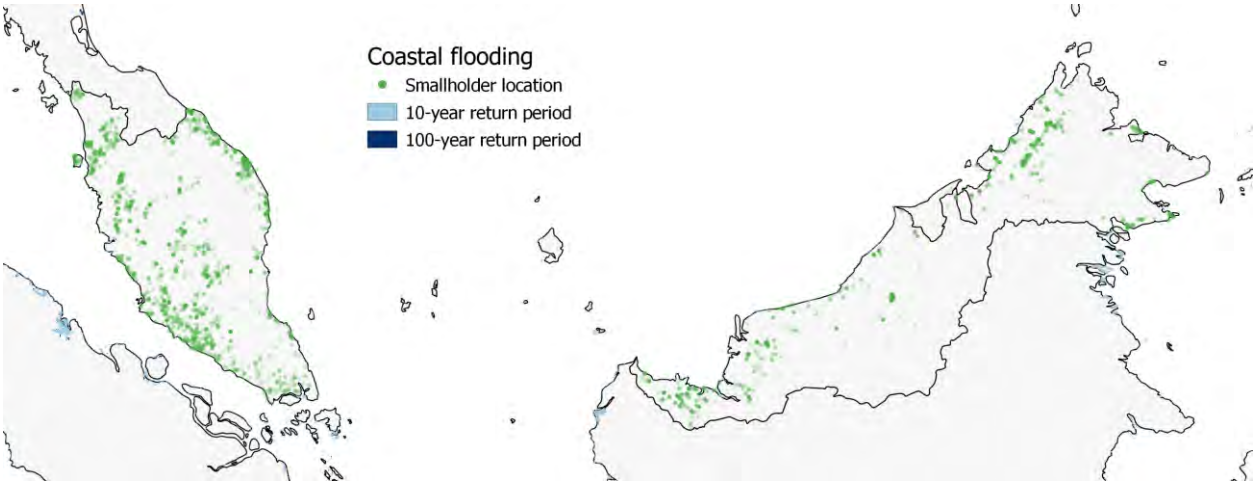
Figure 2.14: Exposure to River Flooding Among Surveyed Smallholders, by District



Source: KRI Illustration

Referring to Figure 2.15, no smallholders are exposed to coastal flooding using either the 10-year return period or 100-year return period.

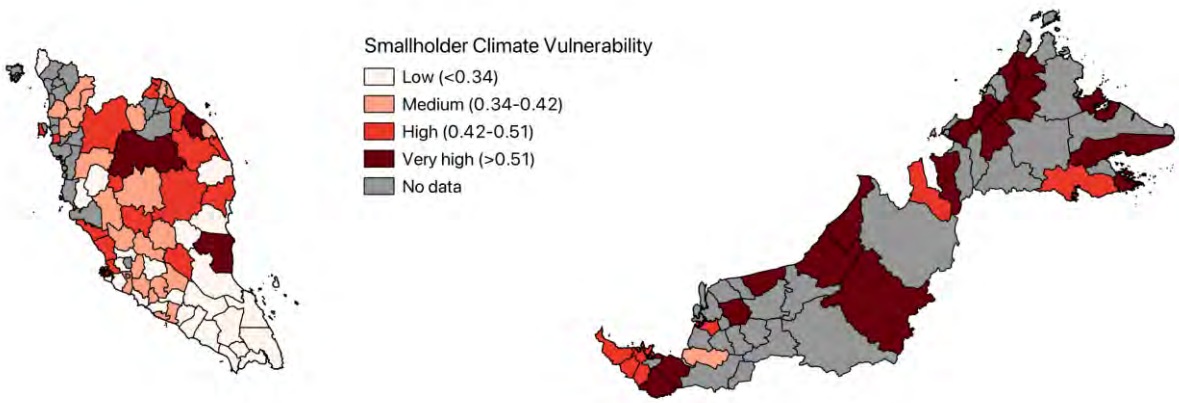
Figure 2.15: Areas with Coastal Flooding



Source: KRI Illustration

Results: (B) Vulnerability

Figure 2.16: Climate Vulnerability of Surveyed Smallholders, by District



Source: KRI Illustration

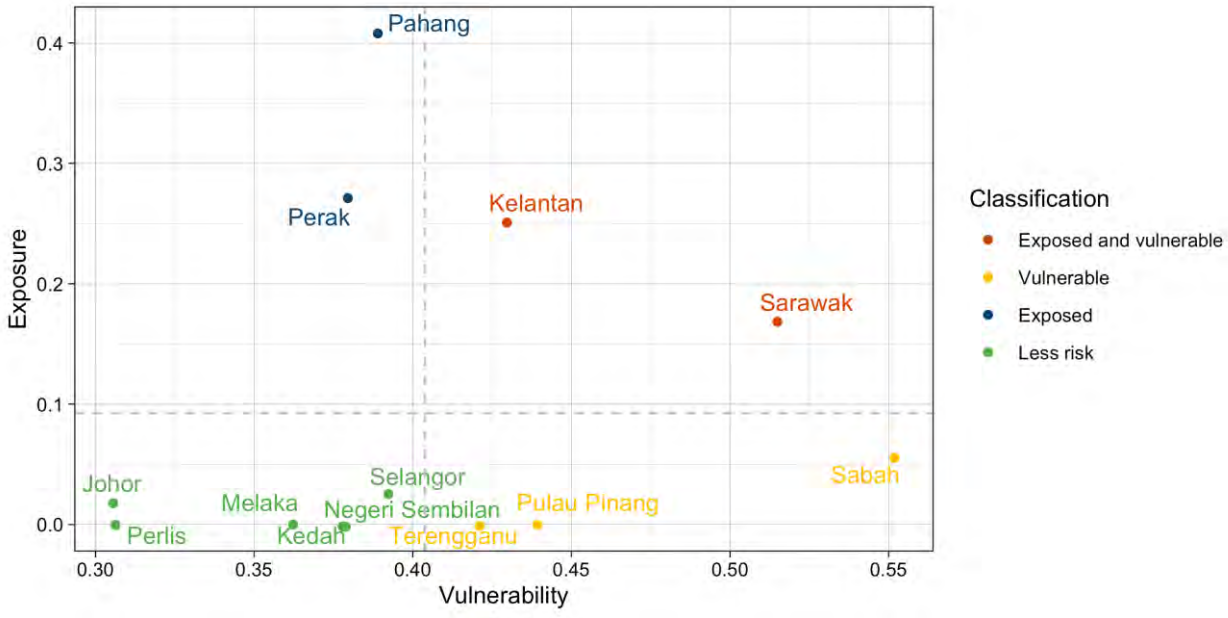
Referring to Figure 2.16, districts are classified into quartiles labelled as low, medium, high, and very high vulnerability. Except for Betong, all districts with sufficient data in Sarawak and Sabah are in the top two quartiles and thus classified as having high or very high vulnerability. In West Malaysia, Gua Musang (Kelantan), Setiu (Terengganu), and Pekan (Pahang) are classified as having very high vulnerability. All districts in Johor are classified as having low vulnerability. Detailed maps for each component of the vulnerability index are available in the Appendix D.

The principal component analysis (PCA) was initially proposed to assign weightage to the vulnerability calculation instead of a simple average. Nevertheless, this approach was rejected due to the limited number of variables and to retain ease of interpretation. Therefore, rescaling each indicator by their maximum and minimum values in the dataset was considered. For example, the district Kinta, Perak, acquired the highest percentage of smallholders in farming associations (72%) among all districts. The vulnerability score for Kinta for the social network sub-indicator was 0.23, indicating that 23% of the smallholders were not involved in an association. Given that Kinta possessed the lowest score among all districts, this district could be reassigned the best score of 0 instead of 0.23 if rescaling was performed. On the contrary, the original scaling was selected to benchmark against hypothetical worst and ideal best cases while minimising complexities. If all districts obtained a C as their "grade" in infrastructure, the standards were not lowered by giving A grades to award the relatively better districts.

Results: Mapping Climate Risk

The Exposure and Vulnerability scores of smallholders by state was plotted in Figure 2.17. For example, Pahang has an Exposure score of 0.41 because 41% of its surveyed smallholders are exposed to climate hazards. Specifically, 37.7% of them are exposed to river flooding along Pahang River, and 3.3% of them (which are at Cameron Highlands) are exposed to extreme precipitation. Note that the percentage might add up to more than the Exposure score, because a smallholder can be exposed to more than one climate hazard, but its contribution to the score will be as if it is exposed to only one. From this figure, the states of Kelantan and Sarawak are outliers within the top right section of the graph, as being both Exposed and Vulnerable.

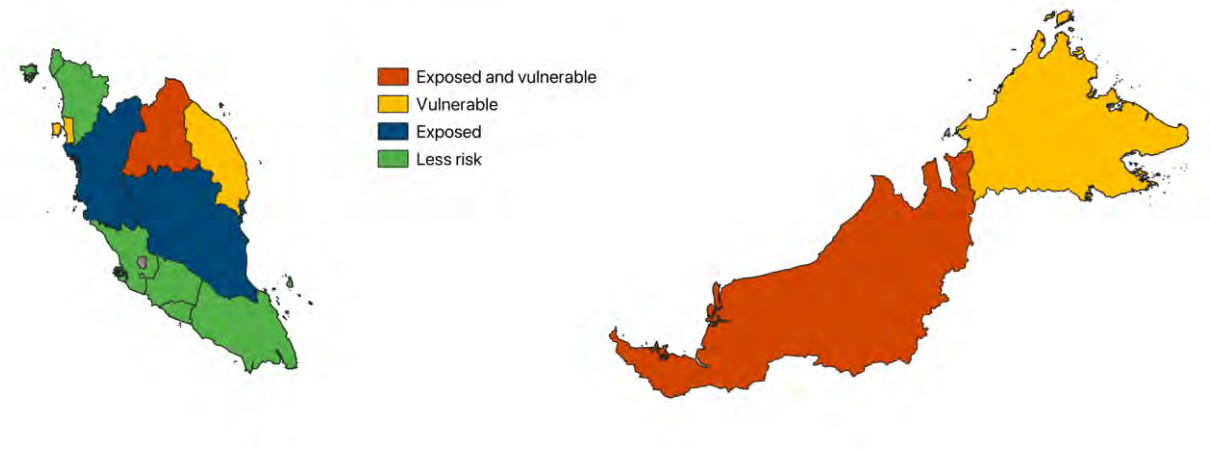
Figure 2.17: Exposure and Vulnerability of Smallholders, by State



Source: KRI Illustration

In Figure 2.18, the mean proportion of smallholders exposed across states is 9%, while the mean vulnerability score across all states is 0.40. The states in Southern Peninsula (Johor, Melaka, Negeri Sembilan), along with Selangor, Kedah, and Perlis were classified as neither exposed nor vulnerable. Pahang, Perak, Kelantan, and Sarawak were classified as exposed. Penang, Kelantan, Terengganu, Sarawak, and Sabah were classified as vulnerable. Note that Kelantan and Sarawak were classified as both Exposed and Vulnerable as per the Figure 2.17. This implies that at the state level, both Kelantan and Sarawak require urgent policy actions to help improve climate adaptation among its smallholders.

Figure 2.18: Climate Exposed/Vulnerability Mapping of Smallholders, by State

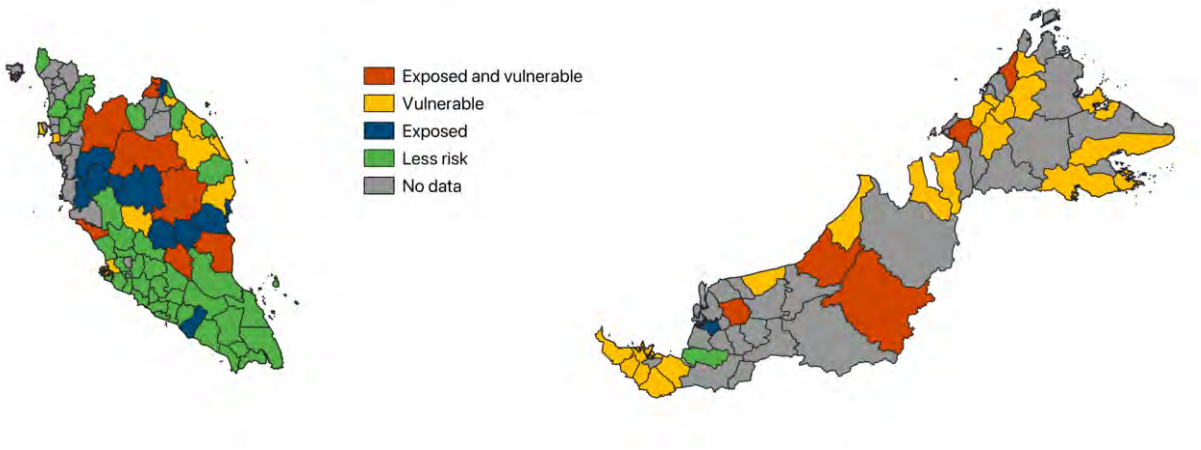


Source: KRI Illustration

In contrast with districts, statistical representativeness is achieved on the state-level data. However, it must be emphasized that states classified as neither Exposed nor Vulnerable can still have pockets of communities that are Exposed or Vulnerable. In this case, data at the district level may provide further insights. Similar to states, districts are classified as Exposed if the proportion of exposed smallholders exceeds the mean across all districts, and Vulnerable if the average smallholder vulnerability exceeded the mean across all districts.

In Figure 2.19, the mean proportion of exposed smallholders is 11%, and the average smallholder vulnerability is 0.42. Except for Betong and Sarikei, all districts in Sarawak and Sabah were classified as Vulnerable. Although most districts in Johor and Selangor were classified with less risk, Muar and Sabak Bernam were classified as Exposed, while Klang and Sabak Bernam were classified as Vulnerable. **Most importantly from this study, it showed that Sibu, Belaga and Bintulu in Sarawak, Kota Belud and Beaufort in Sabah, Pasir Mas, Hulu Perak, Gua Musang, Jerantut, Bera, Pekan and Sabak Bernam in Peninsular Malaysia are examples of districts considered both Vulnerable and Exposed. It also implies climate variability at the local district level. This means that these districts require the most urgent targeted policy action especially in farm adaptation initiatives so that the smallholders are more climate resilient.**

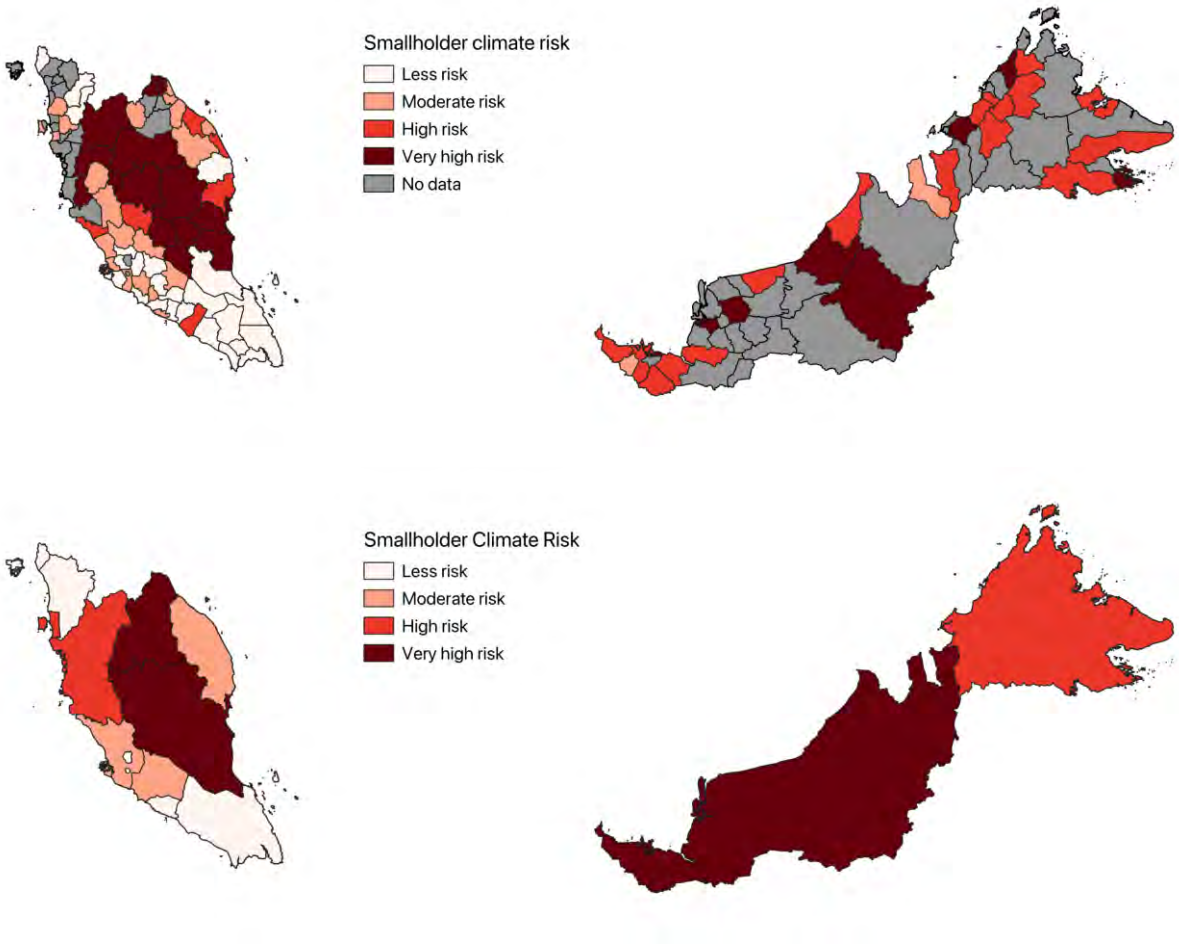
Figure 2.19: Climate Exposed/Vulnerability Mapping of Smallholders, by District



Source: KRI Illustration

In support of the above findings, when the Risk scores were calculated and mapped, Figure 2.20 showed that Sarikei, Sibu, Belaga, and Bintulu (Sarawak), Semporna, Kota Belud and Beaufort (Sabah), Gua Musang and Pasir Mas (Kelantan), Hulu Perak, Kuala Kangsar and Perak Tengah (Perak), Kuantan, Temerloh, Lipis, Cameron Highlands, Bera, Pekan, and Jerantut (Pahang), are examples of districts considered very high risk to extreme weather events. At the state level, Kelantan, Pahang, and Sarawak are categorised as very high risk, followed by Sabah and Perak. However, as elaborated earlier, having a higher risk value may provide some indication of caution but it doesn't allow targeted policy actions as detailed information on the cause of the higher score is lost. For example, the overall risk may be high for a district in Central Peninsula because it may be more exposed to the weather, but its smallholders might be moderately adapted, compared to another district that is equally high risk, but mainly because the adaptation level is very low, such as in some districts in Sabah, Sarawak, and Kelantan. As such the authors of this study emphasize using both the risk outcome (Figure 2.20) together with findings from Figure 2.17, Figure 2.18, and Figure 2.19.

Figure 2.20: Measured Smallholder Climate Risk by District and State*



Source: KRI Illustrations
Note: *Quintile categorisation was adopted

2.3 Research Limitations

Temperature exposure has not been investigated in this paper, while they have shown to be detrimental in affecting crop yield[78]. This is because it requires further data for each crop, livestock, and aquaculture, including the specific species' optimal growing temperature range which is beyond the scope of this study. Our survey findings also showed that farmers are generally less worried about temperature (longer, wider time) compared to changes in rainfall patterns (more immediate issue). One could argue that we could look at temperature exposure from the perspective of labour/farmer's health to heat shock. However, this factor is also beyond the scope of this study. Ocean acidification is also not investigated, but it may have a serious impact on aquaculture smallholders[79]. The exposure and potential adverse effects of soil salinisation, due in part to sea level rises, were also not investigated. As mentioned, the seasonality, duration and speed of the flood were also not considered when producing these maps.

The exposure of a subnational unit only counted the proportion of exposed smallholders, but exposed smallholders could vary widely in their degree of exposure. For example, no differentiation was made between smallholders exposed to 20 days vs. 50 days of extreme precipitation.

Likewise, the measurement of Vulnerability was adapted using data from a smallholder survey (SEMAI). The data available to construct the vulnerability indicator could not fully capture the multi-dimensionality of vulnerability, such as the efficiency of the local governments. Underlying theoretical problems of vulnerability indexes were also present due to the inherent unverifiable nature of vulnerability, which was not explored further in this report[80]. Furthermore, the diversity of smallholder sectors was not considered when calculating the Exposure score. For example, soil moisture anomalies could affect crop farmers more than aquaculture farmers. Even among crop farmers, the effect of the same climate hazard on different crop varieties could vary. Therefore, future mapping can consider forecasting models, such as the Coordinated Regional Downscaling Experiment (CORDEX)[81].

[78] Myers et al. (2017)
[79] Cooley et al. (2012)
[80] Spielman et al. (2020)

2.4 Discussion and Policy Recommendations

According to published literature there are several agricultural adaptation strategies that smallholders could adopt to cope with climatic stressors[82]. Depending on the relevance to Malaysia and the outcome of this study utilising the SEMAI survey data, we have made specific comments to the following suggestions made by Cohn et. al. (2017):

i. **On-farm diversification**. A suggestion made is to diversify the types of crops and livestock grown on the farm so as to ensure that in the event of an environmental shock, the risks to crop loss could be mitigated. However, it is argued that over-diversification reduces economies of scale and specialization, which could be a bigger problem for smallholders in Peninsular Malaysia. Sabah and Sarawak tend to have subsistence smallholders whereby most of the crops grown are for own consumption and the excess is sold. In this case, some form of on-farm diversification is encouraged especially if it is for the purpose of achieving household food self-sufficiency.

ii. **Water technologies and management**. It was noted that water technologies are critical for smallholders to adapt, particularly with regards to non-irrigated places and drought. For the case of Malaysia, most main food producing areas are irrigated and the exposed locations are often related to flooding and precipitation as opposed to extreme drought. For Malaysia, water technologies and management in this case, refers to primarily flooding management (which is a local authority and federal initiatives) which warrants priority.

iii. **New crop varieties**. It is mentioned that new varieties can confer adaptive benefits to environmental shocks. This is especially true for Malaysia where our R&D efforts are behind neighbouring countries. For example, from 1961 to 2014, Malaysia only generated 35 new registered paddy varieties, while Indonesia, the Philippines and India have developed 183, 238, and 1,961 number of new paddy varieties[83]. More can be done to expedite the release of new, climate resilient varieties in Malaysia, especially for crops.

iv. **Non-agricultural adaptation**. Another adaptation strategy suggested is livelihood diversification into non-agricultural activities. Not only is it seen as a way to improve household income, but it is also seen as improving income vulnerability by having an 'insurance' against crop failure. For Malaysia, it is possible for smallholders to have other sources of income especially if we are able to improve farming efficiency and technologies (thereby requiring less labour and farm time). This could be a win-win outcome whereby Malaysia is able to still obtain a supply of domestic food but doing so without overly exposing our smallholders to income vulnerabilities.

[82] Cohn et al. (2017)
[83] Che Omar, Shaharudin, and Tumin (2019)

An important lesson for policymakers in Malaysia is that while Malaysia cannot avoid extreme weather events, the damage to crop loss can be minimised by improving the adaptation capacity of the smallholders. This process aligns with targeting and improving the weakest score in the GFSI index for the Sustainability and Adaptation dimension.

Pahang, Kelantan and Sarawak require the most urgent attention, as it is considered at very high risk to extreme weather events. That means that not only are smallholders in these areas exposed to extreme weather events, but these areas are also ill equipped to adapt and be resilient to these extreme weather events. This suggests that more financial allocations and efforts are needed to improve adaptation both at the household level (smallholders) and at the district/state level. These can be in the form of improving access to ICT, education, insurance access and options, as well as diversifying into non-farm income activities for the smallholders. Non-farm income diversification has indeed been shown to improve climate resilience. For example, highland Dusun communities in Kundasang were concluded to be the most resilient highland growers by Shaffril et al (2020) due to their off-farm income activities[84]. In another study by Salleh et al (2017), it was shown that while Malaysians living in flood-prone areas of Kelantan and Pahang are mostly aware of some form of flood insurance coverage, 44% are not confident of being able to pay for the schemes, which prompted the authors to suggest micro-takaful schemes to be able to provide some livelihood protection to these communities[85].

Improving general poverty can also help, as all four states have one of the lowest household income values, being well below the national median household income of RM6,338/month[86]. In terms of district and state, financial allocations towards improving the infrastructure of rural connectivity (both digital and physical) can help. For example, smallholders living in Kota Bharu in Kelantan, and Betong, Sarikei, Bintulu, and Sibu in Sarawak have a high risk of river flooding. State entities can target these areas for river level monitoring, early warning systems and flood prevention measures.

With the exception of the commodities and industrial crops, for Kelantan and Terengganu, paddy was the main crop being planted and it is exposed to extreme precipitation and flooding. Similarly for Sabah, the areas of Tambunan, Ranau, and Kota Belud experiences extreme precipitation. Pahang is also under the exposed category including Cameron Highlands where most of our vegetables are grown. These areas are important for paddy and vegetable crop cultivation. As such, it is recommended that there are intense research and development (R&D) put into improvising climate resilient varieties especially flood-resistant varieties, explore the value proposition of Controlled Environment Agriculture (CEA)[87] for vegetable crops especially or identify alternative areas that has lower Risk scores for crop cultivation.

[84] H. A. M. Shaffril *et al*. (2020)
[85] Salleh *et al*. (2017)
[86] DOS (2023a)
[87] Benke and Tomkins (2017)

2.4.1 Policy Recommendations

i. **Increase financial allocation and technological support to climate adaptation particularly in dealing with flooding and extreme precipitation**, for areas in Kelantan, Terengganu, Sabah, and Sarawak (Figure 2.18) for both the smallholders and to the district/states. Malaysia should access domestic and international climate finance sources such as the Adaptation Fund, the Green Climate Fund, and Global Environment Facility. In an upcoming work, colleagues at KRI will be exploring the challenges of climate finance for Malaysia.

i. **Introduce non-farm side incomes.** Smallholders within the districts that are both Vulnerable and Exposed may benefit from efforts to introduce non-agricultural side incomes to mitigate their income risks.

ii. **Intensify R&D in developing climate resilient varieties and introduce alternative systems.** New varieties are particularly critical for paddy and vegetable crops, especially flood and salt resistant varieties. It is also possible to include alternative solutions such as greenhouses or vertical farming for vegetable crops to mitigate the risks of total crop loss due to a certain extreme weather event.

ii. **Improve weather communication systems.** These systems can be enhanced between Met Malaysia with smallholders and on-site weather detection technologies in exposed states, such as Sarawak, Kelantan, Pahang, and Perak.

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Source: Cinemanikor, Shutterstock

CHAPTER

03

CHAPTER 3

Empowering Smallholders in Malaysia through MyGAP

By Nik Syafiah Anis Nik Sharifulden

"A sustainable agriculture is one which depletes neither the people nor the land"

Wendell Berry (n.d.)

3.1 Introduction

3.1.1 Definition and Relevance of Sustainability Standards and Certifications

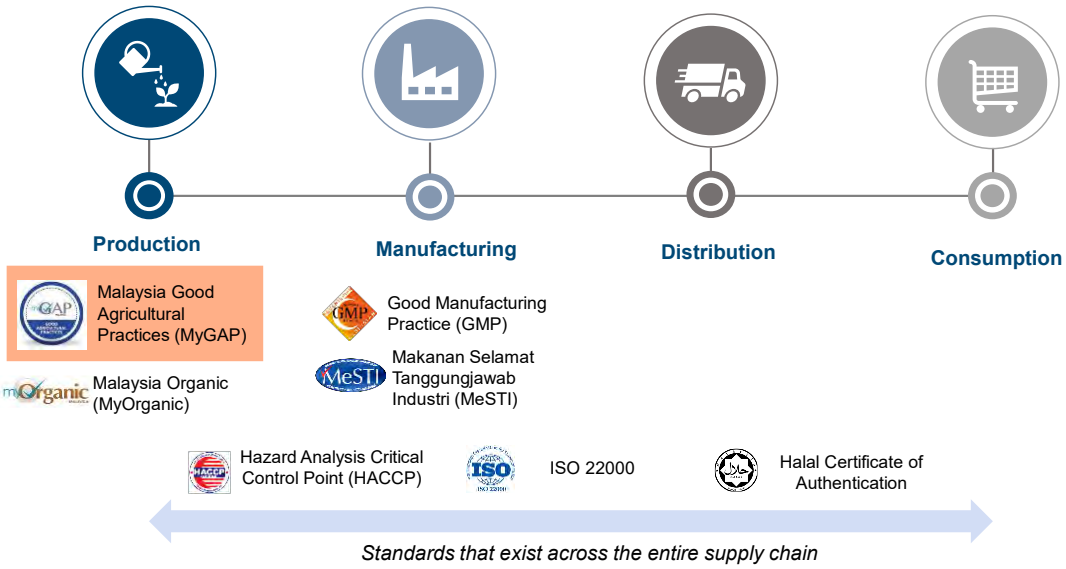
In the dynamic landscape of the agricultural sector, the adoption of sustainability standards and certification may play a role in shaping the practices and outcomes of the agrifood value chain. Standards are defined as "agreed criteria by which a product or a service's performance, its technical and physical characteristics, and/or the process and conditions under which it has been produced or delivered, can be assessed"[88]. Meanwhile, certification refers to the "broad family of voluntary standards set by third-party organisations, against which producers are independently audited and certified (or verified in some cases)"[89]. The standards within the agricultural sector have been focusing mainly on sustainable production and/or sustainability processes or practices. Several sustainability standard examples include Global Good Agricultural Practices (GlobalGAP), Fairtrade, Roundtable of Sustainable Palm Oil (RSPO), and Rainforest Alliance[90].

Standards within the agrifood value chain evolve due to many factors, such as the need to comply with more stringent public food regulations, enhance market repositioning (export purposes), eliminate barriers to market entry (beneficial for smallholders), provide a competitive advantage and fair prices, address labour rights and animal welfare, and reduce costs with food safety risks arising from extended and complicated supply chains[91].

There are numerous standards globally, and Malaysia is no exception. Generally, standards exist across all stages of the food supply chain, including production, manufacturing, distribution, and consumption stages (Figure 3.1). Standards in Malaysia are often overseen by *Jabatan Standard Malaysia*. Example of these standards include Hazard Analysis Critical Control Point (HACCP), Good Manufacturing Practices (GMP), and Halal Certification, among others. In the context of this paper, the focus, will be towards a production standard, particularly MyGAP.

[88] Nadvi and Wältring (2004)
[89] Bray and Neilson (2017)
[90] Meemken *et al*. (2021); International Trade Centre (2022)
[91] J. Lee, Gereffi, and Beauvais (2012)

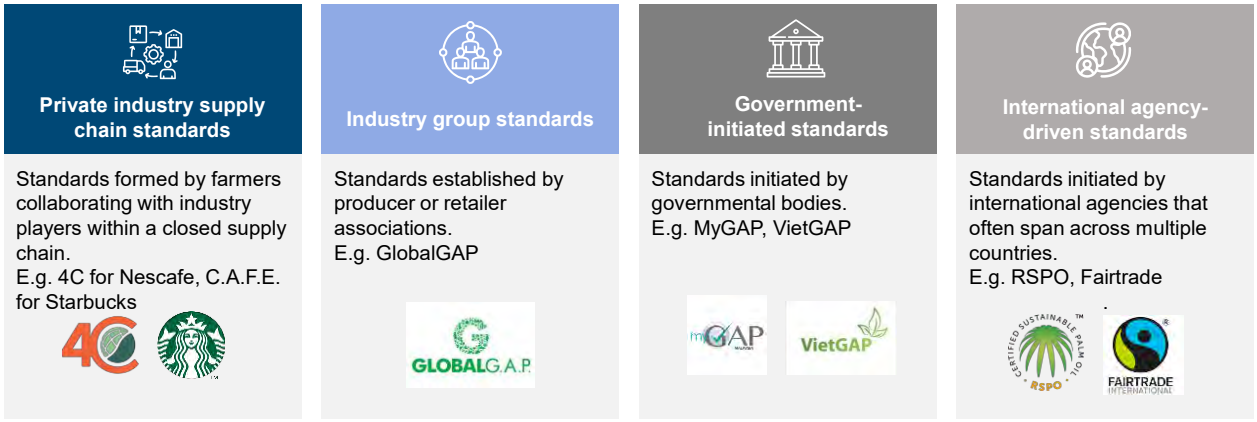
Figure 3.1: Variation of Standards Across Food Supply Chain in Malaysia



Source: KRI Illustration

Generally, standards can be classified into four groups, which include private industry supply chain standards, industry group standards, government – initiated standards, and international agency – driven standards (Figure 3.2).

Figure 3.2: Types of Sustainability Standards



Source: Adapted from Hobbs (2003)

MyGAP is under the classification of government-initiated standard, which falls in the jurisdiction of the DOA, operating within KPKM. SIRIM Berhad, appointed by the Department of Standards Malaysia, is responsible for the development of this standard.

Studies have shown that the impact of the adoption of sustainability standards within the agricultural sector has brought transformative changes in farming practices and supply chain dynamics, as it encourages environmentally conscious practices, promotes fair labour conditions, ensures responsible land use, and to some extent, improve economic conditions for the farming communities[92]. Conversely, each initiative reveals limitations or concerns. For example, stringent GAPs could potentially marginalise smallholders in developing countries, as they cannot compete with large-scale producers. The high standards often lead to higher production costs and demand higher extension services, both of which is limiting among smallholders in a developing country. Nonetheless, although the impact of certification whether in economic, social, or environmental terms may present a complex picture, especially within the context of smallholder farming, instances do exist whereby farmers have reaped benefits from the adoption of such standards and be a catalyst for improvements in cultivation practices and food quality.

Given the limited availability of arable agricultural land (only 103,563 Ha left for food production), sustainable farming practices in Malaysia are essential[93]. The GFSI measures the performances of countries on their food security through a comprehensive set of indicators. Malaysia has received a satisfactory rating for most indicators, performing significantly well on specific indicators (pest infestation with disease mitigation, soil organic content, and forest change) (see Table 3.1). However, Malaysia scored low in terms of agricultural water risk – quality, grassland, and sustainable agriculture, highlighting the need for continuous improvements in the sustainability landscape within the agrifood industry.

The National Agrofood Policy 2.0 (NAP 2.0) has outlined sustainability-related policy objectives that support sustainability practices within the agricultural sector, which includes[94];

- **Policy objective 1: Increase income growth and quality of life for food producers.** Improvement of food producers' income and livelihood through sustainability practices (e.g., post-harvest management strategy) that may be beneficial in the long run.
- **Policy objective 2**: **Improving yield and harvest quality through elevated productivity**. Within this context, the policy underscores the pivotal role of sustainable agricultural practices in the production of crops and livestock as well as efficient land and water management in improving productivity and bolstering food security. This approach aims to balance between the preservation and utilisation of resources for agricultural purposes.
- **Policy objective 4: Elevating public well-being and nutritional standards.** The cornerstone of this policy objective is measured through MyGAP and MyOrganic certifications, alongside internationally recognised certifications. These certifications function as primary benchmarks, which signify a resolute commitment to amplifying the safety and nutritional value of produce, ultimately benefiting the people.
- **Policy objective 6: Encouraging sustainable utilisation and production of food.** The indicators of this objective include post-harvest loss mitigation strategies, extent of food loss, as well as better management of water resources, as measured by water footprint per Ha.

[92] Piñeiro *et al*. (2020a); Rizzo et al. (2023)
[93] DOA (2022)
[94] KPKM (2021)

Overall, the policy objectives underscore the importance of sustainability elements for the agricultural industry to move forward, and sustainable standards and certifications can be valuable tools to achieve these objectives.

Table 3.1: Comparison between Malaysia's Score and Global Average for Sustainability-Related Sub-Indicator in GFSI[95]

Relevant sub-indicator	Description	Malaysia's score	Global average
Agricultural water risk-quantity	A measure of the ratio of total annual water withdrawals to total available annual renewable supply. Data is based on the WRI's agriculture weighting scheme and is an average of baseline water stress, inter-annual variability, seasonal variability, upstream storage, and groundwater stress.	50	40.9
Agricultural water risk-quality	A measure of the risk that water might be polluted. Data is based on the WRI's agriculture weighting scheme for return flow ratio and upstream protected land.	0	41.6
Land degradation	A measure of the proportion of land is degraded over the total land area.	75	69.6
Grassland	A measure of greenhouse gas emissions from the drainage of organic soils (e.g. peatlands) under grassland (Net emissions/removals of CO_2, gigagrams)	41.9	85.3
Forest change	A measure of the health of forests (change in forest areas as a percentage of total land area)	75.6	69.6
Soil organic content	A measure of organic carbon present in soil (tonnes per Ha)	99.7	29.1
Sustainable agriculture	Is there a national policy that promotes sustainable agricultural practices? Does the government provide incentives for sustainable agricultural practices?	50	63.7
Pest infestation and disease mitigation	Is there a national policy in place to mitigate the risk of pest infestation and infections from diseases on production? The national policy can include measures such as use of technology for monitoring pests, suggested crop selection and cropping techniques, or use of natural pesticides	100	69.9

[95] Economist Impact (2022b)

3.1.2 Chapter Objective

The objective of this chapter was to analyse the patterns observed between SEMAI respondents certified under MyGAP and those not. **This report examined the smallholders to identify correlations between obtaining a MyGAP certification with their demographic profile, financial literacy and access, sales channels and marketing stability, and farming support levels. It is crucial to note that due to data limitations, the study focuses on the correlation between the adoption of MyGAP and the selected factors rather than causation. Hence, the findings from the analyses should be interpreted with this in mind.** Overall, the goal of this study is to shed light on how MyGAP certification can contribute to the improvement of smallholders' agricultural practices.

Before delving onto the findings from Project SEMAI, it is essential to provide readers with a comprehensive understanding of sustainability standards, both on a global scale and within the context of Malaysia. This contextualisation serves to lay the groundwork for the subsequent discussions. This chapter's structure is outlined as follows:

i. **Importance of sustainability standards to solve smallholders' challenges**: Exploration of the challenges faced by smallholders and how adherence to standards may serve as a solution.
ii. **Overview of MyGAP**: To provide information on the current status of certified farmers using DOA data, along with detailed explanation of the MyGAP standards.
iii. **Comparison of MyGAP, GlobalGAP, and other relevant sustainability standards**: To identify areas where MyGAP can be improved, particularly in terms of its mechanisms, in order to attract more smallholders.
iv. **Multifaceted impacts of sustainability standards**: To provide global context of impacts of sustainability standards and certification on farmers.
v. **Analysis of MyGAP using SEMAI survey.**

3.1.3 Importance of Sustainability Standards in Solving Smallholders' Challenges

In the dynamic landscape of global agriculture, smallholders face various challenges that can impact their agricultural practices and livelihoods. These shared challenges can consist of more personal limitations such as financial constraints and poor bookkeeping, limited access to resources and lack of training and skills, to broader issues such as environmental degradation (see Figure 3.3). These issues faced by smallholder farmers were found common regardless of their geographical location[96].

[96] Tambi et al. (2021); Abiddin et al. (2023)

Figure 3.3: Common Challenges Faced by Smallholders

Source: Tambi *et al.* (2021); Abiddin *et al.* (2023); KRI Illustration

Addressing the challenges faced by smallholders is very much needed, considering their contribution to around 80% of the global food production in terms of value[97]. Given their role in food production it is therefore imperative to ensure that their production is done in a sustainable manner. Sustainable practices are not only for the improvement of well-being of smallholders but also to guarantee that future generations can continue to benefit from a reliable and sufficient food source as we currently do. Identifying smallholders' challenges is the first step, followed by implementing tailored solutions and collaborative efforts to empower them. This may include policy support, encouragement of technology adoption, and the promotion of sustainable practices.

Sustainability certification emerges as a potential solution to address some of smallholders' challenges. This is because it involves criteria such as training programmes that enhance farming knowledge, adherence to higher quality standards for improved market access, control of chemical usage to minimise environmental degradation, and the incorporation of bookkeeping as a prerequisite for certification to enhance access to finance, among many others [98]. While acknowledging that the benefits are complex and require extensive research, sustainability certification may still represent one of the initial steps towards a more sustainable agriculture.

[97] FAO (2014)
[98] ISEAL Alliance (2016); Meemken (2020)

3.1.4 Malaysia Good Agricultural Practices (MyGAP)

MyGAP is a sustainability standard established by DOA in 2002. Formerly known as the Farm Accreditation Scheme of Malaysia (FASM), it was later rebranded as MyGAP in 2013, following the model of two international standards: GlobalGAP (formerly EUREPGAP) and WHO/FAO Codex of Hygiene Practice[99]. MyGAP certification in Malaysia extends its coverage across all agricultural sub-sectors. Several key scope and requirements are embedded within the standards developed by the Department of Standards Malaysia, such as Malaysian Standard MS 1784:2005 Crop Commodities, MS 2027:2018 Good Animal Husbandry Practice, MS 1998:2017 Good Aquaculture Practice (GaqP) – Aquaculture Farm (First Revision), and MS 2467:2012 – Code of Practice for Seaweed Cultivation[100].

MyGAP for Crops

Diving deeper into MyGAP for crops, it follows a set of strict requirements that cover a wide range of factors. These encompass various facets including meticulous record-keeping, effective soil, and land management, controlled chemical handling, good storage conditions, the welfare of workers in terms of health and safety, ensuring a reliable water source, and even extending through to the post-harvest phase and proper waste management practices. The categories of applicants that may apply for this certification include[101];

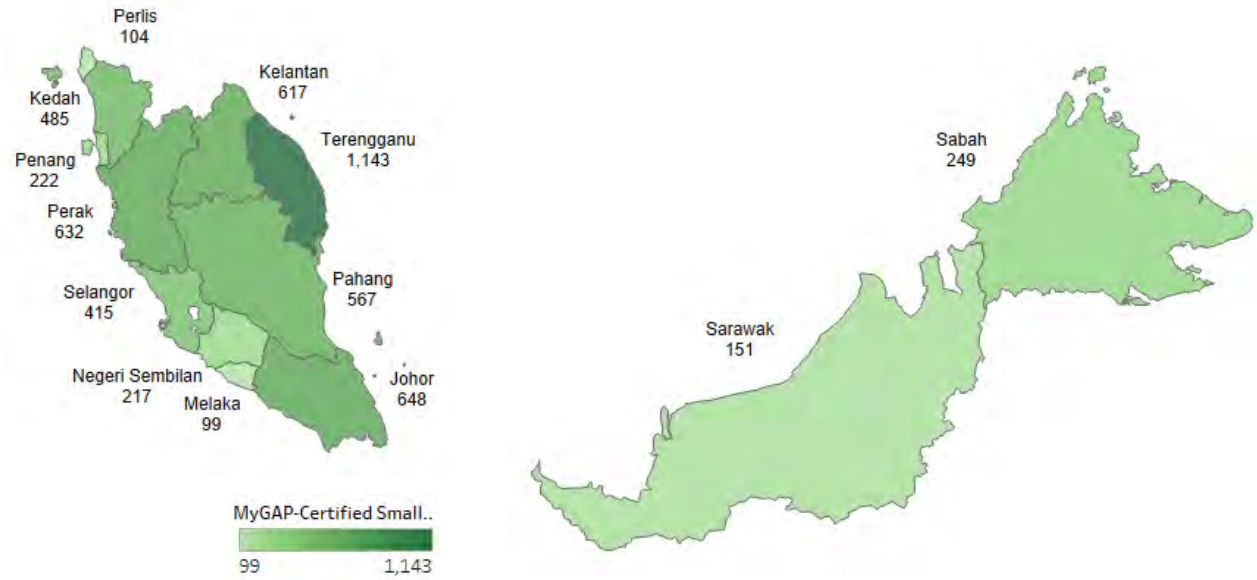
i. Individual applicant
ii. Private companies
iii. Participants under *Taman Kekal Pengeluaran Makanan* (TKPM) project
iv. Agencies / statutory bodies
v. Contract farmers
vi. Agricultural centres under (DOA)
vii. Modern farming project participants

Appendix C outlines the requirement for MyGAP certification for the crop sub-sector. The table itemises a set of stringent criteria and guidelines that producers must follow in order to attain MyGAP certification. Incorporating these comprehensive requirements into agricultural practices ensures that farmers meet the high standards set by MyGAP certification, fostering sustainable, safe, and responsible production.

According to data from DOA, there are currently 6,012 MyGAP-certified crop farmers. Figure 3.4 shows the distribution of MyGAP-certified individuals/farms across all states in Malaysia, for all types of crops. Paddy is the highest certified crop, followed by Durian. By state, it is seen that Terengganu stands out with the highest number of certified smallholders, followed by Johor and Perak.

[99] Tey et al. (2016)
[100] DOA (2023a)
[101] DOA (2017)

Figure 3.4: MyGAP-Certified Crop Farmers, by State, 2023



Source: DOA (2023)

For Terengganu, out of 1,160 individuals/farms that are certified, 49% are paddy farmers which mostly are situated in Besut within the Integrated Agricultural Development Area (IADA) Ketara granary area. The high number of certified paddy farmers in Terengganu is largely contributed by the state government initiatives, whereby they provide an incentive of RM105 for MyGAP-certified farmers for every metric tonne of paddy sent to the consortium factory for processing[102]. This highlights the possibility of introducing incentives for all states in order to encourage MyGAP certification.

Furthermore, Figure 3.4 also highlights the observation of **a low number of MyGAP-certified farmers in Sabah and Sarawak.** This observation was intriguing, given that Sabah and Sarawak comprised a substantial proportion of the Malaysian farming community. The total proportion of the total population comprised 9% for Sabah and 16% for Sarawak[103], which Sarawak surpassed all other states in farming population share. Thus, a plausible reason for the low MyGAP certification rates in Sabah and Sarawak was their geographical locations, where the federal DOA encountered significant challenges in efficiently conducting MyGAP-related training (particularly in rural areas). Compared to the initiatives in the Peninsula states, fewer state-level initiatives in Sabah and Sarawak were also observed in promoting and encouraging MyGAP certification. Overall, this observation provided an avenue for further exploration and encouragement to adopt MyGAP certification within this region.

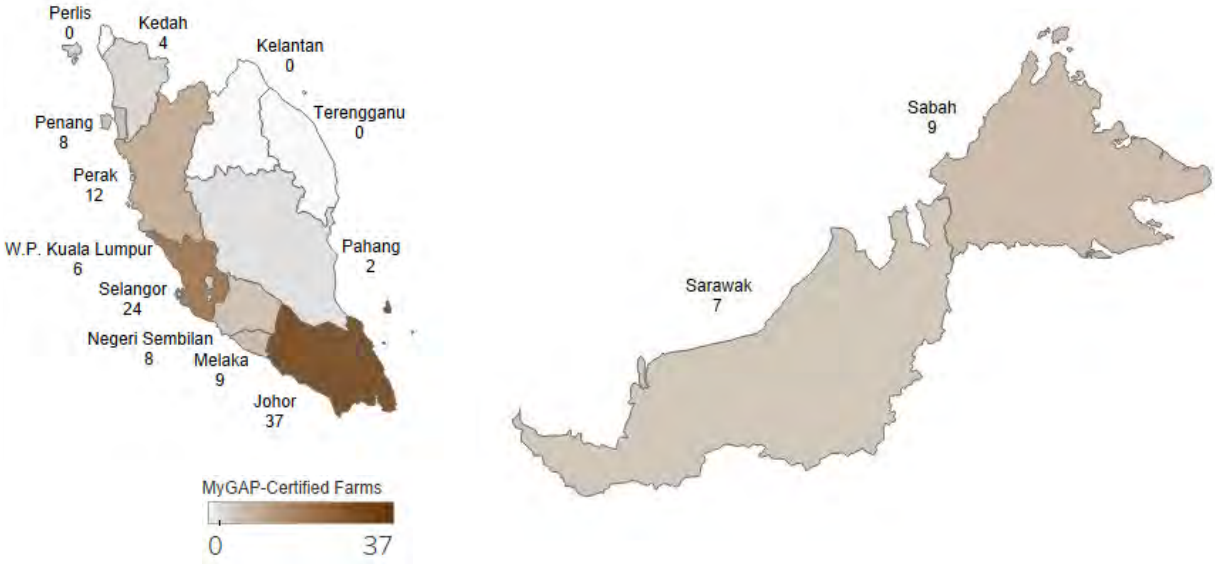
[102] B. Bakar (2023)
[103] DOA (2022)

MyGAP for Livestock

MyGAP for livestock was first introduced in 2003, originally named the Livestock Farm Certification Scheme (SALT). MyGAP is an essential set of guidelines that cover various important aspects, including biosecurity, cleanliness, animal health management, training for farm workers, and ensuring the well-being of animals (as outlined in Appendix C).

Figure 3.5 shows the number of MYGAP-certified livestock farmers in Malaysia. It is observed that the top three states with the highest number of certified farmers are Johor, Selangor, and Perak. Out of the 37 farms that are certified in Johor, 25 of those are chicken farms which can be either broiler farms, breeder farms, or layer chicken farming. The high number of certified chicken farms in Johor could be attributed to the fact that the state produces the highest number of chickens in Malaysia, approximately 53m in 2022 or 18% of Malaysia's chicken production [104]. Another probable explanation for Johor having the highest MyGAP certification for livestock is the likelihood that these producers export their products to Singapore, a country known for its stringent food standards and requirements. Conversely, Kelantan, Terengganu, and Perlis all had no certified farms, despite also being livestock producers although not on a substantial scale.

Figure 3.5: MyGAP-Certified Livestock Farms, by State



Source: DVS (2023)

[104] DVS (2022a)
[105] CNA (2022)

For Sabah and Sarawak, the observation is similar to crops whereby there is a low number of MyGAP- certified livestock farms. This might be concerning because Sarawak, for instance, is a major producer in chicken production, contributing around 16% of the country's total chicken production [106]. The limited adoption of MyGAP certification in this region demands further exploration, particularly because of its substantial contribution to Malaysia's food production. MyGAP certification for livestock promotes the adoption of environmentally friendly practices such as closed-house systems and efficient waste disposal by certified farms. These practices help to mitigate pollution and odorous emissions in surrounding areas, thereby promoting a healthier environment. Another advantage, particularly for human and animal health, is the inclusion of on-farm biosecurity requirements, which is a plan to prevent disease spread within the farm, should there be an outbreak that could be harmful. Despite these advantages, it is recognised **that achieving MyGAP certification requires significant investment, higher operational costs, and higher workload. This financial burden can deter smaller farms from certification, making it more accessible to larger-scale operations, thereby might also explain the low number of MyGAP-certified farms in certain states.**

MyGAP for Aquaculture

In 2005, Malaysia introduced the Aquaculture Farm Certification Scheme (SPLAM), later rebranded as MyGAP. Its primary objectives were to enhance consumer confidence in the safety of aquaculture products and to expand market opportunities for Malaysian aquaculture produce. To be eligible for this certification, farms must meet certain criteria, including[107];

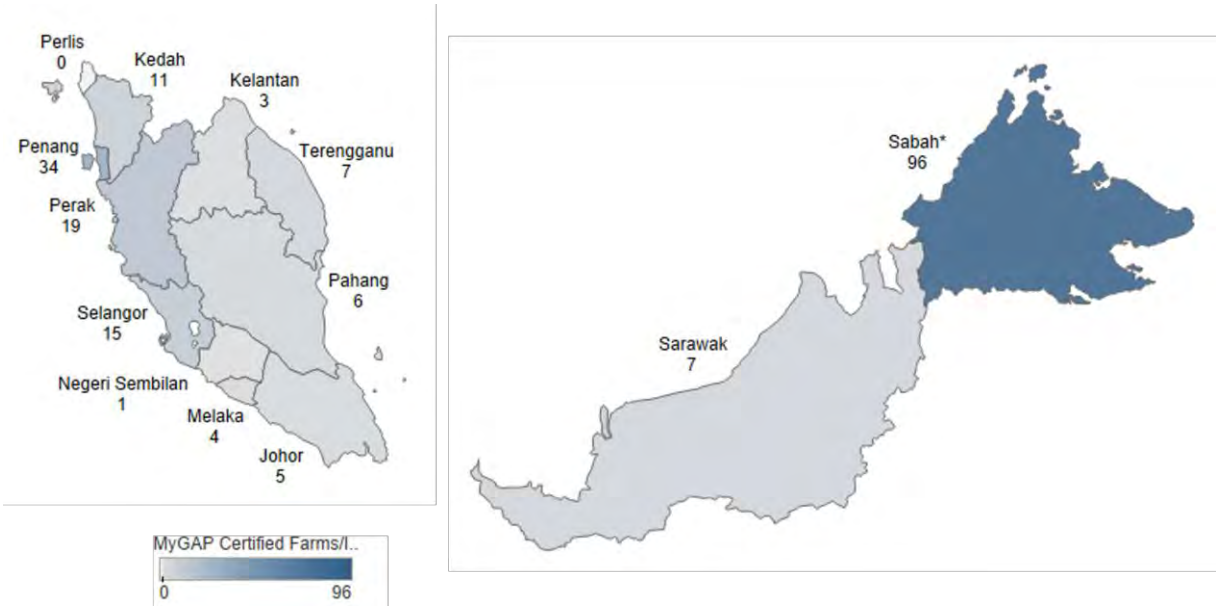
i. Selection of farming sites must be legally owned and operated (private/leased/temporary ownership/taxation);
ii. Farm has been operating for at least one year and has a record of production output;
iii. Maintains updated farm documents and records;
iv. Willing to accept feedback, warnings, and suggestions for improving aquaculture practices; and
v. Possesses quality assurance programme documentation as evidence.

Similar to MyGAP for crops and livestock, MyGAP for aquaculture has its own set of requirements, as outlined in Appendix C. These requirements use the World Organisation for Animal Health Aquatic Animal Health Code as its benchmark for establishment.

[106] DVS (2022a)
[107] DOF (n.d.)

The state with the highest number of certified aquaculture farms in Malaysia is Penang followed by Perak and Selangor (Figure 3.6). This trend can be attributed to the fact that these states are among the top five in aquaculture production[108]. On the other hand, although Sabah has a high number of certifications, only 14 are certified farms while the rest are individual seaweed farmers who have been certified within clusters, hence totalling the number to 96. In the context of Sabah's seaweed farmers, cluster certification involves aggregating farmers under cooperative-owned enterprise system. This system is managed by the farmers themselves but overseen by the government[109]. **The cluster certification programme in Sabah has proven to be an effective means of promoting increased certification rates**, especially among impoverished farmers residing in the coastal regions of Sabah. This initiative has yielded significant benefits, facilitating the export of products to countries such as China, the Philippines, and Japan. Consequently, it has played a pivotal role in improving the income of local farmers in the region as MyGAP-certified products are able to fetch higher prices.

Figure 3.6: MyGAP-Certified Aquaculture Farms/Individuals, by State



Source: DOF (2023)
Note:
1) The map shows all MyGAP-certified aquaculture farms, excluding ornamental fish farms.
2) *The high number in Sabah is due to cluster certifications (82 individuals).

[108] DOF (2023a)
[109] Nor *et al.* (2017)
[110] BERNAMA (2018)

Overall, while this section has provided a brief overview of MyGAP certification rate for the three sub-sectors of agriculture, it should be noted that the certification rate can still be improved to cover a larger proportion of the farming population. Recognising limitations for compliance in terms of cost and capacity, there is an opportunity to enhance the MyGAP mechanism to attract more farmers. Therefore, the next section will look into global standards such as GlobalGAP, Fairtrade, and Rainforest Alliance. The aim is to understand the mechanisms employed by these standards, seeking insights that may inform potential enhancement to MyGAP in the future.

3.1.5 Comparing MyGAP, GlobalGAP, and Other Relevant Sustainability Standards

According to the Ecolabel Index, there are currently 456 sustainability standards/ecolabels in 199 countries across 25 industries[111,112]. These standards may be categorised into two types: single-sector initiatives and multi-sector initiatives[113]. Single-sector initiatives are those that concentrate their efforts on specific products, while multi-sector initiatives cover a broader range of products[114]. Generally, single-sector initiatives tend to provide separate standards tailored for small-scale producers and producer groups[115], whereas multi-sector initiatives typically offer a one-size-fits-all standard for small-scale producers and producer groups.

Sustainability standards vary in their areas of focus. There is no universally applicable standard for the agriculture sector because different standards prioritise different aspects of sustainability[116]. Some standards place greater emphasis on environmental concerns, while others focus on social aspects or economic considerations. These variations arise from the specific requirements outlined by each standard. Furthermore, certain sustainability standards also offer the option of group certification. This helps to ease the auditing process for both producers and the organisations responsible for enforcing the standards. It reduces the administrative burden associated with individual certifications and encourages collective sustainability efforts.

Given the diverse sustainability standards worldwide, all with distinctive characteristics, this section will focus only on a few well-known standards for analysis and comparison purposes to MyGAP. The selection criteria will give preference to standards with mechanisms that differ slightly from those of MyGAP. This is to identify specific areas within MyGAP that can be further improved and refined.

111 "Ecolabel Index" (2023)
112 Number is not exhaustive as this index does not include country-specific standards such as MyGAP, VietGAP, SG GAP, IndoGAP, etc.
113 Potts *et al*. (2014)
114 Ibid.
115 Producer groups are organisations or associations formed by smallholder producers that come together to achieve their goals and promote their common interests.
116 Ibid.

GlobalGAP

In terms of the certification that most closely aligns with the characteristics of MyGAP, GlobalGAP stands out as the primary benchmark. GlobalGAP was initiated by a group of European retailers in 1996, as a way to promote safe food production while safeguarding workers and the environment. GlobalGAP serves as not only a reference point for MyGAP but also for other neighbouring countries in this region, including Brunei (Brunei GAP), Indonesia (IndoGAP), Philippines (PhilGAP), Singapore (SG GAP), Thailand (QGAP/ThaiGAP), Vietnam (VietGAP), Cambodia (Cam-GAP), and Laos (LAO GAP)[117]. There is also ASEANGAP, which is initiated to promote the harmonisation of GAP programmes throughout the Association of Southeast Asian Nations (ASEAN) region. This certification is motivated by the recognition that member countries within ASEAN share common farming practices, infrastructure, and weather patterns. However, despite these similarities, the implementation of GAP programmes varies across nations, where some countries have established government-certified systems, while others started through farmers' awareness[118].

In contrast to the MyGAP certification system, GlobalGAP offers a more versatile approach by allowing both group and individual certification[119]. Within the framework of GlobalGAP, three distinct categories of control points are recognised: Major Musts, Minor Musts, and Recommendations. Obtaining GlobalGAP certification necessitates adherence to the following criteria[120]:

i. **Major Musts:** Full compliance with all relevant Major Must and Quality Management System (QMS) control points is obligatory.
ii. **Minor Musts:** 95% compliance rate with all applicable Minor Must control points is mandatory.
iii. **Recommendations:** No specific threshold for compliance with Recommendations.

According to data from the State of Sustainability Market in 2020, there are only 12 crop farmers in Malaysia that have GlobalGAP certification[121]. Generally, GlobalGAP certification is required for exporting food products to European countries. The benefits of GlobalGAP certification for smallholders have sparked debates due to the high compliance costs which have excluded smallholders from the system. However, there are studies that indicate in some cases, smallholders experience increased productivity, improved market access, and reduced pesticide usage under this certification[122].

[117] Nabeshima *et al*. (2015)
[118] AusAID (2006)
[119] GlobalG.A.P. (2022)
[120] Ibid.
[121] International Trade Centre (2022)
[122] Henson, Masakure, and Cranfield (2011)

A clear advantage of GlobalGAP, which MyGAP could consider adopting, is its user-friendly electronic platform. This platform allows customers to conveniently voice their dissatisfaction with products certified with GlobalGAP certification to the relevant certification body. Subsequently, the lodging of a complaint is processed as a formal case, and all corrective actions are transparently displayed on the official GlobalGAP website. **Such mechanisms are yet to be established within the MyGAP framework** [123]. Furthermore, **GlobalGAP also has an established traceability system through the utilisation of a 13-digit GlobalGAP unique number. This system enables consumers to verify the authenticity of certified products, thereby enhancing transparency and accountability within the certification process**[124].

Fairtrade International

Fairtrade is a certification scheme dedicated to advancing sustainable development and poverty alleviation through the promotion of fairer trade practices[125]. Within the Fairtrade certification framework, several certification types are available, including the Fairtrade for Small-scale Producer Organisations, Fairtrade Trader Standards, and the Fairtrade Standard for Hired Labour. This section, however, will exclusively discuss the Fairtrade Standard for Small-scale Producer Organisations in comparison to MyGAP.

Notably, the Fairtrade Standard for Small-scale Producer Organisations is **designed for collective certification, targeting not individual smallholders but rather small-scale producer organisations**[126]. **This approach highlights the importance of group certification, requiring smallholders to be members of farmers' associations or cooperatives to obtain certification**. What sets this standard apart is its emphasis on equity and democratic principles. It ensures that all members have both a voice and a vote in the decision-making processes, and it mandates that all members are kept informed of any changes to the standard regulations.

Perhaps the most significant difference between Fairtrade and MyGAP lies in the pricing mechanism for certified farmers. Fairtrade introduces two important mechanisms: the Fairtrade Minimum Price and the Fairtrade Premium[127]:

i. **Fairtrade Minimum Price**: This mechanism not only covers the average costs of sustainable production but also functions as a safety net in times of declining global market prices. It even allows room for negotiation, providing an added layer of protection for farmers.

[123] Tey et al. (2016)
[124] Ibid.
[125] Fairtrade International (2019)
[126] Ibid.
[127] Ibid.

ii. **Fairtrade Premium**: This mechanism represents a supplementary amount paid by consumers in addition to the selling price. Through the Fairtrade Premium, farmers receive additional income that can be collectively allocated for the betterment of their farm operation. This allocation may involve investments in training, enhancing production methods, or purchase of farming equipment.

These mechanisms are absent within the MyGAP framework, and farmers often bear the full burden of production costs and consequently struggle to benefit from their labour, hindering their ability to enhance production. **Although Fairtrade and MyGAP may not be direct equivalents, they offer valuable insights that can be instrumental in developing strategies to enhance agricultural production in Malaysia and concurrently shield our farmers from increasing production costs while elevating their economic well-being**. These two certification systems, each with their unique strength and focus areas, can serve as reference points for a more comprehensive and equitable approach to agricultural development in the Malaysian context.

Rainforest Alliance

The Rainforest Alliance stands out prominently among sustainability standards due to its expansive land area coverage, the second biggest next to organic certifications[128]. Rainforest Alliance's influence extends across approximately 60 countries and involves various stakeholders, including farming and forest communities, companies, governments, civil society, and individuals[129]. This extensive reach is primarily attributed to its approach which focuses mainly on environmental aspects.

Coffee, cocoa, and tea are the top three crops with the highest certification under the Rainforest Alliance standards. What sets Rainforest Alliance apart from MyGAP is its distinct emphasis on safeguarding forests and biodiversity, taking climate action, and actively advocating for the rights and improved livelihoods of rural communities[130]. The breadth of topics it covers contributes to its high certification rate.

[128] International Trade Centre (2023)
[129] Rainforest Alliance (n.d.)
[130] Ibid.

One example of Rainforest Alliance's impact is its transformative work in the cocoa sector in Indonesia, particularly in response to the challenges posed by climate change. Rainforest Alliance's interventions include providing training to farmers and equipping them with smart farming techniques geared towards flood prevention and crop health. These techniques range from seasonal pruning and mulching to the construction of rainwater runoff collection pits[131]. Rainforest Alliance's success stories, exemplified by programmes like this, highlight its close connection to certified communities and the tangible improvements it has brought to the lives of certificate holders. **This serves as an important illustration of the necessity for ongoing monitoring and support post-certification. It underscores the fact that certifications, like Rainforest Alliance, require continuous engagement and additional measures beyond auditing to truly make a meaningful impact, and this might be a key consideration to encourage farmers to adopt sustainability certification in Malaysia moving forward**.

Improving MyGAP: Lessons from Major Sustainability Standards

This section highlighted key global sustainability standards and presented primary practices and mechanisms for potential integration into the certification framework. It is worth noting that all of the standards mentioned in the previous section may cater for different markets. Standards like GlobalGAP and Fairtrade are primarily used to facilitate trade in countries such as the US or countries in the European Union (EU). In the case of MyGAP, its acceptance by Singapore positions it as a bridge to international standards, making it a viable option if global market access is desired.

The first lesson extracted from the global sustainability standards is the importance of **group certification, which is a shared feature of GlobalGAP, Fairtrade International, and Rainforest Alliance**. This contrasts with MyGAP's predominantly individual certification approach (except for seaweed clusters as explained in Section 3.1.4). Group certification emerges as a pragmatic avenue for smallholders to pool resources for compliance and reducing audit costs. **Beyond cost-effectiveness, group certification also encourages collaboration along the supply chain, enhancing social interaction, expanding market access, and facilitating knowledge transfer**[132].

The second lesson is the benefit of adopting a good traceability system, which is what MyGAP can emulate from GlobalGap. **Establishing a traceability system is imperative for ensuring food safety at the national level and enabling the identification of the origin, production methods, and quality of food products.**

The third lesson revolves around the need for continuous training and monitoring, as exemplified by Rainforest Alliance. **Continuous monitoring ensures that certified farmers reap the benefits of certification, addressing the common challenge where smallholders may not fully grasp the advantages of certification**. This ongoing support acts as an incentive, making certification more appealing.

[131] Ibid.
[132] Pinto *et al*. (2014)

Having explored major sustainability standards and their valuable mechanisms, the subsequent section will then delve into the impacts of adopting sustainability certification for smallholders. This exploration aims to provide insights into the significance of sustainability certification and why it may serve as an avenue to improve smallholders' livelihood and farming practices.

3.1.6 Multifaceted Impacts of Sustainability Standards

Extensive global studies have been conducted to assess the implications of obtaining GAP or sustainability certificates. The findings of these studies have yielded a mixed perspective. In some instances, there are positive outcomes where specific certification types are adopted, particularly within the context of designated commercial crops. However, the benefits are not uniformly applicable across all types of crops. Conversely, there are instances where the impact of certification is seen as negligible, and in some cases, it has been associated with supplementary costs[133]. This section will break down the impacts of adopting GAP/sustainability standards from various standpoints including economic, social, environmental, food safety and consumer's acceptance. **It is important to note that while this section focuses into the literature findings related to the effects of adopting sustainability standards. The focus here is to offer a global perspective on the reasons why certification could be beneficial for farmers. To clarify, the subsequent SEMAI survey analysis does not intend to conduct an impact study but focuses more on positive associations.**

Economic Perspective

Sustainability certification yields complex economic outcomes, shaped by a multitude of influencing factors. These impacts may encompass various economic incentives and disincentives[134]. Primarily, sustainability certification serves as a gateway to expanded market access, particularly through the opening of both export and domestic markets[135]. In the context of international trade, an increasingly prevalent trend involves countries mandating certification as a prerequisite for imports. An example of this is the case of fresh produce shipments from Malaysia to Singapore are obligated to possess MyGAP certification for market entry[136]. Within domestic markets, sustainability certification plays a role in product differentiation, whereby products with certification are seen to have better safety, cleanliness, and overall quality. In Malaysia, popular supermarket chains like Lotus's (formerly Tesco) and AEON have proactively adopted a policy necessitating MyGAP certification for their suppliers, thus establishing it as a requirement to sell produce within their establishments[137].

[133] Hobbs (2003); Gazi Md Nurul Islam *et al.* (2012); Loconto and Dankers (2014); Hidayat, Glasbergen, and Offermans (2015); Elliott (2018)
[134] Hobbs (2003)
[135] Hobbs (2003); Loconto and Dankers (2014)
[136] Tey *et al.* (2016)
[137] Ibid.

Furthermore, the impact of sustainability certification is deemed to enhance income, although the link between them has been contested with researchers reporting diverse findings[138]. Hobbs highlighted that sustainability certification can potentially enhance revenue stability and decrease farming costs[139]. The study revealed that higher revenue could be associated with the market-driven nature of certification, which production aligned with consumer preferences. This feature allowed for potentially higher prices and the possibility of fetching price premiums[140]. Nonetheless, these premiums were primarily observed within specific sectors. An example was the coffee sector, which contained the crop with the highest certification rates. This benefit enabled smallholders to fetch higher prices using sustainability certification as a marketing tool[141].

While studies have been limited, certain indications have demonstrated that certified farmers can obtain higher prices. A study on MyGAP-certified tomato farmers in Cameron Highlands, Malaysia, reported that MyGAP-certified tomatoes were priced at an average of RM2.50/kg compared to 1.75/kg for conventionally produced tomatoes[142]. Similarly, a study by Hidayat *et al*. (2015) revealed that certified Indonesian palm oil smallholders anticipated higher returns for their fresh fruit bunches (FFB) due to the superior quality associated with certified FFB[143]. Nevertheless, higher prices did not necessarily indicate higher net profit through higher MyGAP adoption costs.

Another way certification can provide a positive economic impact is by reducing input costs using sustainable agricultural practices. These practices include controlled usage of inputs following established standards or guidelines. For example, good farming practices encourage farmers to apply fertilisers at the right time and in the right quantities[144]. Additionally, the awareness of harmful chemicals leads farmers to control pesticide and herbicide use[145]. Over time, these practices aid in cutting costs while enhancing and maintaining farm productivity. Therefore, this outcome potentially translates into higher gross income for farmers.

On the other hand, it is also important to acknowledge the drawbacks of certification programmes, particularly the costs involved in obtaining certification[146]. These costs may vary among different sub-sectors, presenting a major barrier for smallholders seeking certification[147]. Beyond the direct certification expenses, there are additional burdens to consider. These include labour requirements, the need for workers' training, the obligation for a proper record-keeping system, the necessity of using inputs that align with environmental standards, and the establishment of suitable storage conditions for chemicals and inputs[148].

[138] Hobbs (2003); Molenaar et al. (2015)
[139] Hobbs (2003)
[140] Ibid.
[141] Molenaar *et al*. (2015)
[142] Gazi Md Nurul Islam *et al*. (2012)
[143] Hidayat, Glasbergen, and Offermans (2015)
[144] Ibid.
[145] Ibid.
[146] Hobbs (2003)
[147] Loconto and Dankers (2014)
[148] Hobbs (2003)

When considering the attainment of price premiums, it is critical to recognise that some studies suggest smallholders may not be the beneficiaries of such benefits[149]. This is partly because of the elongated food supply chain, which can divert the benefits towards middlemen (e.g. retailers, exporters) rather than the producers themselves. Bray and Nielson (2017) further highlighted on the complexity of this issue, emphasising that even when producers secure higher prices for the certified goods, it does not automatically translate into improved income for their households[150]. The outcome depends on factors such as farm gate prices[151], overall yield, and the costs associated with production.

Environmental & Food Safety Perspective

Measuring the outcomes of natural resources management can be challenging, which explains the limited literature addressing the environmental impacts of sustainability certificates[152]. Elliot (2018) noted that the most commonly observed positive effects revolved around improvements in agrochemical handling, water and waste management and protection[153]. In a review conducted by Blackman and Rivera (2010), it was observed that the results of environmental impact studies of sustainability certification have yielded various outcomes. Some studies indicate no observable differences between certified and non-certified farmers, while others report positive impacts[154].

Focusing on smallholders, Hidayat et al.'s (2017) interviews revealed a notable transformation among Indonesian palm oil smallholders upon their adoption of RSPO membership. These smallholders have undertaken various conservation efforts, benefiting not only their livelihood but the environment. These initiatives include planting bamboo and trees to prevent erosion and floods, adopting soil and water conservation practices, implementing waste management systems, and using natural predators to control pests[155]. While all these practices might not yield immediate environmental impacts, sustainability certificates have equipped smallholders with knowledge and practices for long-term nature preservation[156].

[149] Meemken et al. (2021)
[150] Bray and Neilson (2017)
[151] Farm gate prices are prices of products that are sold directly from producers to buyers at the point of production. The price does not include transport, processing, marketing, and/or any post-production costs.
[152] Ibid.
[153] Elliott (2018)
[154] Blackman and Rivera (2010)
[155] Hidayat, Glasbergen, and Offermans (2015)
[156] Ibid.

A study by Blackman and Naranjo (2012) on the environmental advantages associated with sustainability certification focusing on organic certification for coffee farming in Costa Rica found that certified farmers had significant reduction in the utilisation of chemical inputs, such as pesticides, chemical fertilisers, and herbicides, alongside an increased usage of organic fertilisers [157]. Additionally, the study pointed out that the positive effects of sustainability certification are more evident in changed farming practices which help to conserve the environment. It is, however, harder to notice and measure improvements of ecological indicators, such as changes in biodiversity in the surrounding area[158].

In terms of food safety, the reduction of pesticide usage can lead to safer food for consumers. A study conducted by Kilic et al. (2020) in Samsun Province, Turkey, revealed that farms certified under GAP used 31.1% less nitrogen, 49.4% less phosphorus, and 18.9% less potassium compared to conventional farms[159]. The GAP programme minimizes the harm caused by pesticide, ensuring the safety of produce for consumers. Additionally, concerning food safety, sustainability certification may also serve as a gateway to establishing an effective traceability system, as elaborated further in Box 3.1.

Box 3.1: Improving Food Traceability System through Sustainability Certification

The food industry has witnessed numerous foodborne disease outbreaks, defined as incidents where two or more individuals fall ill after consuming the same food or meal. One such instance occurred in South Africa, involving an outbreak of Listeria monocytogenes linked to a ready-to-eat processed meat plant. This outbreak resulted in 216 casualties. Another example is the listeriosis outbreak caused by rock melons from a farm in New South Wales, which led to seven deaths and impacted several countries, including Singapore and Hong Kong. The source of this outbreak was traced back to Rombola Family farms, located near Griffith in regional New South Wales.

Food outbreaks not only pose significant risks to human and animal health but also result in substantial economic losses, particularly for food companies. These losses include expenses incurred for product recall, disposal of contaminated products, and penalties imposed by regulatory authorities. Additionally, companies face financial burdens related to legal costs in case of lawsuits arising from the outbreak. An example of this is the lawsuit against Kerry Inc. whereby the company had to pay a hefty USD19.2 million fine due to a Salmonella outbreak at one of their processing plants producing Kellogg's Honey Smacks cereal. The outbreak caused food poisoning to 135 people, hospitalizing 34 and is said to be one of the largest food safety fines that a company must bear.

[157] Blackman and Naranjo (2012)
[158] Ibid.
[159] Kılıç, Boz, and Eryılmaz (2020)

On top of this, another consequence of food outbreaks is the loss in consumers' confidence and loyalty towards the brand, leading to decreased sales and long-term negative impacts on the company's reputation and market share[160]. In 2015, an *Escherichia coli (E. coli)* outbreak at Mexican Chipotle outlets in the United States has led to closure of 43 establishments. This outbreak affected 500 individuals due to contamination at multiple outlets. The impact of this extended even to the following year, whereas by the end of 2016, the company recorded a 20% drop in sales, as well as drop in market shares, as consumers remained reluctant to trust the brand[161].

The implementation of a traceability system is integral in managing food outbreaks, as it enables the identification of the contamination source, facilitating prompt actions to halt further transmission. This is especially valuable for preventing future incidents and allows food manufacturers to develop proactive strategies for outbreak control[162]. Recognising its significance, many countries have emphasised establishing and/or improving food traceability systems. China, particularly, recognised the importance of this system following the melamine contamination incident in infant formula[163]. Similarly, Japan has established a traceability system for beef, allowing tracking from the point of purchase back to the farm of origin. This measure was enforced after the outbreak of Bovine Spongiform Encephalopathy (BSE) to enhance food safety protocols[164].

The connection between sustainability certification and traceability systems lies in the fact that the majority of sustainability standards (e.g., Rainforest Alliance, GlobalGAP, MyGAP, etc.) already incorporate traceability requirements as a prerequisite for certification. This means that sustainability certification can promote the creation of traceable food systems. What sets these standards apart is the effectiveness and enforcement mechanism employed in ensuring the practical utility of traceability systems, which may vary in efficiency. For example, GlobalGAP, as highlighted in Section 3.1.5 has a good traceability system due to its use of a 13-digit unique code. This code enables customers to trace the authenticity and origin of the certification, ensuring transparency and accountability. The Rainforest Alliance also mandates certificate holders to maintain traceability through a few methods. Firstly, there is a paper-based approach, where certificate holders are required to maintain physical copies of all documentation related to purchase and sales. Secondly, Rainforest Alliance also has an online traceability system where certificate holders are obligated to register all their transactions online, creating a digital footprint of their activities. MyGAP, as noted in Section 0 also listed traceability requirements as a prerequisite for certification, but the efficiency is currently unknown.

160 Ibid.
161 Gillespie and Long (2015)
162 FDA (2020)
163 L. Xu and Wu (2010)
164 Myae and Goddard (2012)

Blockchain serves as an example of a useful tool for traceability for an efficient and transparent food system. This is because it allows for sources of food contamination to be identified quickly as well as helping to build consumers' trust as all producers within the food supply chain record their transactions on the blockchain[165]. IBM is an example of a company that is actively developing blockchain solutions in the food system under the "IBM Food Trust". The platform allows authorized users to have access to supply chain data, offering a comprehensive view of a product's history and current location. IBM Food Trust has successfully enlisted numerous global food companies, including industry giants such as Nestle and Carrefour. Illustrating the tangible impact of blockchain, Walmart conducted an experiment that showed the difference in traceability times. Without blockchain, it took the company nearly a week to trace a package of sliced mangoes back to its source using available information and documentation. However, with blockchain, the same task was accomplished in just 2.2 seconds, highlighting the transformative efficiency that blockchain brings to the supply chain[166].

Overall, the key message of this section is to show the need of traceability systems in ensuring the efficiency of food systems and protecting consumer safety. Additionally, it aims to emphasise the role of sustainability certification in driving the transformation towards a transparent food industry. However, it is first necessary to prioritise the development of an efficient mechanism, particularly through the strategic utilisation of technology, in order for this transformation to be impactful for the food industry.

Social Perspective

In regard to social impacts, most sustainability certificates mandate that workers undergo training on health and safety issues[167]. This training may include the correct usage of protective gear, appropriate storage of fertilisers and chemicals, first aid procedures, and emergency response procedures[168]. All these measures may contribute to safeguarding the well-being and safety of workers.

[165] Y. Xu et al. (2022)
[166] Sristy (2021)
[167] Hidayat, Glasbergen, and Offermans (2015); Bray and Neilson (2017); Elliott (2018)
[168] Hidayat, Glasbergen, and Offermans (2015); Elliott (2018)

Furthermore, these certifications have a positive influence on workers' financial literacy through the provision of training in bookkeeping skills[169]. This skill set may enhance their value as farm workers. Certain certifications, like Fairtrade, can also foster stronger social connections among farmers, wholesalers, retailers, and input suppliers, as farmers are taught managerial skills during the training process[170]. Additionally, women involved in certification schemes experience increased empowerment, gaining greater confidence and managerial competence through their training[171].

Certification programmes like Rainforest Alliance also place significant emphasis on addressing social issues. Including concerns related to child labour, forced labour, poor working conditions, gender inequality, and the protection of indigenous land rights.

In the specific case of hazelnut production in Türkiye, there are approximately one million seasonal migrant labourers, among whom 220,000 are children[172]. These young individuals are often tasked with hard labour, such as transporting heavy loads up and down steep hillsides in sweltering weather conditions. Rainforest Alliance has taken proactive steps to tackle this issue by providing training to approximately 6,500 farmers. This training is geared towards implementing targeted prevention, monitoring, and remediation strategies to address child labour within the hazelnut production sector. Additionally, Rainforest Alliance enforces a strict record-keeping practice on the farms under its certification guidelines to ensure that children are not engaged in any aspect of the production process. This shows that sustainability standards act as a platform for knowledge dissemination for marginalised communities to learn about the concept of labour rights, as these communities might have limited means to access information about such fundamental principles.

Additionally, within DOA's MyGAP guidelines, there is a specific provision stating that if on-site living quarters exist, they must be maintained in a habitable condition with essential amenities and facilities[173]. This highlights the existence of ensuring the welfare of workers as an integral component of the certification process.

Overall, these examples collectively suggest the presence of social inclusion as part of sustainability standards and go beyond emphasising economic and environmental importance.

[169] Bray and Neilson (2017)
[170] Hidayat, Glasbergen, and Offermans (2015); Bray and Neilson (2017)
[171] Bray and Neilson (2017)
[172] Rainforest Alliance (2023)
[173] Malaysian Standard MS 1784:2005 Crop Commodities

Consumers' Perspective

Another angle of sustainability certification is consumers' acceptance and willingness to pay (WTP). This aspect stands out as one of the most crucial, serving as a marker that distinguishes certified products and uncertified ones. Through certification labelling, it shapes the market positioning of these products, which may aid consumers in their decision-making process[174]. Technically, sustainable certification labelling serves as a direct channel for food producers to communicate with consumers, conveying essential information about product quality and safety attributes[175]. According to De Pelsmacker *et al*. (2005), opting for sustainably produced items falls under the realm of ethical consumption, a concept encompassing products chosen based on ethical considerations such as human rights, animal well-being, and environmental impact[176].

Numerous studies have looked into consumers' WTP for products bearing sustainable labels. Research conducted by Tran *et al*. (2022) focused on Vietnamese consumers' WTP for certified water spinach. The findings noted that consumers exhibited a willingness to pay an additional VND57,150 (equivalent to USD2) to transition from non-certified products to VietGAP-certified ones[177]. Similarly, a study on Belgian consumers' willingness to pay for Fairtrade coffee indicated their readiness to pay a premium of 10.0% above the standard price for products labelled as Fairtrade[178]. A common thread among these WTP studies is the influence of demographic factors on consumers' decisions. Essentially, income and education level emerged as the most influential factors. Individuals with higher incomes and greater educational attainment tend to be more receptive and willing to pay a price premium. This inclination stems from their emphasis on quality when purchasing a product and their understanding of the safety attributes associated with such labelling initiatives.

Collectively, these studies have shown that there is a shift and demand towards a sustainably produced product, albeit not yet universal and might not fully encompass all consumers, particularly those with lower incomes or lower education levels[179]. However, this movement signifies a change in the consumer landscape where it serves as an initial step toward fostering values, responsibility, and shared commitment among consumers to a sustainable future. More than just a label, sustainable certification can shape consumers' attitudes and choices as it redefines how consumers perceive, select, and support products, thereby restructuring market dynamics towards a more ethical and sustainable path.

[174] Vecchio and Annunziata (2015)
[175] Tran *et al*. (2022)
[176] De Pelsmacker, Driesen, and Rayp (2005)
[177] Tran *et al*. (2022)
[178] De Pelsmacker, Driesen, and Rayp (2005)
[179] De Pelsmacker, Driesen, and Rayp (2005); Tran *et al*. (2022)

Overall, this section has outlined both favourable outcomes and some trade-offs associated with sustainability standards at the global level. However, research exploring the positive correlation of sustainability standards, particularly MyGAP, for smallholders in Malaysia remains limited. Existing studies on MyGAP in Malaysia have typically concentrated on specific crops, livestock, or aquaculture products in particular locations[180]. To address this gap, the following section will delve into the context of MyGAP among smallholders in SEMAI Survey, offering a nationwide perspective on smallholder farming in Malaysia. This study is imperative to assess the feasibility of certification adoption for smallholders, its potential in enhancing their farming activities, and to a certain extent, contributing to the improvement of their livelihoods.

3.2 MyGAP Analysis

3.2.1 Methodology and Limitations

Exploratory data analysis from Project SEMAI was carried out to discover patterns, characteristics, and relationships among variables, constituting the primary analysis as described in Chapter 1, followed by subsequent analysis to uncover interesting trends within the datasets. This includes an exploration of MyGAP, exploring intriguing patterns differentiating those with MyGAP certification and those without.

The analysis for this chapter utilised the random forest algorithm, in which its purpose was to identify the most influential variables associated with MyGAP certification (Refer to Appendix D). Random forest is an advanced machine learning technique which operates through a process of randomisation. This entails the creation of numerous decision trees via bootstrapping, where multiple subsets of the original dataset are generated through random sampling. This bootstrapping process introduces a controlled level of randomness, further improving the analysis's robustness[181].

Furthermore, the algorithm introduces a second layer of randomisation at decision nodes. At each node, a specific number of predictors, typically the rounded square root of 'p' for a dataset with 'p' predictors, are randomly chosen from the dataset. The algorithm rigorously tests all possible thresholds for the selected variables, opting for the variable-threshold combination that yields the most optimal split[182]. This process was repeated a significant number of times to grow the random forest.

[180] Gazi Md Nurul Islam *et al*. (2012); Amekawa *et al*. (2017); Mohamad, Fatihah Shaari, and Hafiz Ghazali (2021); Amrol, Ruslan, and Abdullah (2022)
[181] Breiman (2001); Rigatti (2017)
[182] Ibid.

By using this approach, this paper aimed to uncover the most influential variables associated with MyGAP certification, offering insights into the complex landscape of sustainable agricultural practices in Malaysia. However, **it is important to acknowledge the limitations of this method. While random forest analysis highlights influential predictor variables, it may not capture the nuanced relationships among variables comprehensively** [183]. Certain patterns and interactions might be overlooked, and there could be challenges in interpreting the results. Additionally, overfitting is a concern where the model may become overly complex for the dataset, potentially missing the noise present in the data[184].

Therefore, it is crucial to understand that the random forest analysis only served as an initial screening tool, highlighting the most important predictor variables. This preliminary analysis provided a focused foundation for a more detailed descriptive analysis, which was subsequently conducted using Microsoft Excel and Power BI.

Furthermore, this chapter employs the method proposed by Krejcie and Morgan to determine its sample size. Detailed formula for this method can be found in Appendix E. Based on the application of the Krejcie and Morgan formula, the required sample size is calculated to be 361. Given the actual MyGAP population of 5,903 smallholders[185] according to DOA data, the presence of 365 MyGAP-certified farmers within the SEMAI survey is considered sufficient.

3.2.2 Research Questions

During the analysis and literature reviews, several key research questions were formulated to gain a deeper understanding of the MyGAP landscape. These questions include:

i. **How does the demographic composition from SEMAI survey align with DOA data? What is the relationship between MyGAP certification and demographic factors among smallholders?**

   This question aims to compare the composition of smallholders' demographic between SEMAI and DOA data, in order to provide confidence to the collected data. Additionally, this question also explores the correlation between MyGAP certification and various demographic factors among farmers.

ii. **What are the differences in financial literacy and perceived access to financial resources between MyGAP and non-MyGAP smallholders?**

   This inquiry focuses on discerning disparities in financial literacy and farmers' perception regarding their access to financial resources and assistance between those with MyGAP certification and those without.

[183] Donges (2023)
[184] Ibid.
[185] The number is obtained through the author's calculation using smallholders' definition as defined in Chapter 1.

iii. **What are the differences in sales channels and marketing stability between MyGAP and non-MyGAP smallholders?**

This question aims to identify disparities in sales channels and stability in finding buyers for farmers possessing MyGAP certification versus those without it.

iv. **What are the differences in farming support levels between MyGAP and non-MyGAP smallholders?**

This question investigates differences in the level of support received, including training opportunities, participation in farmers' associations, access to technology, and its utilisation, between farmers with MyGAP certification and those without.

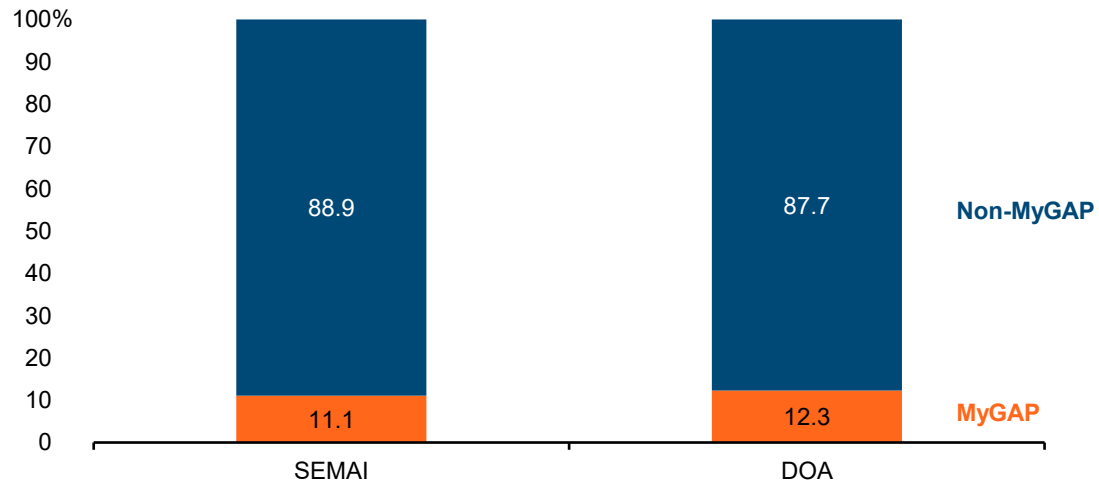
These questions were formulated with the aim to identify potential positive correlations which is deemed important for the agriculture industry. The authors do not intent to impart a causal relationship, as correlation is sufficient and will be discussed in detail in subsequent sections.

3.2.3 Findings and Discussions

Demographic Landscape

MyGAP-certified farmers constitute a relatively small fraction when compared to the overall farming population. Among the 3,300 SEMAI respondents, only 365 individuals or 11.1% were smallholders with MyGAP certification (Figure 3.7). This is similar to Malaysia's overall farming population, in which only 5,903 smallholders or 12.3% holds MyGAP certificates out of a total of 47,918 smallholders[186].

Figure 3.7: Comparison of MyGAP-certified Smallholders out of the Total Population (%)

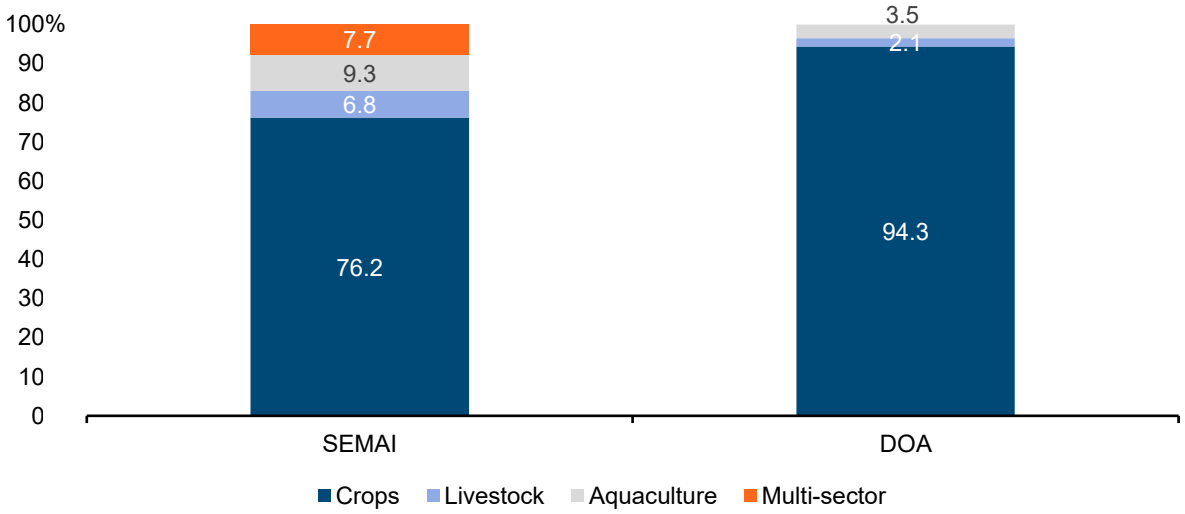


Source: DOA (2023); KNB (2023)

[186] DOA (2023b)

In terms of sectoral distribution, a significantly larger proportion of farmers with MyGAP certification operates within the crops sector compared to the livestock and aquaculture sectors. From the SEMAI survey, among the 365 farmers with MyGAP certification, 76.2% are engaged in the crops sector, 9.3% in aquaculture, 6.8% in livestock, and the remaining 7.7% in multisector activities (Figure 3.8). When analysing the data from DOA, DVS, and DOF, the proportion of certified smallholders in the crops sector is slightly higher, constituting 94.3% of the total certified smallholders, followed by 3.5% for aquaculture, and 2.1% for livestock. Despite the difference, the trend highlights the dominance of the crops sector in MyGAP certification initiatives[187].

Figure 3.8: Comparison of MyGAP-certified Smallholders, by Sector (%)



Note: Data on multi-sector smallholders (grey bar) is only available for SEMAI data as similar data from DOA could not be retrieved.
Source: DOA (2023); KNB (2023)

According to the SEMAI survey, a trend emerges among smallholders whereby those cultivating cash crops[188] exhibit a greater inclination to pursue MyGAP certification. Table 3.2 provides an overview of the top ten crops with the highest number of certified farmers. Chilli cultivation ranks highest in MyGAP certification with 44 certified smallholders, closely followed by cucumber with 27 certified smallholders and coconut smallholders with 21 certified smallholders. In the livestock sector, cow farmers show the highest certification rates with 14 certified smallholders, followed by chicken farmers with 3 certified smallholders. As for aquaculture, silver catfish (*patin*) and tilapia fish are the two leading categories, both having the highest number of 12 and 10 MyGAP-certified smallholders respectively.

[187] DVS (2022b); DOA (2023b); DOF (2023b)
[188] Cash crops are agricultural produce typically cultivated for sale or export, owing to their profitable nature and demand in either local or international markets. There is no fixed list of what can be classified as a cash crop as it depends on region and market demand.

Table 3.2: Number of MyGAP-certified Farmers, by Type and Sector

Crops		Livestock		Aquaculture	
Chilli	44	Cow	14	Tilapia	12
Cucumber	27	Chicken	3	Silver catfish (patin)	10
Coconut	21			Barramundi (*siakap*)	3
Banana	19				
Sawi	16				
Corn	13				
Aubergine	13				
Watermelon	11				
Melon	11				
Pineapple	11				

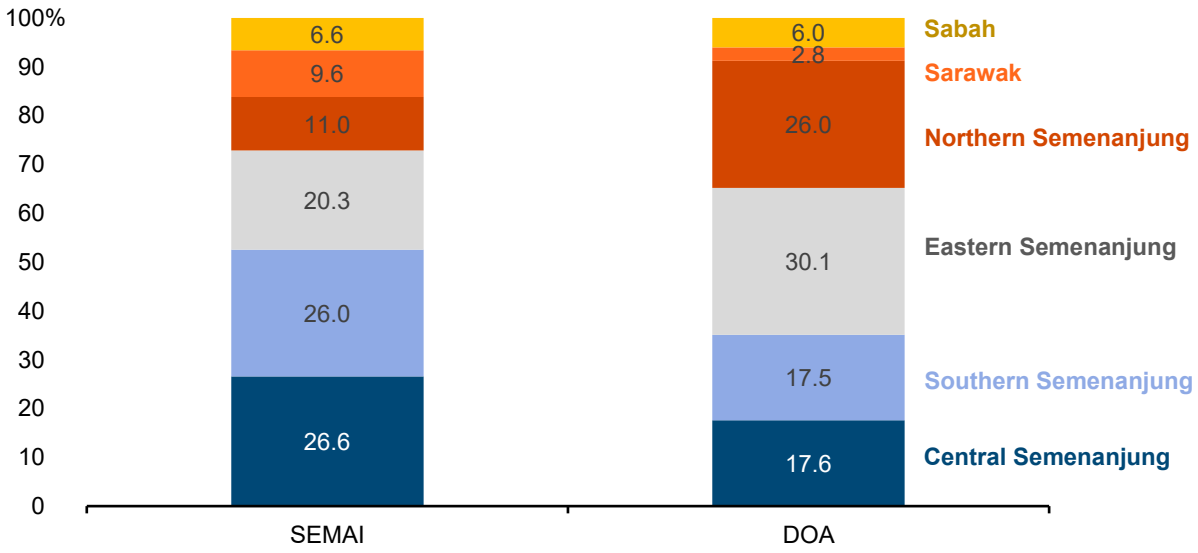
Source: KNB (2023)

Comparing this information with the MyGAP data from DOA, it is clear that certain crops (excluding paddy), such as durian, coconut, chili, corn, pineapple, mango, and mushroom, have a high number of certified smallholders[189]. All of these crops may be categorised as cash crops. This pattern shows farmers are inclined to seek MyGAP certification for these specific crops. The reason behind this preference lies in the ease it offers farmers to sell their produce in markets that demand this certification, emphasising the practical advantage of obtaining MyGAP certification for cash crop cultivation. In further support of the observed trend, it is worth noting that many international markets require certification for the export of agricultural products. Data from UN Comtrade reveals a large export volume for cash crops, especially durian, mushroom, and pineapple, with export value of USD34m, USD11m, and USD5m, respectively, in 2022. This further strengthen the point where these cash crop farmers are more likely to get certified in order to penetrate international markets[190]. For livestock, the sector with the highest number of MyGAP-certified farmers include chickens, pigs, and cows[191]. In aquaculture, seaweed stands out as the predominant type, mainly due to the cluster certification programme in Sabah. Additionally, other notable categories are tiger prawns and barramundi[192].

[189] DOA (2023b)
[190] United Nations (2023)
[191] DVS (2022b)
[192] DOF (2023b)

In terms of geographical distribution, the SEMAI survey shows the majority of MyGAP-certified smallholders are concentrated in the Central Semenanjung region, comprising 26.6% of the total respondents, while Southern and Eastern Semenanjung account for 26.0% and 20.3% respectively. Conversely, DOA data reveals a slightly different pattern, with the Eastern, Northern, and Central Semenanjung regions having the highest numbers of certified smallholders of 30.1%, 26.0%, and 17.6% respectively (Figure 3.9). Eastern Semenanjung has the highest number of MyGAP-certified smallholders due to the proactive efforts of the Terengganu state government in encouraging certification, as explained in Section 3.1.4. Furthermore, the significant numbers in the Eastern and Northern regions are largely attributed to paddy smallholders adopting the MyGAP standards. Interestingly, **both the SEMAI survey and DOA data found that the MyGAP certificate holders in Sabah and Sarawak are comparatively low when compared to the Peninsula**. This trend shows a disparity in MyGAP certification between these regions and Peninsular Malaysia. As mentioned in Section 3.1.4, this disparity could be due to geographical limitations as well as the low frequency of state-level initiatives available in the region.

Figure 3.9: Comparison of MyGAP-certified Smallholders by Region (%)



Note: The geographical regions are grouped as follows:
1. Southern Semenanjung: Includes Melaka, Negeri Sembilan, and Johor.
2. Northern Semenanjung: Comprises Perlis, Penang, Kedah, and Perak.
3. Central Semenanjung: Encompasses Kuala Lumpur, Putrajaya, Selangor, and Pahang.
4. Eastern Semenanjung: Consists of Kelantan and Terengganu.
5. Sabah and Sarawak are standalone regions, each forming one distinct region.
Source: DOA (2023); KNB (2023)

Analysing the correlation between MyGAP certification and factors such as age, farming experience, and education level reveals mixed patterns. The share of MyGap certified smallholders is quite evenly distributed across all age groups (Figure 3.10). The average proportion of MyGAP certified smallholders across all age group is 10.7%.

In regard to farming experience, smallholders with under 1 year of farming experience have a low proportion of certification (1.8%), while those with over 1 year experience higher proportion of MyGAP certification, with the highest being those with more than 30 years of experience (14.4%) (Figure 3.11). The low certification proportion for those with less than 1 year of experience may be attributed to their relative newness to the industry, as they might not have had sufficient exposure to the available resources and requirements for certification. Whereas those with longer experience tend to be more aware of the existence of certification due to exposure that they have received throughout their longer farming experience.

Figure 3.10: Proportion of MyGAP and Non-MyGAP Smallholders Across Different Age Groups (%)

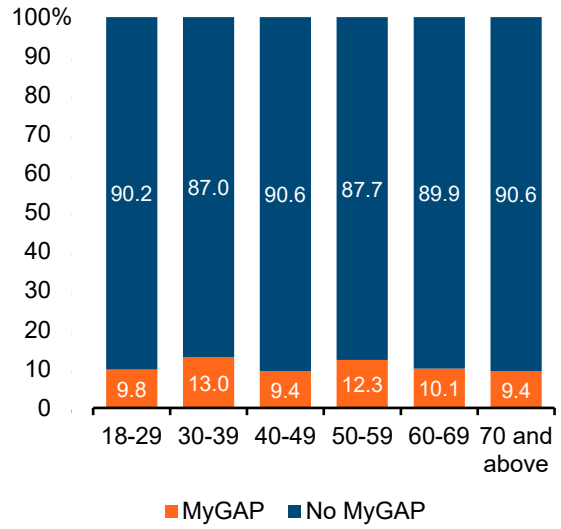
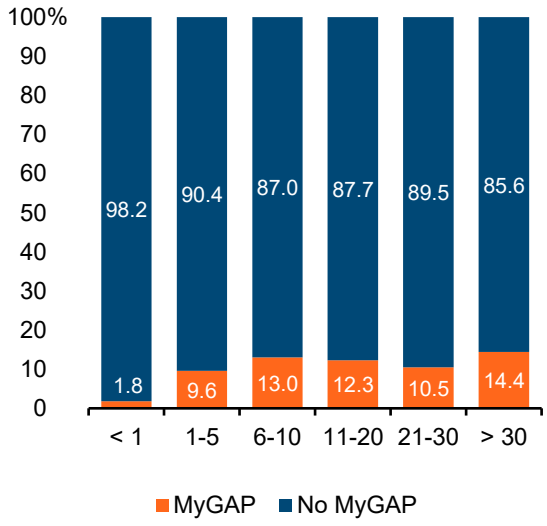


Figure 3.11: Proportion of MyGAP and Non-MyGAP Smallholders by Different Farming Experience (%)



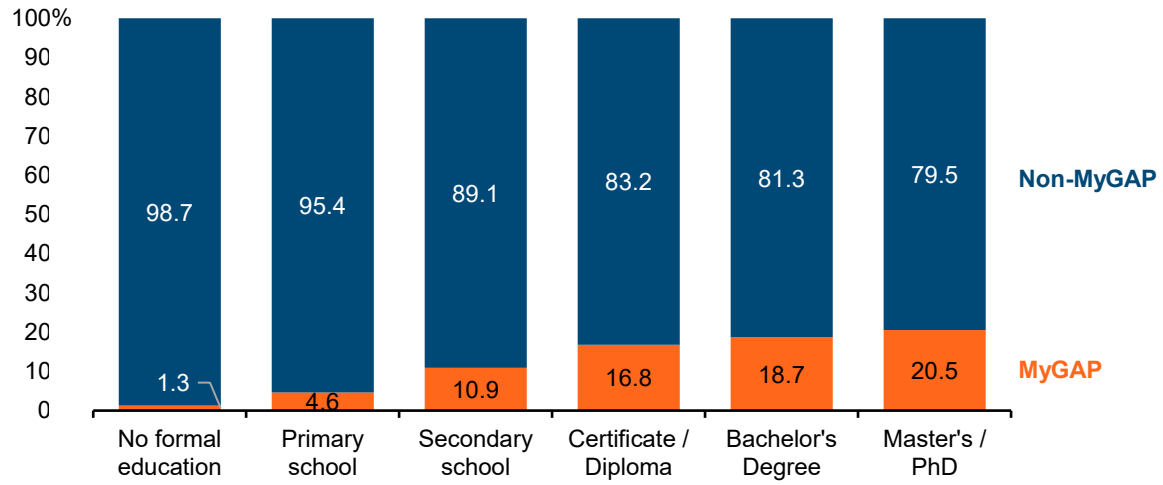
Source: KNB (2023)

The most interesting observation, however, is seen for education levels. The proportion of MyGAP certified smallholder seems to increase as the education level gets higher. From Figure 3.12, we can see that the proportion of MyGAP certified smallholders with no formal education is 1.3% out of those with the same education level, in contrast with those with Master's/PhD in which the proportion is 20.5%. Numerous studies have explored the relationship between education levels and certification. For instance, a study conducted by Amekawa *et al*. (2017) on MyGAP-certified durian farming in Pahang, Malaysia, revealed that 79.0% of farm managers working on certified farms possessed at least a secondary education, while 58.0% of uncertified farm managers had primary education or lower[193]. This finding aligns with another study conducted by Asfaw *et al*. (2010), which focused on 439 small-scale export vegetable producers in Kenya adopting European standards. The study indicated that households led by individuals with higher education levels demonstrated a greater tendency to adopt certification standards[194].

[193] Amekawa *et al*. (2017)
[194] Asfaw, Mithöfer, and Waibel (2010)

What these findings show is that **MyGAP seems to attract more educated farmers, as they might have better exposure on the importance of MyGAP in optimising their farming practices.** Higher education levels may equip farmers with a deeper understanding on the complexities and benefits associated with MyGAP. Additionally, it also **highlights the importance of raising awareness among less educated farmers**. Without adequate information, these individuals may not appreciate the advantages MyGAP offers, including reduced environmental impact through expanded market access, decreased pesticide and chemical fertiliser usage, as well as enhanced product quality and safety. Support and guidance are crucial for encouraging adoption among non-educated farmers, ensuring they too can benefit from MyGAP practices.

Figure 3.12: Proportion of MyGAP and Non-MyGAP Smallholders by Educational Attainment (%)

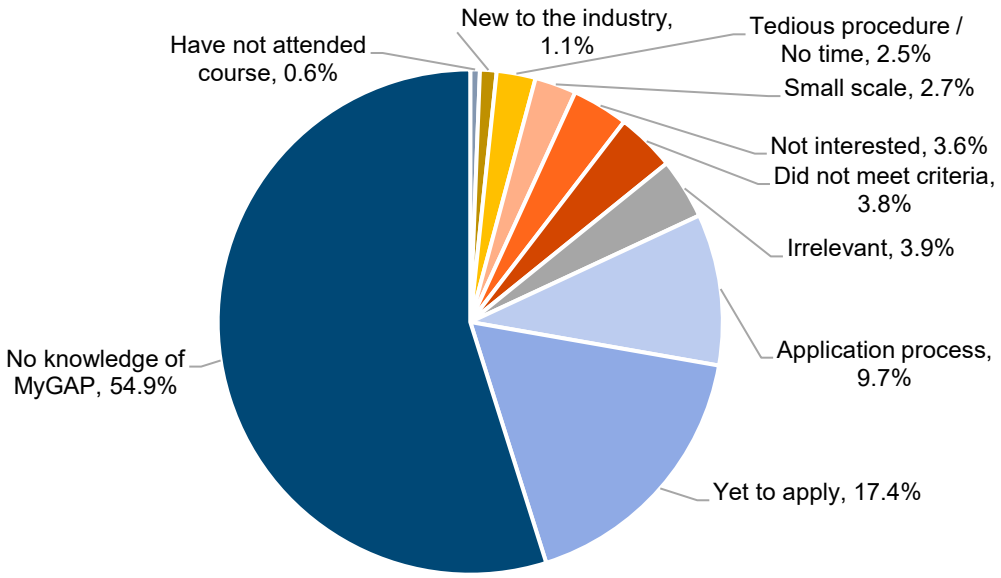


Source: KNB (2023)

On the other hand, a significant portion of surveyed smallholder (*n*=2446) who did not possess MyGAP certification were questioned about the reasons, as depicted in Figure 3.13. The primary explanation cited was 'no knowledge of MyGAP' whereby 54.9% answered this as their reason of not having MyGAP. No/lack of knowledge has been a common reason for the lack of sustainability certificate adoption in many literatures[195]. This shows that there is a need for widespread dissemination of knowledge regarding MyGAP, its benefits, and the application procedures. The second most prevalent reason was 'yet to apply' whereby 17.4% responded this as their main reason. This indicates that these respondents were aware of the certification but were likely to delay due to the tedious process. In order to apply for MyGAP, farmers are required to record all their farming practices and transactions, a demanding task coupled with the necessity for continuous inspections by officers from the DOA. Both of these tasks might discourage potential applicants from pursuing MyGAP certification. Moreover, 9.7% reported 'application process' as a reason of them not having MyGAP. This means that they have applied and are awaiting approval. Delays in application approval is not uncommon, as noted by Mohd Ali et al. (2021), who highlighted that the **application procedure for MyGAP may be delayed, and acquiring approval may take up from 6 – 24 months**[196].

[195] Brandi et al. (2015); Amekawa et al. (2017); Mohamad, Fatihah Shaari, and Hafiz Ghazali (2021)
[196] Mohd Ali *et al.* (2021)

Figure 3.13: Factors Influencing Non-Adoption of MyGAP Certification Among Smallholders (%)



Source: KNB (2023)

Key Takeaways from Research Question 1

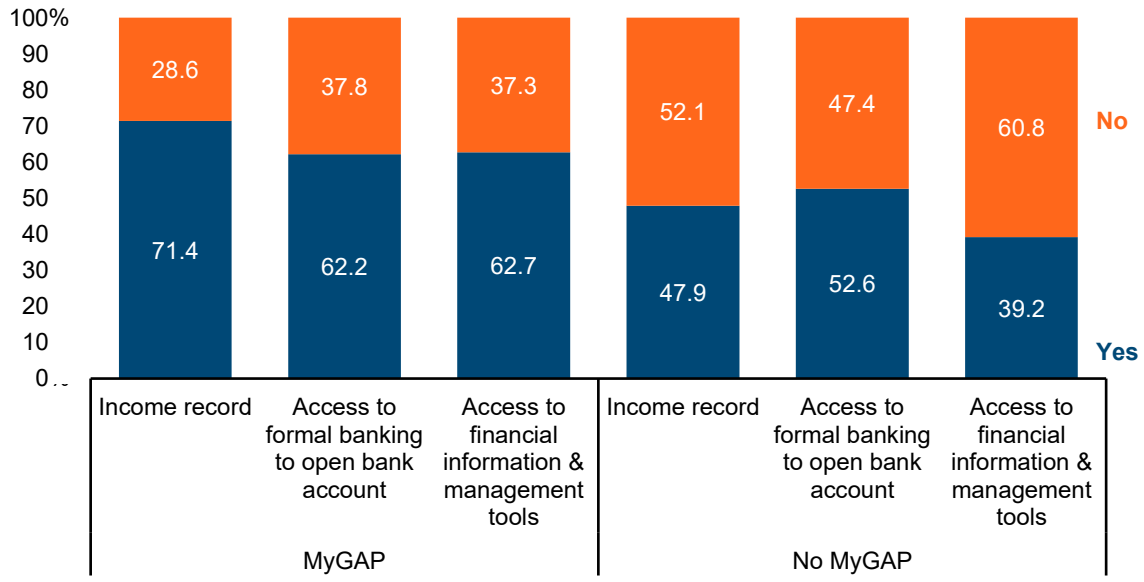
- The demographic compositions from SEMAI survey are similar to DOA data, providing a degree of reliability despite the inherent limitations in survey collection.
- Certified farmers are mostly in the crop subsector, particularly those engaged in cash crop cultivation, and are concentrated in the Peninsula region. There is a low certification rate in Sabah and Sarawak, highlighting the need for intensified efforts in these regions to increase certification rates.
- Farming experience and education level may have an influence on certification status, with higher certification rate among those with longer farming experience and higher education attainment. This demand for intervention programmes targeting individuals with shorter farming experience and lower education level.
- The top three reason for non-certification include no knowledge about MyGAP, individuals are yet to apply despite knowing what MyGAP is, and some in the application process awaiting approval. Addressing these barriers requires a focus in knowledge-sharing sessions and refining the certification procedure to make it more accessible and less time-consuming for farmers.

Financial Literacy and Financial Access

Smallholders' possession of MyGAP certification is closely linked to their financial management practices as MyGAP requirements mandate proper bookkeeping and management of expenditure and income. In the SEMAI survey context, three specific questions were used to gauge smallholders' perceived financial literacy. The first question (C2) inquired about the presence of an income record for their farming activities. The second question (C3) focused on their access to formal banking services for opening a bank account. Lastly, the third question (C4) explored whether smallholders had access to financial information and management tools.

Figure 3.14 shows perceived financial literacy among smallholders. A positive response ('yes') indicates that smallholders affirmed these three criteria. The figure reveals a higher proportion of smallholders with perceived financial literacy are among those with MyGAP certification. For MyGAP certified smallholders, 71.4%, 62.2%, and 62.7% smallholders responded that they have income record, access to formal banking to open a bank account, and have access to financial information and management tools respectively. This is higher compared to those without MyGAP where only 47.9%, 52.6%, and 39.2% answered yes when asked about their possession of income record, access to formal banking to open a bank account, and access to financial information and management tools respectively. This can be directly linked to the clear prerequisites of MyGAP and other sustainability certifications for maintaining proper financial records [197]. The improved financial literacy for certified smallholders is supported by a study conducted by Rainforest Alliance on 110 coffee and cacao producers, 63 of whom they certified, which revealed that 90% of certified farmers kept records of their revenue and expenses, whereas only 30% of noncertified farmers did the same[198].

Figure 3.14: Perceived Financial Literacy between MyGAP and Non-MyGAP Smallholders (%)

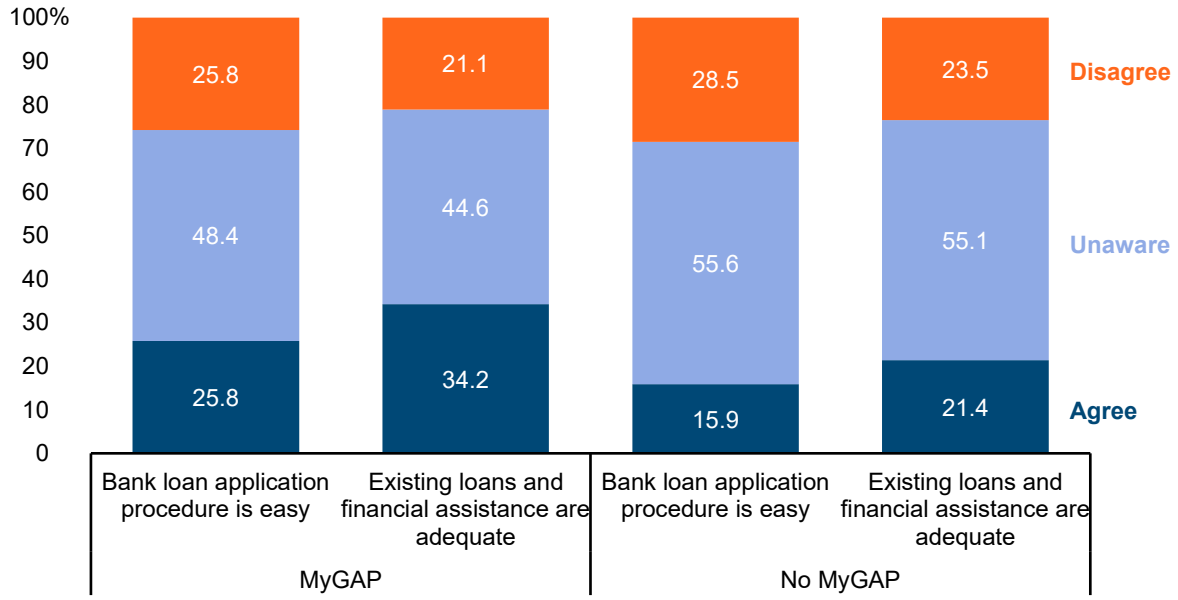


Source: KNB (2023)

[197] DOA (2017); Fairtrade International (2019); GlobalG.A.P. (2022); Rainforest Alliance, n.d.
[198] Rainforest Alliance (2013)

The respondents were also asked on whether they find bank loan application procedures are easy to fulfil (C5a) and the existing loans and financial assistance are adequate (C5b). The survey found that smallholders with MyGAP certification exhibit a higher proportion of positive responses, with 25.8% perceived that bank loan application procedure easy to fulfil and 34.2% considered existing loans and financial assistance sufficient for their needs, in contrast with 15.9% and 21.4% for non-MyGAP smallholders (Figure 3.15). Furthermore, the result shows that a lower percentage of MyGAP-certified smallholders responded 'unaware' compared to their non-certified counterparts when asked these questions. This suggests that MyGAP certified smallholders have an advantage in terms of financial literacy as they are able to navigate banking more easily and make informed decisions regarding financial loans/assistance. Although the causality between financial literacy and certification cannot be ascertained for this study due to data limitations, the study by Rainforest Alliance asserted that farmers with certification have easier access to short-term financing due to better bookkeeping. From the study, certified farmers on average received loans amounting to USD5,562, in contrast to the USD3,311 received by non-certified farmers[199]. Moreover, certified farmers received 1.36 loans annually, while their noncertified counterparts received only 0.66 loans per year[200]. This shows that certification does have an impact on farmers' access to finance, especially in the agricultural sector where there is limited financial accessibility.

Figure 3.15: Perceived Financial Literacy Between MyGAP and Non-MyGAP Smallholders (%)



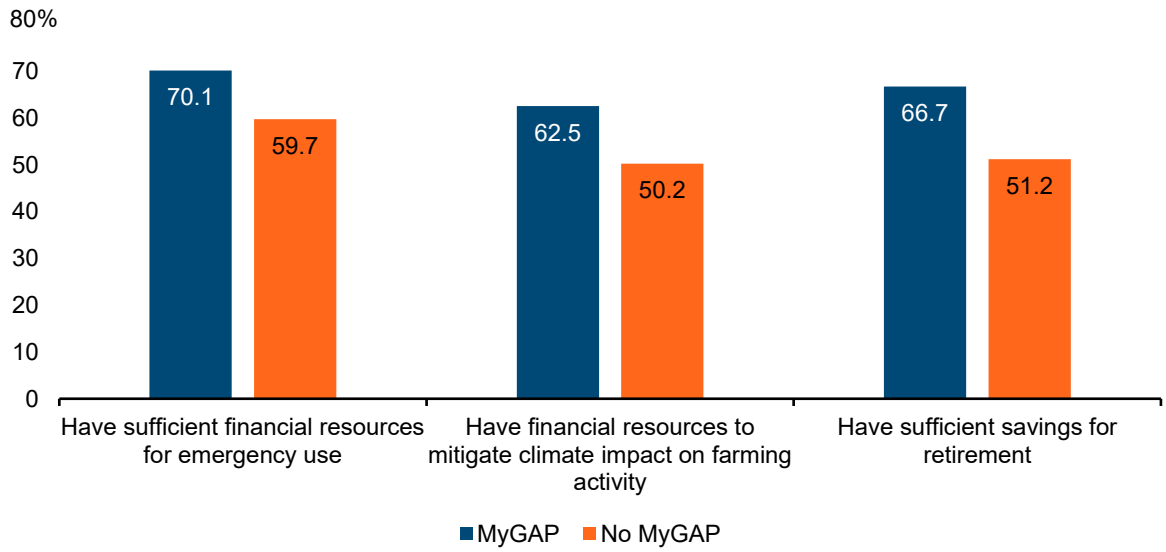
Source: KNB (2023)

[199] Ibid.
[200] Ibid.

To assess the financial security of smallholders, the respondents were asked whether they have sufficient financial resources for (1) emergency use, (2) to mitigate climate impact for their farming activity and (3) to have sufficient savings for retirement. Figure 3.16 demonstrates a higher proportion of certified smallholders reporting a greater perceived financial security, as indicated by their positive responses to the three questions mentioned above. 70.1%, 62.5%, and 66.7% of MyGAP certified smallholders responded 'yes' when asked whether they have sufficient financial resources/savings for emergency use, to mitigate impact of climate change, and for retirement respectively. This observation aligns with the previously discussed idea that certified smallholders tend to have better financial literacy, which was contributed by their better bookkeeping practices and a better understanding of existing loans and procedures, therefore these are all contributing factors of them having better perceived financial security.

A comparative study by Crowder and Reganold (2015) delved into various factors affecting farmers' financial security, including production costs, gross returns, benefit/cost ratios, and net present values of agricultural yields. The research revealed that certified farmers, particularly those receiving price premiums, tend to experience better financial security[201]. This holds true even when accounting for farming costs, gross returns, benefit/cost ratios, and net present values. The additional income from price premiums acts as a buffer, enhancing the overall economic stability of certified smallholders compared to their noncertified counterparts, who do not receive such premiums[202]. Therefore, this might explain the finding above whereby certified farmers might have better financial security due to the higher price that they receive for their produce.

Figure 3.16: Perceived Financial Security between MyGAP and Non-MyGAP Smallholders (%)



Source: KNB (2023)

[201] Crowder and Reganold (2015)
[202] Ibid.

In terms of types of assistance received, Figure 3.17 shows a disparity in the types of assistance received by smallholders based on MyGAP certification. There is a higher proportion of MyGAP-certified smallholders receiving agricultural-related aid, including in-kind assistance (64.1%), agricultural cash aid (15.1%), and agricultural subsidies (10.4%) (Figure 3.17). In contrast, a higher proportion of non-certified smallholders receive non-agricultural related aid, such as cash assistance (45.4%). On the source of assistance received as shown in Figure 3.18, there is a higher proportion of MyGAP certified farmers receiving aid from the state government (51.3%), whereas non-certified smallholders receive assistance predominantly from the federal government (54.0%). There is, however, minimal difference in assistance received from cooperative/association. Other sources of assistance, such as from family/friends and local council remain relatively low for both groups.

It is worth noting that limited research has explored the link between certification and financial assistance[203]. Existing studies primarily focus on certificate adoption and access to financial resources, such as loans. A plausible explanation for the observed trend could be that certified smallholders are more likely to receive agricultural-related assistance due to their inclusion in relevant databases upon registering for MyGAP. This increased accessibility to agricultural assistance could be attributed to their certification status, enabling them to tap into specific financial avenues. MyGAP-certified smallholders might also be more aware of agricultural-related assistance available since they are more engaged with the Department of Agriculture (DOA) to acquire certification Furthermore, as MyGAP farmers are more likely to be more financial literate, they might have more understanding of the financial sector and the available financial services, hence making it easier for them to navigate the financial landscape to their advantage which will eventually lead them to getting more assistance.

Additionally, the higher prevalence of MyGAP assistance from state governments can be attributed to the fact that registration typically occurs at the state level, facilitated by the respective agricultural departments of each state. This localised approach results in a higher concentration of state-based aid for certified smallholders.

[203] Bray and Neilson (2017)

Figure 3.17: Proportion of Respondents by Types of Agricultural Assistance Received Between MyGAP and Non-MyGAP Smallholders (%)

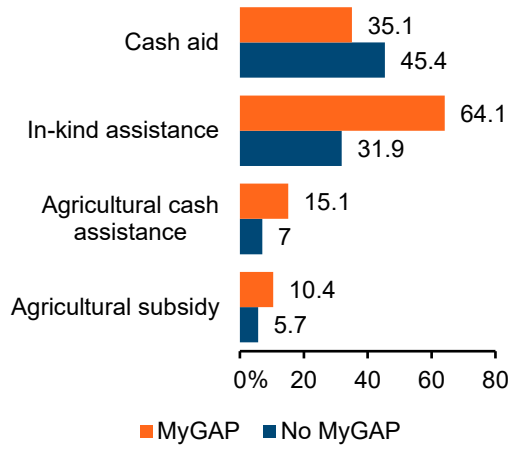
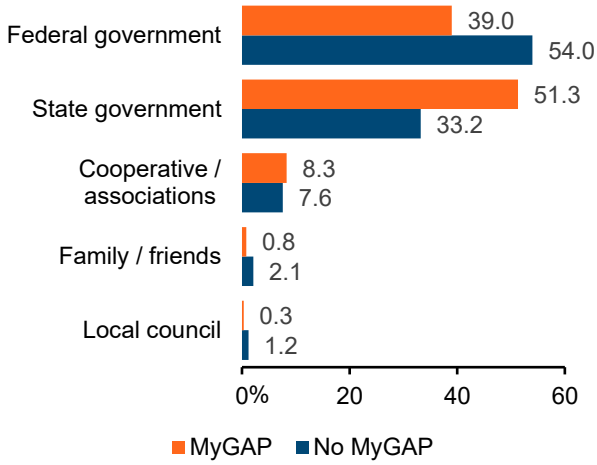


Figure 3.18: Proportion of Respondents by Source of Agricultural Assistance Received Between MyGAP and Non-MyGAP Smallholders (%)



Source: KNB (2023)

Key Takeaways from Research Question 2

- It is observed that MyGAP-certified farmers tend to have better perceived financial literacy, evident from their possession of income records, access to formal banking service, and access to financial information. Additionally, they are more likely to agree that bank loan application procedure was easy, and that existing loans and financial assistance were adequate for their needs.
- This could be possibly linked to the bookkeeping requirement of MyGAP, which lead farmers to be more responsible in managing their income and expenses, which might contribute to improved financial security.
- MyGAP-certified farmers exhibited a higher perceived financial security level, which was denoted by their increased likelihood to possess financial resources or savings for emergencies, retirement, and mitigating the impact of climate change.
- Additionally, MyGAP certification enhances the likelihood of certified farmers receiving agricultural-related assistance, as their registration with MyGAP places them within the system, facilitating access to financial support services.

Sales Channels and Marketing Stability

In regard to sales channels, Figure 3.19 shows the difference in sales practices between MyGAP-certified and non-MyGAP smallholders. Evidently, a higher proportion of MyGAP-certified smallholders are selling their produce to fixed buyers (52.8%) compared to non-certified smallholders (40.8%). A breakdown of the sales channels adopted by MyGAP and non-MyGAP smallholders reveals that a higher proportion of MyGAP-certified smallholders are selling their produce to wholesalers (41.2%) and retailers (24.4%) (Figure 3.20). This indicates that there is a slight improvement in stability in securing buyers and higher chances of attaining a more secure income.

Figure 3.19: Proportion of Respondents by Buyers' Type (Fixed or Unfixed Buyer) (%)

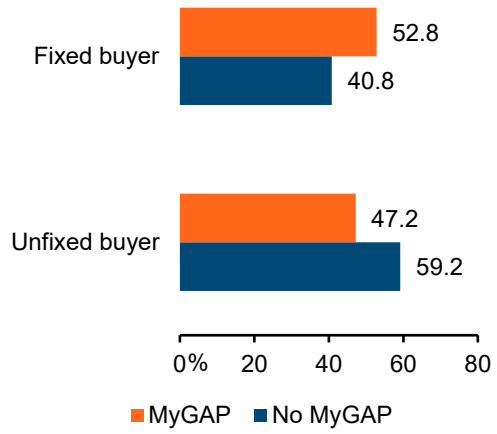
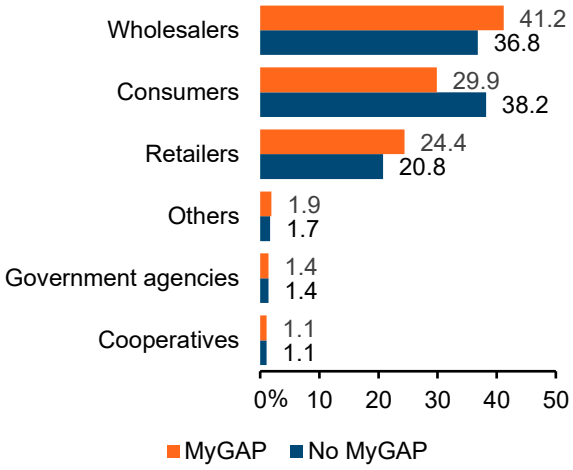


Figure 3.20: Proportion of Respondents by Buyers' Types/Sales Channels (%)



Source: KNB (2023)
Note: For Figure 3.20, percentage is calculated out of number of responses within the group (MyGAP/No MyGAP), and not out of number of respondents.

This trend can be attributed to the assurance of higher produce quality guaranteed by adherence to the stringent requirements mandated by MyGAP certifications. The certification not only ensures product quality but also acts as a gateway to new market opportunities for smallholders. Increased consumer trust in the quality and safety of MyGAP-certified produce has led to higher demand from wholesalers, retailers and consumers who prioritize sustainable and environmentally friendly products. This expanded market access enables MyGAP farmers to diversify their customer base and reduce dependency on a limited number of buyers.

There are several studies that highlight the benefits of certification on market access and sales, whether in local markets or for export. For instance, research conducted by Amekawa et al. (2017) on durian farmers in Pahang showed that certified farmers experience significantly higher durian sales compared to their uncertified counterparts, with a difference as high as 51.5%[204]. This surge in sales is due to the inherently better quality of the durian harvested by certified farmers.

[204] Amekawa et al. (2017)

Additionally, certification opens doors to lucrative export opportunities, further enhancing sales stability for these farmers[205]. This is supported by another study by Gazi Md Nurul Islam et al. (2012) which noted that MyGAP-certified tomato farmers in Cameron Highlands have a wider range of buyers as well as shorter marketing chains. These certified farmers, often financially stable and equipped with their own transportation means, may fetch higher prices for their produce. According to their findings, 60% of the certified farmers' output is directed towards the export market, with the remainder supplied to large supermarket chains[206]. The study also highlighted that non-certified farmers rely heavily on intermediaries for transportation, leading to reduced profits due to the involvement of middlemen. These farmers typically sell their products to wholesalers and supermarkets, with a smaller portion for hypermarkets. Although the study by Gazi Md Nurul Islam et al. (2012) does not explicitly show the difference in sales stability between certified and non-certified farmers, given that both groups typically sell to reliable buyers such as wholesalers and supermarkets, it does highlight a critical point whereby certified farmers have a distinct advantage in securing buyers that yielded higher returns was observed (provided both groups frequently sell to reliable buyers, such as wholesalers and supermarkets).

Another aspect of improved market stability for certified farmers revolves around consumer demand and their willingness to pay for certified food products. A study by Ramli et al. (2022) on the population of Klang Valley demonstrated that consumers were aware of the enhanced safety standards associated with MyGAP-certified cabbage. These consumers were not only aware but also willing to pay an additional RM2.13 for cabbages that carried the certification, compared to non-certified cabbages[207]. However, this willingness to pay a premium depended on various demographic factors among consumers, including income, education level, and age. This statement was supported by another study by Yu et al. (2014) which examined consumers' behaviour in a few provinces in China. The research revealed that consumers are willing to pay a premium of 40% for vegetables and 43% for meat products, respectively, if these items were certified as "Green Food", a certification programme in China that is similar to MyGAP[208].

Key Takeaways from Research Question 3

- MyGAP-certified farmers demonstrate a slightly higher percentage of having stable buyers, often selling their produce to wholesalers and retailers rather than straight to buyers.
- The broader market access of MyGAP-certified farmers may be attributed to the certification instilling consumer trust in the quality and safety of their produce.
- Furthermore, the expanded market for MyGAP-certified farmers may be fuelled by the growing consumer demand for sustainable food products, aligning with the environmentally conscious practices promoted by MyGAP.

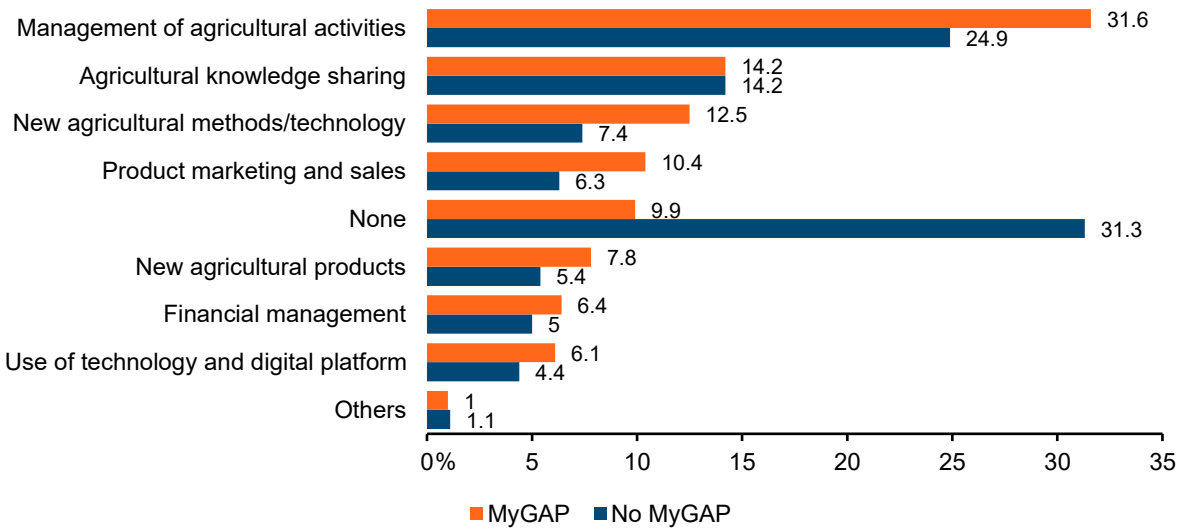
[205] Ibid.
[206] Gazi Md Nurul Islam *et al*. (2012)
[207] Ramli *et al*. (2022)
[208] Yu, Gao, and Zeng (2014)

Farming Support Levels

The SEMAI survey covered a few questions to assess the support level for smallholders, including their training attendance, technology ownership, and participation in cooperatives and associations. This support allowed smallholders to acquire new farming techniques, enhance their agricultural practices, engage in knowledge exchange, sell their products, and access information and assistance regarding agriculture. Moreover, these avenues empowered smallholders to elevate their skills and potentially boost their productivity.

Figure 3.21 shows the diverse range of training programmes attended by smallholders. A higher proportion of MyGAP-certified smallholders participated in various types of training sessions, including on management of agricultural activities (31.6%), new agricultural methods/technology (12.5%), product marketing and sales (10.4%), new agricultural products (7.8%), financial management (6.4%), and technology adoption (6.1%). The figure also highlights a higher proportion of non-certified smallholders responded 'None' (31.3%) when asked about the training programmes they have attended.

Figure 3.21: Type of Training Attended by MyGAP and Non-MyGAP Smallholders (%)

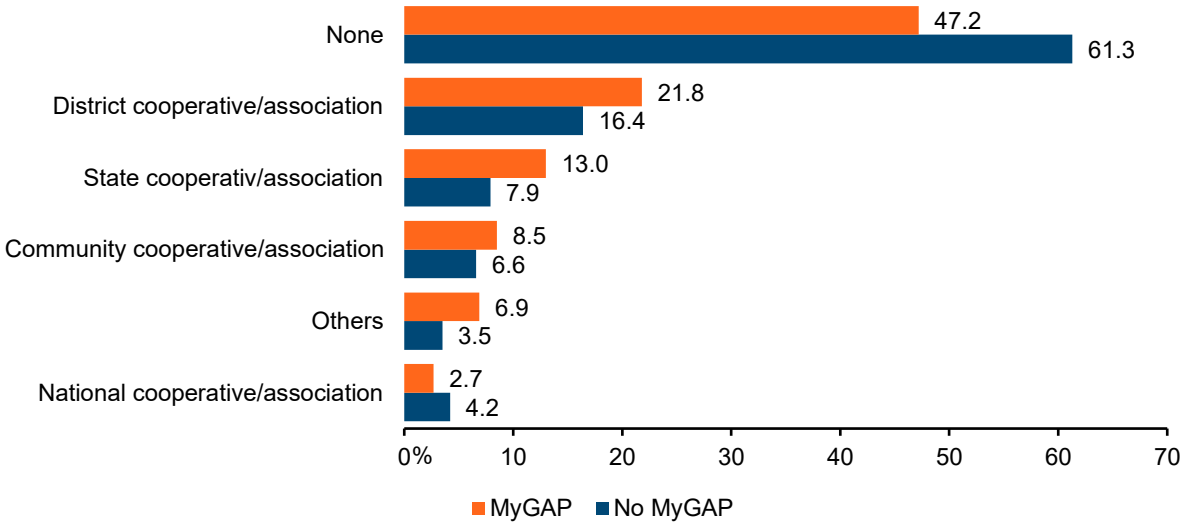


Note: Percentage is calculated out of number of responses within the group (MyGAP/No MyGAP), and not out of number of respondents.
Source: KNB (2023)

This can be explained by the mandatory training prerequisite for MyGAP, where farmers must complete training before applying for certification. This practice is similar to other sustainability certification programmes globally. For instance, in Ghana, cocoa farmers seeking certification will undergo an intensive 6-month training period conducted by an appropriate capacity-building organisation[209]. Furthermore, research conducted by Mori Junior *et al*. (2016) highlighted that organisations adhering to environmental standards demonstrate higher labour productivity. This is due to employees receiving training related to daily farm operations, consequently enhancing their efficiency and productivity in the agricultural sector[210].

On participation in cooperatives and associations, it can also be seen that there is a higher proportion of MyGAP-certified smallholders being affiliated with cooperatives/associations, at the district (21.8%), state (13.0%), and community levels (8.5%) (Figure 3.22). Conversely, when it comes to non-certified smallholders, a higher proportion responded with 'None' (61.3%) as opposed to 47.2% for MyGAP certified smallholders regarding their involvement in cooperatives/associations, indicating a similar pattern observed in training participation. The higher participation rate of MyGAP-certified farmers in cooperatives and associations could be attributed to their engagement with DOA during the certification process. Through training and certification procedures, these farmers might become more aware of the existence and benefits of cooperatives and associations, hence encouraging them to join these community structures.

Figure 3.22: Proportion of Participation in Cooperative/association between MyGAP and Non-MyGAP Smallholders (%)



Note: Percentage is calculated out of number of responses within the group (MyGAP/No MyGAP), and not out of number of respondents.
Source: KNB (2023)

[209] Ansah *et al*. (2020)
[210] Mori Junior, Franks, and Ali (2016)

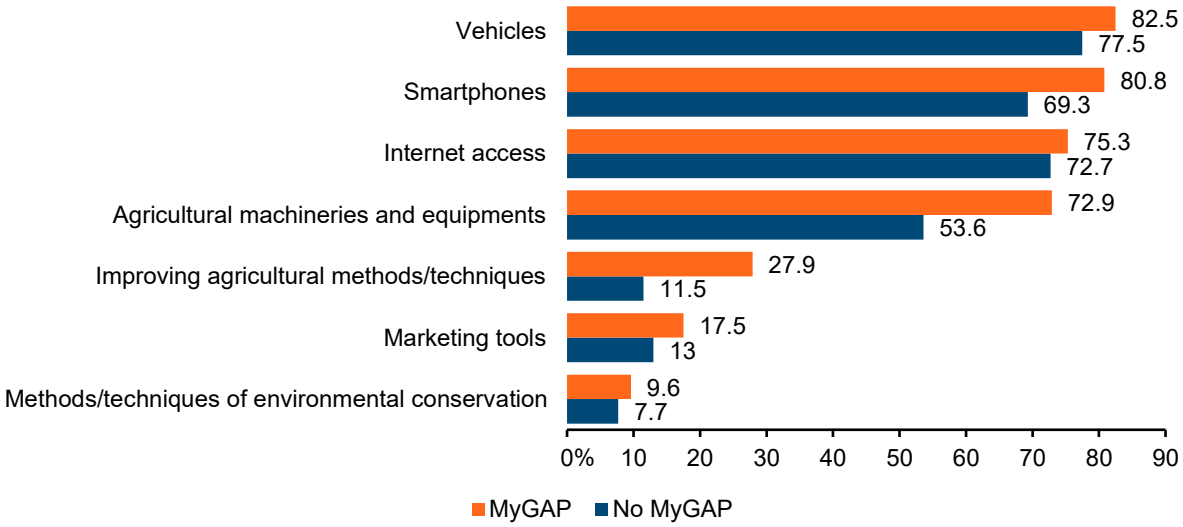
This is supported by a study by Rueda and Lambin (2013), examining the impact of certification on small-scale coffee growers in Colombia. Their research showed that certified farmers exhibit a higher probability of joining associations and informal groups compared to their non-certified counterparts. Specifically, the study revealed that 34 certified coffee growers were affiliated with agricultural-related organisations, a difference from only 13 non-certified farmers[211].

A broader global perspective highlights sustainability certification as a catalyst for farmers to establish a strong community structure. This is through sustainability certification, such as Fairtrade, which allows for group certification[212]. This collective certification approach empowers farmers to collaborate effectively, pool resources, share costs, and collectively pursue certification. This endeavour not only nurtures a strong sense of community but also ensures that farmers operate within an interconnected and supportive network. Furthermore, participating in a network of farmers may enhance collective bargaining power. Farmers within such networks may negotiate more effectively for better return of their produce[213]. This is in contrast with individual farming scenarios, where the bargaining power may be comparatively weaker, emphasising the advantage of community-driven farming structure for the overall advancement of the agricultural sector.

In terms of technology access, MyGAP certified smallholders have a higher proportion of access to technology, including vehicles (82.5%), smartphones (80.8%), internet access (75.3%), agricultural machineries and equipment (72.9%), marketing tools (17.5%), as well as improved agricultural methods/techniques (27.9%) (Figure 3.23). The improved access to technology for certified farmers is supported by a study by Gazi Md Nurul Islam *et al*. (2012) which mentioned that MyGAP-certified farmers tend to be more well-off, owning vehicles to transport their produce from Cameron Highlands. In contrast, uncertified farmers tend to rely on intermediaries for transportation services[214]. Additionally, Bray et al's (2017) study stated that in some cases, certification has the ability to ensure higher and consistent prices for produce, which will then incentivise farmers to invest in physical capital[215]. This investment may include various equipment and technologies essential for enhancing their daily agricultural activities. These two studies showed that it is important to own technology for farming operations, but it depends on farmers' economic capacities to afford such advancements. Looking at the correlation between MyGAP certification and access to technology from a different perspective, farmers with existing access to technology may be inclined and also are better equipped to adopt MyGAP after discovering its features and benefits online. This shows that the correlation between MyGAP certification adoption and technology accessibility may be reciprocal, with each influencing the other.

[211] Rueda and Lambin (2013)
[212] Fairtrade International (2019)
[213] Sokchea et al. (2015)
[214] Gazi Md Nurul Islam *et al*. (2012)
[215] Bray and Neilson (2017)

Figure 3.23: Technology Access between MyGAP and Non-MyGAP Smallholders (%)



Source: KNB (2023)
Note: Percentage is calculated out of number of respondents within the group (MyGAP/No MyGAP).

Key Takeaways for Research Question 4

- It is observed that MyGAP-certified farmers exhibit a higher likelihood of having farming support, evident through their higher training attendance, participation in agricultural-related cooperatives/associations, and access to technology.
- A good farming support level is crucial to enhance farmers' farming practices, at the same time, an avenue for them to receive essential information and updates related to their farming activities.

3.3 Conclusion & Policy Recommendations

In summary, the concept of sustainability standards, particularly their impact on smallholders, is complex and requires in-depth exploration. While existing studies offer a varied perspectives on the effects of sustainability standards – some positive, others neutral, and some negative – our focus has been on highlighting the positive aspects.

SEMAI survey revealed several favourable outcomes, one of them being the positive correlation between the adoption of MyGAP and enhancements in perceived financial literacy and security among smallholders. Given the informal nature of many smallholder operations, accessing financial assistance can be challenging, making MyGAP useful in bridging this gap and providing avenues for improved financial support for agricultural communities. Additionally, **this study also showed positive correlation between MyGAP certification and smallholders' marketing channel, whereby having certification contributes to the establishment of stable marketing channels**, particularly through sales to more fixed buyers like wholesalers and retailers as opposed to direct sales. Moreover, **MyGAP-certified farmers exhibit a higher likelihood to have farming supports, including training, association/cooperative participation, and access to technology** which are all important to enhance smallholders' farming capacity.

Despite the positive findings in the SEMAI project, there exists **substantial room for improvement of the MyGAP framework.** The survey highlighted that there is a **lower proportion of smallholders with less experience or lower educational attainment have MyGAP certification**. There is also a **low certification rate in Sabah and Sarawak**, despite the two states having a large farming community. Notably, the **primary reason for non-certification is a lack of awareness among smallholders, followed by them still considering to apply, as well as some still waiting for approval**. **To improve certification rate, suggested actionable policy recommendation are as follows:**

i. **Conducting MyGAP-related intervention programmes targeting smallholders with specific demographic background** especially **smallholders in Sabah and Sarawak, those with shorter farming experience (e.g. 1 year and below), and those with lower educational attainment**.

ii. **Having more knowledge-sharing/training sessions** on MyGAP to smallholders to ensure the receiving of necessary information on the principles of MyGAP and its application procedures.

iii. **Improving the MyGAP application process and minimising bureaucracy by simplifying the application and approval process.** This is to make MyGAP more appealing to smallholders as they might find application process to be quite tedious or approval time might be too lengthy.

v. **Addressing financial barriers might also be essential**, considering that smallholders may face challenges in affording the compliance costs associated with certification. We recommend **considering providing incentives, following the example set by the Terengganu state government.**

vi. **Exploring collaborative avenues, such as group certification models might be a promising strategy.** Group certifications allow smallholders to pool their resources and share certification costs, which not only will foster a sense of community but also offers a practical solution to financial challenges.

vii. **To enhance the effectiveness of MyGAP mechanisms through analysing and incorporating best practices from global standards.** An example of this is the adoption of a digitalised platform like in GlobalGAP. This platform allows consumers to trace products using unique product IDs and facilitates the lodging of complaints should there are any issues. Another possible approach involves implementing continuous training and monitoring programmes for certified farmers as done by Rainforest Alliance. This ensures that they can fully capitalise on the benefits of certification and can also be an avenue to promote certification among those who are not yet certified.

In conclusion, while MyGAP demonstrates positive benefits, strategic efforts are required to refine its mechanisms, enhance accessibility, and promote awareness. Addressing these aspects should be done first to ensure widespread acceptance and maximising the benefits gained by smallholders in the agricultural sector. The journey towards a sustainable agricultural practice requires a multifaceted approach, which include addressing challenges through thoughtful and effective solutions.

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CHAPTER

04

CHAPTER 4

Understanding the Gender Gap among Agrifood Smallholders

By Dr Teoh Ai Ni

4.1 Introduction

4.1.1 Background

Agriculture is an important source of livelihood and food, especially in developing countries. The International Labour Organization (ILO) denoted that 873 million people were employed in the global agriculture, forestry, and fishery sectors in 2021. Africa accounted for the highest share of agricultural employment (48%), followed by Asia (29.3%)[216]. Both regions are also characterised by high engagement of women in agriculture. Irrespective of gender distribution, it is widely recognised that both men and women play indispensable roles in this sector[217]. While gender-based divisions of certain aspects, such as crop choices and agricultural tasks, are present in specific contexts[218], both men and women similarly contribute to labour and are significantly involved in many production and post-harvest activities[219].

Despite their similar reliance on agriculture for livelihood, many studies have demonstrated that women in this sector encounter a consistent gender gap compared to their male counterparts[220]. Gender gap is defined as the "disproportionate difference between men and women and boys and girls, particularly as reflected in attainment of development goals, access to resources and levels of participation"[221]. This definition implies gender inequality[222]. In the agricultural context, gender gaps are usually reflected in the unequal constraints women face relative to men, which are mainly due to discriminatory social norms[223].

Generally, farming practices and gendered experiences vary across contexts. Nevertheless, several commonalities are observed in the gender gap women encounter in agriculture. Women are consistently reported to be less likely to have access and control over land, access to information, extension services, financial services, and new technologies[224]. They are also more likely to face labour constraints[225]. These gender gaps often lead to reduced resources and opportunities that would otherwise enable women agricultural workers to make the most productive of their work.

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[216] World Bank (2023); The definitions used by ILO in defining agriculture, forestry, and fishery employment include agriculture, hunting, forestry, and fishing, as explained in the Glossary.
[217] FAO (2023b); Ismail (1995)
[218] Ahmad and Ismail (1998); Owens et al. (2018); Akter et al. (2017); Palacios-Lopez, Christiaensen, and Kilic (2017)
[219] SOFA Team and Doss (2011); Peralta (2022)
[220] Amran and Abdul Fatah (2020); Agarwal, Anthwal, and Mahesh (2021); Bello et al. (2021); Bergman Lodin et al. (2019); Gebre et al. (2022); Mudege et al. (2017); Peterman, Behrman, and Quisumbing (2014); Quaye et al. (2019); Panter and Arekapudi (2018)
[221] UNICEF (2017)
[222] Ibid.
[223] FAO (2011); (2023a); UNCTAD (2015); Agarwal, Anthwal, and Mahesh (2021); Panter and Arekapudi (2018); UN Women (2019)
[224] FAO (2011); (2023a); UN Women (2019)
[225] Ibid.

4.1.2 Women's Roles in Agriculture

The involvement of women in agriculture, similar to that of men, usually spans the entire agricultural production and post-production process[226]. Therefore, contributions to agricultural production cannot be clearly divided by gender[227]. Women's roles in agriculture, however, have historically been undervalued, mostly due to age-old, ingrained social norms and gender stereotypes. Traditionally, men, as the head of the household and the legal landowner, are typically regarded as the farmer[228]. Women are often being viewed as the 'farmer's wife' or the helping hand[229]. These gender stereotypes lead to insufficient recognition of women's roles in agriculture, rendering them as the 'invisible farmers'[230].

Another common misconception regarding women's roles in agriculture is their association with low farm productivity[231]. Previous studies examining men's and women's agricultural productivity reported that the productivity of women-headed households or women-managed farms was lower than that of their male counterparts[232]. This approach failed to account for women's contributions in men-headed households or men-managed farms and vice versa[233]. Other studies documented that women farmers were just as productive as men farmers[234]. In the presence of gender differences in productivity, the underlying disparities in access to inputs and resources, not the gender of the farmers, were found to be the significant determinant[235].

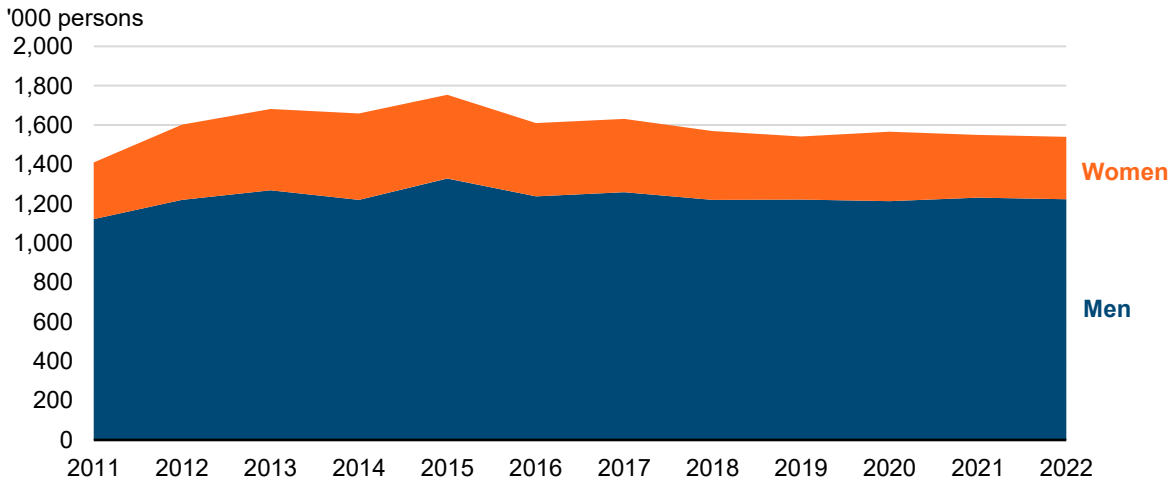
The unequal distribution of household work also impacts women's visibility in agriculture. Women tend to shoulder more household responsibilities in terms of unpaid care and domestic work, which are not recognised as productive work[236]. This leads to time scarcity that limits their engagement in agricultural activity[237]. Although women are significantly involved in agricultural production, their participation in decision-making concerning the production process and activity tends to be much lower than men's[238]. This is attributed to the unequal power dynamics between men and women stemming from social norms, resulting in women's limited autonomy and influence in certain aspects, such as sales and resource allocation[239]. Hence, the invisibility of women and their work alongside gender stereotypes has led to inadequate recognition of their roles in agriculture and the persistent gender gaps observed across countries and contexts[240].

[226] SOFA Team and Doss (2011)
[227] Ibid.
[228] Richardson Gilley and Roberts (2020); Bolwig (2012)
[229] Ibid.
[230] Pannell and Vanclay (2011)
[231] Kawarazuka et al. (2022)
[232] Aguilar et al. (2015); Mugisha et al. (2019); Palacios-López and López (2015)
[233] Quisumbing and Doss (2021)
[234] Doss (2018); Peterman, Behrman, and Quisumbing (2014)
[235] Ibid.
[236] Pannell and Vanclay (2011)
[237] SOFA Team and Doss (2011)
[238] Owens et al. (2018); Acosta et al. (2020); Peralta (2022); Gebre et al. (2021)
[239] Peralta (2022)
[240] FAO (2023b); (2011)

4.1.3 Gender Gaps in Malaysia's Agriculture

The gender gap in agriculture is prevalent across countries and regions, ranging from countries with a high share of women[241] engaged in the sector (e.g. Vietnam[242], India[243], Cambodia[244], and Kenya[245]) to those that are dominated by men (e.g. Philippines[246], Ethiopia[247], and Colombia[248]). This finding also holds in Malaysia, where the agriculture, forestry, and fishery sectors lean to men's dominance. The 2022 LFS reported that one in five employed persons in agriculture, forestry, and fishery were women (20.6%) (see Figure 4.1)[249]. This consistently low employment of women in the agriculture, forestry, and fishery sectors can be attributed to a combination of interrelated factors, such as their rising educational attainment, aspirations to move into relatively better-paying jobs in other sectors, and the modernisation of the agricultural sector displacing their roles[250]. However, these factors are not unique to women; they can also affect men's employment in the sector but in different ways[251]. Therefore, the consistent gender pattern in agricultural employment raises doubts about whether women could engage in and benefit from participating in this sector. Gender gaps are believed to impede women's engagement in the agricultural sector.

Figure 4.1: Gender Distribution of the Agriculture, Forestry, and Fishery sector by Number of Employed Persons, 2011 – 2022



Source: DOS (various years)

[241] This data is based on employment, which includes anyone of working age who is engaged in any activity to produce goods or provide services for pay or profit.
[242] ILO (2021)
[243] Agarwal, Anthwal, and Mahesh (2021)
[244] Sam, n.d.
[245] Kihiu (2021)
[246] Ani and Casasola (2020)
[247] Gella and Tadele (2015)
[248] Pirela Rios *et al.* (2023)
[249] DOS (2023c); (various years). Employed persons include all persons who, at any time during the reference week of the survey worked at least one hour for pay, profit, or family gain. This includes employers, employees, own-account workers, or unpaid family workers who are either Malaysian or non-Malaysian citizens.
[250] N. A. A. Bakar and Abdullah (2010); Yahaya (1988)
[251] ILO (2015); Takeshima, Diao, and Anisimova (2021)

Previous studies conducted in Malaysia documented gender-specific challenges encountered by women in agriculture, such as gender stereotypes, a higher burden of unpaid care, resistance from male stakeholders, and poorer access to finances and extension services[252]. However, two of these studies mainly examined women entrepreneurs' experiences without meaningful comparison to men's. Hence, these studies could not pinpoint the specific gender gaps and their magnitude[253]. Another study by Amran and Abdul Fatah (2020) compared gender experience among paddy farmers in the IADA. The study identified challenges to women's empowerment, including inadequate participation in decision-making processes, poorer access to finances and credit, and lack of training[254]. Even though the findings were not generalisable to the broader agricultural context, they provided insights into women's inequitable experience in agriculture.

In Malaysia, women farmers were also found to be less likely to engage in off-farm employment and contract farming than men farmers[255], which could offer additional opportunities and benefits. The differences in farming practices between genders, such as crop types, labour division, and participation in decision-making processes, were also observed among specific communities[256]. Taken together, these studies suggested that gender differences exist not only in terms of access to resources but also in farming practices and opportunities. The results highlighted the need to examine gender differences across a broader context, encapsulating the sociodemographic factors, practices, resources, and opportunities to comprehend better the factors leading to gender gaps in agriculture.

4.1.4 Policy Significance

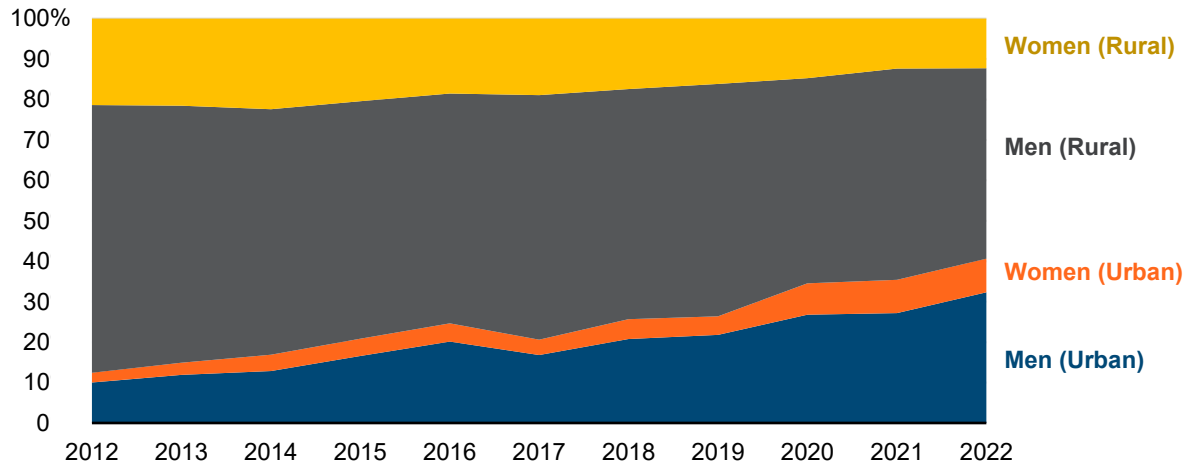
Gender gap does not only cost women their livelihood, well-being, and opportunities. It also impedes agricultural growth and impacts the broader economy and society in terms of economic development, poverty alleviation, food security improvement, and gender equality[257]. According to FAO, closing the gender gap in farm productivity and the wage gap in agricultural employment could increase global gross domestic product (GDP) by approximately USD 1 trillion while reducing the total number of food-insecure people by USD 45 million. In light of the declining share of agriculture employment to the total employment, maximising the output and productivity of everyone in it, including women, is critical. The FAO also estimates that the 20-30% yield gap between men and women is attributed to the gap in access to resources, not because of the differences in skills[258]. If women farmers had access to the same resources as men, they would be able to achieve similar yields[259].

[252] Amran and Abdul Fatah (2020); Haimid, Nik Mohd Masdek, and Rahim (2016); Nik Mohd Masdek (2017)
[253] Haimid, Nik Mohd Masdek, and Rahim (2016); Nik Mohd Masdek (2017)
[254] Amran and Abdul Fatah (2020)
[255] Abdul-Hakim and Hadijah Che-Mat (2011); Kaur, Kamarulzaman, and Hamzah (2015); Lawrence et al. (2012); Man and Sadiya (2009); Arumugam et al. (2011)
[256] Münke et al. (2011)
[257] FAO (2011)
[258] FAO (2011)
[259] Ibid.

Given that the agriculture, forestry, and fishery sectors are the third largest contributors to the Malaysian GDP, the gender gap could impact economic growth. The FAO stated that gender inequalities encountered by women in their agricultural work alongside higher unpaid care burden could result in lower productivity by 24% compared to their male counterparts with equal-sized farms [260]. Nonetheless, this value could differ across countries and contexts. The Malaysian agricultural value added per worker as of 2017 was 45% or less than half of the high-income country averages. This data indicates the need for solutions to increase the productivity of the agriculture sector to be on par with high-income status[261]. Therefore, closing the gender gaps could be a policy option to improve Malaysian agricultural productivity.

Agriculture is also crucial in driving rural economy and social development. Over one-third of the total employment in rural areas in Malaysia is in the agriculture, forestry, and fishery sectors, indicating the significance of these sectors for rural livelihoods[262]. The share of urban men and women employed in the Malaysian agriculture, forestry, and fishery sectors have risen over the past decade due to the growing urban population. However, rural employment still accounts for a significant proportion of employment. Figure 4.2 depicts that approximately 60% of agriculture, forestry, and fishery employment were from rural areas, and one-fifth (20.6%) of them were women. However, as the employment statistics provided by LFS included fishery and forestry sectors that are normally dominated by men[263], this observation could not be generalised entirely in the agrifood context.

Figure 4.2: Distribution of Agriculture, Forestry, and Fishery Sector by Gender and Strata in Malaysia, 2012 – 2022 (%)

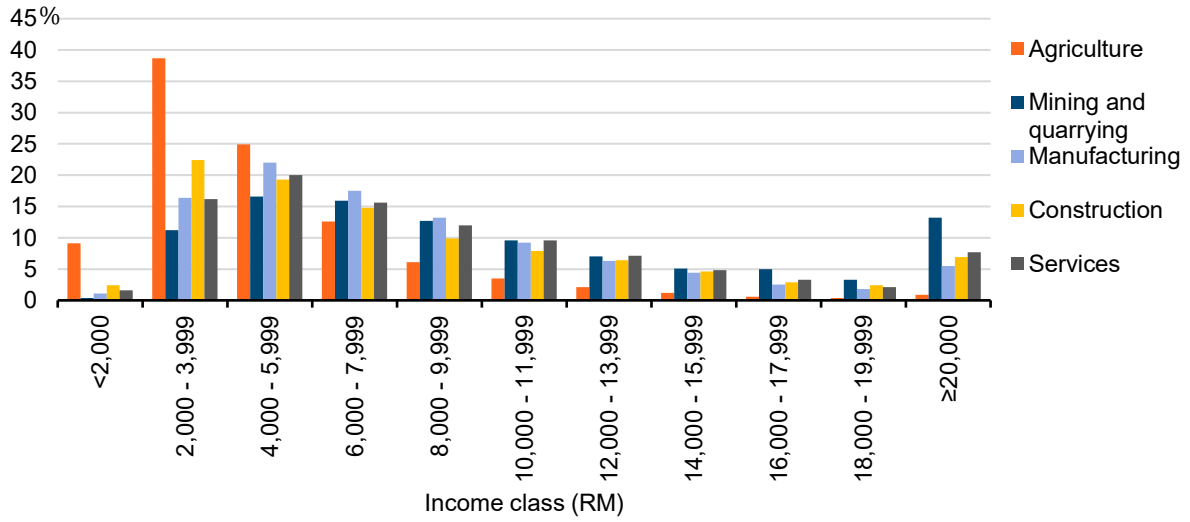


Source: DOS (2023c), KRI Illustration

[260] FAO (2023a)
[261] World Bank (2019)
[262] DOS (2023c)
[263] Ratnasingam *et al.* (2013)

Due to the significant role of agriculture in rural livelihood, addressing the gender gaps in agriculture can help to reduce poverty. Data reveals that households headed by those who work in agriculture tend to have lower income, with the majority (58%) earning below RM4,000. In comparison, the national average poverty line income (PLI) is RM2,589 in 2022[264]. This indicates a higher likelihood for households whose primary source of income is from agriculture activity to fall into poverty[265] (Figure 4.3). Indeed, a similar pattern can be observed between the size of the agriculture, forestry, and fishery workforce and the incidence of absolute poverty. States with a higher rural population and a sizeable agriculture, forestry, and fishery workforce, such as Sabah and Sarawak also have a higher poverty incidence (Figure 4.4 and Figure 4.5)[266]. The gender gaps within these states can further aggravate the economic well-being of women working in agriculture.

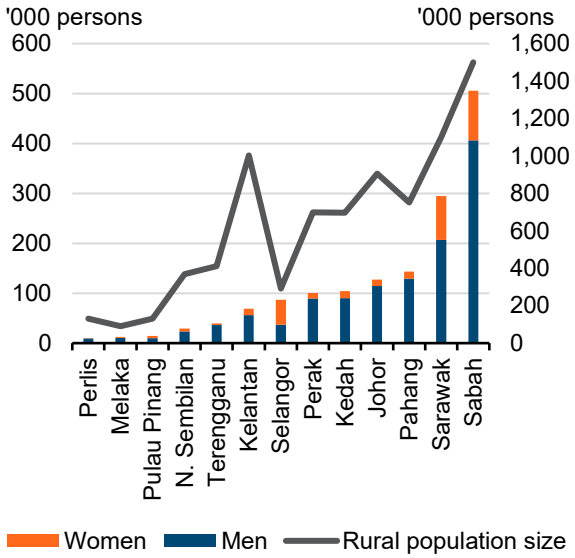
Figure 4.3: Distribution of Households by Employment Sector and Income Class (RM), 2022 (%)



Source: DOS (2023b)

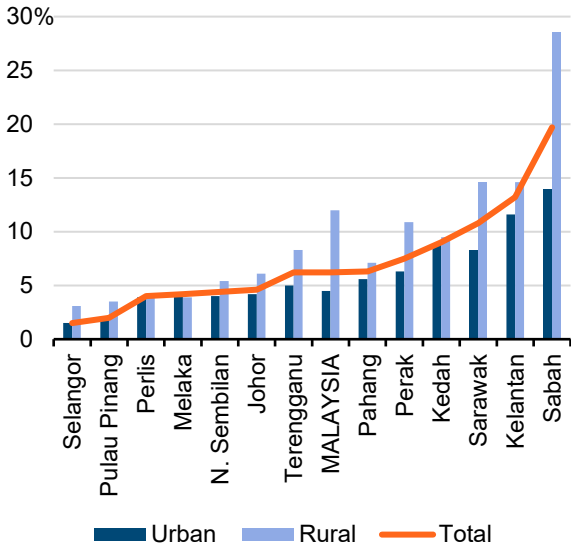
[264] DOS (2023d)
[265] DOS (2023b)
[266] DOS (2022a); (2023b)

Figure 4.4: Total Number of Employed Persons in Agriculture, Forestry, and Fishery Sector in 2022 and Rural Population Size in 2020 by States



Source: DOS (2022a, 2023c)

Figure 4.5: Incidence of Absolute Poverty by States, 2022 (%)



Source: DOS (2023b)

In addition to the direct impacts on economic growth and poverty alleviation, closing the gender gaps can help strengthen food security and produce a spill-over effect on children's nutrition, health, and education[267]. In general, women play a crucial role in ensuring household food security as they are typically responsible for managing the household's food resources, preparation, and consumption[268]. Compared to men, women prioritise spending on food, healthcare, and education for the family[269]. Their incomes are also more strongly related to improvement in their children's nutritional status[270]. When gender gaps are present in households headed by women engaging in agriculture, the families are therefore more susceptible to income reduction and food insecurity[271]. Even within a dual-headed household, women who are more disproportionately affected by gender gaps may have inequitable decision-making or bargaining power and face a higher risk of intra-household food insecurity[272]. Taken together, addressing the gender gap in agriculture is necessitated not only by moral and equity imperatives but also by its economic and social significance.

[267] IFC (n.d.); FAO (2023a)
[268] Quisumbing *et al.* (1996)
[269] Quisumbing *et al.* (1996); Carranza and Niles (2019); King and Hill (1997); H. B. Lee, McNamara, and Bhattacharyya (2022); Rufai *et al.* (2021)
[270] Alderman *et al.* (2014)
[271] Tibesigwa and Visser (2016); Modika and Oluwatayo (2022)
[272] Casco and Fellmer (2023)

4.2 Objectives and Research Questions

While it is clear that closing the gender gap has multifaceted impacts, the primary focus should be investigating whether gender gaps exist among agricultural smallholders in Malaysia. If such gaps are present, it becomes crucial to pinpoint the specific areas where these disparities lie, which will serve as the entry points for intervention. This chapter first identified gender disparities among smallholders in Malaysia across multiple aspects of their agrifood production, before delving into the factors that explain these disparities. By pinpointing the specific gender gaps, this will enable the identification of areas that can be addressed through policy tools to ensure a more equitable experience in agrifood production.

The research question guiding the analyses in this chapter is as follows:

- Do men and women smallholders differ in the following aspects?
    - Sociodemographic characteristics
    - Farming practices
    - Agricultural resources and training experience
    - Participation in contract farming
    - Perceived sales challenges

4.3 Methodology

This chapter utilised a quantitative approach to identify the gender disparities in sociodemographic and farming characteristics, perceived challenges, and the types of support received. The data analysis was primarily performed using the Project SEMAI survey data and supported with secondary data extracted from published databases, literature, and national reports (LFS report, Annual Economic Statistics, and *Perangkaan Agromakanan Malaysia*). Chapter 1 detailed the methodology of the Project SEMAI survey[273], including sampling, data collection, and questionnaire. Findings from previous quantitative and qualitative studies on gendered practices and disparities were also included in the discussion of the results in this chapter. This is crucial in elucidating the norms and roles involving the observed gender disparities and identifying policy entry points to address these gaps.

Preliminary analyses were conducted using Spearman's rank correlation test before data analysis to identify the degree of correlation between the independent variable (gender) and dependent variables (sociodemographic, productivity, financial literacy, training, technology adoption, research participation, climate perception, and future planning). This chapter used a non-parametric test due to the non-random sampling method employed for the SEMAI survey. The variables producing a Spearman's rank correlation coefficient closer to one were identified and further examined (see Appendix F). Finally, the results of the analyses were presented using a descriptive approach to uncover trends and patterns.

[273] KNB (2023)

In this chapter, agrifood smallholders consisted of those working in the production of crops, livestock, and aquaculture. The gender gaps were investigated by region (Peninsular Malaysia with Sabah and Sarawak) due to preliminary analysis indicating a regional disparity in farming practices, which may mask the extent of gender gaps when analysed at the national level. Past studies including KRI's previous publications examining the paddy and rice industry shed light on the variations in the agricultural landscape and its associated socioeconomic characteristics and cultural practices between these two regions[274]. Considering that gender norms and farming practices are highly context-specific[275], region-specific analysis of gender gaps is warranted. As farming practices, needs, and experience could vary between the types of farm production, gender gap analysis by subsector was also performed when necessary.

4.4 Findings and Discussion

This section first examined the smallholders' sociodemographic characteristics and farming practices by gender. This would then provide the necessary contexts to understand the gender disparities in access to resources and training, participation in contract farming, and perceived sales challenges discussed in the following subsections.

4.4.1 Sociodemographic Characteristics of Men and Women Smallholders

Higher Women Representation in Agrifood Smallholding in Sabah and Sarawak than in Peninsular Malaysia

The Project SEMAI included 3,300 agrifood smallholders, of which 77.2% were men and 22.8% were women. These values were consistent with the findings reported in the 2022 LFS Malaysia report, which revealed that the proportion of women employed in the agriculture, forestry, and fishery sectors was 20.6%[276]. Similar to LFS 2022 statistics, there was a higher proportion of surveyed women smallholders in Sabah and Sarawak than in Peninsular Malaysia (Chapter 1, Figure 1.4). Over one-third of the smallholders surveyed in Sabah and Sarawak were women, whereas in Peninsular Malaysia, about every one in ten were women.

[274] KRI (2022); (2019); Hill (2013)
[275] Hillenbrand and Miruka (2019)
[276] DOS (2023c)

The higher women's participation in agricultural smallholding in Sabah and Sarawak than in Peninsular Malaysia can be attributed to economic and sociocultural differences. Sabah and Sarawak have bigger populations in rural areas than other states[277], which are more likely to rely on agriculture as their main economic activity[278]. As previously shown in Figure 4.2, the proportion of rural women employed in the agriculture, forestry, and fishery sector is higher than that of urban women. Traditionally, rural women tend to participate in agricultural production alongside men[279]. They can take on different agricultural roles, such as working independently, as unpaid labourers on family farms, or as paid workers on other farms[280]. In general, women's high involvement in agriculture is a common phenomenon in developing countries and the Southeast Asian region[281]. Furthermore, subsistence farming, which women are highly involved in[282], is more common in Sabah and Sarawak, especially among the Indigenous communities[283]. Together, these factors naturally contribute to a higher proportion of women engaged in the agrifood sector in Sabah and Sarawak.

Additionally, with urbanisation, men may move out of agriculture or to urban areas for employment, whereas women are more likely to stay and continue agricultural activity on their own for food sources and to supplement their household income[284]. The dominance of women in rural agriculture as a result of the outmigration of men from rural areas has been observed in other countries, such as Nepal[285], China[286], India[287], and Vietnam[288]. Although the findings did not show the dominance of women in agrifood smallholding, the gendered trend in migration has been reported in local studies of paddy farmers in Sabah and Sarawak[289].

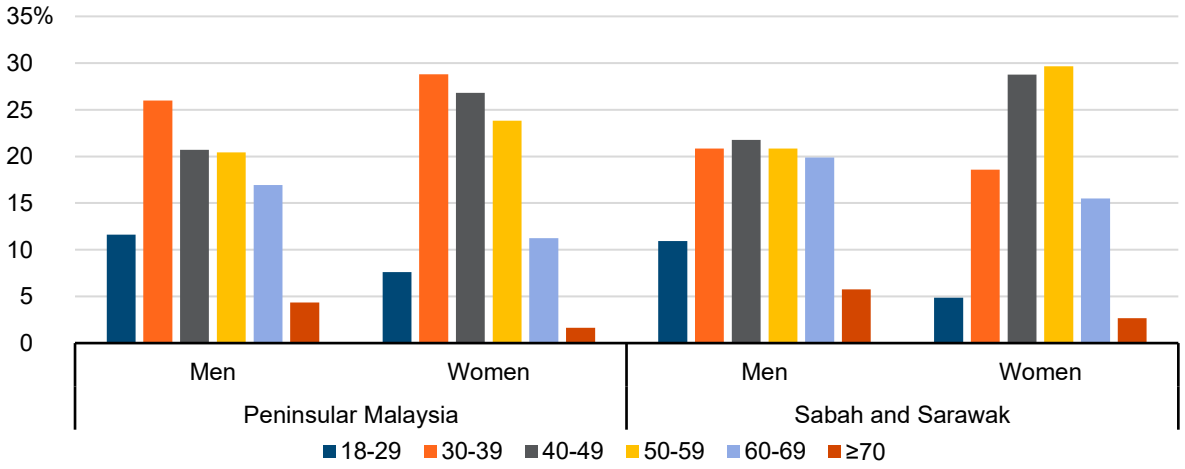
Cultural views that consider men to leave the village in search of a job as appropriate, but women leave only for education and marriage are also common among specific indigenous communities, such as the Iban community[290]. With urbanisation and better access to education, women leaving the villages for job opportunities in the cities have grown more accepting[291]. Nevertheless, a study by Owens *et al*. (2018) reported that gender differences in migration influenced by cultural norms were still prevalent in some indigenous communities. Thus, the higher prevalence of rural agriculture and subsistence farming alongside gendered outmigration patterns may explain the higher share of women smallholders in Sabah and Sarawak than in Peninsular Malaysia.

[277] DOS (2022b); (2022c)
[278] UN/DESA (2021)
[279] SAWO (1992)
[280] Patil and Suresh Babu (2018); FAO (2011)
[281] Akter et al. (2017); FAO (2011)
[282] SAWO (1992)
[283] Hansen and Mertz (2006); Münke et al. (2011); Owens et al. (2018)
[284] Kawarazuka et al. (2022); Slavchevska, Kaaria, and Taivalmaa (2016)
[285] Slavchevska et al. (2020)
[286] Mu and van de Walle (2011)
[287] Pattnaik et al. (2018)
[288] Bacud et al. (2021)
[289] Echoh et al. (2017)
[290] Owens et al. (2018)
[291] Sim (2007); Hew (2003)

Men and Women Smallholders Surveyed were of Similar Age and Farming Experience

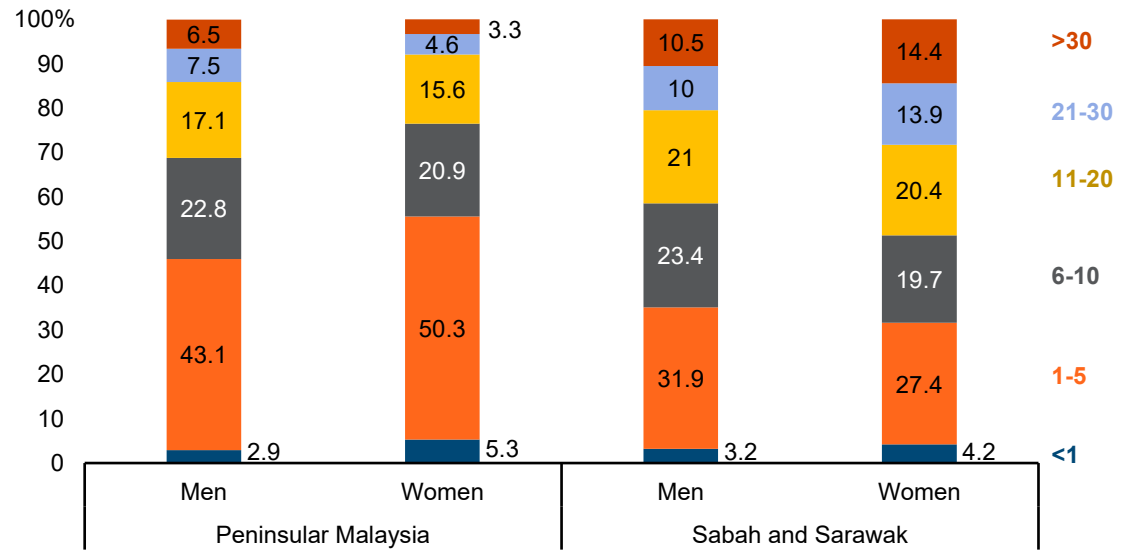
At the time of the survey, men and women smallholders were aged between 45 and 49 years, with Sabah and Sarawak smallholders being slightly older by 2 to 4 years than those in the Peninsula (see Figure 4.6). Similarly, smallholders in Sabah and Sarawak had more farming experience (9.2–10.7 years) than those in Peninsular Malaysia (5.4–6.9 years), regardless of their gender (see Figure 4.7). The SEMAI survey defined farming experience as the years spent in agricultural production. There was little difference in the median age and farming experience between genders. The age pattern among the surveyed smallholders was also consistent with the 2022 LFS Malaysia statistics. The LFS 2022 documented that the median age of men and women engaged in agriculture, forestry, and fishery sectors were 36 and 35 respectively, with only one year of age difference.

Figure 4.6: Distribution in Age Group Among SEMAI Smallholders, by Gender and Region (%)



Source: KNB (2023)

Figure 4.7: Distributions in Years of Farming Experience Among SEMAI Smallholders, by Gender (%)

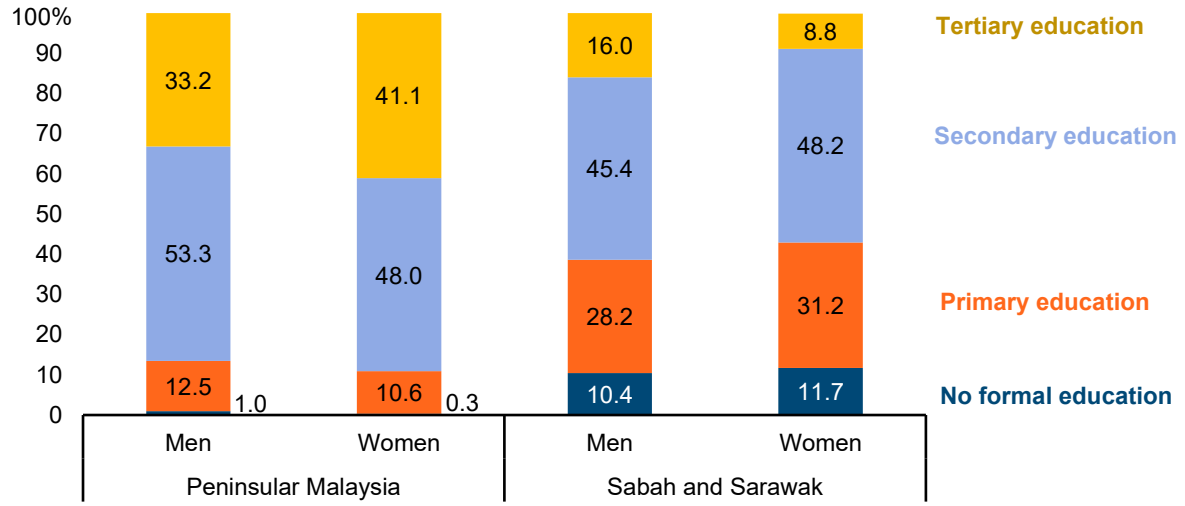


Source: KNB (2023)

Education Levels were Largely Similar Between Genders

Overall, the distribution of education levels between men and women smallholders was largely similar (Figure 4.8). In Peninsular Malaysia and Sabah and Sarawak, most men and women smallholders had a secondary education as their highest educational qualification. Among the smallholders in Peninsular Malaysia, a slightly higher proportion of women smallholders reported having a tertiary education as compared to their male counterparts. On the contrary, the proportion of men smallholders who had a tertiary education was almost double of women smallholders in Sabah and Sarawak, albeit both groups made up a relatively smaller proportion. Otherwise, the distributions in other education levels, namely no formal education, primary education, and secondary education, were similar between gender.

Figure 4.8: Distribution in Education Level Among SEMAI Smallholders, by Gender (%)



Source: KNB (2023)

Higher Proportion of Non-Malaysian Citizens Among Men Smallholders in Sabah and Sarawak

Almost all the smallholders surveyed in Peninsular Malaysia were Malaysian citizens, with 0.2% and 0.8% of non-Malaysian citizens in the men's and women's groups, respectively. On the contrary, the smallholders surveyed in Sabah and Sarawak comprised a higher proportion of non-Malaysian citizens. Approximately 81.4% (n = 610) of the men smallholders were Malaysians, with the rest consisting of foreigners or migrant workers (n = 130, 16.1%), stateless individuals (n = 18, 2.4%), and temporary residents (n = 1, 0.1%). Meanwhile, migrant workers and stateless individuals constituted only 7.1% (n = 32) and 0.2% (n = 1) of the total number of women smallholders in Sabah and Sarawak, respectively.

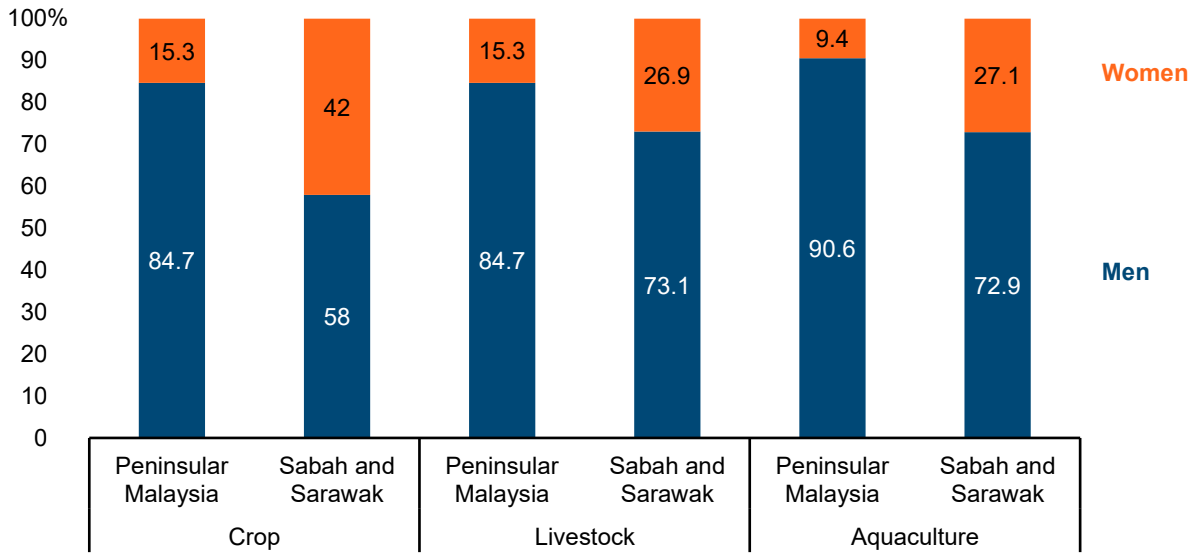
In summary, women smallholders did not differ significantly in median age, education level, and years of farming experience from their male counterparts. However, regional differences were observed. Smallholders in Sabah and Sarawak were slightly older and had a lower educational level and longer farming experience than those in Peninsular Malaysia.

4.4.2 Gender Differences in Farming Practices

Proportionally More Women Smallholders in Sabah and Sarawak were Engaged in Crop Farming than in Peninsular Malaysia

The differences in the men-to-women ratio between Peninsular Malaysia and Sabah and Sarawak were more pronounced at the subsector level. All three subsectors (crop, livestock, and aquaculture) in the Peninsula predominantly consisted of men smallholders (see Figure 4.9). In comparison, all three subsectors in Sabah and Sarawak had a higher representation of women. **Notably, there was a higher proportion of women crop smallholders in Sabah and Sarawak than those in the livestock and aquaculture subsectors**. With 58% men and 42% women, the crop smallholder group in Sabah and Survey showed a nearly equal representation of both genders. Although the surveyed livestock and aquaculture smallholders in Sabah and Sarawak were mostly men, the proportion of women smallholders was notably higher than that in the Peninsula.

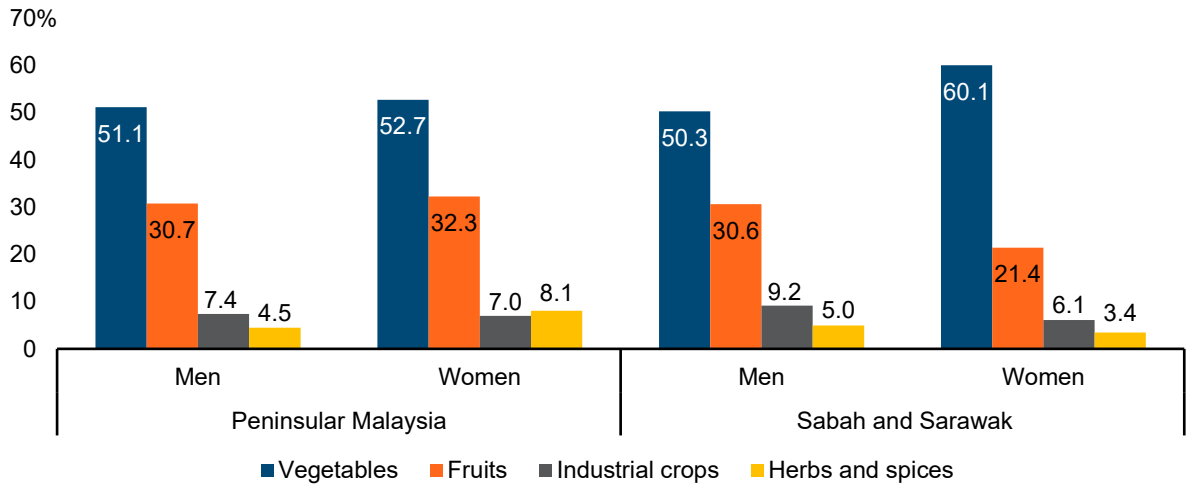
Figure 4.9: Distribution of SEMAI Smallholders by Gender, Subsector, and Region (%)



Source: KNB (2023)

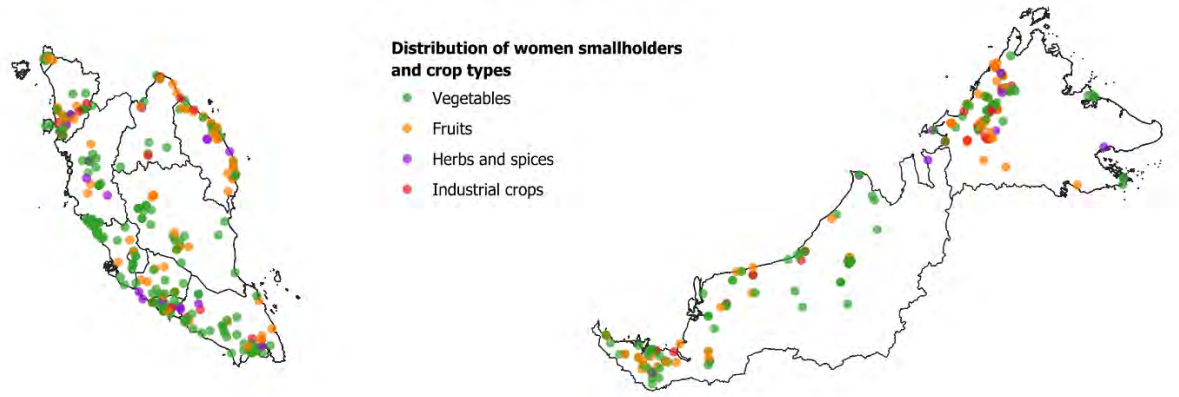
Figure 4.10 illustrates the gender variation in crop types among the surveyed smallholders in Sabah and Sarawak. **The men and women smallholders in the Peninsula primarily engaged in vegetable and fruit farming**, followed by a smaller proportion cultivating herbs, spices, and industrial crops such as durian and coconut (see Figure 4.11 and Figure 4.12). **In Sabah and Sarawak, the majority of women smallholders were involved in vegetable farming, and fewer grew fruits, industrial crops, herbs, and spices. Although most of the men smallholders in Sabah and Sarawak also focused on vegetable cultivation, their participation in fruits, industrial crops, herbs, and spices was higher than that of women.** These differences were particularly distinct among the smallholders in Sarawak.

Figure 4.10: Distribution of Crop Types Grown by Smallholders, by Gender and Region (%)



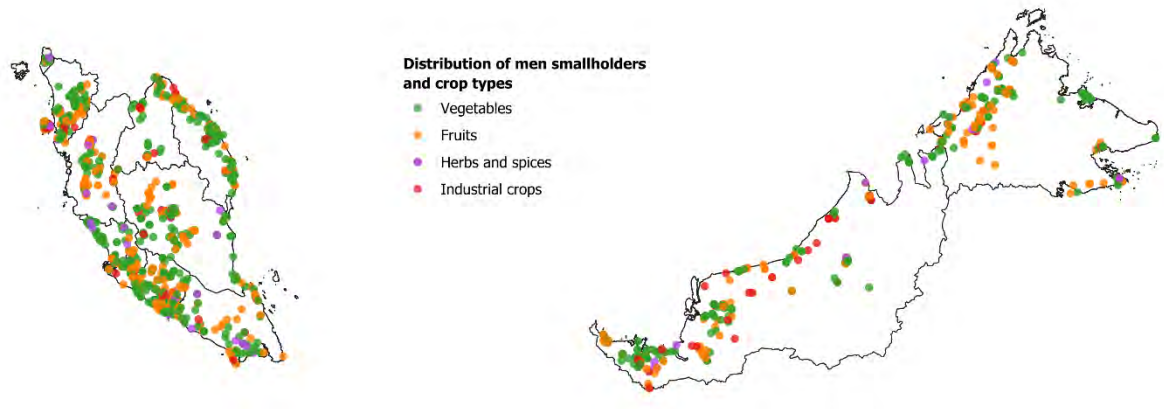
Source: KNB (2023)

Figure 4.11: Distribution of Women Smallholders Surveyed across Malaysia and the Types of Crops Grown



Source: KNB (2023), KRI Illustration

Figure 4.12: Distribution of Men Smallholders Surveyed across Malaysia and the Types of Crops Grown



Source: KNB (2023), KRI Illustration

This finding is consistent with the observation from a study on the Iban community. In their research, Owens et al. (2018) found that vegetable and fruit cultivation were considered women's prerogative. In contrast, men exclusively produced profitable cash or industrial crops, such as oil palm. Labour for growing paddy and other cash crops like pepper and rubber was more equally shared between men and women[292].

The seemingly preference of women smallholders towards crop farming, particularly vegetable farming in Sabah and Sarawak, may be related to the nature of crop farming, which requires less capital and technological use[293]. Historically, women in agriculture are engaged in less-skilled agricultural activities such as fruit, vegetable, and paddy farming. A smaller proportion are involved in cultivating and managing field or short-term cash crops such as rubber, cocoa, and coconut[294]. Conversely, men are less constrained by social norms and socially prescribed roles and responsibilities, especially in the household, allowing them to be involved in a broader range of agricultural activities. Even within the same subsector, men and women usually take on different agricultural roles (see Box 4.1).

Box 4.1: The Traditional Gender Differentiation of Agricultural Roles and Activities

Traditionally, agricultural roles are divided along the gender line due to socially constructed norms and can vary across cultural and economic contexts[295]. The most common gender stereotype is that men are the heads of household, assuming decision-making roles. Meanwhile, women are regarded as helpers or "farmers' wives"[296]. Currently, cultural norms and values remain influential over gender roles in agriculture[297]. Although women are equally or even more knowledgeable due to their significant involvement in agricultural activities, decisions concerning agricultural production and issues are typically made by men[298].

The gender differentiation of agricultural work is also attributed to the time constraints facing women. Women typically spend considerable time managing domestic work, such as cooking, laundry, cleaning, and looking after their children or grandchildren. These household responsibilities, in addition to farm work, can limit their capacity to engage in income-generating activities[299]. Many gender differences in production activities also arise from women's limited access to inputs and resources, lower education levels, and greater labour constraints[300], which are reinforced by the abovementioned norms and constraints.

[292] Owens et al. (2018)
[293] FAO, n.d.
[294] Ibid.
[295] Hillenbrand and Miruka (2019); Richardson Gilley and Roberts (2020)
[296] Richardson Gilley and Roberts (2020); Bolwig (2012)
[297] Marcus Raja (2015); Ishak, Taibi, and Yaakub (2017)
[298] Ibid.
[299] Akter et al. (2017); Ishak, Taibi, and Yaakub (2017)
[300] Argaw, Phimister, and Roberts (2021)

Despite gender roles varying across contexts and cultures, certain gender generalisations regarding traditional agricultural roles are observed. Generally, men in agriculture are involved in physically demanding work such as ploughing, fertiliser spraying, and loading and unloading of produce[301]. In contrast, women tend to perform different but similarly labour-intensive tasks, such as weeding, planting, and harvesting[302]. Such gender distributions in agricultural tasks are still practised among Malaysian paddy smallholders in their rice cultivation activities[303]. Livestock activities are also specialised along gender lines due to the greater labour and time constraints women face[304]. Women are more likely to raise poultry, dairy animals, rabbits, and other animals housed within the homestead, whereas more men are involved in managing grazing animals like cattle[305].

Women's participation in capture fisheries is usually lower than in the other agricultural sectors. Their involvement in fisheries, particularly in commercial offshore and long-distance capture fisheries, is thought to be limited by the vigorous nature of the work, women's household responsibilities[306], and traditions and superstitions that link women to poor catches[307]. This holds in Malaysia, except for certain areas in the Peninsula, such as Kelantan, Terengganu, and Kedah[308], where wives or daughters of fishers are involved in small-scale fisheries[309]. However, women's involvement in aquaculture[310] is higher, especially if the activity is small-scale and requires low technical input[311].

In specific contexts, crop cultivation also appears to be segregated along the gender line. Context-dependent evidence shows that women tend to grow staple or subsistence food crops due to their responsibilities in nourishing their families. In contrast, men tend to grow cash crops for their commercial values and to provide income for the family[312]. However, these gender differences were rather cultural perceptions because production practices and control cannot be clearly divided by gender[313]. In fact, men and women often collaborate along the process of the production, processing, and marketing of crops[314].

[301] Gella and Tadele (2015); Akter et al. (2017); Mutiara, Yuerlita, and Febriamansyah (2022); Owens et al. (2018)
[302] FAO (2011); UNCTAD (2015); Palacios-Lopez, Christiaensen, and Kilic (2017); Akter et al. (2017)
[303] Marcus Raja (2015)
[304] FAO (2011)
[305] UNCTAD (2015); FAO (2011)
[306] FAO (2011)
[307] FAO, n.d.
[308] Ibid.
[309] Siason et al. (2001)
[310] Aquaculture is distinct from fishery; It refers to the farming of aquatic animals and plants, such as fish, shellfish, and seaweed, in various water environments including freshwater, marine water, brackish water, or inland saline water. Source: World Fish Center (n.d.)
[311] Siason et al. (2001)
[312] Gurung (2006); Carr (2008)
[313] Hillenbrand and Miruka (2019)
[314] Manfre et al., n.d.

For example, Doss' study of the agricultural practices of men and women farmers showed that no crops were cultivated exclusively by either men or women in Ghana[315]. However, gender-based cropping existed in some ecological zones, with certain crops being disproportionately grown by men or women. While gendered cropping patterns exist in some contexts, Doss concluded that it is only one of many factors that influence farmer's crop choices. Lack of labour, capital, land and education level, and inaccessibility to agricultural information are significant factors that constrain women in agricultural production, contributing to gender differences[316]. These findings imply that understanding of the differences in choices and outcomes between gender needs to expand beyond gender focus and take into account the socioeconomic drivers.

Women Smallholders Tended to Reserve Some of Their Farm Outputs for Household Use

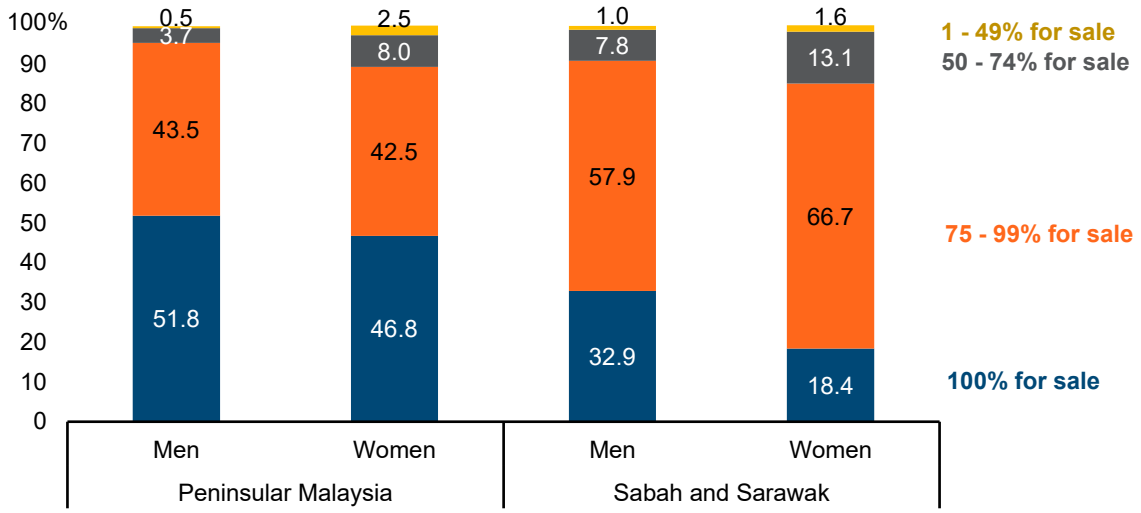
Most surveyed smallholders used their farm outputs for two primary purposes: sales and household consumption. A small proportion of them also bartered their farm outputs with other producers. The number of smallholders who farmed entirely for subsistence was small, with no gender differences (Peninsular Malaysia: n = 2; Sabah and Sarawak: n = 4). However, men and women smallholders reported different utilisation of their farm outputs.

Fewer women smallholders would completely sell their farm outputs for sales than their male counterparts (see Figure 4.13). **Instead, most women smallholders allocated a small portion ranging from 1% to 49% for household consumption** (see Figure 4.14). On the contrary, more men smallholders sold all their farm outputs and kept none for household consumption. Nonetheless, a considerable proportion of the men smallholders still kept part of their outputs for household use (Peninsular Malaysia: 45.9%; Sabah and Sarawak: 65.2%), albeit mostly at a small portion ranging from 1% to 24%. These gender differences were particularly noticeable among the smallholders surveyed in Sabah and Sarawak.

The gender disparities in output utilisation were found to be consistent across crop types in this report. Women were more likely to keep their farm produce for household consumption than their male counterparts, regardless of the types of crop they cultivated. On the other hand, those who primarily bred livestock and aquaculture, regardless of gender, were more likely to sell all their farm outputs. This could be related to the higher commercial values of animal products than crops, motivating the smallholders to prioritise their sales over household usage.

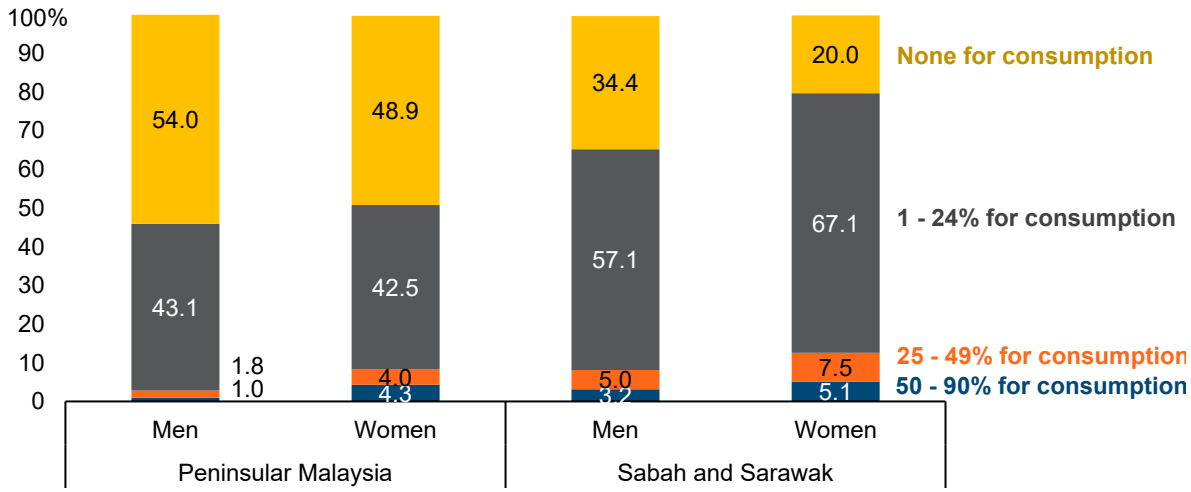
[315] Doss (2002)
[316] Ge et al. (2023)

Figure 4.13: Breakdown of Smallholders' Outputs for Sales, by Gender (%)



Source: KNB (2023)

Figure 4.14: Breakdown of Smallholders' Outputs for Household Use, by Gender (%)



Source: KNB (2023)

Women smallholders' tendency to utilise the farm outputs for household consumption may be linked to their household roles in managing the food resources, preparation, and consumption of the household[317]. Women are usually more inclined to cultivate crops suitable for home consumption[318]. A study by Carr (2008) recorded that women's production was oriented to their household first and their own needs second. Such a gendered production pattern was especially prominent in women-headed households, where women raised staple food crops primarily for consumption and marketed the surplus for income[319].

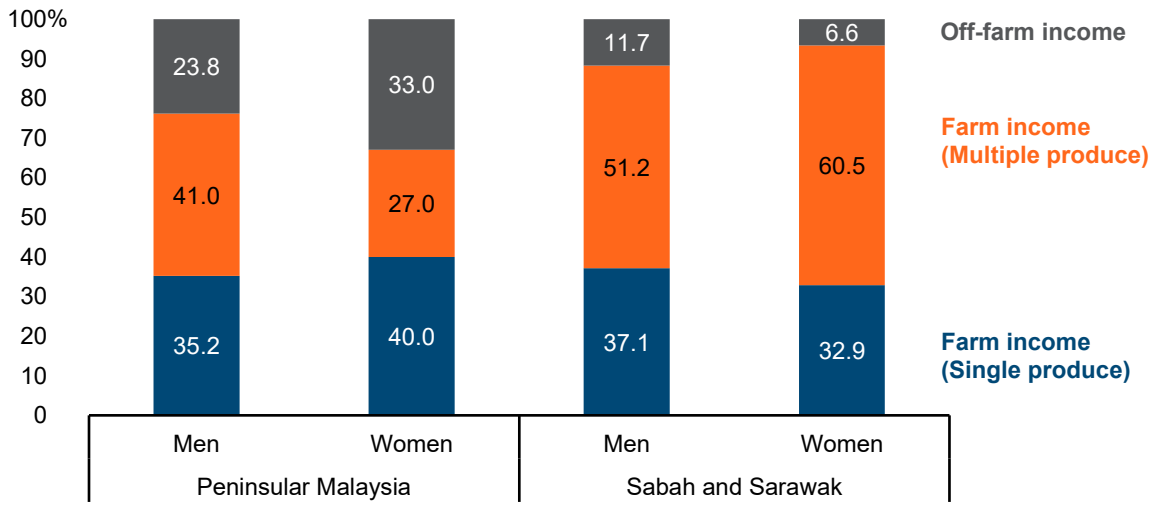
[317] Argaw, Phimister, and Roberts (2021)
[318] Carr (2008); Owens *et al.* (2018)
[319] Carr (2008)

The average proportion used for household consumption was also found to be higher in Sabah and Sarawak. Sabah and Sarawak present a higher rural population than Peninsular Malaysia and have a higher prevalence of subsistence or semi-subsistence agriculture. Typically, rural agriculture is for personal consumption rather than market supply. This observation is opposed to urban agriculture, where farm outputs are mainly sold at the market, and little is kept for consumption[320]. While this study observed a difference in output utilisation between the two regions, most men and women smallholders (> 85%) still sold at least 75% of their outputs for livelihood. This indicates their significant reliance on agrifood production for income generation.

Agriculture had Greater Economic Significance to Smallholders in Sabah and Sarawak

The gender variation in output utilisation may have a differential influence on the smallholder's income. **The results showed that both men and women smallholders had a similar degree of reliance on farm income**. **However, a distinction between regions were observed** (see Figure 4.15). **The income generated from agrifood production was particularly significant for the livelihood of agrifood smallholders in Sabah and Sarawak due to their high reliance on farm income**. **Conversely, more smallholders in the Peninsula diversified their income sources with both farm and off-farm work**. This difference between regions can be attributed to several economic and social differences.

Figure 4.15: Main Sources of Income Among Smallholders, by Gender (%)



Source: KNB (2023), KRI Illustration

[320] Tibesigwa and Visser (2016); De Bon, Parrot, and Moustier (2010)

Off-farm employment has been associated with several socioeconomic benefits for agricultural workers. It primarily serves as a means to diversify or supplement the agricultural income of farm households[321]. Off-farm or non-agricultural work also tends to pay higher than agricultural work in general[322]. These works function as a risk management tool for spreading farm income risks. Therefore, off-farm income can contribute to the reduction of food insecurity and poverty, particularly among rural farmers[323].

However, off-farm employment opportunities may vary by geographical location[324]. Agriculture is more likely to be a more permanent and significant livelihood strategy in rural areas. In contrast, agriculture is usually regarded as a partial or temporary livelihood in urban areas[325]. This is off-farm formal employment opportunities are normally scarce in rural areas, whereas in urban areas, employment opportunities are greater and more diverse[326]. This urban-rural difference can explain a higher prevalence of off-farm employment among the smallholders in Peninsular Malaysia than in Sabah and Sarawak.

Education is another major determinant of off-farm labour participation[327]. Educational attainment has been shown to be positively associated with off-farm work, whereby farmers with a university degree were 20% more likely to engage in off-farm work[328]. Indeed, results from the present study similarly demonstrate such a pattern. **A considerable proportion (42.9%) of surveyed smallholders who relied on their off-farm work as their primary income source had a tertiary education. In contrast, those who relied primarily on farm income were mostly secondary educated (50.8%)**. The higher reliance of surveyed smallholders in Sabah and Sarawak on farm income can, therefore, be explained by their overall lower education level as compared to those in the Peninsular (see Subsection 4.4.1).

In summary, gender differences in certain farming practices such as crop choices and farm output utilisation were observed, with greater distinctions among the surveyed smallholders in Sabah and Sarawak.

[321] Anang and Apedo (2023)
[322] Hertz *et al*. (2019)
[323] Al-Amin and Hossain (2019); Eshetu and Mekonnen (2016); S. Li *et al*. (2021)
[324] Chang and Yen (2010); Giannakis, Efstratoglou, and Antoniades (2018)
[325] De Bon, Parrot, and Moustier (2010)
[326] Chang and Yen (2010)
[327] Giannakis, Efstratoglou, and Antoniades (2018)
[328] Alasia et al. (2009)

4.4.3 Gender Differences in Agricultural Resources and Training Experience

Access to farming inputs and productive resources like land, labour, knowledge, tools, equipment, and training is critical to improving smallholders' productivity and income. However, the existing body of evidence from local and international studies suggests that men and women have differential access to agricultural resources despite their seemingly comparable agricultural roles[329]. Women in agriculture tend to face disadvantages regarding access to six key resources and agricultural inputs: land, labour, credit, information, extension, and technology[330]. Therefore, this subsection examined the gender differences in land ownership, agricultural resources, and training experience with needs.

Men and Women Smallholders Had Similar Farmland Ownership Rate

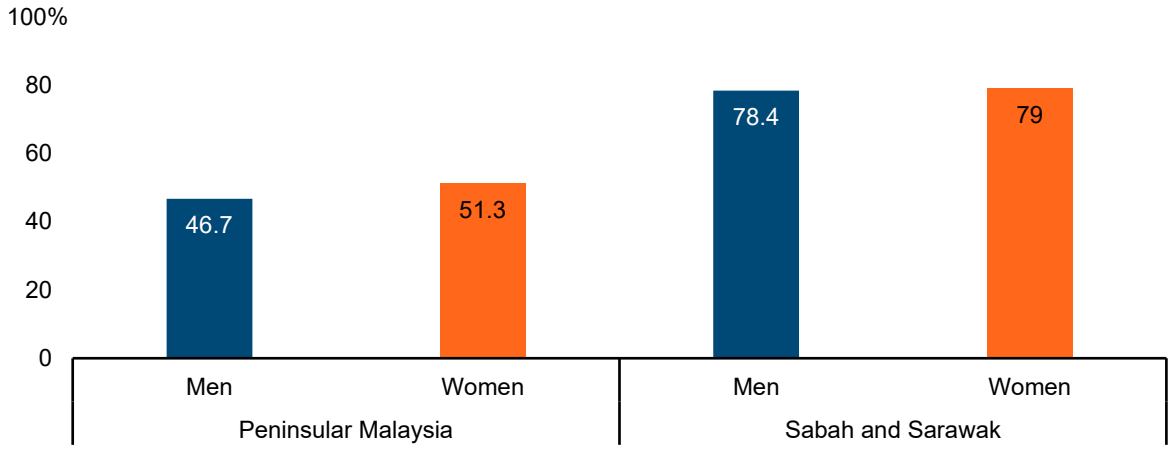
Land is the most critical asset for agriculture workers, providing autonomy and job security while ensuring stable production[331]. Land ownership allows producers to alienate, transfer, manage, or make improvements, decide their farm activity, and control the proceeds from the land. Hence, ownership over the farmland is typically linked to higher productivity in agriculture, higher incomes, and better well-being[332]. Among the surveyed smallholders in the Peninsula, the rate of land ownership among women was marginally higher at a difference of 4.6% compared to men. In Sabah and Sarawak, 74% of the surveyed women smallholders owned their farmland, 10% higher than their male counterparts. Considering that citizenship is a determinant of land ownership, further analysis was conducted to examine gender differences while adjusting for citizenship.

The previous subsection showed that approximately one-fifth of surveyed men smallholders in Sabah and Sarawak were non-Malaysians. **When excluded non-citizens, the rate of farmland ownership was comparable between men (78.4%) and women (79.0%) smallholders in Sabah and Sarawak** (see Figure 4.16). The farmland ownership rate among the smallholders in Peninsular Malaysia remained similar between genders. **Therefore, the finding suggested that men and women smallholders in this survey presented similar farmland ownership rates.** The overall higher rate of landownership among smallholders in Sabah and Sarawak than in Peninsular Malaysia can be attributed to the different practices of land rights. In Sabah and Sarawak, indigenous customary land rights are practised based on the *adat* system, whereby customary land is inherited across generations among the indigenous people[333]. Indeed, the smallholders surveyed in Sabah and Sarawak are mostly *Orang Asal* (84.5%). However, as the status of land ownership was self-reported by the smallholders, the legality of the self-reported land ownership based on the respective state laws, Sabah Land Ordinance 1930 and Sarawak Land Code 1958, is unknown due to potential reporting bias among the smallholders.

[329] FAO (2011)
[330] World Bank (2012); Sheahan and Barrett (2014); World Bank (2010); Mudege et al. (2017)
[331] Zhang et al. (2023)
[332] Schweigert (2006)
[333] FOE Malaysia (2021); Nuar and Lunkapis (2019)

Only half of the smallholders in the Peninsula, mostly Malay, Chinese, or Indian (98.6%), had ownership of their farmland. For them, land rights are governed under the statutory law, namely the National Land Code (NLC) 1965[334]. The lower rate of land ownership in the Peninsular is also related to the higher degree of urbanisation in the Peninsular states, which means more land is used for development, and less land is available for agricultural landholding[335]. Although Peninsular Malaysia has more extensive land suitable for agrifood production than Sabah and Sarawak, a high proportion of the arable land is used to grow industrial crops like oil palm, rubber and cocoa due to higher returns[336], leaving a smaller balance for small agrifood plantations.

Figure 4.16: Rate of Land Ownership Among Malaysian Smallholders, by Gender (%)



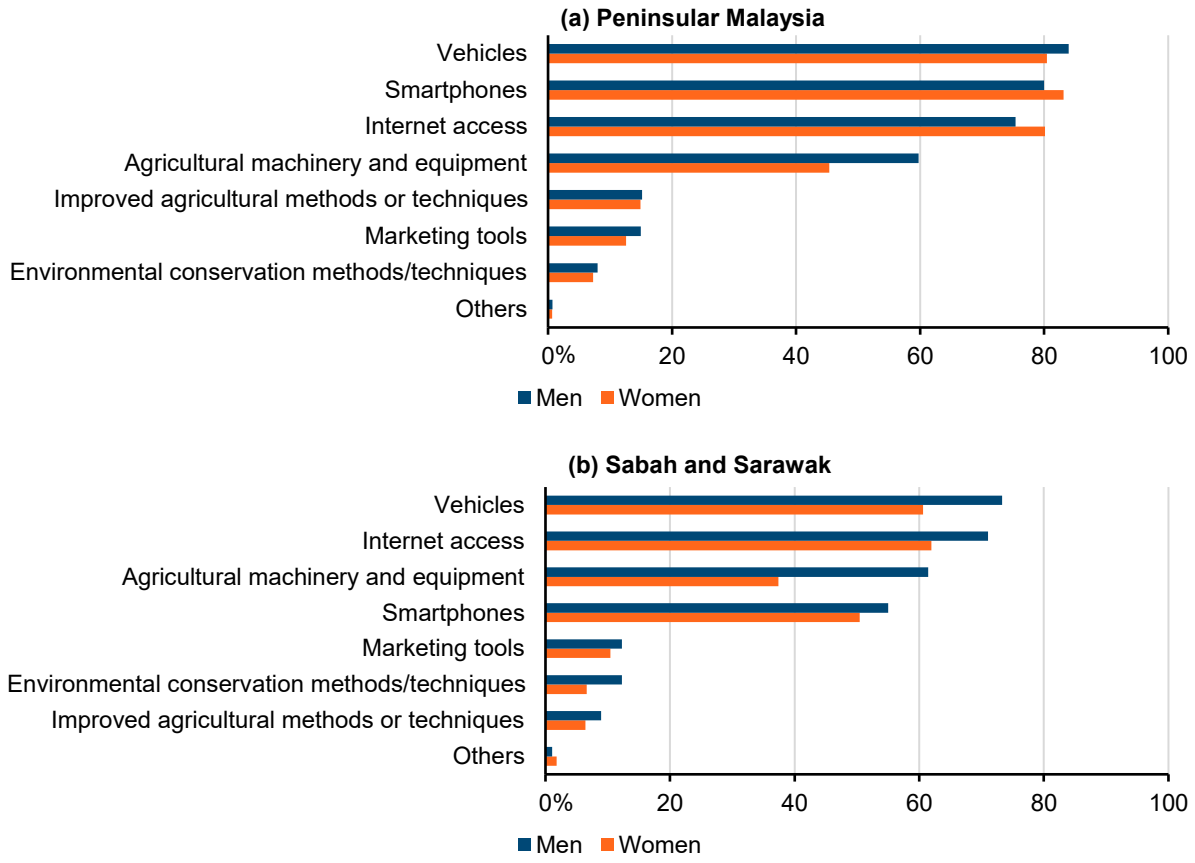
Source: KNB (2023)
Note: Results excluded non-Malaysian citizens.

Fewer Women Smallholders Had Any Machinery or Equipment

Fewer women smallholders in Sabah and Sarawak had agricultural machinery and equipment, vehicles, and internet access than their male counterparts (Figure 4.17). Notably, the gender difference was more prominent in terms of the possession of machinery and equipment. Proportionally more men smallholders had agricultural machinery and equipment (Men: 61.4%; Women: 37.4%). A similar gender disparity in agricultural machinery and equipment possession was also observed in Peninsular Malaysia (Men: 59.8%; Women: 45.4%).

[334] Lim et al. (2019); NRECC (1965)
[335] Olaniyi et al. (2013)
[336] Abu Dardak (2022)

Figure 4.17: Possession Rates of Agricultural Knowledge, Technology, and Tools Among Smallholders, by Region and Gender (%)



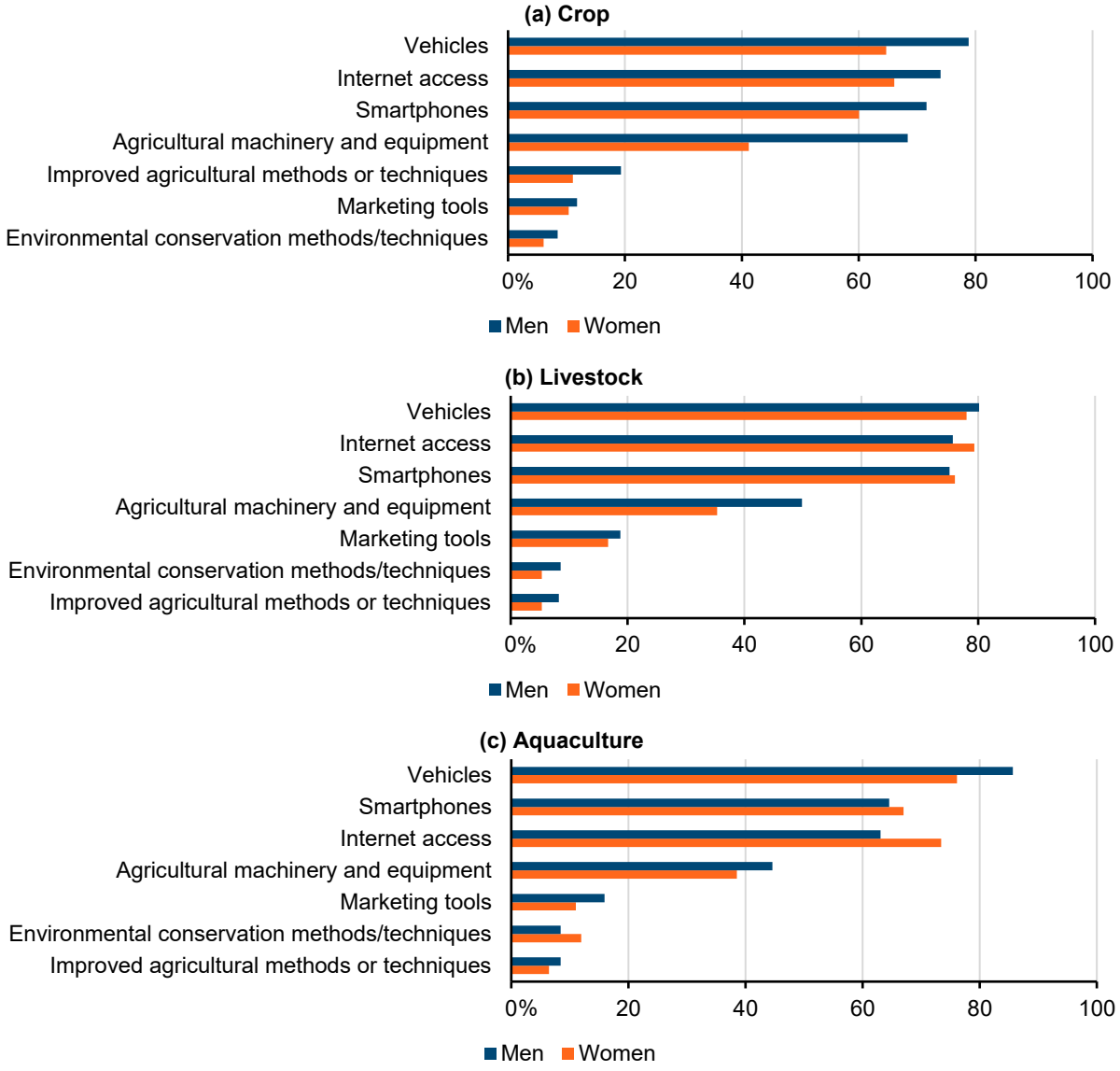
Source: KNB (2023)

Considering the potential variations in knowledge and resources between the types of agrifood production, further analysis was conducted at the subsector level**. The results showed similar gender disparities in machinery and equipment possession at the subsector level, particularly among crop and livestock smallholders** (Figure 4.18). Gender disparities were particularly prevalent among crop smallholders, which consisted of a higher representation of women than the livestock and aquaculture groups. On top of machinery and equipment, women crop smallholders were also behind their male counterparts in having vehicles, internet access, and smartphones. Interestingly, such consistent gender-based distributions were not observed among aquaculture smallholders.

Compared to those working in livestock breeding and aquaculture farming, crop smallholder's total machinery and equipment possession rate was higher. This may be due to the nature of crop farming which requires machinery and equipment to cope with the brunt of the planting, cultivating, and harvesting work[337]. **These gender disparities that were present even at the subsector level suggest the potentially significant impact on women smallholders, whose participation is generally higher in the crop subsector**.

[337] Engku Ariff et al. (2023)

Figure 4.18: Possession Rates of Agricultural Knowledge, Technology, and Tools among Smallholders, by Gender and Subsector (%)



Source: KNB (2023)

The gender gap in access to and adoption of agricultural machinery can be linked to women's limited access to extension services, technical training, and the unequal power dynamics within men-headed households. These factors can limit women's autonomy and influence in decision-making[338]. Given the similarity in educational profiles and farming experience between the surveyed men and women smallholders, education level and technical skills may have a lesser role in the gender disparity observed in this report.

[338] Fischer et al. (2018); Peterman, Behrman, and Quisumbing (2014)

Although the surveyed smallholders in this report were either farm managers or owners, it is plausible that the partners of women smallholders played a role in influencing resource distribution (ability to own and keep machinery and equipment) and farming practices (application of machinery and equipment), depending on the gender dynamics in the households. Previous studies have reported that decisions concerning agricultural production were made either solely by men or jointly by men and women, even when women assumed the primary role in farming operations[339]. As the survey did not collect the relevant data, the differential impacts of men's and women's decision-making roles on agricultural machinery and equipment adoption were uncertain.

The notable gender disparity in the possession of agriculture machinery and equipment can be related to a combination of factors. **This report indicated that smallholders who were engaged in contract farming and farm activity management training were 1.3 to 1.4 times more likely to own agricultural machinery or equipment than those who were not.**

Possessing agricultural machinery and equipment can be both a pre-condition and outcome of contract farming. The gender disparity in agriculture machinery and equipment possession could contribute to women smallholders' lower participation rate in contract farming, particularly among those primarily cultivating crop (see Subsection 4.4.4). Contract farming has been criticised for its unintended effect in fostering inequalities between contract and non-contract producers[340]. Buyers may favour wealthier producers and leave out resource-poor producers for the sake of meeting production goals, further widening the income gap.

A study by Sharma (2016) confirmed that the selection of contract farmers contained a selectivity bias of the contracting companies or buyers. This observation implied that the choice of a company significantly determined the participation in contract farming rather than the producer's decision to participate[341]. The study also revealed that contracting companies selected better resource-endowed farmers who were more educated, owned bigger farms, and acquired more agricultural machinery[342]. Likewise, Warning and Key (2002) showed that possessing a greater value of agricultural equipment predicted contract participation[343]. However, evidence on the impact of farm machinery and equipment ownership on contract participation remained mixed, as most studies did not discover any correlation between farm or household assets and the likelihood of involvement.

[339] Owens et al. (2018); Acosta et al. (2020); Peralta (2022); Gebre et al. (2021)
[340] Sharma (2016); Bellemare (2012)
[341] Sharma (2016)
[342] Sharma (2016)Ibid.
[343] Warning and Key (2002)

Additionally, the greater prevalence of machinery and equipment possession among men smallholders may be a result of their higher engagement rate in contract farming. Participating in a contract farming scheme can help facilitate credit access, allowing smallholders to invest in assets, inputs, and labour. Contract farming can also contribute to better and more secure income, thereby increasing the smallholder's financial capability to invest in farm resources[344]. For example, the contract smallholders in this report were likelier to report regular buyers. This finding implied more stability in sales and, potentially, their income. Large firms sometimes lease or provide the necessary machinery or equipment for producers without such resources[345]. Nevertheless, the findings on the tools and technology possessions in this report did not consider the ownership types (such as whether the devices were owned entirely by the smallholders or borrowed from third parties) due to the lack of relevant data.

Access to training on relevant subject matters, such as farm activity management, also likely influences the knowledge, attitude, and perception of smallholders[346]. This can, in turn, affect their decision concerning the adoption of agricultural machinery and equipment[347]. Training on farm activity management has been shown to sensitise the smallholders on the reduction measures of the production cost while increasing agricultural yield. Training exposures can also increase the awareness of the benefits of machinery adoption and the means to obtain the resources or support[348]. With a differential participation rate in contract farming and training experience between genders, women smallholders are therefore more likely to face greater financial constraints, fewer access to support and benefits associated with contract farming, and fewer opportunities to improve their knowledge that is necessary to enhance their farm production. Together, these factors explain the lower possession rate of agricultural machinery and equipment among women smallholders.

Cultural norms may also play a role in influencing the use of agricultural machinery and equipment among smallholders. In some contexts, women's use of agricultural machinery is constrained or even inhibited by cultural norms that associate machinery work with masculinity[349]. Tractor operation, for example, is often constructed as men's domain[350]. This has been linked to reduced opportunities or lower adoption of machinery for women in agriculture[351]. In India, such norms were reflected in the differential growth rate of men and women agricultural workers in states with higher tractor density, indicating that machinery operations are largely taken up by men workers[352]. Mehta (2018) also highlighted the gender differences in ergonomic requirements that interfere with women's use of agricultural machinery, mostly designed to suit men's anthropometry and ergonomic characteristics.

[344] Phoumanivong and Ayuwat (2013); Tuan (2012); Hoang (2021); Kaur, Kamarulzaman, and Hamzah (2015); Mazwi, Chambati, and Mudimu (2020)
[345] Huppert, Anseeuw, and Bokelmann (2015); Suksa-ard and Raweewan (2016)
[346] Meijer et al. (2015)
[347] Peterman, Behrman, and Quisumbing (2014); Aryal et al. (2021)
[348] Aryal et al. (2021)
[349] Kansanga et al. (2019)
[350] Quaye et al. (2019); Hansda (2017); Croppenstedt, Goldstein, and Rosas (2013)
[351] Momsen (2010)
[352] Mehta, Gite, and Khadatkar (2018)

The role of ergonomic considerations in driving gender difference in machinery and equipment possession was uncertain due to the absence of disaggregated data on agricultural machinery and equipment types in the survey. Nonetheless, past studies suggested that **designing and using fit-for-purpose tools and equipment for men and women depending on their agricultural activity, needs, and preferences are crucial in facilitating small farm mechanisation[353].**

The gender gap in agricultural machinery and equipment ownership or usage may result in inequitable outcomes. Given the importance of mechanisation in saving labour, time, and cost, women smallholders could encounter issues in production efficiency[354]. This can consequently influence their productivity and farm profitability [355]. Their adoption of other agricultural technologies may also be affected as farmers who use tools and equipment were shown to have a higher tendency to adopt additional technologies[356].

Women Smallholders in Sabah and Sarawak were Behind in Training Attendance

Even though a considerably similar interest from men and women smallholders in attending agricultural training was observed, women smallholders in Sabah and Sarawak were notably lacking in their training experience compared to their male counterparts (see Table 4.1). Approximately 57.7% of women smallholders surveyed in Sabah and Sarawak had not attend any training compared to 39.6% of men smallholders. This gender disparity was not observed in Peninsular Malaysia; the proportion of smallholders without training experience was 39.7% and 38.1% for men and women, respectively.

Table 4.1: The Prevalence of Smallholders Who Lacked Interest in Attending Training by Gender and Region

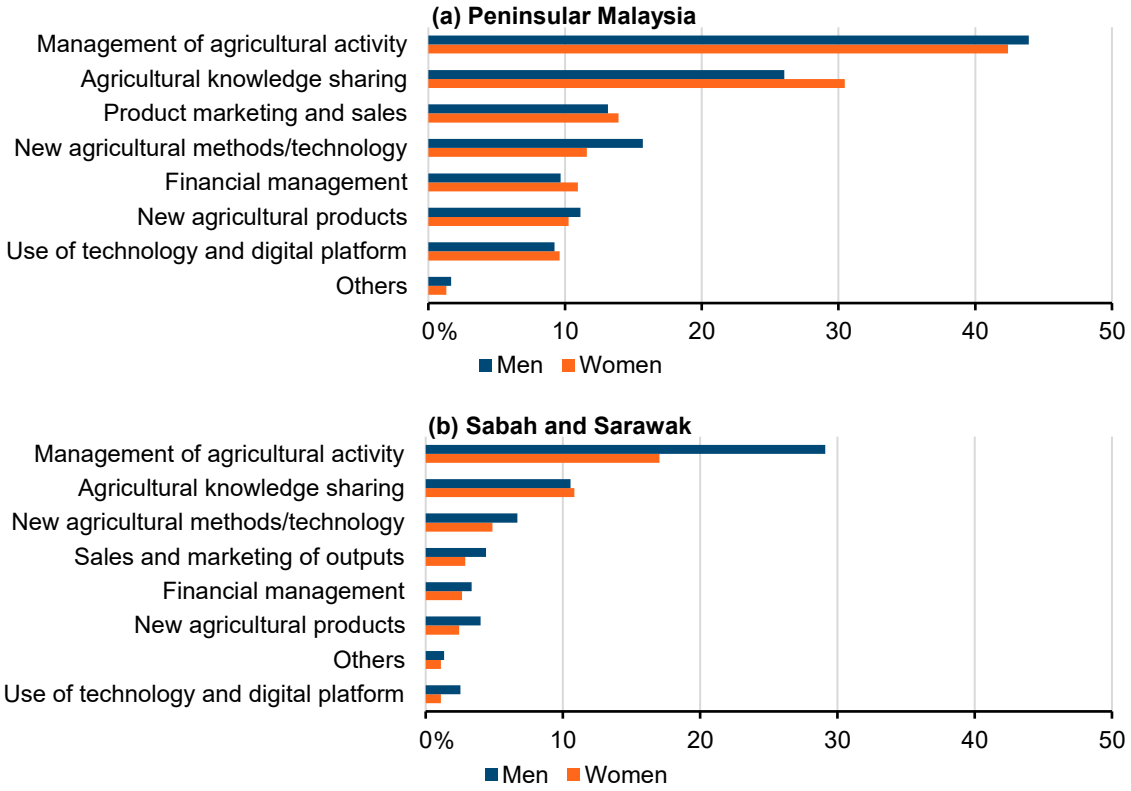
	Smallholders Who Expressed a Lack of Interest in Attending Training, *n* (%)	
	Peninsular Malaysia	**Sabah and Sarawak**
Total	282 (13.4)	114 (9.5)
Men	257 (14.4)	68 (9.3)
Women	25 (8.6)	46 (10.6)

Source: KNB (2023)

Figure 4.19 depicts that the participation rate of women smallholders in Sabah and Sarawak in agricultural activity management-related training (17%) is far behind their male counterparts (29.1%). Although the participation of the women in other types of training, such as new agricultural methods, product sales and marketing, new agricultural products, financial management, and use of technology, was also behind men, the differences were minor (< 2%) due to the overall low participation rates. These gender differences were not distinct among the smallholders surveyed in Peninsular Malaysia, who recorded higher attendance across all training types (see Figure 4.19).

353 Mehta, Gite, and Khadatkar (2018)
354 Fischer *et al.* (2018)
355 Ibid.Fischer et al. (2018)
356 Gabriel and Gandorfer (2023)

Figure 4.19: Training Received Among the Smallholders, by Gender and Region (%)



Source: KNB (2023)

The findings imply that access to training, which is usually lower in rural areas due to geographic constraints, may be even lower for women smallholders in these areas. Previous studies reported that women encountered inadequate access to formal training and extension services due to time and mobility constraints associated with household responsibilities on top of their farm work[357]. Additionally, gender dynamics in social engagement and information exchange may also reinforce gender disparities in access to information, particularly in rural areas.

In certain contexts, men farmers tend to obtain information from external sources, such as media, farmer associations, and formal groups, due to their access to a broader range of social networks[358]. On the contrary, women farmers leverage their social connections and obtain information through informal social gatherings within their families, friends, and the immediate community[359]. This finding is supported by the observation of the Malaysian Agroecology Society for Sustainable Resource Intensification (SRI-Mas)[360], whereby women's participation was higher when the group training occurred in more private, casual settings. Additional analyses also presented that gender disparities in training attendance similarly existed at the subsector level (see Figure 4.20).

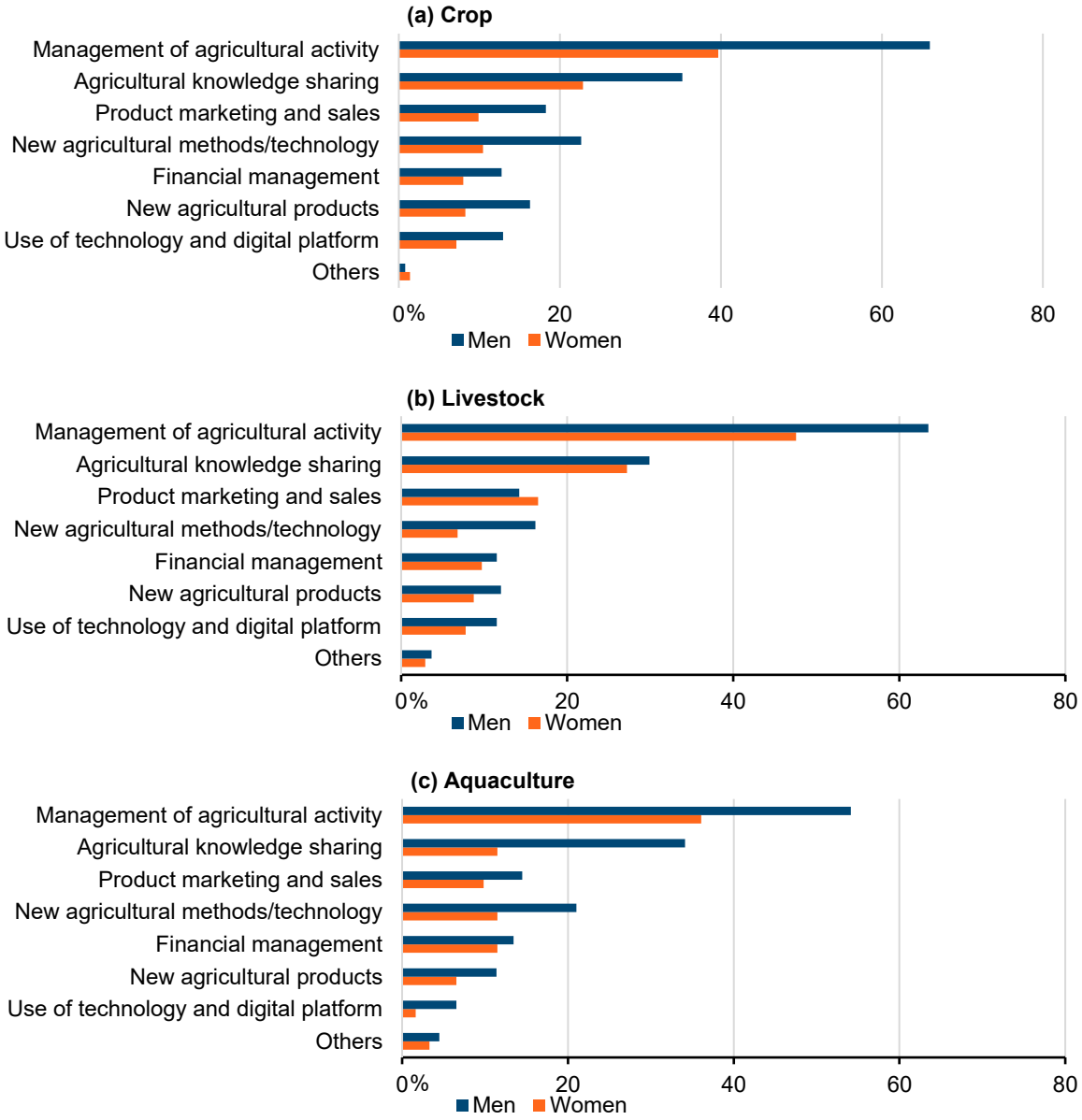
[357] OECD and ASEAN Secretariat (2021); Bergman Lodin et al. (2019); Bello et al. (2021); Haimid, Nik Mohd Masdek, and Rahim (2016)

[358] Bergman Lodin et al. (2019); Friedman et al. (2023)

[359] Bergman Lodin et al. (2019); Friedman et al. (2023); Rahman, Ara, and Khan (2020)

[360] SRI-Mas is a non-profit and non-partisan organisation working to enhance food security in Malaysia through the adoption and application of agroecology.

Figure 4.20: Training Received Among the Smallholders, by Subsector (%)



Source: KNB (2023)

Another factor that can reinforce gender gaps in access to training, extension services, and knowledge lies in the extension officers. Typically, negative gender stereotypical perceptions of agricultural extension officers have been demonstrated to influence training recruitment and result in gender biases in access to training and information[361]. These gender biases in the extension approaches are often driven by the assumptions that men, as the head of household and the farmland owner, naturally shoulder decision-making responsibilities[362].

[361] Mudege et al. (2017); Bergman Lodin et al. (2019)
[362] ADB (2013)

Gender imbalances among agricultural extension officers, where men officers dominate, also further contribute to such gender biases[363]. In some contexts, cultural, social, or religious practices or norms may prohibit contact between a male agricultural officer and a woman farmer[364]. Local studies investigating the experience of women agricultural entrepreneurs and paddy farmers highlighted the lack of training and challenges in obtaining technical support from extension officers, but the contributing factors to this were uncertain[365]. Considering the primary role of extension officers in disseminating information, especially in rural areas[366], the findings suggest the potential of closing the gender gap in training attendance via sensitising training or extension officers to gender gaps among agrifood smallholders.

Given the positive impacts agricultural training present, the gender differences in access to training can lead to disparities in women smallholders' farm productivity and livelihood. Participation in agricultural extension services, including training provided by the government and non-governmental organisations (NGOs), has been shown to enhance the welfare of farmers through improved farm productivity[367], income[368], and household food security[369].

Several studies also suggested that access to extension services was a major determinant of adopting new farming practices and technologies and sustainable agricultural practices [370], implying wider benefits of training opportunities beyond economic gains. Therefore, women smallholders' lower participation in farm management training may result in missed opportunities to enhance their farm management skills and maximise the potential of their farms. The results also imply that efforts are needed to improve the accessibility to training for smallholders, particularly for those in Sabah and Sarawak where one-third lacks training experience.

Training Needs Differed between Gender in Sabah and Sarawak

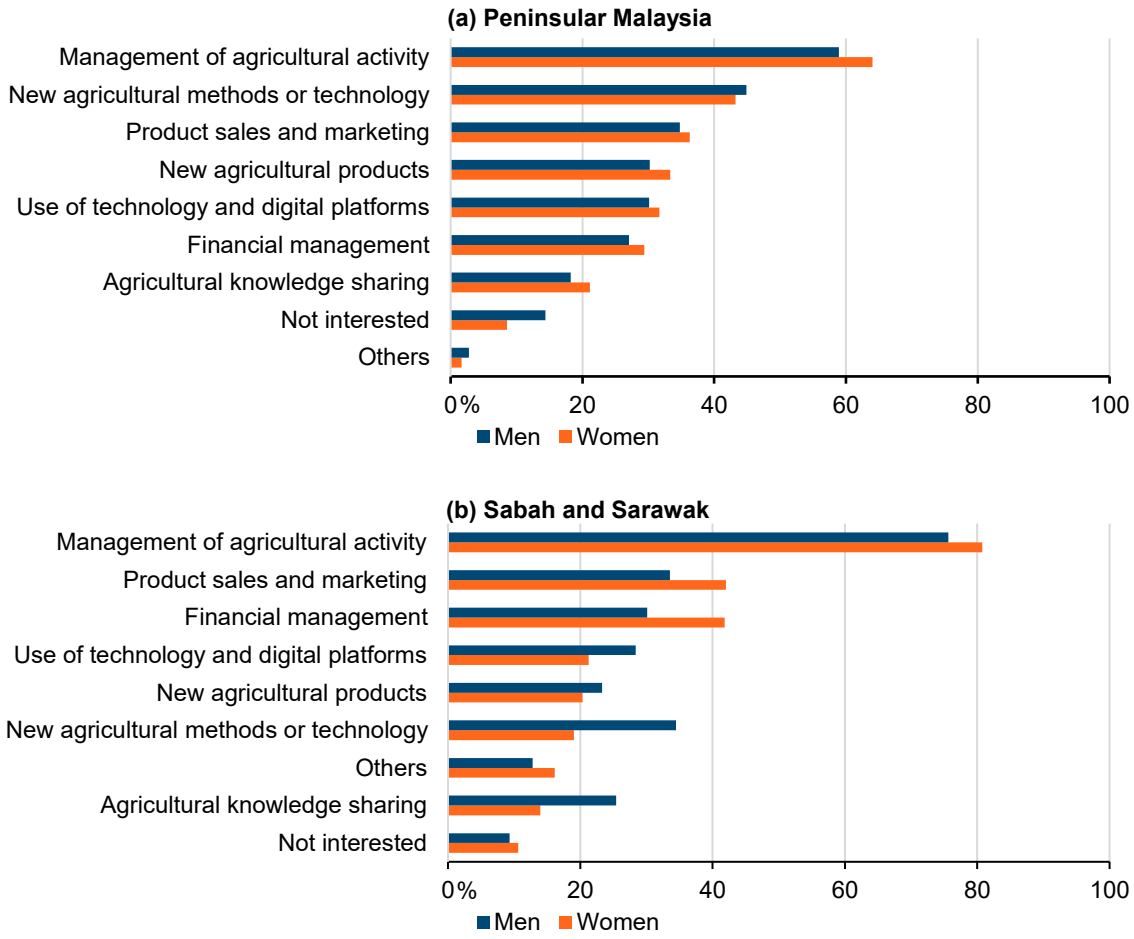
In addition to actual training experience, training needs also appear to differ by gender among the smallholders in Sabah and Sarawak. **Among the surveyed men smallholders in Sabah and Sarawak, the three most demanded types of training were management of agricultural activity, new agricultural methods or technology, and product sales and marketing.** Smallholders in the Peninsula, both men and women, also expressed the same preferences. However, the training needs of women smallholders in Sabah and Sarawak seemed to differ. **Most women smallholders preferred agricultural activity management, product sales and marketing, and financial management-related training**.

[363] Peterman, Behrman, and Quisumbing (2014); World Bank and IFPRI (2010)
[364] ADB (2013)
[365] Nik Mohd Masdek (2017); Amran and Abdul Fatah (2020)
[366] Mie (2007)
[367] Pan, Smith, and Sulaiman (2018)
[368] Danso-Abbeam, Ehiakpor, and Aidoo (2018); Anang and Apedo (2023)
[369] Raidimi (2014); Pan, Smith, and Sulaiman (2018)
[370] Zeweld et al. (2017); Piñeiro et al. (2020b)

The greater interest of women smallholders in Sabah and Sarawak in attending product sales and marketing-related training may be related to their perceived difficulty in sales. Among those who expressed an interest in sales and marketing-related training, three-fifths had trouble finding buyers. Concurrently, over half relied on irregular buyers as their primary buyer sources (see Subsection 4.4.5). These findings imply the significance of targeted training that takes into account varying needs between men and women smallholders.

Smallholders generally expressed a higher degree of interest in learning about agricultural activity management than other matters. Although it was the most attended training, the training attendance among the surveyed smallholders remained relatively low (Peninsular Malaysia: 43.2%; Sabah and Sarawak: 23.1%, see Figure 4.21. This observation suggests that gaps remained with training delivery, particularly in Sabah and Sarawak, despite the high interest of smallholders.

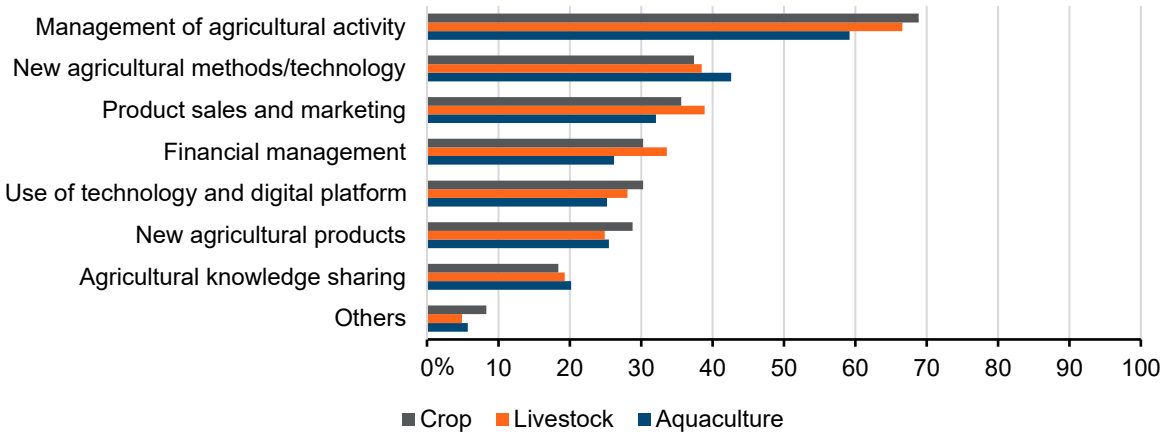
Figure 4.21: Training Needs Among Smallholders, by Gender and Region (%)



Source: KNB (2023)

Training preferences did not vary significantly between subsectors, indicating that smallholders shared similar training needs regardless of their production activity. The management of agricultural activity remained the most desired training, in which more than half of the smallholders in each subsector were interested (Figure 4.21). Over one-third of the smallholders in each subsector were also keen to attend training on new agricultural methods or technology and product sales and marketing. Therefore, the gender gap in training needs observed among the smallholders in Sabah and Sarawak may reflect gender variations in preferences and needs rather than the activity types (subsector). **Overall, the findings imply that accessibility to training, not propensity to attend training, is an issue for women smallholders, particularly those in Sabah and Sarawak. Nonetheless, the results provide insights into the gender-differentiated interests of the smallholders. This can allow further identification and targeting to ensure future training matches the needs of smallholders.**

Figure 4.22: Training Needs Among Smallholders, by Subsector (%)



Source: KNB (2023)

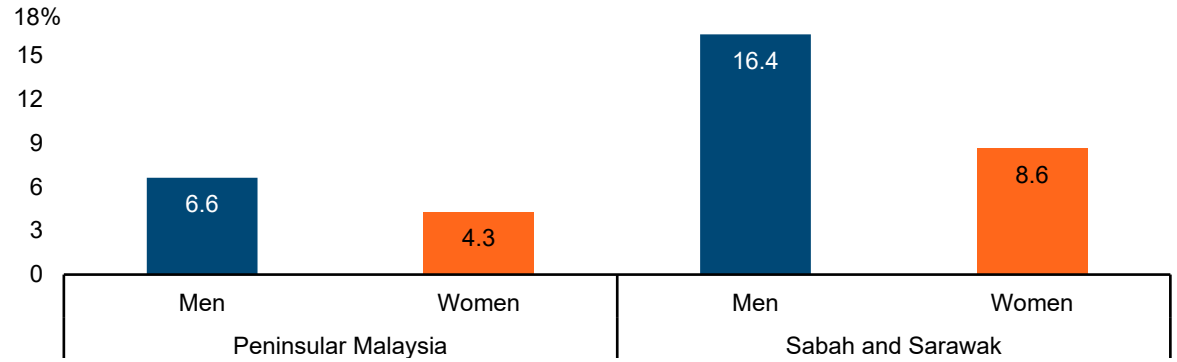
4.4.4 Gender Differences in Contract Farming

Fewer Women Smallholders were Contract Farmers

Farmland ownership is one of the determinants of contract farming (see Box 4.2 for the definition), as the former helps ensure unrestricted access to the land and autonomy over the farm activity[371]. Other enabling factors of contract farming include having a suitable physical environment that favours production, availability of utilities, facilities and inputs, and alignment of contractual obligations with the cultural practices of the producers[372]. **Despite a similar land ownership rate between genders, women smallholders' share in contract farming was lower than their male counterparts (Figure 4.23). The gender disparity was starker among those surveyed in Sabah and Sarawak.**

[371] Minot and Ronchi (2011); Arumugam et al. (2011); Meemken and Bellemare (2020); Khan, Nakano, and Kurosaki (2019); Ton et al. (2018)
[372] Minot and Ronchi (2011)

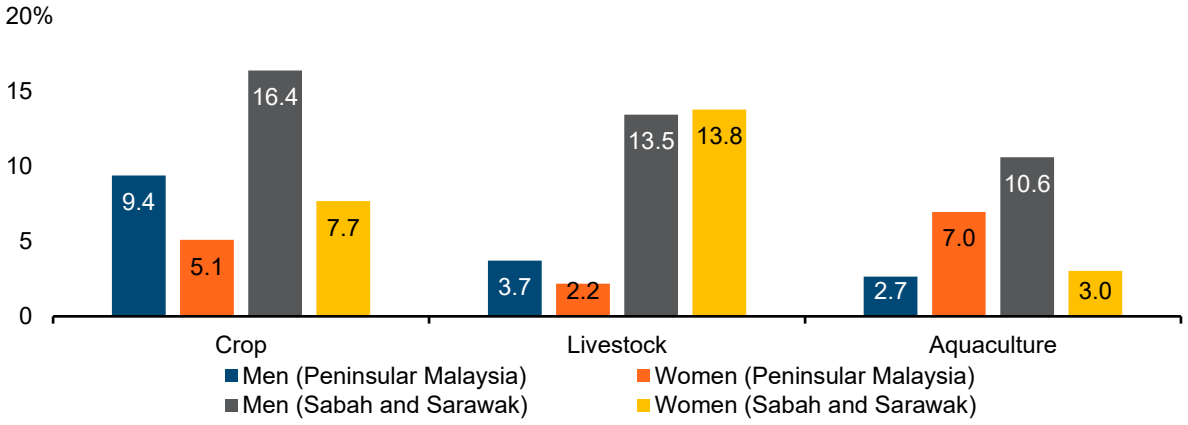
Figure 4.23: Rates of Contract Farming Among Smallholders, by Gender (%)



Source: KNB (2023)

When the rates of contract farming by subsector were investigated, the gender disparity was more apparent among crop and aquaculture smallholders (Figure 4.24). **In Sabah and Sarawak, women crop and aquaculture smallholders were less likely to be engaged in contract farming (7.7% and 3%, respectively) than their male counterparts (16.4% and 10.6%, respectively).** There was an equal rate of contract farming among those who breed livestock.

Figure 4.24: Rates of Contract Farming Among Smallholders, by Subsector and Gender (%)



Source: KNB (2023)

The lower participation rate of women smallholders in contract farming in this report is consistent with previous studies conducted among contract farmers in Malaysia[373] and other developing countries (China, India, Bangladesh, Nigeria, Madagascar, and Tanzania)[374]. Women's lower participation rate was also observed in export-oriented contract farming schemes in Kenya[375], China, and Senegal[376]. This outcome was attributed to the selective bias of the exporting companies, which preferred contracting with men farmers. These companies believed that women farmers would not be able to guarantee delivery of a stable flow of produce due to their lack of access to productive resources, such as land and labour.

[373] Kaur, Kamarulzaman, and Hamzah (2015); Lawrence et al. (2012); Arumugam et al. (2011)
[374] Meemken and Bellemare (2020); Machio and Meemken (2023); Bellemare (2012); Holly Wang, Zhang, and Wu (2011)
[375] Dolan (2001); Wainaina, Okello, and Nzuma (2014)
[376] Eaton and Shepherd (2001)

Box 4.2: Contract Farming and its Definition and Benefits

Contract farming refers to an agreement between agricultural producers and buyers in which both parties agree in advance on the terms and conditions for the production and supply of farm products, normally at predetermined prices[377]. Other matters that can be included in the agreement are the quantity and quality of the products requested by the buyer, the delivery timeline, and detailed instructions on the production manners[378]. In some cases, the buyer also provides production support by supplying inputs such as seeds and fertilisers and providing agronomic advice [379]. Such arrangements are built on the basis of mutual commitment—agricultural producers supply a specific commodity based on the terms and conditions while buyers support the production and promise to purchase the commodity.

With effective management, contract farming can be mutually beneficial to both the producers and buyers. For the producers, it is a means to have guaranteed buyers and access to markets and support in the form of technology transfer, agricultural inputs, credit facilities, extension services, and training[380]. Contract farming is also considered a tool to alleviate poverty among resource-poor agricultural producers with difficulty accessing modern market channels, promoting rural development and employment[381]. Companies that process agricultural products prefer contract farming to secure a regular supply of commodities that meet their quality and quantity requirements[382].

However, contract farming is not without disadvantages. Due to the monopsonist (single buyer) nature of specific contract farming schemes, contract farmers may be vulnerable to exploitation by coercive and unreliable buyers. This normally happens due to the dependency on a single buyer and the unequal bargaining power between the producers and buyers[383]. Most contract farming arrangements are based on monocropping, which can pose production risks, especially when producers are working with new and unfamiliar crops. Additionally, environmental risks due to the heavy use of agrochemicals and the introduction of crops that are uncommon or invasive to the local environment are the other common concerns with contract farming[384].

[377] FAO (n.d.); Eaton and Shepherd (2001)
[378] Ibid.
[379] Eaton and Shepherd (2001); ADB (2015)
[380] FAO (n.d.); ADB (2015)
[381] FAO (n.d.); Minot and Ronchi (2011)
[382] Eaton and Shepherd (2001)
[383] FAO (n.d.); Eaton and Shepherd (2001); Sivramkrishna and Jyotishi (2008)
[384] Setboonsarng (2008); Bijman (2008); Putra et al. (2020); FAO (n.d.)

Contract farming may have an inequitable impact on smallholders; contract opportunities are typically awarded to larger farms and better-off producers with the resources, such as land and labour, required for such commitments[385]. In some studies where the contractual agreements are signed and the income being controlled by the head of household, the bulk of farm work tends to fall disproportionately onto women as they are often engaged as unpaid family labour[386]. Buyers also have to bear certain risks from offering prices higher than the prevailing market prices and the possibility of crop failure[387]. However, the widespread adoption of contract farming seems to indicate that the benefits outweigh the disadvantages[388]. These disadvantages can be minimised through the producer's involvement in farmer cooperatives to gain collective bargaining power in negotiating the contract terms coupled with the provision of alternative production possibilities for producers[389].

Contract farming has gained popularity in Malaysia in the past decades due to increasing food demand. Established in the 1980s, contract farming was initially introduced as a private sector initiative to poultry-based broiler farms and then expanded to other types of farming like aquaculture[390]. Chilli contract farming established by Nestle in Kelantan and broiler chicken contract farming are some of Malaysia's early forms of contract farming.

Over the years, the Government has played a more active role in using contract farming to uplift the rural population. The scheme was proposed in the Ninth Malaysia Plan (9MP) as a high-impact project under the Ministry of Agriculture and Agro-based Industry (currently known as KPKM) to boost the competitiveness and profitability of agricultural production and to improve farmers' income[391]. Several government agencies were involved in the initiative, including DOA, LPP, Malaysian Pineapple Industry Board (MPIB), Ministry of Agriculture, Fisheries and Food Industry or MAFI Sabah (currently known as the Ministry of Agriculture, Fisheries and Food Industry, MAFFI), and Ministry of Modernisation of Agriculture or MOMA Sarawak (presently known as the Ministry of Food Industry, Commodity & Regional Development Sarawak, M-FICORD).

385 Ton et al. (2018); Wainaina, Okello, and Nzuma (2014)
386 Faizi and Shah (2014); Brewin and Murphy (2019)
387 Setboonsarng (2008)
388 FAO (n.d.); Minot and Ronchi (2011); Kaur, Kamarulzaman, and Hamzah (2015)
389 Sivramkrishna and Jyotishi (2008)
390 Mohd Azwan, Abas, and Ahmad Shabudin (2016)
391 EPU (2006)

Currently, the most established public-assisted contract farming programme is implemented by FAMA, which acts as the buyer and also the mediator between the producers and buyers[392]. FAMA Corporation Sdn Bhd (FAMACO), Malaysia Agro Food Corporation (MAFC) and private entities such as exporters, food processors, retailers, and wholesalers are also involved as buyers. Producers engaged in the contract farming programme include farmers under DOA, LPP, MPIB, KPKM, MAFFI, and M-FICORD[393]. Fruit and vegetable contract farming, in particular, prioritises farmers who operate cluster farms[394], entrepreneurs, individuals registered under agencies or departments, and individual private manufacturers[395].

Such a gender difference in contract farming has been associated with women's lack of control over and access to resources, particularly land, hindering women's ability to obtain contracts[396]. In contract farming, land is more than just an asset necessary for production. Land ownership also serves as a precondition to enter into commercial agreements with agribusinesses and collateral to obtain financing from banks[397]. Hence, insufficient landholding can affect the autonomy of producers over farm activity and prevent producers from acquiring financial loans to make investments and purchase the necessary inputs to take part in contract farming.

The gender difference in the contract farming rate for this report appeared to be independent of farmland ownership, a determinant of contract participation[398]. Out of all men smallholders engaged in contract farming, a higher proportion (75.2%) did not possess landholding. The opposite was observed among the women smallholders; the majority (58.8%) had farmland ownership. Farm labour also did not explain the gender disparities in contract farming participation. A separate analysis (not shown here) demonstrated that similar proportions of men and women smallholders in Peninsular Malaysia and Sabah and Sarawak had farm labourers, either full-time, part-time, or unpaid workers. The number of farm workers engaged also did not differ between genders, with a median of 4 workers employed at both men and women-managed or owned farms.

[392] FAMA, n.d.

[393] Ibid.

[394] Cluster farming is the merging of several smallholder farms in the same locality through a participatory approach to share resources, production costs, revenues, and infrastructure (Bhaiya and Parmar, 2019; Karki et al., 2021; Hamzat, 2022). The main objective of cluster farming is to reduce risks and maximise returns by carrying out the same activity, such as by growing the same crop, in order to generate produce of uniform quality and consolidate the produce for bulk delivery (Bhaiya and Parmar, 2019).

[395] FAMA, n.d.

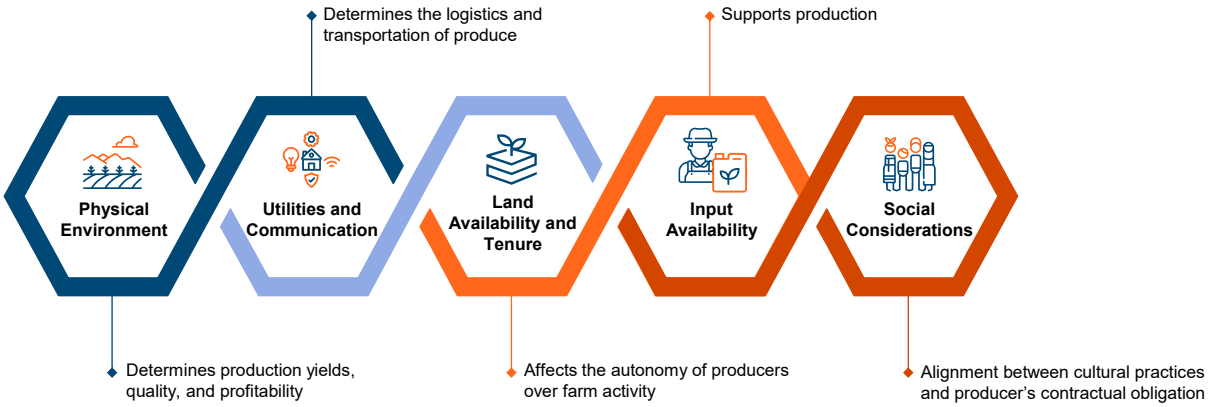
[396] Rocca (2016); Pultrone (2015); Wainaina, Okello, and Nzuma (2014)

[397] Pultrone (2015); Phoumanivong and Ayuwat (2013); Negash and Swinnen (2013)

[398] Arumugam et al. (2011); Eaton and Shepherd (2001)

Further analysis highlighted that the subsector or crop types of the contract smallholders did not vary by gender. Across both regions, men and women smallholders engaged in contract farming primarily produced fruits and vegetables like watermelon, banana, cabbage, chilli, and tomato. The higher rates of contract farming among smallholders who cultivated fruit and vegetable farming were likely a result of the efforts of the ministry to focus on contract farming involving fruits, vegetables, herbs, and flowers[399]. **This indicates that the gender disparity in contract farming is likely influenced by factors other than land ownership and crop choices** (see Figure 4.25).

Figure 4.25: The Preconditions that Increase Producer's Participation in Contract Farming



Source: Eaton and Shepherd (2001), KRI Illustration

Although this survey did not evaluate the attitude of smallholders on contract farming, previous studies demonstrated a similar positive attitude on contract farming among Malaysian men and women youths[400]. This finding suggested that the insufficient interest or awareness of the contract farming benefits may not a significant factor impeding women smallholders' engagement in contract farming. **This study highlights that although both men and women smallholders shared similar characteristics that could influence their chances of contract engagement (location, education level, land ownership, and agricultural activity), women smallholders were less likely to be involved in contract farming. The gender disparity in contract farming participation may be contributed by other factors, such as the lower adoption of machinery and equipment, inadequate training experience (see Subsection 4.4.3), and lower sales priority of women smallholders (see Subsection 4.4.5).**

[399] Baqutayan et al. (2021)
[400] D'Silva (2010); H. Shaffril et al. (2010)

In Malaysia, contract farming has been shown to increase farmers' income by around 30%[401]. In addition to improved income, contract farming is also associated with food security, better market access, assurance over pricing, and access to credit support, marketing information and extension services[402]. While the impact of the gender difference in contract farming on income was unknown due to insufficient data collected in the SEMAI survey, differences in the regularity of buyers between contract and non-contract smallholders were observed, implying the possible impacts on sales due to contract participation.

Overall, non-contract smallholders were more likely to depend on irregular buyers as their main buyers (see Subsection 4.4.5). In Sabah and Sarawak, where contract farming and gender disparities were more prevalent, the difference in the types of buyers was more distinct. Approximately 83.4% of contract farmers engaged regular buyers as their primary sources of buyers, whereas 68.8% of non-contract smallholders primarily relied on irregular buyers. Non-contract farmers also reported greater difficulty finding buyers (31.2%) than those engaged in contracts (11.3%).

The gender gap in participation in contract farming suggests that women smallholders have fewer opportunities to improve their farm production, market access, and income, albeit running similar agricultural production (crop cultivation). Thus, the lower participation of women smallholders in Sabah and Sarawak could affect their income and well-being, especially when they similarly rely on farm income as their main income source as their male counterparts (see Subsection 4.4.2).

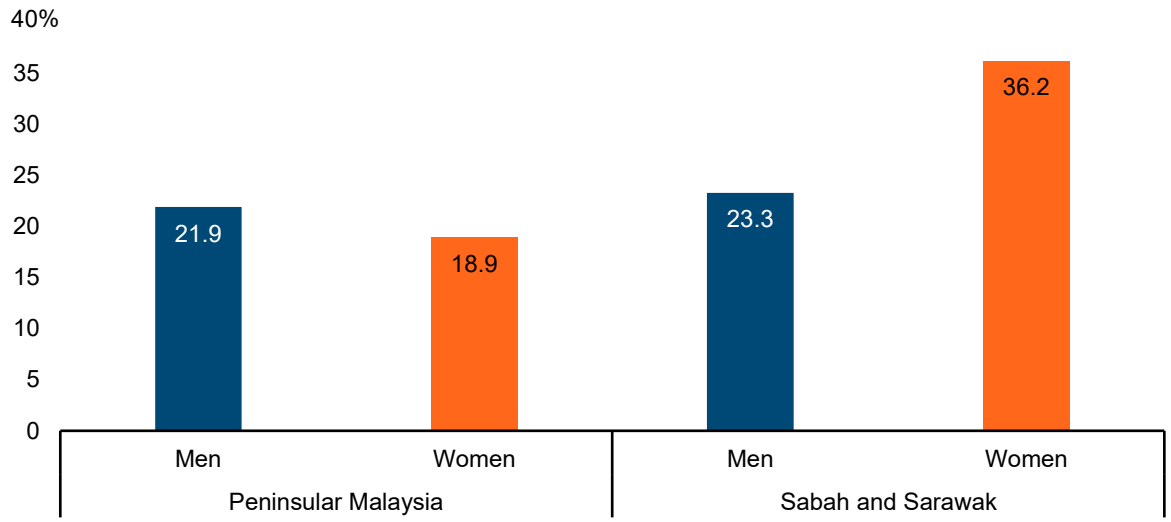
4.4.5 Gender Differences in Perceived Sales Challenges

More Women Smallholders in Sabah and Sarawak Faced Difficulty in Sales and Primarily Relied on Irregular Buyers

Figure 4.26 depicts the proportion of smallholders who reported difficulty finding buyers. **Over one-third of women smallholders surveyed in Sabah and Sarawak (36.2%) found the process difficult compared to one-fifth of their male counterparts (23.6%). Women smallholders from both regions were also less likely to have regular buyers than their male counterparts** (Figure 4.27). These perceptions about buyers appeared to be interrelated; among the smallholders surveyed in Sabah and Sarawak, **those who relied primarily on irregular buyers were nearly two times more likely to report difficulty in finding buyers (32.3%) compared to those who had regular buyers as their main sources of buyers (17.4%).** A differential perception was also observed among the smallholders in the Peninsula with a marginal difference (24.7% and 17.1%, respectively). Even though a similar proportion of women smallholders in Peninsular Malaysia relied on irregular buyers, the reported difficulty in finding buyers was much lower. The lower reliance of women smallholders in Peninsular Malaysia on farm income could be a reason easing their perception of difficulty in finding buyers.

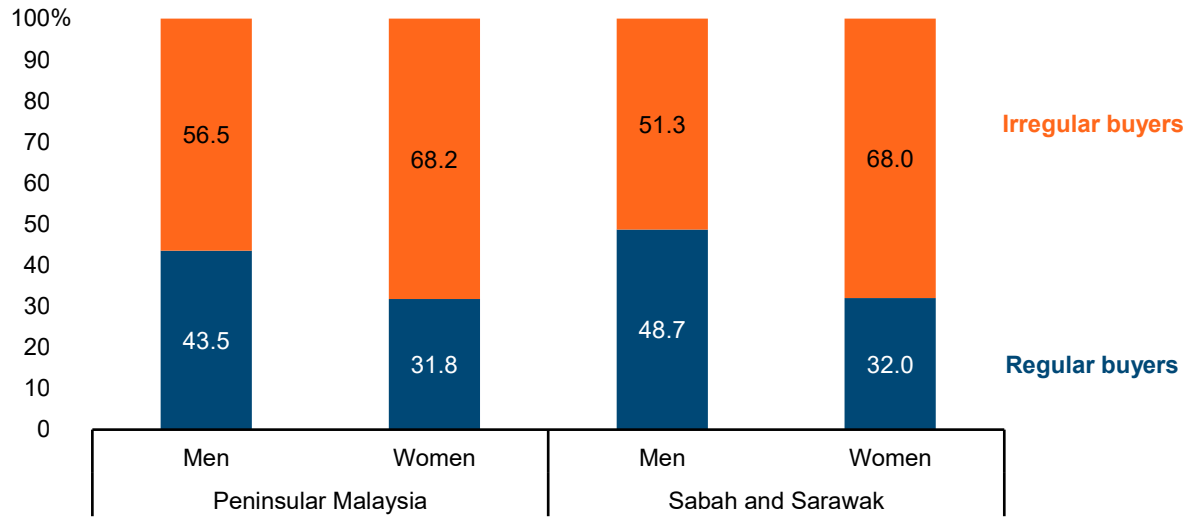
[401] Kaur, Kamarulzaman, and Hamzah (2015)
[402] Man (2010); Man and Nawi (2021); Bellemare (2012)

Figure 4.26: Proportion of Smallholders Reported Having Difficulty in Finding Buyers (%)



Source: KNB (2023)

Figure 4.27: Types of Buyers Engaged by Smallholders, by Gender and Region (%)



Source: KNB (2023)

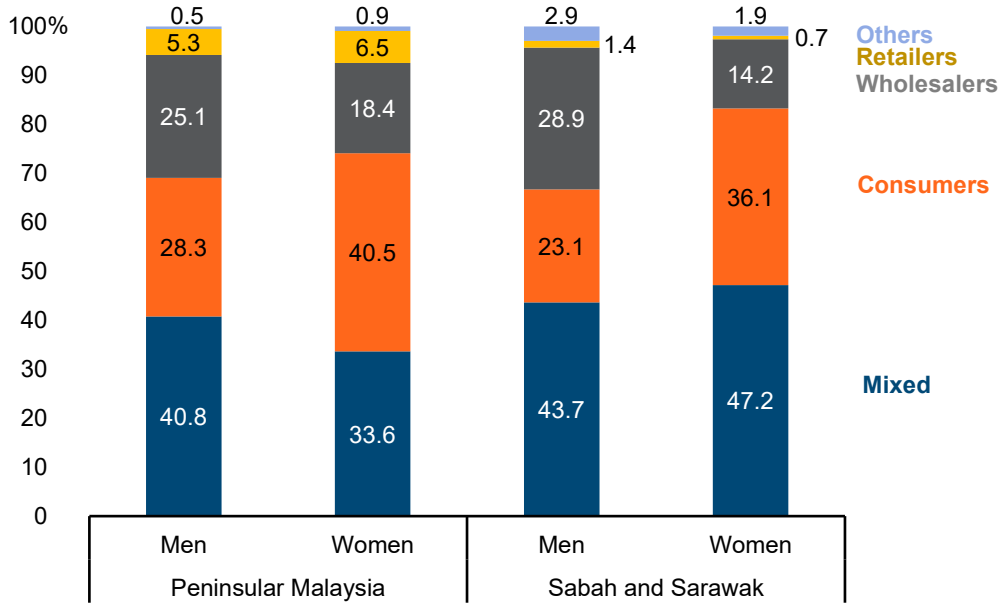
These gender differences in the ease of finding and regularity of buyers were related to the differential contract farming participation rate. **Contract smallholders in Sabah and Sarawak were less likely to report difficulty finding buyers (15.6%) and had more regular buyers (73.4%). On the contrary, more non-contract smallholders found it challenging to find buyers for their outputs (24.8%) and relied primarily on irregular buyers (61%).** Hence, the gender differences in sales experience may be shaped by the disparity in contract farming rate. As discussed in Subsection 4.4.4., women smallholders' participation in contract farming was far behind that of their male counterparts.

Direct-to-Consumer Sales were More Common Among Women Smallholders

The types of buyers or sales channels that women smallholders primarily engage may be a factor influencing their perceived difficulty finding buyers. Indeed, the primary sale channels used by the surveyed smallholders varied between genders. **The surveyed smallholders in this report diversified or used a combination of sales channels, ranging from wholesalers and retailers to selling directly to consumers.** Only a small proportion sold directly to government agencies and cooperatives. Over one-third of the smallholders in both Peninsular Malaysia and Sabah and Sarawak used more than one sales channel at a time, with varying combinations comprising direct-to-consumer sales, wholesalers, and retailers.

A distinction between genders was the differential reliance on wholesalers and consumers as the primary sales channel (Figure 4.28). The proportion of men smallholders who primarily sold to wholesalers (Peninsular Malaysia: 25.1%; Sabah and Sarawak: 28.9%) was consistently higher than that of women smallholders (Peninsular Malaysia: 18.4%; Sabah and Sarawak: 14.2%). **On the contrary, more women smallholders relied on direct-to-consumer sales (Peninsular Malaysia: 40.5%; Sabah and Sarawak: 36.1%) than their male counterparts (Peninsular Malaysia: 28.3%; Sabah and Sarawak: 23.1%).** These gender differences were apparent in the Peninsula, where the majority (40.5%) of the women smallholders sold their outputs directly through consumers. In contrast, most their male counterparts used a combination of sales channels (40.8%).

Figure 4.28: Primary Sales Channel Engaged by Smallholders, by Gender



Source: KNB (2023)

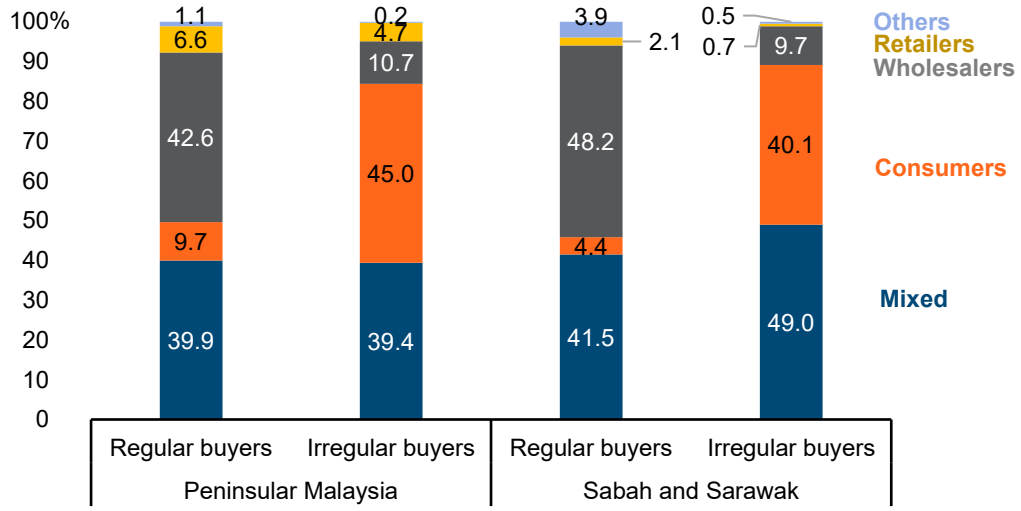
Note: Mixed sales channels refer to varying combinations of sales channels used by the smallholders, comprising direct-to-consumer sales, wholesalers, and retailers. Other sales channels include government agencies and cooperatives,

Previous studies involving different contexts similarly reported the observed gender patterns concerning the primary sales channels[403]. Two studies by Aregu *et al*. (2011) and Gebre *et al*. (2022) described that Ethiopian women farmers preferred to sell their farm produce directly to consumers, while men farmers sold to traders and cooperatives. There are several explanations to this observation. Firstly, proximity to the sales channel was more significant to women producers due to the household responsibilities that limited them from travelling to sources further away[404]. Typically, direct-to-consumer sales occur in local markets that are usually more accessible, making it a more convenient choice for women producers. Secondly, researchers argue that women producers possess a social advantage in their engagement with consumers—often local women buying food for their families—due to their greater interest in fostering social bonds[405]. Thirdly, wholesalers tend to purchase in bulk, whereas direct-to-consumer sales usually involve smaller quantities. **As women smallholders, such as those in this survey, tend to keep some of their farm outputs for household consumption, they may have smaller quantities to sell, limiting their sales channel options.**

Interestingly, further analysis showed that smallholders, regardless of gender, who tend to depend on direct-to-consumer sales, were more likely to report having irregular buyers (Figure 4.29). The opposite was observed for wholesalers. **This means that the surveyed smallholders are more likely to perceive wholesalers as regular buyers and consumers as irregular buyers.** Based on the existing literature, different sales channels have pros and cons. Direct-to-consumer sales are settled relatively quickly, with payment, usually cash, being provided immediately[406]. Those who sell to consumers directly also tend to sell at higher prices comparable to retail prices, thus providing higher profitability[407]. However, direct sales to consumers can incur additional costs, such as labour costs for selling activity and transportation expenses, offsetting the higher selling prices and lower packaging costs associated with direct-to-consumer sales[408].

[403] Aregu, Puskur, and Bishop-Sambrook (2011); Gebre et al. (2022); (2021); Schmidt, Goetz, and Tian (2021)
[404] Gebre et al. (2021)
[405] Trauger (2004); Trauger et al. (2010); DeLind and Ferguson (1999); Inwood and Stengel (2020); Gebre et al. (2021)
[406] Barrowclough et al. (2019)
[407] Ibid.
[408] Hardesty and Leff (2010)

Figure 4.29: Sale Channels by Perceived Buyer Regularity Among Smallholders, by Region



Source: KNB (2023)

On the other hand, selling to wholesalers can be more attractive due to the lower marketing costs, transparency in selling prices, and lower risk[409]. Even though producers who market through wholesaler channels usually sell at lower prices, it can be more profitable when sale volume[410], time, marketing expenses, and management skills (controlling input costs) [411] are taken into account. However, the existing results comparing the advantages of direct-to-consumer sales and wholesales are mixed. Other studies found that direct-to-consumer sales gave a higher net sales income than sales through wholesalers or traders due to the higher labour costs and longer time needed for field sorting and bunching of products[412]. **Taken together, mainstream (selling to wholesalers and retailers) and local (direct-to-consumer sales) sales channels seem to have their benefits and can complement each other[413]. Therefore, diversifying to a combination of sales channels may seem more beneficial to the producers through risk distribution.**

The impact of the differences in the use of main sales channels on men's and women's smallholders was uncertain due to the lack of data on their profits. Nonetheless, the differential perception of the smallholders on their primary sales channels suggests that selling to a wholesaler provides more certainty in their income, since the wholesale is typically based on prior agreements or formal contracts. However, relying on direct-to-consumer sales may result in greater uncertainty and irregular sales. This is because sales to consumers are determined by the needs of consumers and their relationship with the sellers. **Given their reliance on farm income and irregular buyers (consumers), it is likely that women smallholders, especially those in Sabah and Sarawak, vulnerable to the issues arising from sales challenges that can consequently affect their income security.**

[409] Kim, Curtis, and Yeager (2014)
[410] LeRoux et al. (2010)
[411] Hardesty and Leff (2010); Park, Mishra, and Wozniak (2014)
[412] LeRoux et al. (2010); Gebre et al. (2022)
[413] Milford, Lien, and Reed (2021)

4.5 Conclusion

Utilising the gender lens in examining agricultural practices, experience, and support among smallholders in Malaysia, this study identified several key findings as below:

Subsection 4.4.1: Sociodemographic characteristics

- Men and women smallholders surveyed in Project SEMAI were largely similar in age, farming experience, and education level. Nevertheless, regional differences were present. The smallholders in Sabah and Sarawak were older, more experienced in farming, and had lower educational attainment than those in Peninsular Malaysia.
- Consistently across the subsectors, agrifood smallholding in Sabah and Sarawak had a higher women-to-men ratio than in the Peninsula.

Subsection 4.4.2: Farming practices

- There were proportionally more women in crop farming, especially vegetable cultivation in Sabah and Sarawak, while their male counterparts cultivated a more diverse range of crops.
- Women smallholders allocated a portion of their farm outputs for household consumption, whereas men smallholders primarily farmed for sales. Nevertheless, both men and women smallholders sold at least three-quarters of their outputs for income.
- A greater proportion of smallholders in Peninsular Malaysia relied on off-farm work as the primary source of income. In contrast, smallholders in Sabah and Sarawak predominantly depended on farm income for their livelihood.

Subsection 4.4.3: Agricultural resources and training experience

- Fewer women smallholders owned any agricultural machinery or equipment than their male counterparts. These differences were more pronounced in Sabah and Sarawak and among crop smallholders.
- Although women smallholders in Sabah and Sarawak expressed a similar degree of interest in training as their male counterparts, fewer of them had actual training experience. Their training needs also differed from men's, possibly shaped by the differences in sales experience and farming practices.

Subsection 4.4.4: Contract farming

- Fewer women smallholders in Sabah and Sarawak were engaged in contract farming than their male counterparts.

Subsection 4.4.5: Perceived sales challenges

- Women smallholders, particularly those in Sabah and Sarawak, were more likely to rely on direct-to-consumer sales, perceive their sales as irregular, and experience difficulties finding buyers for their farm outputs.

4.5.1 Policy Considerations

A key observation emerges from the findings: gender gaps are present among agrifood smallholders, with women smallholders being more likely to fall behind in multiple aspects. Such gender disparities are also more prevalent among the surveyed smallholders in Sabah and Sarawak. Although variations in farming preferences and practices can partly explain these gender gaps, they are, by and large, reflections and results of social and gender norms. For example, certain behaviours of women smallholders, such as the tendency to reserve some outputs for household consumption and sell their farm outputs directly to consumers, are tied to socially perceived women's roles. These may consequently constrain their opportunities, such as engaging in more efficient sales and contract farming, which can positively impact their livelihood. The persistent gender gaps observed among agrifood smallholders in Sabah and Sarawak also suggest underlying socioeconomic constraints.

While gender-specific initiatives, such as empowerment-oriented training and the provision of agricultural entrepreneurship, opportunities, or assistance for women[414], are in place, they typically do not actively address the underlying factors of gender gaps. **The imperative focus should be cultivating a more equitable environment for everyone in the agrifood sector, regardless of gender.**

Therefore, undertaking more inclusive and gender-responsive[415] approaches to ensure an equitable environment for everyone in agrifood production is crucial, particularly for women who are more likely to be disadvantaged by gender gaps. This indicates that policies aimed at closing gender gaps need to acknowledge and address the underlying social and gender factors that drive differences in in agrifood production and unequal outcomes. These include gender differences in household roles and constraints, unpaid care work, power dynamics in decision-making, and access to resources and information.

The following policy recommendations are guided by this perspective:

i. **Introduce tailored training programmes:** Tailor the timing, duration, location, and content of training based on the practical needs and skill gaps of men and women smallholders. Provide group training near communities with a hands-on approach and shorter duration in a casual setting to increase the participation of women smallholders. Meanwhile, sensitising agricultural extension officers to gender gaps through regular training ensures effective implementation.

ii. **More training on sales and marketing:** Provide group training introducing sales channels and product marketing strategies to smallholders. These initiatives should focus more on smallholders in Sabah and Sarawak, especially women, to improve their sales.

[414] Bernama (2022); Agrobank (n.d.); (n.d.); Nik Mohd Masdek (2015)

[415] Gender-responsive policies refer to policies that consider gender norms, roles, and inequalities, and actively address the causes of gender inequities. Such policies go beyond raising sensitivity and awareness and include ways to transform harmful gender norms, roles, and relations. They are distinct from gender-sensitive policies, which consider gender norms, roles and relations but do not address the resulting inequalities. Source: WHO (2009)

iii. **Introduce fit-for-purpose agricultural machinery and equipment support:** Undertake additional steps when aiding or providing incentives to identify specific production needs and preferences of the smallholder and provide assistance accordingly.

iv. **Connect smallholders to more sales channels:** Explore the provision of sales platforms connecting smallholders, particularly those in Sabah and Sarawak, to regular buyers through contract farming and PPP initiatives. These initiatives should provide greater attention to women smallholders who tend to primarily rely on irregular direct-to-consumer sales.

v. **Provide gender-sensitive contract farming opportunities:** Conduct gender-specific assessments of smallholders before engagement to identify gaps and provide tailored support. This is to allow smallholders who are otherwise constrained by social and economic factors to participate in and benefit from contract farming.

vi. **Conduct gender-sensitive impact assessment:** Disaggregate impact assessment of agricultural policies and initiatives by gender, location, and strata to evaluate the true equity. Additionally, allocate support for empirical research on agricultural gender gaps in Malaysia.

vii. **Enhance multi-ministerial collaboration.** Undertake a multi-ministerial approach between KPKM, KPWKM, KKDW, EPU, and the state governments to implement the abovementioned gender-responsive policies and strengthen the existing gender gap-targeted initiatives. A greater focus should be provided to smallholders in Sabah and Sarawak.

4.5.2 Limitations and Future Work

The findings presented in this report should be interpreted in light of their limitations. Gender roles in agriculture are socially constructed and highly context-specific, particularly in rural areas, where the community is culturally and economically diverse. Geographical differences within the same state also contribute to the diversity in agricultural practices and gender norms. Gender-based disparities are part of a broader set of multiple intertwined inequalities. Hence, the results should be assessed with the wider context, including income, race, ethnicity, and location. A complete analysis taking these factors into account is beyond the scope of this report due to the limitation of the survey. Hence, future research should provide a more comprehensive analysis considering these factors, thereby providing a more nuanced understanding of gender gaps in agriculture and their intricate interplay within diverse Malaysian contexts.

Furthermore, the findings may not be applicable to farmers or smallholders in other subsectors, such as paddy, oil palm, and other cash crops, as this report included only agrifood smallholders involved in crop farming, livestock breeding, and aquaculture farming. Given that the responses were self-reported, the experience and challenges reported by the smallholders were likely to be subjective and could contain reporting bias. Nonetheless, the findings provided important insights into the gender gaps among agrifood smallholders in Peninsular Malaysia and Sabah and Sarawak. These findings could aid in guiding gender-responsive policies and programme design and implementation.

4.5.3 Concluding Remarks

Gender gaps do not only limit women's opportunities. They can contribute to additional disadvantages such as low income and food insecurity at the household level. Yet, at the heart of gender gaps in agrifood production are gender inequalities that constrain women from fully engaging in income-generating activities, such as the double burden of productive and unpaid care work as well as gender norms. As such, the ultimate focus should be to tackle the root causes of the broader gender inequality.

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ABBREVIATIONS

9MP	:	Ninth Malaysia Plan
AR4	:	Fourth Assessment Report
AR5	:	Fifth Assessment Report
AR6	:	Sixth Assessment Report
ASEANGAP	:	ASEAN Good Agricultural Practice
BSE	:	Bovine Spongiform Encephalopathy
Cam-GAP	:	Cambodia Good Agricultural Practice
CEA	:	Controlled Environment Agriculture
CGE	:	Computable General Equilibrium
CHIRPS	:	Climate Hazards Group InfraRed Precipitation with Station data
CO2	:	Carbon dioxide
CORDEX	:	Coordinated Regional climate Downscaling Experiment
DAN	:	Dasar Agromakanan Negara
DOA	:	Department of Agriculture
DOF	:	Department of Fisheries
DOV	:	Department of Veterinary
DVS	:	Department of Veterinary Services
EU	:	European Union
FAMA	:	Federal Agricultural Marketing Authority
FAO	:	Food and Agriculture Organization of the United Nations
FASM	:	Farm Accreditation Scheme of Malaysia
FFB	:	Fresh fruit bunches
GAP	:	Good Agricultural Practice
GaqP	:	Good Aquaculture Practice
GDP	:	Gross domestic product
GFSI	:	Global Food Security Index
GHGs	:	Green House Gases
GIS	:	Geographical Information System
GlobalGAP	:	Global Good Agricultural Practices
GMP	:	Good Manufacturing Practices
GPS	:	Global Positioning System
Ha	:	Hectare

ABBREVIATIONS

HACCP	:	Hazard Analysis Critical Control Point
IADA	:	Integrated Agricultural Development Area
IBM	:	The International Business Machines Corporation
ICT	:	Information and communications technology
ILO	:	International Labour Organization
IndoGAP	:	Indonesian Good Agricultural Practices
IPCC	:	Intergovernmental Panel on Climate Change
ISO	:	International Organisation for Standardisation
KNB	:	Khazanah Nasional Berhad
KPKM	:	Ministry of Agriculture and Food Security
KPWKM	:	Ministry of Women, Family and Community Development
KRI	:	Khazanah Research Institute
LAO GAP	:	Laos Good Agricultural Practice
LFS	:	Labour Force Survey
LKIM	:	Department of Fisheries
LPP	:	Lembaga Pertubuhuan Peladang
LVI	:	Livelihood Vulnerability Index
m	:	Million
MAFC	:	Malaysia Agro Food Corporation
MAFFI	:	Ministry of Agriculture, Fisheries and Food Industry
MAFI	:	Ministry of Agriculture, Fisheries and Food Industry
MeSTI	:	Makanan Selamat Tanggungjawab Industri
M-FICORD	:	Ministry of Food Industry, Commodity & Regional Development Sarawak
MOMA	:	Ministry of Modernisation of Agriculture
MPIB	:	Malaysian Pineapple Industry Board
MRANTI	:	Malaysian Research Accelerator for Technology & Innovation
MyGAP	:	Malaysia Good Agricultural Practices
MyOrganic	:	Malaysia Organic
NAFAS	:	National Farmers Organization
NAP 2.0	:	National Agrofood Policy 2.0
NASA	:	National Aeronautics and Space Administration

ABBREVIATIONS

NASH	:	National Association of Smallholders Malaysia
ND-GAIN	:	Notre Dame-Global Adaptation Initiative
NGOs	:	non-governmental organisations
NLC	:	National Land Code
OECD	:	Organisation for Economic Co-operation and Development
PCA	:	Principal component analysis
PhilGAP	:	Philippine Good Agricultural Practices
QGAP	:	Thai National Good Agricultural Practice
QMS	:	Quality Management System
R&D	:	Research and development
RA	:	Rainforest Alliance
RC	:	Regional Coordinator
RMK10	:	Tenth Malaysia Plan
RSPO	:	Roundtable of Sustainable Palm Oil
SALT	:	Livestock Farm Certification Scheme
SG GAP	:	Singapore Good Agricultural Practice
ThaiGAP	:	Thailand Good Agricultural Practice
TPKM	:	Taman Kekal Pengeluaran Makanan
UMT	:	Universiti Malaysia Terengganu
UN Comtrade	:	The United Nations Comtrade Database
UNIMAS	:	Universiti Malaysia Sarawak
UniSZA	:	Universiti Sultan Zainal Abidin
UPM	:	Universiti Putra Malaysia
US	:	United States
USD	:	United States Dollar
VietGAP	:	Vietnamese Good Agricultural Practices
WHO	:	World Health Organisation
WTP	:	Willingness to pay

GLOSSARY

Agricultural extension services	:	The entire set of organisations that facilitate and support people engaged in agricultural activities to solve problems and to obtain information, skills, and technologies to improve their livelihoods and well-being. *Source: Davis, Babu and Ragasa (2020)*
Agricultural land use	:	The utilisation of land for the purpose of planting, growing, cultivating, and harvesting crops for human and livestock consumption, as well as for pasturing livestock. *Source: Law Insider (n.d.)*
Agriculture	:	Broadly describes agriculture, forestry, fisheries, land & water, agro-industries, environment, manufacturing of agricultural inputs and machineries, regional & river development, and rural development. *Source: FAO (n.d.)* A more narrow definition covers the cultivation of crops and animal husbandry as well as forestry, fisheries, and the development of land and water resources. *Source: FAO (2003)*
Agriculture, forestry, and fishery employment	:	Persons of working age who were engaged in any activity in agriculture, hunting, forestry, and fishing to produce goods or provide services for pay or profit, whether at work during the reference period or not at work due to temporary absence from a job, or to working-time arrangement. *Source: ILO (n.d.)*
Agrifood value chain	:	Created as a partnership between producers, processors, and marketers to enhance quality, optimise operational efficiencies, or develop and promote distinctive products. *Source: Government of Manitoba (n.d.)*
Animal health management	:	Diverse knowledge and practices focused on maintaining and improving animal health. *Source: Noordhuizen (2002)*
Aquaculture	:	Farming of aquatic animals and plants, such as fish, shellfish, and seaweed, in various water environments including freshwater, marine water, brackish water, or inland saline water. *Source: World Fish Center (n.d.)*

GLOSSARY

Arable agricultural land	:	Areas devoted to temporary crops such as cereals, temporary meadows for mowing or pasture, and land left temporarily fallow. *Source: OECD (n.d.)*
Biodiversity	:	The diverse array of life forms found in a specific area, including a variety of animals, plants, fungi, and microorganisms such as bacteria. *Source: WWF (n.d.)*
Biosecurity	:	Measures designed to prevent the intentional and unintentional introduction and spread of harmful organisms, including viruses, bacteria, plants, and animals, outside their native range or within new areas. *Source: Renault et al. (2021)*
Blockchain	:	Innovative database system facilitating transparent information sharing within a business network. It stores data in interconnected blocks, forming an unmodifiable chain, ensuring chronologically consistency through network consensus. *Source: Amazon (n.d.)*
Bookkeeping	:	Recording of an individual/company's financial transactions on a regular basis. *Source: Corporate Finance Institute (n.d.)*
Breeder farm	:	Establishment dedicated to the production of fertilised eggs, where eggs are hatched into chicks and sent to broiler farms. *Source: National Land (n.d.)*
Broiler chicken	:	Any chicken bred and raised, particularly for meat production. *Source: PETA (n.d.)*
Broiler farm	:	A facility where chickens are raised for meat production for the purpose of human consumption. *Source: National Land (n.d.)*
Capture fishery	:	Catching or harvesting wild fish and other aquatic organisms in freshwater, brackish water, or seawater. Capture fisheries are usually further divided into two types: (1) large-scale, industrial, or commercial fisheries, and (2) small-scale, or artisanal, fisheries. *Source: Garces, Pido and Pomeroy (2008)*

GLOSSARY

Cash crops	:	Agricultural crops that are planted for the purpose of selling on the market or for export to make profits, as distinguished from subsistence crops planted for the purpose of self-supply of the farmer (like livestock feeding or food for the family). *Source: EU (n.d.)*
Child labour	:	Work that deprives children of their childhood, potential, and dignity and that is detrimental to their physical and mental development. *Source: ILO (n.d.)*
Closed-house systems	:	A type of housing system where animals are raised within an enclosed building. This system employs controlled ventilation to minimise airborne contamination. *Source: The Star (2021)*
Consortium factory	:	Factories that pool their resources and expertise to achieve a common objective while maintaining independence in their day-to-day operations. *Source: Cambridge Dictionary (n.d.)*
Contract farming	:	An agreement between agricultural producers and buyers in which both parties agree in advance on the terms and conditions for the production and supply of farm products, normally at predetermined prices. *Source: FAO (n.d.)*
Crops	:	Plants that are cultivated either for sale or for subsistence. *Source: USDA (n.d.)*
Digital footprint	:	Trace of data that an individual generates through their online activities. *Source: Kaspersky (n.d.)*
Ergonomics	:	The study of aligning a job's needs with the worker's and work environment's ability to provide the most efficient workspace possible while simultaneously reducing the risk of injury. *Source: Edwards, Fortingo and Franklin (2022)*
Farm productivity	:	A measure of the capacity of the farm to convert the inputs into the final output given a certain level of knowledge and technology. *Source: Gaviglio et al. (2021)*

GLOSSARY

Financial literacy	:	Cognitive comprehension of financial elements and skills, encompassing areas such as bookkeeping, budgeting, investing borrowing, and personal financial management. *Source: Corporate Finance Institute (n.d.)*
Financial security	:	State of well-being in which an individual or household possesses sufficient financial assets to meet their expenses, handle emergencies, and fund retirement. *Source: Experian (n.d.)*
First aid	:	Immediate medical care provided to an individual shortly after they have been injured in an incident or have suddenly fallen ill. *Source: Cambridge Dictionary (n.d.)*
Food crops	:	Crops that are cultivated through agriculture for the purpose of supplying food for the growing population of people. *Source: Aly and Borik (2023)*
Food insecurity	:	The lack of adequate physical and economic access to sufficient, safe, and nutritious foods that meet their dietary needs and preferences for an active and healthy life. *Source: World Food Summit (1996)*
Food safety	:	The assurance that food, when prepared and consumed according to its intended use, will not cause harm to the consumer. *Source: FAO (2023)*
Food security	:	When all people, at all times, have physical and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life. *Source: World Food Summit (1996)*
Forestry	:	The science and practice of establishing, managing, using, and conserving forests, trees, and associated resources in a sustainable manner to meet desired goals, needs, and values. *Source: USDA (n.d.)*
Fresh fruit bunches	:	Clusters of fruit produced by oil palm trees, which serve as the raw material for the production of palm oil. *Source: IGI Global (n.d.)*

GLOSSARY

Gender disparities	:	Statistical differences between men and women, boys, and girls, that reflect inequalities in a certain extent. *Source: UNICEF (n.d.)*
Gender equality	:	Equal valuing of the similarities and the differences of men and women and the roles they play. This is to ensure that men and women, boys and girls have equal conditions, treatment, and opportunities for realising their full potential, human rights, and dignity, and for contributing to and benefitting from economic, social, cultural, and political development. *Source: UNICEF (n.d.)*
Gender equity	:	The process of being fair to men and women, boys and girls, and ensuring the equality of outcomes and results by positively addressing a bias or disadvantage stemmed from gender roles or norms or differences between the sexes. *Source: UNICEF (n.d.)*
Gender gap	:	Disproportionate difference between men and women and boys and girls, particularly as reflected in attainment of development goals, access to resources and levels of participation. *Source: UNICEF (n.d.)*
Gender inequality	:	The disparities between women and men in a society concerning their access and opportunities in social, economic, and political spheres, as well as their representation and decision-making power across all social levels. *Source: Inter-Agency Network for Education in Emergencies (n.d.)*
Gender mainstreaming	:	The process and strategy for making girls' and women's, as well as boys' and men's, concerns and experiences an essential dimension of designing, implementing, monitoring, and evaluating policies and programmes to ensure gender equality. *Source: UNICEF (n.d.)*
Gender neutral	:	Anything that is not associated with either the male or female gender. *Source: UNICEF (n.d.)*
Gender norms	:	Ideas about how men and women should be and act that are specific to a particular society, culture, and community at a particular point in time. *Source: UNICEF (n.d.)*

GLOSSARY

Gender stereotypes	:	Generalised view or preconception about attributes, characteristics, or the roles that are or ought to be possessed by, or performed by, women and men. *Source: OHCHR (n.d.)*
Grazing animals	:	Grazing herbivores, both domesticated and wild, that feed mainly or only on forage and do not include insects or other animals that consume vegetation to some degree. *Source: Allen et al. (2011)*
Household/domestic responsibilities	:	Tasks performed inside a household in order to ensure that the basic needs of its members are met, such as cooking, cleaning, and caring for children or older adults and other dependent family members. *Source: EIGE (n.d.)*
Indigenous land rights	:	The right of indigenous peoples to their traditional lands, waters, and territories stems from their historical occupation and possession of ancestral lands. This right is rooted in pre-existing customary laws that have endured despite colonisation. *Source: Gilbert (2007)*
Industrial crops	:	Crops which are normally not sold directly for consumption because they need to be industrially processed prior to final use. *Source: EU (n.d.)*
Labour productivity	:	Economic performance metric that assesses the production efficiency by comparing the quantity of output to the amount of input used. *Source: Reserve Bank of Australia (n.d.)*
Layer chicken farm	:	Poultry farm specifically designed for the commercial production of eggs by raising laying birds *Source: National Agricultural Advisory Services (n.d.)*
Livestock breeding	:	Domesticated terrestrial animals that are raised to provide a diverse array of goods and services such as traction, meat, milk, eggs, hides, fibres, and feathers. *Source: FAO (n.d.)*
Market positioning		The process of creating an impression on consumers and persuading them to perceive a product or brand in a specific manner. *Source: Indeed.com (n.d.)*

GLOSSARY

Masculinity/Feminity	:	Dynamic socio-cultural categories used in everyday language to refer to specific behaviours and practices recognised within a culture as "masculine" or "feminine". *Source: UNICEF (n.d.)*
Modern farming	:	Farming practices that utilise technology, methods, and scientific advancements to enhance agricultural productivity. *Source: Farmer Scion (n.d.)*
Monopsonist	:	A situation in a market in which there is only one buyer for goods or services offered by several sellers. *Source: Cambridge Dictionary (n.d.)*
Multi-sector	:	Involved in more than one industry. *Source: Cambridge Dictionary (n.d.)*
Nutritional value	:	The balanced proportion of essential nutrients, including carbohydrates, fats, proteins, minerals, and vitamins, relative to the consumer's nutritional needs. *Source: Biology Online (n.d.)*
Odorous emissions	:	The emission of offensive or irritating gases, fumes, and vapours into the atmosphere by an industrial operation, facility, or source. *Source: Law Insider (n.d.)*
Off-farm employment	:	Any economic activity other than own-farm production. *Source: Haggblade and Hazell (1989)*
Post-harvest	:	The phase of crop production that takes place immediately after harvesting, including activities such as cleaning, sorting, and packing. *Source: Cambridge Dictionary (n.d.)*
Price premium		High price associated with something of high quality, rarity, and difficulty to obtain. *Source: Cambridge Dictionary (n.d.)*
Product differentiation		Incorporation of unique and distinctive characteristics or features into a product to establish a unique selling proposition and set it apart from competitors. *Source: Corporate Finance Institute (n.d.)*

GLOSSARY		
Social norms	:	Perceived informal, often unwritten, rules that define appropriate and acceptable actions or behaviours within a given group or community. Social norms can have beneficial or harmful effects on people's well-being. *Source: UNICEF (2021)*
Sustainable agricultural practice	:	Agricultural practice that involves cultivating the land in a manner that safeguards the environment, promotes the preservation and expansion of natural resources, and optimally utilises non-renewable resources. *Source: USDA (n.d.)*
Taman Kekal Pengeluaran Makanan (TKPM)	:	A strategy under the National Agricultural Policy 3 (DPN3) to encourage the development of large-scale, commercialised, and high-tech farming, focusing mainly on producing fruits and vegetables. *Source: DOA (n.d.)*
Traceability system	:	A system that allows for retrieving any or all information regarding a product throughout its life cycle by employing a system of recorded identifications. *Source: International Institute of Sustainable Development (2015)*
Unpaid care work	:	Services provided within a household for its members, including personal care and housework. *Source: UNIFEM (2000)*
User-friendly	:	Something that is easy to learn, use, understand, or handle, particularly in the context of computer-related activities. *Source: Cambridge Dictionary (n.d.)*
Waste management	:	Various processes and activities associated with the handling and disposal of waste, including collection, transportation, treatment, and final disposal. *Source: Biology Online (n.d.)*
Water footprint	:	An environmental metric that quantifies the amount of fresh water, typically measured in litres or cubic metres, consumed across the entire production chain of a consumer product or service. *Source: Iberdrola (n.d.)*
Willingness to pay		The highest price a customer is prepared to pay for a product or service. *Source: Harvard Business School (2020)*

APPENDIX A

Survey of MALAYSIAN SMALLHOLDERS (SOMS) QUESTIONNAIRE – PHASE 2

Notis Perlindungan Data Peribadi / Personal Data Protection Notice (PDPN)

Respondents are required to **sign on either the English OR Malay version of the PDPN form**. The **Chinese and Tamil versions** of the PDPN serve as a guide for verbal explanation only, they should not be used for signing.

Seksyen A: Demografi

<table>
<tr><th>No.</th><th>Question</th><th>Objectives and Remarks</th></tr>
<tr><td>A1</td><td>Saya mengusahakan aktiviti

Tanda ‘✓’

<table>
<tr><td rowspan="2">Tanaman</td><td></td><td>Buah-buahan: Kurang daripada 12 ekar (5 hektar)</td><td>☐ Ya
☐ Tidak</td></tr>
<tr><td></td><td>Sayur-sayuran dan herba: Kurang daripada 5 ekar (2 hektar)</td><td>☐ Ya
☐ Tidak</td></tr>
<tr><td rowspan="3">Ternakan</td><td></td><td>Ayam: Kurang daripada 30,000 ekor</td><td>☐ Ya
☐ Tidak</td></tr>
<tr><td></td><td>Lembu: Kurang daripada 50 ekor</td><td>☐ Ya
☐ Tidak</td></tr>
<tr><td></td><td>Kambing: Kurang daripada 100 ekor</td><td>☐ Ya
☐ Tidak</td></tr>
</table></td><td>Screening question to ensure that relevant smallholders are being surveyed

After Piiot phase, the criteria for smallholders have been revised for crops (tanaman) and aquaculture (akuakultur).

Specifically,

• Size for fruits revised to 12 acres
• Size for vegetables and herbs revised to 5 acres
• Size for Akuakultur Sangkar revised to less than 0.25 acres</td></tr>
</table>

			Lain-lain, sila nyatakan nama ternakan: _____	Sila nyatakan bilangan ekor: _____	
	Akuakultur		Kolam: Kurang daripada 1 ekar	☐ Ya ☐ Tidak	
			Sangkar: Kurang daripada 0.25 ekar	☐ Ya ☐ Tidak	
A2	Saya adalah ☐ Pemilik ladang ☐ Pemilik tanah ☐ Bukan pemilik tanah ☐ Pengurus ladang				Screening question to ensure that respondent manages farm operations and can answer the survey accurately Survey respondents who manage and involve in day-to-day farm operations
A3	Umur ☐ 18 - 29 ☐ 30 - 39 ☐ 40 - 49 ☐ 50 - 59 ☐ 60 - 69 ☐ 70 dan ke atas				To identify the age group of existing smallholders
A4	Jantina ☐ Lelaki ☐ Perempuan				To identify the gender of existing smallholders
A5	Warganegara ☐ Warganegara Malaysia ☐ Jika bukan warganegara Malaysia, nyatakan: _____				To identify the nationality of existing smallholders

A6	Kaum ☐ Melayu ☐ Cina ☐ India ☐ Jika Bumiputera Sabah dan Sarawak atau Lain-lain, sila nyatakan nama kaum: _____	To identify the ethnicity of existing smallholders • Options for 'Bumiputera Sabah dan Sarawak' and 'Lain-lain' are merged into one option • Make sure to state the exact ethnicity (kaum) for 'Bumiputera Sabah dan Sarawak' and 'Lain-lain'
A7	Tahap pelajaran tertinggi ☐ Sekolah rendah ☐ Sekolah menengah ☐ Sijil / Diploma ☐ Berkaitan bidang pertanian ☐ Sarjana muda ☐ Berkaitan bidang pertanian ☐ Sarjana / PHD ☐ Berkaitan bidang pertanian ☐ Tiada sekolah formal	To gauge the education level of existing smallholders
A8	Sumber pendapatan utama saya adalah dari *(Pilih satu sahaja)* ☐ Pertanian ☐ Pengeluaran sejenis / tunggal ☐ Pengeluaran berlainan jenis / berbagai ☐ Pekerjaan lain, sila nyatakan: _____	To identify the main income of the respondent • Main differentiation is farm income vs non-farm income • All other non-farm income will be considered as 'Pekerjaan lain' including pension and must be specified
A9	Saya merupakan petani berkontrak* (*contract farmer*)	To understand the stability of output sales and farm income

	*(*sebarang perjanjian formal / informal antara petani dengan entiti seperti pihak swasta atau agensi kerajaan berkenaan harga pengeluaran dan pembelian produk)* ☐ Ya ☐ Tidak	• Contract farmers are those who have agreement (formal or informal) with entities like private companies or government agencies on the purchase and purchase price of their outputs
A10	Saya mempunyai keahlian yang berkaitan dengan pertanian dalam *(Boleh pilih lebih daripada satu)* ☐ Koperasi / persatuan: ☐ Peringkat kebangsaan ☐ Peringkat negeri ☐ Peringkat daerah ☐ Peringkat komuniti ☐ Tiada ☐ Lain-lain, sila nyatakan: _____	To gauge the participation of smallholders in industry organisations • Include agriculture- and industry-related organisations only
A11	Saya mempunyai sijil *Malaysian Good Agricultural Practice* (myGAP) daripada Jabatan Pertanian ☐ Ya ☐ Tidak, sila nyatakan sebab: _____	To understand the participation in myGAP among smallholders • myGAP is also known as 'Skim Amalan Pertanian Baik Malaysia' in Malay • Good Agricultural Practice (GAP) is an agricultural practice that addresses environmental, economic, and social aspects to ensure healthy and excellent quality products
A12	Saya telah menceburi bidang pertanian selama _____ tahun ☐ Kurang daripada 1 ☐ 1 – 5 ☐ 6 – 10 ☐ 11 – 20 ☐ 21 – 30 ☐ Lebih daripada 30	To gauge the experience of existing smallholders

Seksyen B: Produktiviti

<table>
<tr><th>No.</th><th>Question</th><th>Objectives and Remarks</th></tr>
<tr>
<td>B1</td>
<td>Tanaman / ternakan / akuakultur utama saya adalah
(Sila nyatakan unit mengikut unit ukuran yang diberikan)
<table>
<tr><th></th><th>Hasil utama 1</th><th>Hasil utama 2</th><th>Hasil utama 3</th><th>Hasil utama 4</th><th>Hasil utama 5</th></tr>
<tr><td>Jenis hasil utama</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Nama hasil utama</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Keluasan / bilangan</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Nyatakan unit: ekar, ekor</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Bilangan tuaian / jualan dalam setahun</td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
</td>
<td>To understand the main products of the respondents and productivity of these products

After Pilot phase, dedicated rows for units of measurement have been added, alongside more detailed notes to help enumerators gauge production volume more accurately.

• Must state unit using the units of measurement given for each subsector (refer to the ‘Contoh dan Nota’ table at the bottom)
• Refer to ‘Scenarios for QB1’ table at the end of this Survey Guide
• Conversion to the units of measurement given should be done during data entry
• Do not use fraction and unconventional expression (e.g. 1(100), 1/2) and report numerical values only
• Read the notes below the table for clarifications on information to be reported
• ‘Nama hasil utama’ - capture the exact breeds and species of the products (e.g. sawi putih, sawi pahit, ayam kampung, ikan keli)
• ‘Bilangan tuaian / jualan dalam setahun’ - no. of times a crop will be harvested / a livestock or aquaculture will be sold in a year</td>
</tr>
</table>

Anggaran hasil setiap kali tuaian / setiap kali jualan					
Nyatakan unit: kg, ekor					
Anggaran harga jualan					
Nyatakan unit: RM/kg, RM/ekor, RM/papan telur					

Contoh dan Nota:

	Contoh 1	**Contoh 2**	**Nota**
Jenis hasil utama	*Sayur-sayuran*	*Ternakan*	*Contoh: Sayur-sayuran, buah-buahan, ternakan, akuakultur*
Nama hasil utama	*Cili merah*	*Lembu*	*Dapatkan nama khusus hasil*

Tips:

- 'Keluasan' - enumerators may ask respondents the total farm size for all the products listed and get estimated percentage of land used for the respective products, then calculate the estimated size for each product (i.e. % land used for product A x total farm size)
- 'Hasil' and 'Harga' - enumerators can get any 2 of these 3 variables (total revenue received from every selling of a product in RM, total output in kg, price per kg) to derive 'Hasil' and 'Harga' (i.e. RM/kg = revenue for product A / product A output in kg)
- Use 'revenue / hasil' rather than mentioning 'profit / keuntungan', respondents may feel profit is a sensitive question

	Keluasan / bilangan	*1.5*	*20*	*Tanaman dan akuakultur: laporkan keluasan dalam ekar* *Ternakan: laporkan bilangan dalam ekor*		
	Nyatakan unit: ekar, ekor	*ekar*	*ekor*			
	Bilangan tuaian / jualan dalam setahun	*5*	*3*	*Tanaman: laporkan bilangan tuaian* *Ternakan dan akuakultur: laporkan bilangan jualan*		
	Anggaran hasil setiap kali tuaian / setiap kali jualan	*200*	*10*	*Tanaman dan akuakultur: laporkan hasil tuaian dalam kg* *Ternakan: laporkan jualan dalam ekor*		
	Nyatakan unit: kg, ekor	*kg*	*ekor*			
	Anggaran harga jualan	*8.50*	*5000*	*Tanaman dan akuakultur: laporkan RM/kg* *Ternakan: laporkan RM/ekor* *Telur: laporkan RM/papan telur (30 biji)*		
	Nyatakan unit: RM/kg, RM/ekor, RM/papan telur	*RM/kg*	*RM/ekor*			

	Nota: ***Dapatkan nama khusus kepada jenis/spesies untuk hasil utama, contohnya:*** • ***Sayur-sayuran: s****awi pahit, sawi putih, sawi bunga, cili padi, cili merah* • *Buah-buahan: pisang tanduk, pisang awak, limau kasturi, limau madu* • ***Ternakan:*** *ayam, telur ayam, itik, lembu, khinzir, kambing* • ***Akuakultur:*** *ikan keli, ikan talapia, ketam nipah, ketam bunga* ***Rujukan unit ukuran*** • ***Untuk keluasan*** o *1 hektar = 2.5 ekar* o *1 padang bola sepak = 1.3 ekar; 0.5 padang bola sepak = 0.65 ekar* • ***Untuk hasil*** o *1 tan = 1000 kg* • ***Untuk harga jualan*** o *1 papan telur = 30 biji telur*	
B2	Sumber benih tanaman / baka ternakan / baka akuakultur saya adalah dari *(Boleh pilih lebih daripada satu)* ☐ Simpanan sendiri / turun-temurun ☐ Pembekal / pekedai ☐ Agensi kerajaan ☐ Koperasi / persatuan ☐ Petani dan pengusaha ladang lain ☐ Lain-lain, sila nyatakan: _____	To identify the sources of inputs for smallholders
B3	Dalam setahun, kegunaan utama hasil tanaman / ternakan / akuakultur saya adalah untuk a. Jualan kepada pihak lain — % b. Diproses sendiri menjadi produk lain untuk dijual — % c. Kegunaan harian / keluarga — %	To gauge the primary uses of outputs by smallholders

	d. Pertukaran dengan petani lain termasuk sistem barter — % e. Kegunaan lain, sila nyatakan: _____ — % **100%**	
B4	Dalam setahun, jualan hasil tanaman / ternakan / akuakultur utama saya adalah kepada *(Boleh pilih lebih daripada satu)* ☐ Agensi kerajaan ☐ Koperasi / persatuan ☐ Pemborong ☐ Pekedai / peruncit ☐ Terus kepada pengguna ☐ Lain-lain, sila nyatakan: _____	To identify the main sources of buyers of outputs for smallholders
B5	Dalam setahun, jualan hasil tanaman / ternakan / akuakultur utama saya adalah kepada *(Pilih satu sahaja)* ☐ Pembeli tetap ☐ Pembeli tidak tetap	To identify the stability of buyers of outputs for smallholders After Pilot phase, this question was separated from B4 for clarity.
B6	Jumlah pekerja dalam ladang saya adalah	To gauge the size and composition of labour in the agriculture industry

	Jumlah	Warganegara Malaysia	Berumur lebih daripada 55 tahun
Tetap / sepenuh masa *(termasuk diri sendiri)*			
Upahan / separuh masa			
Tidak berupah			

- **There should be at least 1 pekerja in any farm**
- Tetap / sepenuh masa: work in farm full time and paid either by wage or profit-sharing
- Upahan / separuh masa: work in farm part time and paid, or hired seasonally
- Tidak berupah: work in farm and unpaid

Examples:
- 1 farm owner managing the farm by himself only = 1 Tetap
- 3 farm owners who work in each other's farm together on profit-sharing basis = 3 Tetap

	(termasuk ahli keluarga, rakan)				• 1 farmer owner who manages the farm by himself and hires 2 workers during harvest season = 1 Tetap + 2 Upahan • Husband is full time farmer, wife sells nasi lemak in the morning and helps out in the farm in the afternoon = 1 Tetap + 1 Tidak berupah
B7	Ciri-ciri pekerja yang sukar dicari adalah *(Boleh pilih lebih daripada satu)* ☐ Tidak memerlukan pekerja ☐ Warganegara Malaysia ☐ Muda ☐ Berpengalaman ☐ Lain-lain, sila nyatakan _____				To gauge gaps in labour force
B8	Saya menghadapi masalah produktiviti yang rendah dalam pertanian saya (*hasil yang semakin berkurangan)* ☐ Ya ☐ Tidak ☐ Tidak pasti				To understand if low productivity is a challenge for smallholders
B9	TIGA cabaran terbesar yang saya hadapi dalam 5 tahun yang lepas dalam mengusahakan ladang adalah *(Boleh pilih lebih daripada satu)* ☐ Kekurangan pekerja tempatan, mahir dan muda ☐ Kenaikan harga input **(perlu jawab Soalan B10)** *(contoh: benih, baja, makanan untuk ternakan)* ☐ Kekurangan penyelidikan ☐ Kekurangan prasarana *(contoh: jalan raya, sistem pengairan, internet)* ☐ Kekurangan pengetahuan kaedah pertanian dan penggunaan teknologi *(contoh: kaedah pertanian, pam air, IoT)* ☐ Kekurangan akses kepada mekanisme kewangan *(contoh: pinjaman bank)* ☐ Kekurangan sokongan kerajaan *(contoh: subsidi, kursus, bekalan benih)*				To understand the main challenges of smallholders • Respondents can pick between 1 to 3 options, enumerators should try to capture 3 options from respondents

<table>
<tr><td></td><td>☐ Serangan perosak (contoh: haiwan liar, serangga)
☐ Kekurangan akses kepada pasaran dan pengetahuan mengenai pemasaran
☐ Perubahan cuaca dan kejadian bencana alam (contoh: tanah runtuh, kemarau, banjiri)
☐ Lain-lain, sila nyatakan: _____</td><td></td></tr>
<tr><td>B10</td><td>Jika perubahan harga input ditandakan dalam Soalan B9, sila tandakan tahap kenaikan harga bagi input berikut

(Sila tandakan '✓')

<table><tr><th>Input</th><th>Rendah</th><th>Sederhana</th><th>Tinggi</th><th>Tidak berkaitan</th></tr><tr><td>Benih / baka haiwan</td><td></td><td></td><td></td><td></td></tr><tr><td>Baja</td><td></td><td></td><td></td><td></td></tr><tr><td>Racun perosak</td><td></td><td></td><td></td><td></td></tr><tr><td>Makanan haiwan</td><td></td><td></td><td></td><td></td></tr><tr><td>Perubatan haiwan (contoh: antibiotik untuk ayam)</td><td></td><td></td><td></td><td></td></tr></table></td><td>To gauge the increase in input prices

• Please choose 'Tidak berkaitan' only when the option is not relevant to the respondent</td></tr>
<tr><td>B11</td><td>Saya bersetuju / tidak bersetuju dengan kenyataan berikut

(Sila tandakan '✓')</td><td>To gauge the smallholders' sentiment on farming operation and need

• Choose 'Tidak berkaitan' only when the statement is not relevant to the respondent</td></tr>
</table>

Kenyataan	Sangat tidak setuju	Tidak setuju	Neutral	Setuju	Sangat setuju	Tidak berkaitan / tiada kesan
a. Saya mengalami kesukaran mendapatkan maklumat tentang harga pasaran terkini untuk hasil saya						
b. Saya mengalami kesukaran mencari pembeli untuk hasil saya						
c. Saya mengalami kesukaran mencari pekerja						
d. Kenaikan harga upah semakin menjejaskan keuntungan saya						

Seksyen C: Kewangan

No.	Question	Objectives and Remarks
C1	Pengusahaan ladang saya dibiayai melalui *(Boleh pilih lebih daripada satu)* ☐ Modal / keuntungan sendiri ☐ Modal daripada ahli keluarga / rakan ☐ Modal daripada pelabur ☐ Pinjaman daripada ☐ Bank ☐ Agensi kerajaan ☐ Koperasi / persatuan ☐ Ahli keluarga / rakan ☐ Geran / bantuan kewangan tanpa bayaran balik daripada ☐ Agensi kerajaan ☐ Pihak swasta ☐ Badan bukan kerajaan ☐ Derma dan sumbangan daripada individu / badan amal ☐ Lain-lain, sila nyatakan: _____	To understand smallholders' sources of financing to support their farm operation
C2	Saya mempunyai simpanan rekod pendapatan untuk aktiviti pertanian saya ☐ Ya ☐ Tidak	To understand the respondents' financial health and practices • The financial records refers to personal and business accounts as long as it is to record farming activity
C3	Saya mempunyai akses kepada bank untuk membuka akaun simpanan ☐ Ya ☐ Tidak	To understand the respondents' financial health and practices
C4	Saya mempunyai akses kepada maklumat kewangan dan cara pengurusan kewangan ☐ Ya ☐ Tidak	To understand the respondents' financial health and practices

C5

Saya bersetuju / tidak bersetuju dengan kenyataan berikut

(Sila tandakan '✓')

Kenyataan	Sangat tidak setuju	Tidak setuju	Neutral/ Tidak pasti	Setuju	Sangat setuju	Tidak berkaitan/ tidak tahu
a. Saya mendapati prosedur permohonan pinjaman bank **mudah** untuk dipenuhi						
b. Skim pinjaman dan bantuan kewangan yang sedia ada **bertepatan** dengan keperluan kewangan saya						
c. Saya mempunyai sumber kewangan yang **mencukupi** untuk kegunaan kecemasan						

To understand the respondents' financial health and practices

- **Choose 'Tidak berkaitan' only when the statement is not relevant to the respondent**

C6	Dalam 12 bulan yang lepas, jenis bantuan yang telah saya terima adalah *(Boleh pilih lebih daripada satu)* ☐ Bantuan kewangan untuk sara hidup *(contoh: BR1M)* ☐ Bantuan kewangan untuk pertanian *(contoh: program khusus untuk pertanian)* ☐ Subsidi pertanian *(contoh: subsidi minyak)* ☐ Bentuk barangan *(contoh: benih, peralatan, baja, makanan, beras)* ☐ Tiada **(terus ke Soalan D1)** ☐ Lain-lain, sila nyatakan: _____	To understand the types of assistance respondents have received • 'Subsidi' refers to rebate and discounted price, respondents still need to incur some expenses at discounted rate • 'Bentuk barangan' refers to material goods given to respondents at no zero cost including farm inputs and daily goods for subsistence
C7	Sumber bantuan yang saya terima di atas adalah *(Boleh pilih lebih daripada satu)* ☐ Kerajaan persekutuan ☐ Kerajaan negeri ☐ Koperasi / persatuan / agensi ☐ Ahli keluarga / rakan ☐ Lain-lain, sila nyatakan: _____	**To understand the sources of assistance respondents have received** • **Skip this question if 'Tiada' in QC6** • **QC6 and QC7 should be consistent - if there is an assistance picked in QC6, then there should be a source picked for QC7**

Seksyen D: Kemahiran

No.	Question	Objectives and Remarks
D1	Dalam 5 tahun yang lepas, saya PERNAH menyertai kursus latihan mengenai *(Boleh pilih lebih daripada satu)* ☐ Tiada / tidak pernah menyertai kursus latihan **(terus ke Soalan QD3)** ☐ Pengurusan aktiviti pertanian ☐ Pengurusan kewangan ☐ Penggunaan teknologi dan platform digital ☐ Pemasaran dan jualan hasil ☐ Percubaan kaedah / teknologi pertanian baru ☐ Produk pertanian baru ☐ Sesi perkongsian pengetahuan tentang pertanian (tidak formal)	To understand the types of training respondents have received • **Proceed to QD3 if this question if 'Tiada / tidak pernah menyertai kursus latihan' is picked** • **The response should be consistent - if 'Tiada / tidak pernah menyertai kursus latihan' is picked, there should not be other options picked**

	☐ Lain-lain, sila nyatakan: _____	
D2	Dalam 5 tahun yang lepas, kursus latihan yang PERNAH saya sertai di atas adalah daripada *(Boleh pilih lebih daripada satu)* ☐ Agensi kerajaan ☐ Koperasi / persatuan ☐ Pihak swasta ☐ Badan bukan kerajaan ☐ Universiti / institusi akademik / pusat penyelidikan ☐ Komuniti / organisasi setempat ☐ Tidak formal *(contoh: ahli keluarga, media sosial, Youtube)* ☐ Lain-lain, sila nyatakan: _____	To understand the types of training respondents have received • **Skip this question if 'Tiada / tidak pernah menyertai kursus latihan' is picked in QD1**
D3	Dalam 5 tahun yang akan datang, TIGA kursus latihan yang INGIN saya sertai adalah mengenai *(Boleh pilih lebih daripada satu)* ☐ Tidak berminat untuk menyertai kursus latihan ☐ Pengurusan aktiviti pertanian ☐ Pengurusan kewangan ☐ Penggunaan teknologi dan platform digital ☐ Pemasaran dan jualan hasil ☐ Percubaan kaedah / teknologi pertanian baru ☐ Produk pertanian baru ☐ Sesi perkongsian pengetahuan tentang pertanian (tidak formal) ☐ Lain-lain, sila nyatakan: _____	To understand the types of training respondents would like to attend • **The response should be consistent - if 'Tidak berminat untuk menyertai kursus latihan' is picked, there should not be other options picked**
D4	Saya lebih cenderung untuk menyertai kursus secara *(Boleh pilih lebih daripada satu)* ☐ Atas talian ☐ Bersemuka ☐ Tidak berminat	To understand the modes of training respondents would like to attend

Seksyen E: Teknologi

No.	Question	Objectives and Remarks
E1	Saya mempunyai kemudahan atau teknologi berikut *(Boleh pilih lebih daripada satu)* ☐ Mesin, jentera dan peralatan pertanian *(contoh: penjana elektrik, pam air)* ☐ Kaedah / teknik pertanian yang lebih baik *(contoh: penanaman organik, rumah kaca, hidroponik)* ☐ Kaedah / teknik pemuliharaan alam sekitar (*contoh: tenaga suria, pengitaran semula air*) ☐ Alat pemasaran *(contoh: laman sesawang, aplikasi e-dagang)* ☐ Kenderaan (*contoh: kereta, motosikal, lori*) ☐ Telefon pintar ☐ Akses kepada Internet ☐ Lain-lain, sila nyatakan: _____	To understand the types of technology respondents are using and identify any technological gaps
E2	Bagi aktiviti pertanian, saya SEDANG menggunakan aplikasi telefon pintar untuk tujuan berikut *(Boleh pilih lebih daripada satu)* ☐ Tidak mempunyai telefon pintar / tidak menggunakan sebarang aplikasi telefon pintar ☐ Mendapatkan maklumat tentang kaedah pertanian yang lebih baik ☐ Mendapatkan maklumat tentang ramalan cuaca ☐ Mendapatkan maklumat tentang harga pasaran semasa input (baja, benih) ☐ Mendapatkan maklumat tentang harga pasaran semasa hasil ☐ Mendapatkan maklumat tentang bekalan dan permintaan semasa hasil ☐ Mencari pembekal input ☐ Mencari pembeli hasil ☐ Mencari pekerja ☐ Mendapatkan sokongan kewangan ☐ Mendapatkan insurans pertanian ☐ Lain-lain, sila nyatakan: _____	To understand the utilisation of smartphones and apps among smallholders and identify any gaps • **The response should be consistent - if 'Tidak mempunyai telefon pintar / tidak menggunakan sebarang aplikasi telefon pintar' is picked, there should not be other options picked**

E3	Dalam 5 tahun yang akan datang, bagi aktiviti pertanian, saya INGIN menggunakan aplikasi telefon pintar untuk tujuan berikut *(Boleh pilih lebih daripada satu)* ☐ Tidak berminat untuk menggunakan telefon pintar / aplikasi telefon pintar ☐ Mendapatkan maklumat tentang kaedah pertanian yang lebih baik ☐ Mendapatkan maklumat tentang ramalan cuaca ☐ Mendapatkan maklumat tentang harga pasaran semasa input (baja, benih) ☐ Mendapatkan maklumat tentang harga pasaran semasa hasil ☐ Mendapatkan maklumat tentang bekalan dan permintaan semasa hasil ☐ Mencari pembekal input ☐ Mencari pembeli hasil ☐ Mencari pekerja ☐ Mendapatkan sokongan kewangan ☐ Mendapatkan insurans pertanian ☐ Lain-lain, sila nyatakan: _____	To understand the utilisation of smartphones and apps among smallholders and identify any gaps • **The response should be consistent - if 'Tidak berminat untuk menggunakan telefon pintar / aplikasi telefon pintar' is picked, there should not be other options picked**

Seksyen F: Penyelidikan

No.	**Question**	**Objectives and Remarks**
F1	Dalam 5 tahun yang lepas, saya PERNAH menyertai kajian penyelidikan mengenai pertanian sebelum ini *(contoh: tinjauan, temu bual)* ☐ Ya ☐ Tidak	To understand activeness of local research and participation in research among smallholders to identify any gaps
F2	Dalam 5 tahun yang lepas, saya berasa bahawa terdapat kekurangan penyelidikan dalam bidang pertanian ☐ Ya ☐ Tidak ☐ Tidak pasti / tidak tahu	To understand the perception and awareness of smallholders on local research in agriculture sector

Seksyen G: Cuaca dan Iklim

<table>
<tr><th>No.</th><th>Question</th><th>Objective

Remarks</th></tr>
<tr><td>G1</td><td>Saya bersetuju / tidak bersetuju dengan kenyataan berikut
(Sila tandakan '✓')

<table>
<tr><th>Kenyataan</th><th>Sangat tidak setuju</th><th>Tidak setuju</th><th>Neutral</th><th>Setuju</th><th>Sangat setuju</th><th>Tidak berkaitan / tidak tahu</th></tr>
<tr><td>a. Saya berasa peningkatan / pengurangan hujan dalam 5 tahun yang lepas telah menjejaskan pengeluaran saya</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>b. Saya berasa perubahan suhu dalam 5 tahun yang lepas telah menjejaskan pengeluaran saya</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>c. Saya berasa peningkatan kejadian bencana alam dalam 5 tahun yang lepas telah menjejaskan pengeluaran saya (contoh: banjir, kemarau, ribut)</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table></td><td>To understand the impact, awareness, and sentiments with regards to climate change among smallholders

• Choose 'Tidak berkaitan' only when the statement is not relevant to the respondent</td></tr>
</table>

	d. Saya mempunyai sumber maklumat untuk menghadapi kesan perubahan cuaca terhadap aktiviti pertanian saya							
	e. Saya mempunyai sumber kewangan untuk menghadapi kesan perubahan cuaca terhadap aktiviti pertanian saya							

Seksyen H: Masa Depan

No.	Question	Objectives and Remarks
H1	Saya bersetuju / tidak bersetuju dengan kenyataan berikut *(Sila tandakan '✓')*	To understand the sentiments with regards to farming activity and agriculture industry among smallholders • **Choose 'Tidak berkaitan' only when the statement is not relevant to the respondent**

Kenyataan	Sangat tidak setuju	Tidak setuju	Neutral	Setuju	Sangat setuju	Tidak berkaitan / tidak tahu
a. Saya akan terus mengusahakan ladang saya paling kurang						

	untuk 5 - 10 tahun akan datang						
b.	Saya ingin mengembangkan perniagaan pertanian saya dalam masa 5 tahun akan datang						
c.	Saya akan menggalakkan anak-anak saya dan golongan muda untuk menceburi bidang pertanian						
d.	Saya perlu mencari pekerjaan di luar bidang pertanian dalam masa terdekat						
e.	Saya mempunyai simpanan yang mencukupi untuk persaraan saya						
f.	Sokongan kerajaan yang sedia ada bertepatan dengan keperluan saya						

Maklumat Responden

Question	Objective	Remarks
Maklumat Responden Nama : No. telefon : Alamat ladang : Poskod : Daerah : Negeri : Nama organisasi keahlian : No. keahlian : Tarikh bancian :	Respondent's details for verification • 'Nama', 'No. telefon' and 'Alamat ladang' are the primary layers of identification • 'Alamat ladang' should be specific containing lot no. names of streets / kampung • 'Nama organisasi keahlian' refers to agriculture- and industry-related organisations only	

Scenarios for QB1

For	If	Then
Keluasan	Very small or ditambat di tepi jalan	Give range/value estimation
Bilangan tuaian / jualan dalam setahun Anggaran hasil setiap kali tuaian / setiap kali jualan	Baru bermula, belum tuai, belum berbuah, baru tanam	0
	Tidak bermusim, sepanjang tahun	Give range/value estimation
	On demand	Give range/value estimation
Anggaran hasil setiap kali tuaian / setiap kali jualan Anggaran harga jualan	Kegunaan harian	0 Entry will be rejected if most of the listed products are reported as such, focus is those on sales
Anggaran hasil jualan Anggaran harga jualan	Kegunaan harian	0
Anggaran harga jualan	Inconsistent units of measurement and denomination (e.g. RM4 setiap 6 tongkol, RM/ikat)	Convert to units of measurement given
All	**Reported as fraction or unconventional values (e.g. 1(100), 1/2)**	**Should report as simplified numerical value**

NA, tidak pasti, tidak tentu, blank	**Entry will be rejected**
RM4 setiap 6 tongkol	**To report on standardised unit**

APPENDIX B

Figure A: Areas Exposed to Extreme Precipitation in 2021

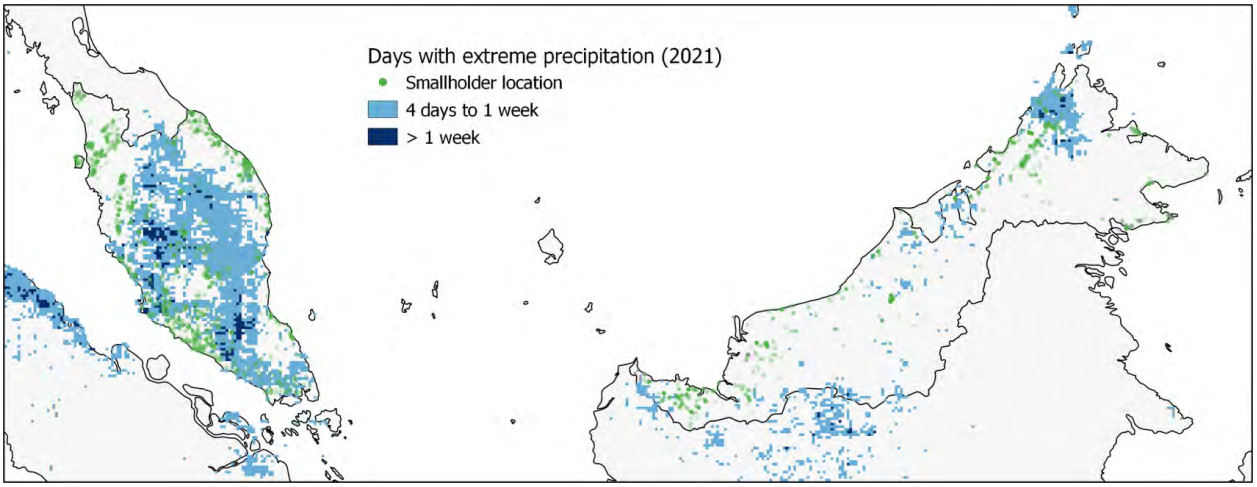


Figure B: Areas Exposed to Extreme Precipitation in the 10-year period, 2011 – 2021

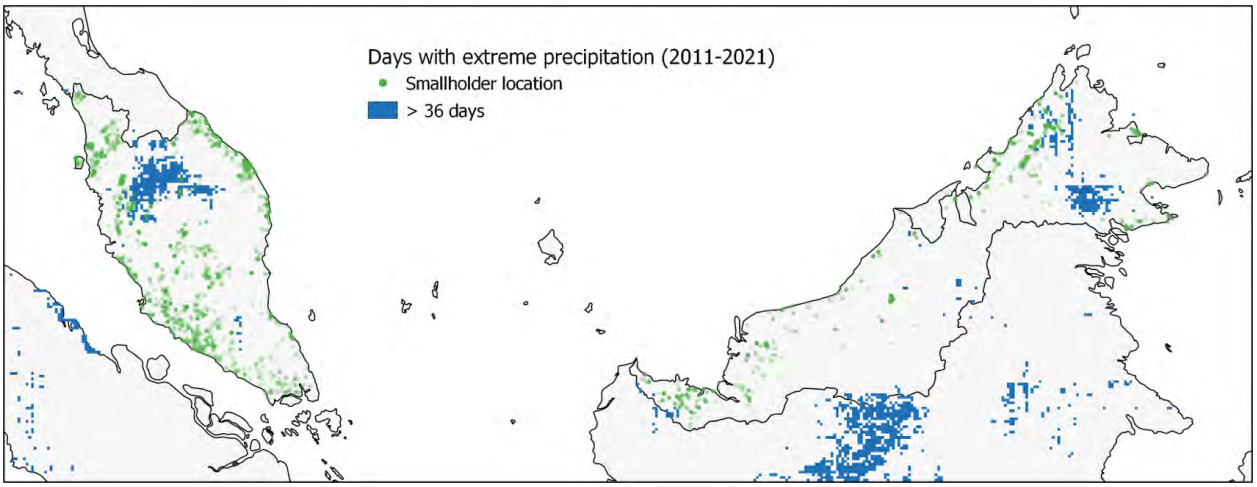


Figure C: Soil Moisture Anomaly in 2021

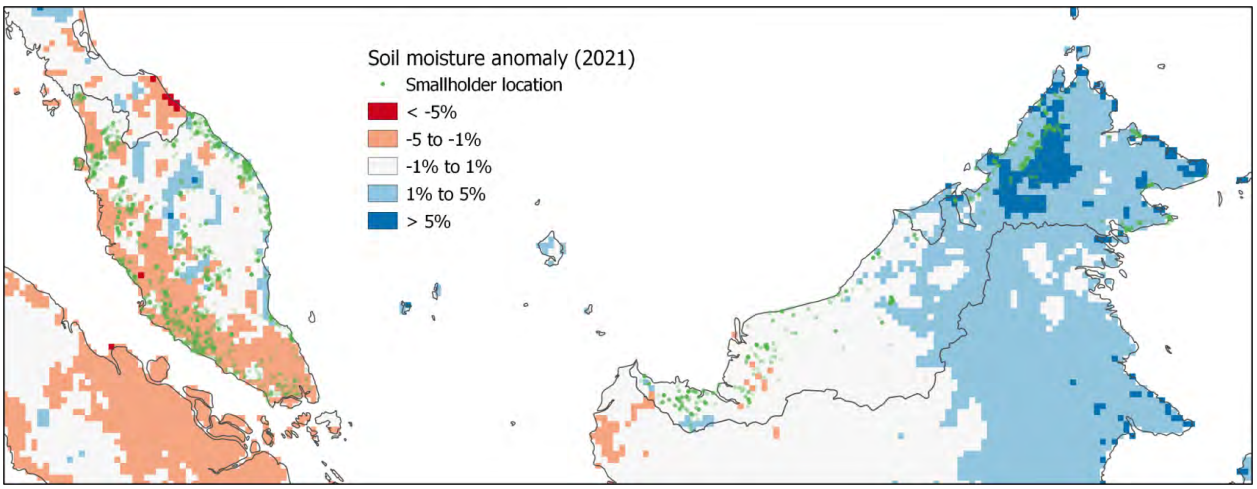


Figure D: Soil Moisture Anomaly in the 10-year Period, 2011 – 2021

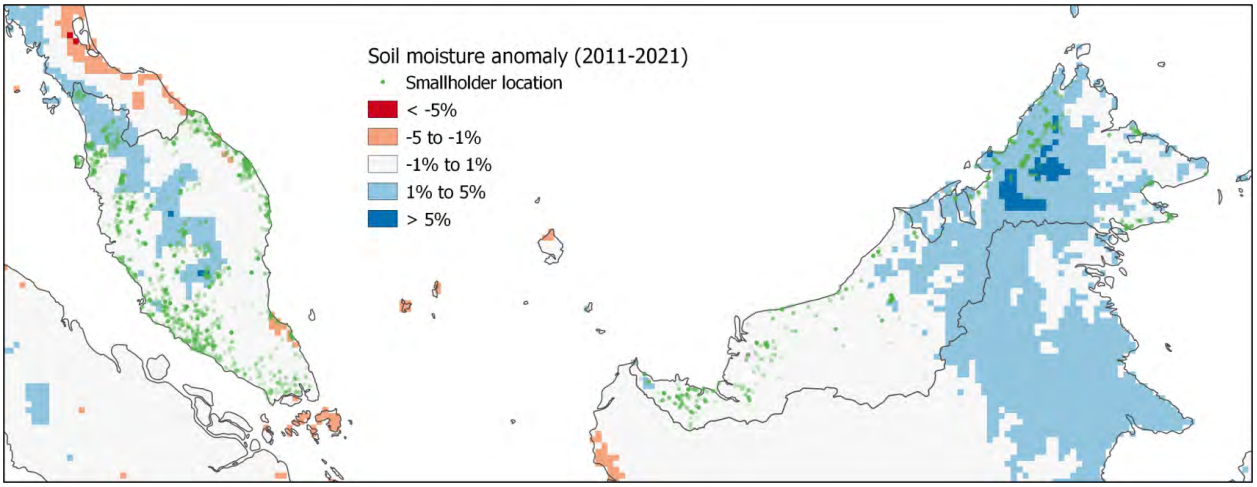


Figure E: Vulnerability in the Component of Education Among Surveyed Smallholders, by District

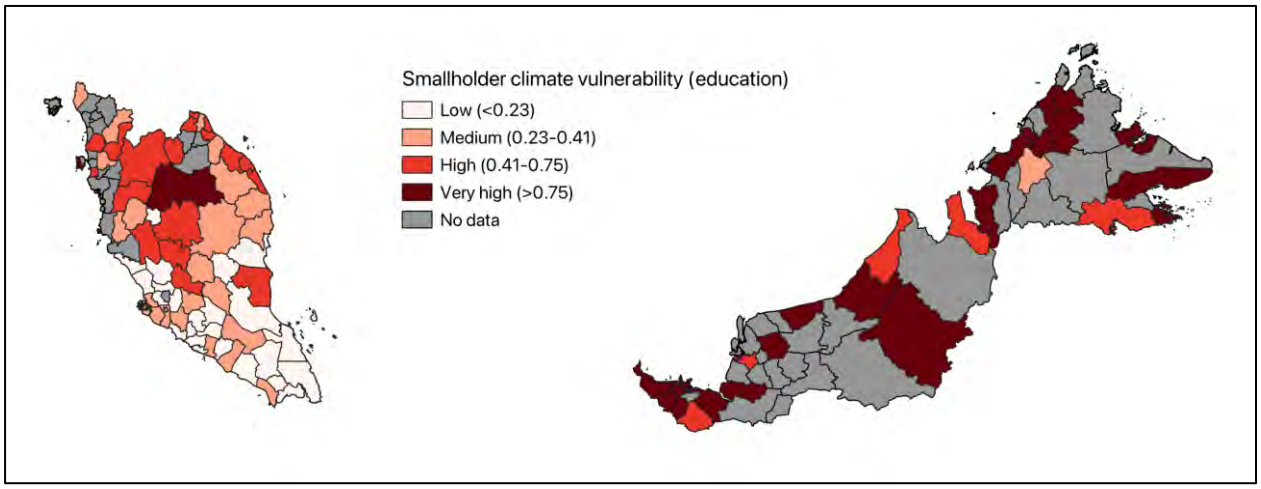


Figure F: Vulnerability in the Component of Farm Dependence Among Surveyed Smallholders, by District

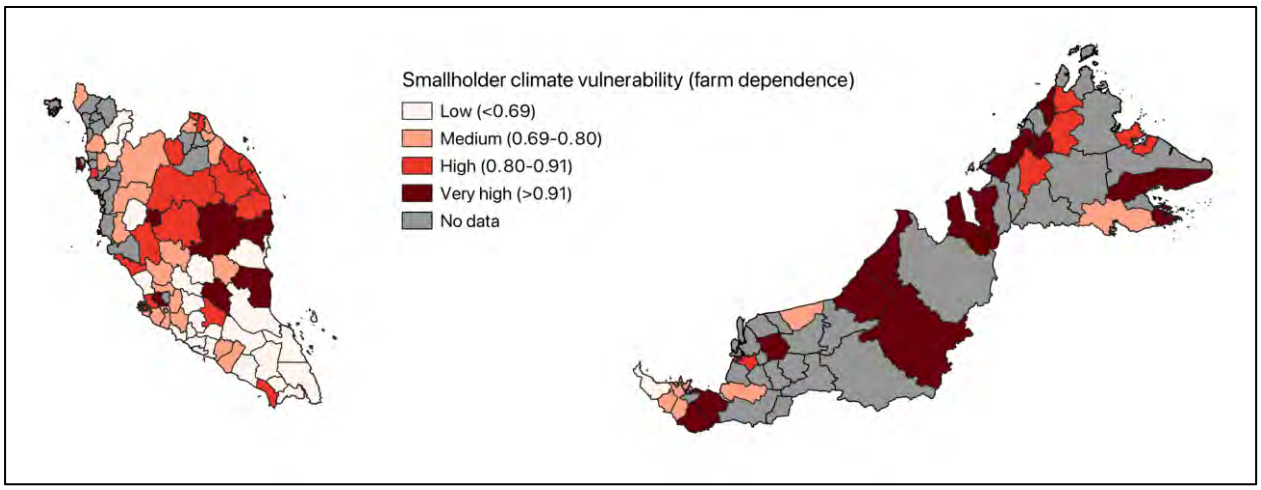


Figure G: Vulnerability in the Component of Infrastructure Among Surveyed Smallholders, by District

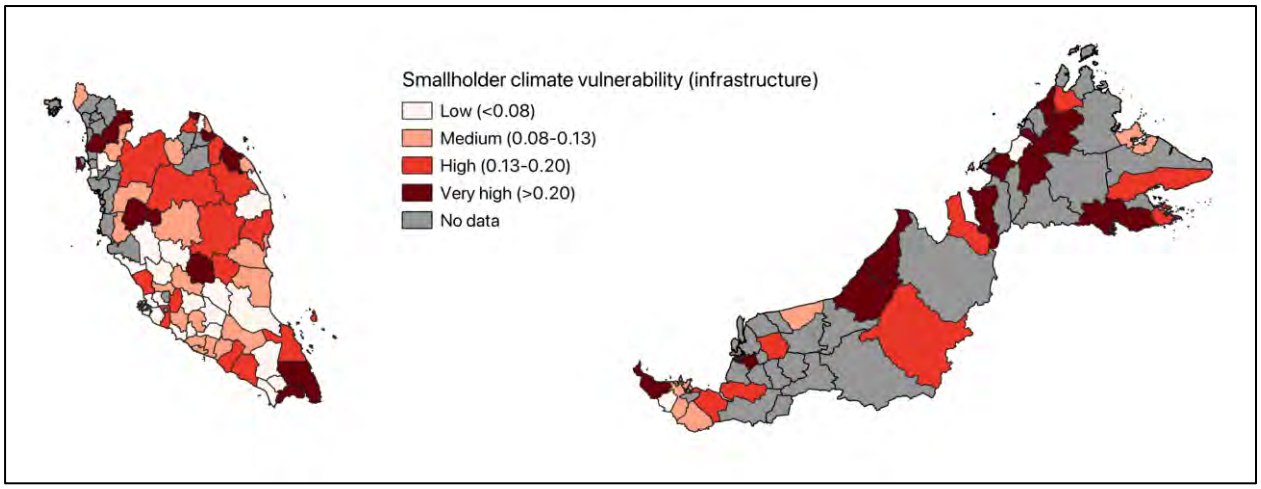


Figure H: Vulnerability in the Component of ICT Among Surveyed Smallholders, by District

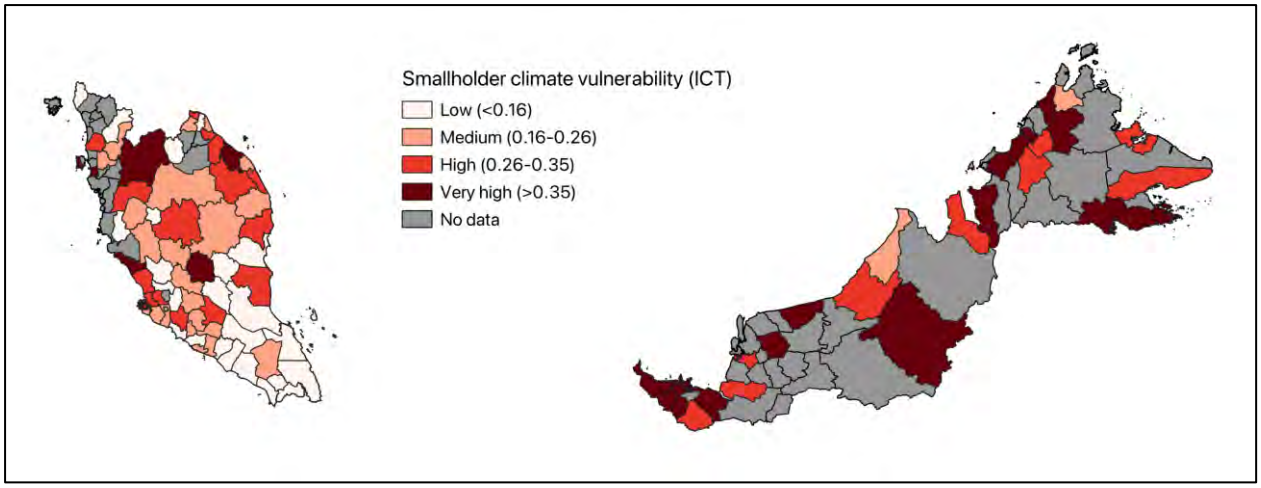
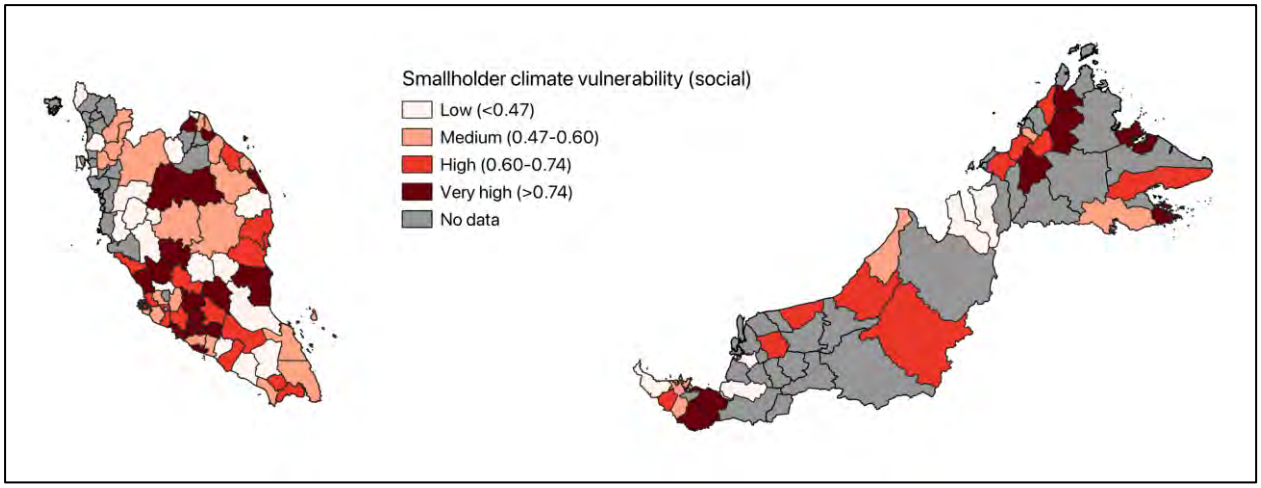


Figure I: Vulnerability in the Component of Social Networks Among Surveyed Smallholders, by District



APPENDIX C

MyGAP Standards for Crops, Livestock, and Aquaculture

Table A: MyGAP Requirements (for crops) and Key Descriptions (table contents are taken from Malaysian Standard MS1784:2005 Crop Commodities)[416]

MyGAP Requirements	Description
1. Traceability	The produce shall be traceable back to its origin
2. Record-keeping and internal audit	Regular updates and maintenance of records are essential, with a minimum retention period of six months. Internal audits must be carried out annually. Any corrective corrections shall be executed and documented.
3. Crop and rootstocks selection	Selection of crop, use of genetically modified organism (GMO) shall be agreed between producers and consumers. All necessary information shall be recorded accordingly.
4. Land history and management	Assessing land history and field layout, including crop background. Conduct a risk assessment for new sites, considering previous land use, potential impacts on nearby crops and areas, and on adjacent activities. Shall also possess legal rights to conduct all farming activities.
5. Soil and chemical substrates	Soil maps shall be prepared for rotations and planting programmes. Cultivation techniques must minimise soil erosion. Record soil fumigation activities first (exploring alternatives first). Prioritise organic substrates and maintain records of chemical usage.
6. Fertiliser management	Adhere to best practice guidelines for usage, testing type, quality, method, and frequency for optimal outcomes. Document all applications, maintain current stock records, properly label, and store appropriately to prevent contamination. Hazards should be indicated clearly.
7. Irrigation and fertigation	Base irrigation and fertigation on well-founded historical and scientific data. Utilise the most efficient water delivery system. Incorporate a water management plan to optimise water and nutrient use. Usage of untreated sewage water is prohibited; annual laboratory analysis is required. Water should be sourced sustainably.
8. Crop protection (pesticide use)	Minimise pesticide usage and keep detailed records. Properly train operators in pesticide use and ensure the use of protective equipment and clothing. Maintain disposal records and store pesticides safely with emergency handling instructions. Utilise only chemicals registered under the Malaysian Pesticide Act 1974. Avoid chemicals banned in destination countries for exported crops.
9. Harvesting	Farm workers must complete basic hygiene and food safety training prior to handling fresh produce. On-site clean washing facilities should be accessible, and packaging materials must be stored in a clean condition.
10.Post-harvest handling	Usage of chemicals should be minimised and used within recommended levels. Records for all treatments shall be kept. Use of potable water.
11. Pesticide residue analysis	Conduct pesticide residue analysis periodically as determined by risk assessment. Ensure documentation of testing evidence and submit samples to an accredited laboratory.
12. Waste and pollution management	Identify potential waste products and sources of pollution. Develop strategies to prevent or minimise waste and pollution, avoiding landfilling and burning through recycling initiatives.
13. Worker health, safety, and welfare	Provide sufficient training in safety, pesticide handling, and basic hygiene. Ensure employment conditions align with local and national regulations. If on-site living quarters exist, ensure they are habitable with essential amenities and facilities.
14. Environmental issues	Producers must comply with environmental legislation and demonstrate awareness of wildlife and biodiversity conservation.

[416] Malaysian Standard MS 1784:2005 Crop Commodities

Table B: MyGAP Requirements (for livestock) and Key Descriptions (table contents are taken from Malaysian Standard MS 2027:2018 Good Animal Husbandry Practice) [417]

MyGAP Requirements	Description
1. Skill and responsibility of farm operators and workers	Farm operators and workers must be trained in proper animal handling, routine management practices, and equipment usage. They should maintain good fitness, prioritise safety and health, and ensure precise harvesting for optimum quality.
2. Animal welfare	Animals must not experience hunger, thirst, discomfort, pain, injury, disease, anxiety, or abnormal behaviour due to their conditions and surrounding environment.
3. Traceability	Accurate record-keeping is essential for tracking animals throughout the supply chain, which is also useful to mitigate the spread of zoonotic diseases.
4. Farm and animal management records	Operations and management records must be retained, including animal identification (tagging, branding, ear notching, tattooing, batch numbering), performance, breeding performance, animal movement, feeding, health, vaccine, and medication records.
5. Farm design, infrastructure, facilities, and equipment/management tools	Design should be appropriate and well maintained, including proper flooring, lighting, and biosecurity infrastructure. Adequate ventilation, efficient drainage, good security measures, ample space for animals, and conditions that prevent stress are also essential.
6. Farm biosecurity	The biosecurity plan should target significant sources and routes of pathogen transmission to prevent disease spread within the farm. This encompasses written protocols, appropriate layout and infrastructure, personal protective equipment (PPE), and mechanisms to assess the efficacy of biosecurity measures.
7. Farm sanitation programme	Maintain a clean farm environment devoid of conditions conducive to pest, parasite, and pathogen breeding. Regularly remove waste, change bedding, and implement an effective drainage system.
8. Pest control programme	The farm must establish, implement, maintain, and document an efficient pest control programme. Only chemicals approved by the relevant authority should be used and applied in controlled quantities.
9. Animal health management	Maintaining optimal animal health through proper management practices which includes prevention, treatment, and control measures. Continuous monitoring, good vaccination programme, and essential healthcare practices are imperative.
10. Feed and feeding	Animals must receive the ideal nutrient required for their well-being, in accordance with the Feed Act 2009. All aspects should be considered including diet adequacy and feed sources (free from porcine, filthy sources, or their derivatives. Proper feed storage condition is also important.
11. Breeding and reproduction	Breeding shall be done by trained personnel, ensuring animals are in suitable conditions including sexual maturity, healthy body weight, and free from disease.
12. Weaning	Weaning shall be conducted with minimal stress, adhering to the recommended body weight and age.
13. Handling and restraining of animals	Animals must be consistently handled and restrained to prevent fear, stress, pain, and injury. Employ correct techniques and ensure the availability of appropriate facilities, equipment, and tools.
14. Transportation	Transportation must prioritise stress-free conditions, done without delay, and be segregated by social groups. Vehicles must also be properly designed for the purpose.
15. Environmental management	Effective waste management is imperative, with odour control measures in place. Farm should be away from noise disturbances that could hinder animal growth and productivity. Farms situated near public areas must control noise emissions.

[417] MS 2027:2018 Good Animal Husbandry Practice

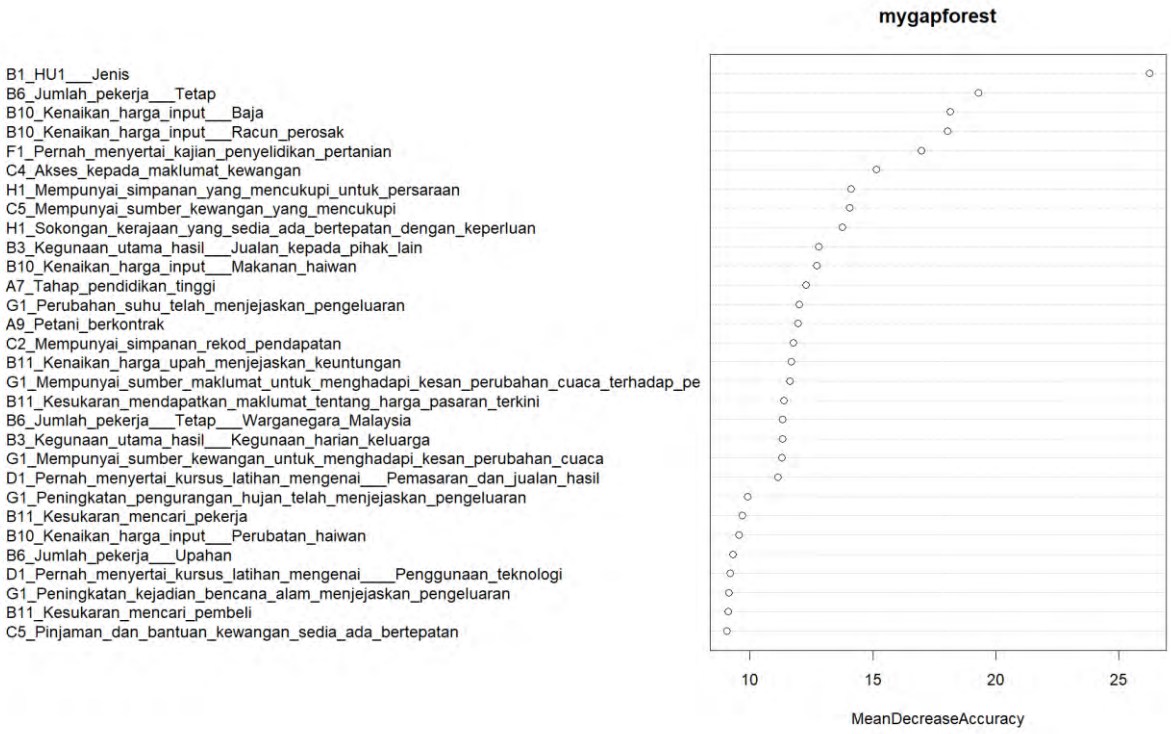
Table C: MyGAP Requirements (for aquaculture) and Key Descriptions (table contents are taken from Malaysian Standard MS 1998:2017 Good Aquaculture Practice – Aquaculture Farm (First revision)) [418]

MyGAP Requirements	Description
1. Site selection	The site shall be approved by competent authorities, prioritising minimal conflicts in land and water use. It should be situated in a low-contamination area, with no adverse impact on human health upon consumption.
2. Construction	The farm design and layout shall adhere to regulations set by competent authorities. Utilisation of environmentally friendly materials is mandated, and any site clearing must consider the conservation or preservation of natural habitats.
3. Culture practice	Fertilisers and chemicals shall adhere to competent authorities. Seed shall originate from verified, reliable sources. Broodstock for seed production and seed for culture shall be sourced to prevent pathogen transmission to growing stocks and potential human health hazards. Feed shall be free from prohibited antibiotics, banned substances, porcine/filthy source and its derivatives, contaminants/adulterated substances. Feeding practices shall align with competent authority guidelines, including proper storage of feeds and adherence to their requirements and recommendations. All chemicals shall be stored securely, and Manufacturer Product Specification and Material Safety Data Sheets (MSDS) shall be made available. Water quality shall be maintained, monitored, and recorded throughout the culture period. Effluent shall not be discharged into the public or municipal water body without proper treatment. Harvesting and post-harvest handling shall ensure the quality, safety, and value of produce. Produce shall be transported without delay. Cultured organisms shall be actively monitored and recorded for health issues, with immediate disease outbreak reporting to authorities. Prohibited antibiotics, chemicals, and substances are prohibited for treatment. Implementation of physical biosecurity measures is encouraged.
4. Trans-boundary	Aquatic animal health management and movement shall align with applicable provisions in the OIE Aquatic Animal Health Code to prevent disease or infectious agent transfer. The implementation of alien species and GMOs requires approval from competent authorities.
5. Worker's safety, health, and welfare	Workers shall be treated in accordance to national labour law and regulations, without discrimination or child labour. They should be in good health. The workplace should follow safety guidelines from the Occupational Safety and Health Act 1994 and ILO Conventions. Accessible PPE, first aid kits, and clear hazard signs are required.
6. Training	All workers shall receive training on good agricultural practices, aquatic animal health and welfare management.
7. Traceability	All produce shall be traceable to its origin.
8. Record keeping	All records shall be maintained, updated for a minimum of two years, accessible, and audited.
9. Auditing	Auditing shall be done annually, with corrective actions implemented and documented.
10. Social responsibilities	Farm operators shall take measures to minimise potential adverse impacts and shall demonstrate equal rights on public land and water use to surrounding communities.

[418] MS 1998:2017 Good Aquaculture Practice (GaqP) – Aquaculture Farm (First Revision)

APPENDIX D

RANDOM FOREST



APPENDIX E

FORMULA FOR SAMPLE SIZE SUFFICIENCY

Krejcie and Morgan formula[419]:

$$s = \frac{X^2 NP(1-P)}{d^2(N-1) + X^2(1-P)}$$

Where:

s represents the required sample size

X^2 is the chi-square table value for 1 degree of freedom at the desired confidence level (3.841)

N is the population size (in this case, 6,346 farmers based on DOA MyGAP data)

P is the population proportion (assumed to be 0.5 for maximum sample size)

D is the degree of accuracy expressed as a proportion (0.5)

[419] Krejcie and Morgan (1970)

APPENDIX F

LIST OF SPEARMAN COEFFICIENTS ON GENDER GAP ANALYSIS

Table D: Spearman's Correlation Coefficients between the List of Dependent Variables and Gender

Dependent variables	Gender (Ref = Men)
Region	0.184256449
B3_Output utilisation_Own or family use	0.177971888
B3_Output utilisation_Sell to third party	0.170916384
E1_Knowledge, technology, and tool possession_Agricultural machinery and equipment	0.166360530
A1_Types of activity_vegetable smallholder	0.161110756
C2_Keep income record	0.155502794
A1_Crop	0.149892175
B10_Perceived rise in input price_Animal feed	0.137120662
E1_Knowledge, technology, and tool possession_Transportation	0.124238661
E1_Knowledge, technology, and tool possession_None	0.122433733
B2_Source of seed or breed_Own seeds	0.120642529
D3_Top 3 desired training_Trial of new agricultural method or technology	0.112673857
D1_Training attended_Farm management	0.107947719
B6_Number of unpaid workers_Malaysian	0.10633074
A2_Farm owner and manager	0.104688682
State	0.103153599
A10_Membership_Cooperative or organisation_None	0.102422142
E3_Purpose of using smartphone application in the next five years_To obtain agricultural insurance	0.096294024
A1_Types of activity_Fish cage	0.096174674
D4_Training mode preference_In person	0.094881708
B6_Number of unpaid workers_55 years old and above	0.09336639
C1_Source of farm financing_Loan from cooperative or association	0.093347048
A7_Education level	0.093057891
E1_Knowledge, technology, and tool possession_Smartphone	0.092294322
B10_Perceived rise in input price_Veterinary medicine	0.091356286
B9_Top 3 challenges_Input price rise	0.091161068
D3_Top 3 desired training_Farm activity management	0.090609022
A1_Aquaculture	0.08784404
C4_Access to financial information	0.086421255
D2_Training provider_Government agency	0.085783662
G1_Perceive that the temperature changes affected production in the last five years	0.082795889
D1_Training attended_Trial of new methods	0.082701093
A11_MyGAP certification	0.081844938
D3_Top 3 desired training_Financial management	0.081086669
C6_The assistance I have received in the past 12 months_In-kind assistance	0.081082238

F2_Perceive agricultural research as insufficient	0.080956286
B10_Perceived rise in input price_Seed/animal breed	0.079645442
A1_Types of activity_Cow	0.079441123
B4_Buyers of outputs_Wholesalers	0.078365195
C1_Source of farm financing_Loan from government agency	0.078323486
E3_Purpose of using smartphone application in the next five years_To obtain financial support	0.077513014
B6_Number of unpaid workers	0.077480361
C6_The assistance I have received in the past 12 months_Financial assistance for cost of living	0.077136695
B11_Difficult to find buyers	0.076528975
E2_Purpose of using a smartphone app_To look for buyers	0.076497715
B4_Buyers of outputs_Directly to consumers	0.07573195
A1_Types of activity_Fruits	0.074396886
B6_Total number of workers_Regular/full-time	0.072616143
C7_Source of assistance_Local government	0.072437614
B2_Source of seed or breed_Supplier or retailer	0.072052949
B6_Number of paid workers_Malaysian	0.071824602
B6_Number of paid workers	0.070731345
E2_Purpose of using a smartphone app_To look for input suppliers	0.067619367
G1_Have sources of information to face the impact of climate change on agricultural activity	0.067462176
E2_Purpose of using a smartphone app_To obtain market information on input price	0.067321404
B3_Output utilisation_Barter with other farmers	0.065799502
B9_Top 3 challenges_Lack of research	0.064545613
D1_Training attended_None	0.063737717
C1_Source of farm financing_Grant from government agency	0.063197146
E2_Purpose of using a smartphone app_To obtain market information on selling price	0.061550617
B2_Source of seed or breed_Other farmers	0.060562872
D1_Training attended_New agricultural product	0.059275204
A10_Membership_Cooperative or organisation_District	0.058969304
A10_Membership_Cooperative or organisation_State	0.058202953
B11_Difficult to find workers	0.057876048
G1_Perceive that the increase in the incidences of natural disasters affected production in the last five years	0.057250187
B9_Top 3 challenges_Lack knowledge in agricultural techniques	0.056598914
A1_Types of activity_Poultry	0.056542253
A1_Livestock	0.056327798
F1_Participated in agricultural research	0.05498204
E2_Purpose of using a smartphone app_No smartphone or not using any smartphone app for farm activity	0.054527237
E1_Knowledge, technology, and tool possession_Better agricultural method or technique	0.052509227

B5_Regularity of buyers	0.051590392
B9_Top 3 challenges_Changes in weather	0.051056189
D1_Training attended_Knowledge sharing session	0.050067333
E2_Purpose of using a smartphone app_To obtain information on better agricultural methods	0.047121759
D3_Top 3 desired training_Marketing and sale of outputs	0.046727098
D1_Training attended_Use of technology	0.046488076
D1_Training attended_Marketing and sale of outputs	0.046143615
B9_Top 3 challenges_Lack access to financial mechanisms	0.046049063
E1_Knowledge, technology, and tool possession_Internet access	0.045737341
B9_Top 3 challenges_Lack local workers	0.043775958
D2_Training provider_Private sector	0.043346323
A1_Types of activity_Goat	0.042903817
B9_Top 3 challenges_Lack access to market	0.041779778
D2_Training provider_Others	0.041236845
C7_Source of assistance_State government	0.041085183
G1_Perceive that the changes in rainfall affected production in the last five years	0.040653237
D3_Top 3 desired training_Not interested	0.039846594
H1_Wish to expand the agricultural business in the next 5 years	0.039646801
B11_Difficult to obtain information about the latest market price	0.038881039
E3_Purpose of using smartphone application in the next 5 years_To look for buyers	0.03848112
A9_Contract farmer	0.03843789
E2_Purpose of using a smartphone app_To obtain information on supply and demand	0.038117317
D2_Training provider_University or academic institution	0.038019747
H1_Have sufficient savings for retirementMempunyai_simpanan_yang_mencukupi_untuk_persaraan	0.037633026
D3_Top 3 desired training_Agricultural knowledge sharing session (informal)	0.037474448
B6_Number of workers_Malaysian	0.037437759
D4_Training mode preference_Not interested	0.036764332
H1_Will continue operating the farm for the next 5 to 10 years	0.03645676
C5_Have sufficient financial resources for emergency use	0.03627789
C6_The assistance I have received in the past 12 months_Subsidy	0.035994101
B7_Characteristics of workers that are hard to find_Young	0.035432239
C1_Source of farm financing_Bank loan	0.035056724
E1_Knowledge, technology, and tool possession_Marketing tool	0.03447376
E3_Purpose of using smartphone application in the next 5 years_To obtain information on better agricultural methods	0.034032614
E3_Purpose of using smartphone application in the next 5 years_To obtain information on supply and demand during yield season	0.033490699
C7_Source of assistance_Others	0.033241281
B8_Face low production issue	0.033070944
D3_Top 3 desired training_Use of technology and digital platform	0.032696037

D3_Top 3 desired training_New agricultural product	0.030750461
E2_Purpose of using a smartphone app_To obtain information on weather forecast	0.030653149
C7_Source of assistance_Family or friend	0.030603935
D1_Training attended_Financial management	0.029648546
B11_Wage increment affects profits	0.028578976
G1_Have financial resources to face the impact of climate change on agricultural activity	0.028044143
C6_The assistance I have received in the past 12 months_Financial assistance for agriculture	0.027876712
B7_Characteristics of workers that are hard to find_Malaysian	0.027606032
B4_Buyers of outputs_Retailers	0.026658501
A12_Farming experience	0.026517119
D2_Training provider_Non-governmental organisation	0.02649521
A10_Membership_Cooperative or organisation_Community	0.02602427
B10_Perceived rise in input price_Pesticides	0.025730111
E3_Purpose of using smartphone application in the next 5 years_To obtain information on weather forecast	0.025602203
C7_Source of assistance_Federal government	0.025200495
B3_Output utilisation_Processed into products	0.025131604
D2_Training provider_Local community or organisation	0.024398973
H1_Encourage the younger generation to participate in the agriculture sector	0.023687504
E3_Purpose of using smartphone application in the next 5 years_To look for input suppliers	0.022850694
A8_Main income souce_Multiple produce	0.0226492
E1_Knowledge, technology, and tool possession_Environmental-friendly method or technique	0.022137319
B9_Top 3 challenges_Pest attack	0.021645451
B1_Type of main produce	0.021560515
C1_Source of farm financing_Fund from family or friend	0.021379516
C1_Source of farm financing_Donation and contribution	0.021312399
E3_Purpose of using smartphone application in the next 5 years_To obtain information on input price	0.020451161
C5_Bank loan application procedure is easy to be fulfilled	0.020166611
B4_Buyers of outputs_Cooperative or organisation	0.020103069
E1_Knowledge, technology, and tool possession_Others	0.019902938
B10_Perceived rise in input price_Fertiliser	0.019845201
E3_Purpose of using smartphone application in the next 5 years_Not interested	0.019643168
E3_Purpose of using smartphone application in the next 5 years_To obtain agricultural insurance	0.018730277
A5_Nationality	0.01743584
C7_Source of assistance_Cooperative or association	0.017155493
A3_Age	0.016948693
B9_Top 3 challenges_Lack of infrastructure	0.016655666
D2_Training provider_Informal	0.016247786

B7_Characteristics of workers that are hard to find_Experienced	0.016098564
C1_Source of farm financing_Loan from family or friend	0.015451142
Single or multiple subsectors	0.015232457
C6_The assistance I have received in the past 12 months_None	0.014442621
C3_Access to bank	0.01351524
D4_Training mode preference_Online	0.012157303
E2_Purpose of using a smartphone app_To obtain financial support	0.011423373
B6_Number of paid workers_55 years old and above	0.010020591
B7_Characteristics of workers that are hard to find_Do not need worker	0.009965205
H1_Feel the need to find job opportunities outside of agriculture soon	0.009443826
E2_Purpose of using a smartphone app_To recruit workers	0.008934217
C1_Source of farm financing_Grant from non-governmental organisation	0.008913456
C5_Current loan and financial assistance are meeting my financial needs	0.008020603
B2_Source of seed or breed_Government agency	0.007470977
A10_Membership_Cooperative or organisation_National	0.007126647
B6_Number of workers_55 years old and above	0.006842243
E3_Purpose of using smartphone application in the next 5 years_To recruit workers	0.006679537
A7_Education level_agriculture-related	0.006595833
C1_Source of farm financing_Fund from investor	0.006374991
B4_Buyers of outputs_Government agencies	0.006085946
A1_Types of activity_Pond	0.005006862
E2_Purpose of using a smartphone app_To obtain agricultural insurance	0.004834166
A1_Others	0.003943605
H1_Feel that the existing governmental support is meeting need	0.003620508
B9_Top 3 challenges_Lack of governmental support	0.002840172
D2_Training provider_Cooperative or association	0.001291382
C1_Source of farm financing_Own fund or profits	0.001163836
D1_Training attended_Others	0.001052254
C1_Source of farm financing_Others	0.00098091
A8_Main income souce_Single produce	0.000883481
C1_Source of farm financing_Grant from private sector	0.00078277
B2_Source of seed or breed_Cooperative or organisation	0.000761941
B3_Output utilisation_Other usages	8.48525E-05

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