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The Paddy and Rice Industry of Sabah and Sarawak
STATUS AND POTENTIAL

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Fax: +603 2705 6100; email: enquiries@KRInstitute.org

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Cover photo depicts heirloom paddy grains in East Malaysia. Image was provided by Ts. Dr. Januarius Gobilik and edited by Khoo Wei Yang.
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EXECUTIVE SUMMARY

Background on Specialty/Heirloom Paddy Industry in East Malaysia

Exploration of the specialty/heirloom paddy varieties in Sabah and Sarawak through a multidisciplinary angle showed that it holds the potential to spur the competitiveness of Malaysia's paddy and rice industry. This report supports Strategy 2.0 '*Memanfaatkan potensi varieti beras istimewa tempatan'* within the National Agriculture Policy (2021 – 2030) and is within the scope of Sabah's Agricultural Policy (2015 – 2024) and Sarawak's 2030 target to be a net food exporter.

Chapter 2, titled **Paddy and Rice Statistics in East Malaysia**, shows that Malaysia is still not 100% self-sufficient in rice. However, achieving 100% self-sufficiency at all costs may not be the best strategy for the country, as there are other critical dimensions of food security that still need to be addressed. Nonetheless, an SSL level above 60% is considered a comfortable state to be in. Unfortunately, both Sabah and Sarawak have rice SSLs below 60%, with a declining trend in the planted paddy area and a small contribution (4.2% and 5.3%, respectively) to the total rice produced in Malaysia. However, this does not mean that the paddy and rice industry in East Malaysia is not essential. Alongside increasing rice production using lowland, modern varieties, East Malaysia may want to venture into the artisanal, premium rice segment by leveraging their traditional, heirloom varieties.

Chapter 3, titled **Status of Food Security in East Malaysia**, examines the four pillars of food security, namely food availability, accessibility, utilisation, stability, and sustainability. This chapter discusses the potential of specialty rice in improving rice SSL in East Malaysia and reducing the reliance on imports. Market expansion of specialty rice could potentially be a source of poverty alleviation, especially among rural communities. This is because the excess rice cultivated can be sold at a premium price, thereby giving the rural communities extra income. Subsequently, income improvement could possibly address the high prevalence of malnutrition in East Malaysia. Having a disposable income is likely to enable farming households to purchase more nutritious foods, allowing them to diversify their diets while maintaining their chosen way of life.

Chapter 4, titled **Rice Cultures of East Malaysia**, presents the historical and cultural aspects of rice cultivation. Historically, colonial policies have prioritised lucrative commercial crops, which largely neglected the rice sector as a local productive industry in East Malaysia. Post-colonial policies continue to allow the development of commercial crops, with an additional target on improving rice self-sufficiency. As a result, there has been a focus on cultivating more lowland commercial, high-yielding paddy varieties, especially in the granary areas, and less so on low-yielding traditional heirloom rice varieties. Rice farming can have values other than economy and calories. Policymaking could seek better ways of empowering local communities without compromising their agencies and the right to self-actualisation.

Chapter 5, titled **Characterising Paddy Varieties in East Malaysia**, estimated that there are hundreds of unique paddy varieties in East Malaysia. Genetic studies showed that these local varieties are genetically diverse from the modern high-yielding varieties commonly planted in Peninsular Malaysia. With numerous distinct characteristics such as taste, colour, and texture, these varieties are candidates for the artisanal, premium rice segment. These varieties are also candidates to breed climate-resilient and disease-resistant traits that the nation requires.

The above exploration of the specialty/heirloom paddy varieties in Sabah and Sarawak showed that it holds the potential to spur the competitiveness of Malaysia's paddy and rice industry. However, several barriers remain that need to be removed before we can witness the rise of the next 'Musang King' of the country. The following are two barriers:

Barrier 1: Poor Variety Nomenclature and Seed Preservation (Chapter 5)

The paddy variety nomenclature is mainly informal, with the same varieties often being given different names by different communities. Except for some, such as Bario Adan, Bajong, and Biris, many varieties are not completely collected, characterised, and the parent seeds saved in seed vaults. As such, we risk losing the genetic purity of some of these precious varieties due to on-field crossbreeding incidences. We acknowledge that there have been attempts to collect and characterise some of these varieties at the state level, which is lauded. We, therefore, recommend allocating more financial and human resources to expedite the complete characterisation, recognition, and seed storing of these varieties. If it is not expedited, research work and commercialisation may continue to be lethargic.

Barrier 2: One-Size-Fits-All Approach to Paddy and Rice Regulations (Chapter 6)

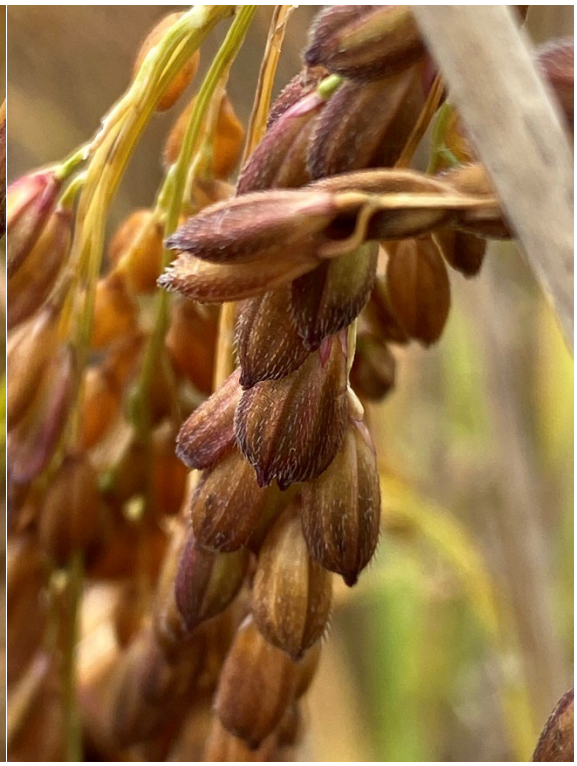
Act 522 is acknowledged as an important act to protect the paddy and rice industry, particularly for the cheaper medium-grained plain rice type. This includes restrictions to move rice across states, the implementation of price ceilings, and stringent storing requirements. However, while safeguarding the supply and access to rice, protective measures do not necessarily mean that it is good for competition, commercialisation, and export growth. These are two different objectives requiring separate policies and regulations. Under Act 522, there is no distinction between cheap medium-grained rice for food security and premium rice for commercialisation purposes. This could prove problematic because rice meant for commercialisation must have an enabling business environment, such as ease of movement across states and export opportunities.

Policy Recommendations

To overcome these barriers, formally differentiate between the cheaper medium-grained rice and specialty rice and include this difference in Act 522. To do this, specialty rice should first be characterised and recognised at the state and federal levels. Once this is done, we recommend to:

1. Allow the export of specialty rice without needing special permission from the Director General;
2. Allow the default transportation of specialty rice across states;
3. Remove input subsidies for specialty rice growers meant for export; and
4. Lower the required working capital for the relevant licenses for micro, small, and medium enterprises (MSMEs).

Padi Keladi Merah



Padi Keladi Putih

Padi Seribu

Padi Bukit Bulan

Padi Tadong Padi Tamparuli

Source: Dr Januaris Gobilik (2019)
Note: Examples of the diversity of paddy varieties from just one village (Kampung Katagayan), Tambunan, Sabah.

Source: Mohd Firdaus, Shutterstock

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CHAPTER 1

INTRODUCTION

1.1 Report Overview & Relevance

This report is one of Malaysia's few publicly available policy reports dedicated to the paddy and rice industry in East Malaysia prepared through a multidisciplinary approach. It attempts to unravel the significance of this crop to both Sabah and Sarawak and to underscore the potential of local varieties in spurring the artisanal segment of the market.

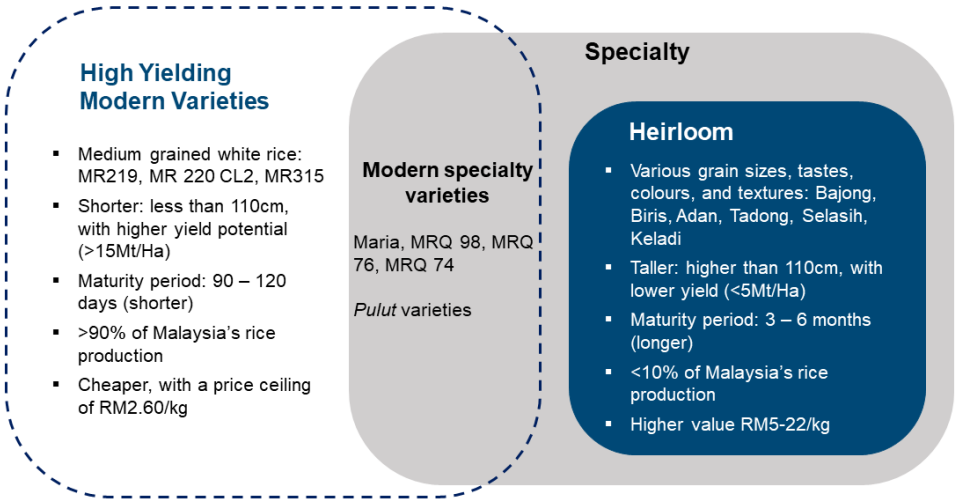
1.1.1. Definitions

In this report, **heirloom/specialty** rice refers to traditional rice cultivated in East Malaysia (Figure 1.1). While the authors recognise that there are specialty varieties bred by MARDI, this report focuses on the heirloom category in East Malaysia. Heirloom paddy varieties are often grown from seeds inherited over several generations or shared between communities. These varieties have longer plant maturity periods of up to six months; are taller, more disease and abiotic-resistant, tend to have lower yields (less than 5Mt/Ha, but can be improved through breeding and good agricultural practices) and are often planted for the farmer's own consumption. Examples of heirloom rice in East Malaysia include Bajong, Biris, Adan, and Tadong which can be roughly associated to certain regions (Figure 1.2). These varieties are planted either as wetland or dry land paddy (*padi bukit*). In terms of product characteristics, these varieties have distinct colours, tastes, and textures compared to the plain medium-grained white rice. The former category of rice is associated with discussions on higher value, premium products cultivated sustainably, with the potential of giving higher income to the farmers.

On the contrary, high-yielding modern varieties that have been bred in Malaysia have far shorter plant maturity periods of less than 120 days, some even as short as 90 days[1]. These are medium-grained white rice that contribute up to 90% of Malaysia's total rice production. These modern varieties also have higher yield potential, in some cases more than 15Mt/Ha if planted according to recommendations and cultivated as lowland wet paddy. This category of rice is associated with discussions on food security (specifically rice supply and self-sufficiency, but not the other dimensions of food security, see Chapter 3).

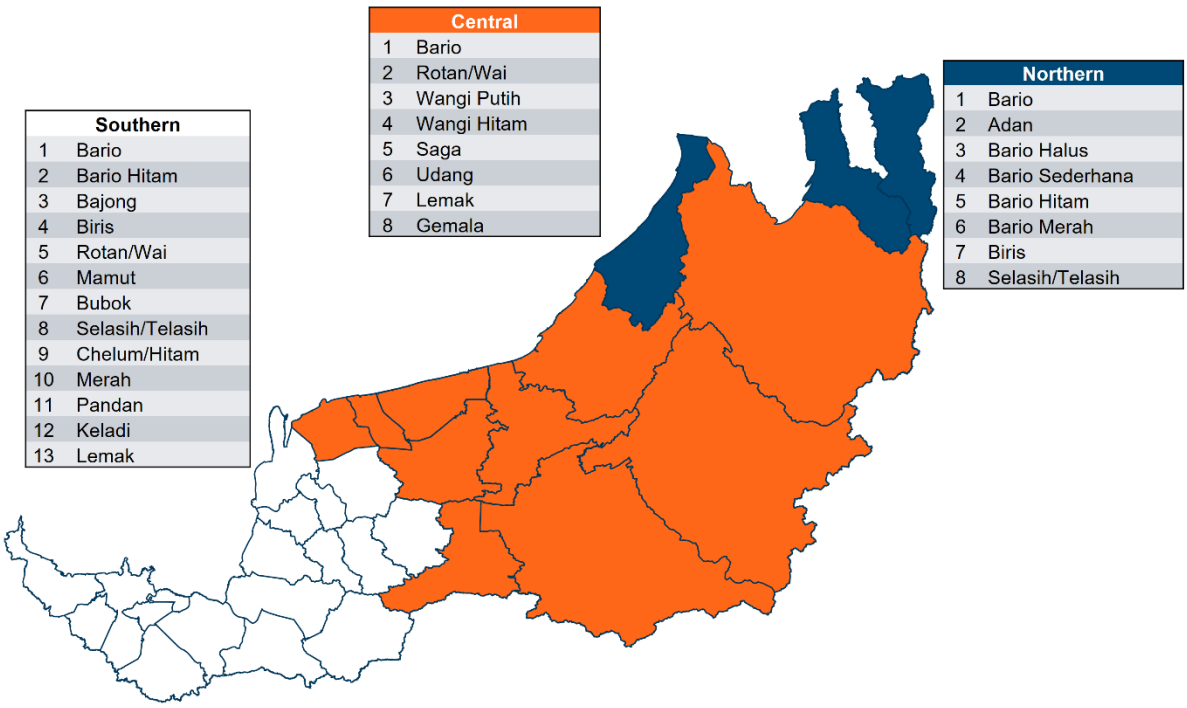
[1] MARDI (2022)

Figure 1.1: Categories of Rice in Malaysia



Source: DOA Sarawak (2022); DOA Sabah (2022); MARDI (2022); KRI field study; KRI illustration

Figure 1.2: The Generalised Distribution of Heirloom Paddy Varieties According to Regions in Sarawak



Source: DOA Sarawak (2022), no data for Sabah.

1.1.2. Paddy and Rice National Policy

This report supports the strategies crafted in the *Dasar Agromakanan Negara* 2021-2030 (DAN 2.0). Specifically, it is directly relevant to the Paddy and Rice Subsector of DAN 2.0. In this subsector, five strategies were identified, comprising a total of 14 action plans (Figure 1.3). The second strategy (2.0) is the most relevant strategy for this report, which is ***"Memanfaatkan Potensi Varieti Beras Istimewa Tempatan"*** or "to leverage on the potential of local specialty rice varieties". The aim of strategy 2.0 is to develop the specialty rice segment to give farmers more options in terms of varieties to plant. It comprises 3 action plans, namely 2.1, 2.2, and 2.3 (Table 1.1), whereby each is being supported by this report.

Figure 1.3: Strategies and Plans for the Paddy and Rice Sector as Outlined in DAN 2.0

Source: DAN 2.0, KRI illustration

Table 1.1: DAN 2.0 Strategy 2.0 Action Plans and KRI Report Contribution

Strategy Two's Action Plans	KRI's Report Relevance
Strategy 2.1: Recognise and/or develop specialty rice varieties as Malaysian premium agro-food products	This report highlights the value and potential of rice varieties and identifies weaknesses that impact the growth of artisanal rice in the premium agro-food segment.
Strategy 2.2: Encourage and facilitate contract farming cooperation with new/existing food producers growing specialty rice varieties	This report looks into the role of non-governmental organisations (NGOs), MSMEs, and social enterprises (SEs) and their relationship with local communities, especially with regard to improving sustainable agricultural practices and yield, through various forms of contract farming.
Strategy 2.3: Updating the Acts and Regulations to create an environment that supports the participation of SMEs in the specialty rice market	This report made specific suggestions for improvements to the legislations supporting Act 522. It looks into improving the licencing requirements as well as rice export and import regulations for ease of business.

Source: DAN 2.0

1.1.3. Paddy and Rice Policies in East Malaysia

The Sabah state government recently developed the Third Sabah Agricultural Policy (SAP3) 2015 – 2030. Within this, they have identified 15 issues. Three issues are most relevant to the specialty/heirloom segment:

1) Lack of high-impact R&D Initiatives (*a need for more research on traditional paddy varieties*);

2) Lack of strategic marketing and effective distribution networks (*the specialty rice industry can be a potential segment for the private sector to provide sound marketing, supply chain, and branding value add*); and

3) Inadequate private sector investment (*the specialty rice market is a promising sector for the proliferation of private sector players*).

"... issues of food security, unstable food prices and the uncertainly of climate change have become main drivers for the state government to consider production of rice in the state as its top priority... the need to achieve 60% in terms of SSL"[2]
Third Sabah Agricultural Policy 2015 – 2030

The authors support Sabah's intention to put the growth of the paddy industry as their primary agenda. We hope this is not limited to the high-yielding modern varieties in the lowlands but also to expand into the specialty/heirloom rice segment. Tapping into the specialty segment may not only help improve SSL, but it can also nurture good environmental practices, which is one of the 13 policy enablers for the paddy and rice industry in SAP3. The authors also fully support policy enabler 5: To set up Sabah Research Council, whereby this topic is elaborated more in chapter 5.

The Sarawak agricultural policies, by extension, its rice policies, are also oriented similarly. In 2022, the Ministry of Food Industry, Commodity and Regional Development Sarawak (MANRED) outlined strategic objectives to raise the status of the state as a net exporter of food by 2030[3]. This effort includes the adjusted goal of rice SSL from 51% to 70% in the targeted period[4]. This is premised upon scaling up the production of mainstream rice varieties MR269 to fulfil domestic needs and export the rest[5]. The ministry adopted the approach of (1) infrastructural and drainage improvement, (2) SMART Large-Scale Paddy Planting Model, (3) adoption of modern variety, as well as (4) automation and mechanisation drive[6]. This policy view of the rice sector being dominated by industrial, wet lowland, high-yielding paddy cultivation is important for food security reasons. However, in doing so, it may be easy to overlook the potential of existing traditional smallholders in producing specialty rice fit for export which, in turn, helps to achieve their 2030 goal as a net exporter.

[2] MAFI Sabah (2017)
[3] 'Usaha Meningkatkan SSL Padi Menjelang 2030' (2021)
[4] 'Usaha Meningkatkan SSL Padi Menjelang 2030' (2021); *The Star* (2017)
[5] 'Usaha Meningkatkan SSL Padi Menjelang 2030' (2021)
[6] *Utusan Borneo Online* (2022)

Adopting a singular view and value of rice (increase SSL through modern varieties), despite the potential of the traditional paddy varieties in Sabah and Sarawak, could be an opportunity missed. These additional values, embedded in its nutritional, cultural, genetic, and potential to create new markets, should be embraced sooner rather than later. By re-examining these values, as this report sets out to do, we hope to open a window for consideration for policymakers in this field.

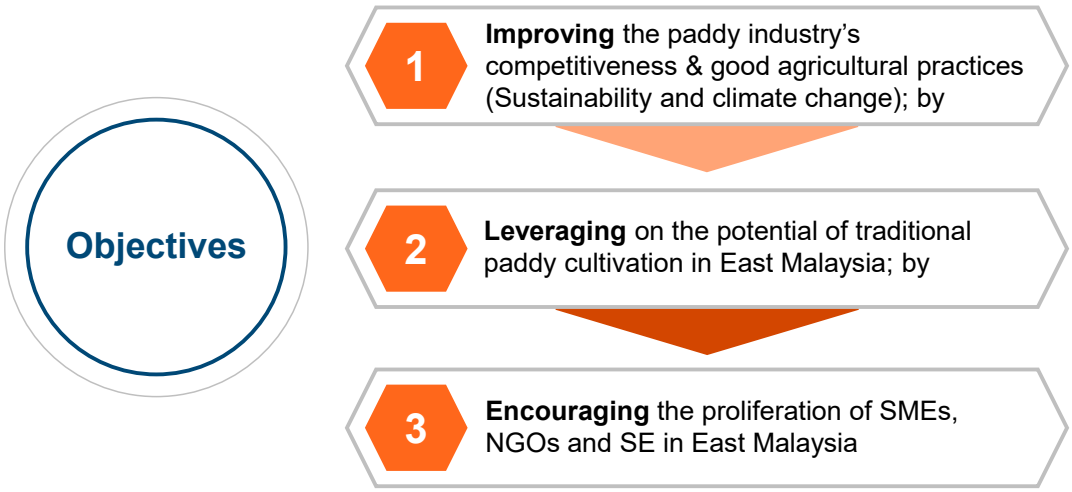
1.1.4. Research Questions & Policy Objectives

The research questions of this report are:

- What is the food security status of Sabah and Sarawak? (Chapter 3)
- How can specialty rice play a role in supporting food security in Sabah and Sarawak? (Chapter 3)
- Is there an importance in traditional rice farming and potential in exploring the premium rice segment (from social-cultural and biological perspectives)? (Chapters 4 and 5)
- How are specialty rice varieties categorised in East Malaysia? (Chapter 5)
- How are seeds produced and regulated in East Malaysia? (Chapter 6)
- What are the regulatory issues limiting the business activities of social enterprises (SEs) and MSMEs for this segment of the industry? (Chapter 6)

By answering the research questions, this report hopes to spur the competitiveness of the paddy and rice industry and improve sustainable, good agricultural practices in East Malaysia. This can be done by encouraging the proliferation of MSMEs, NGOs, and SEs in East Malaysia by promoting the business-friendliness of the specialty rice sector through specific policy recommendations and regulatory changes relevant to the traditional paddy industry (Figure 1.4).

Figure 1.4: Policy Objectives of This Report



Source: KRI illustration

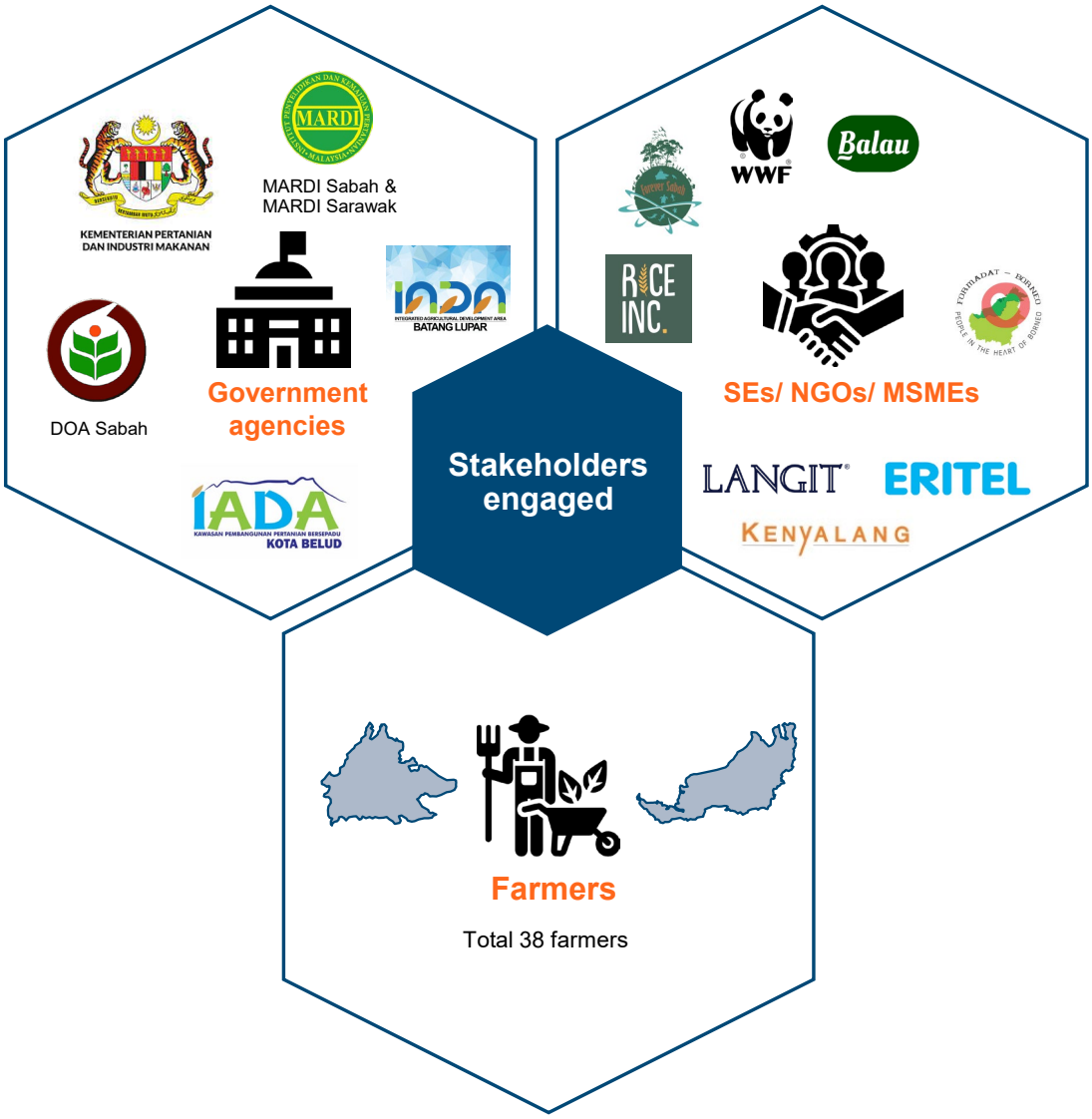
1.1.5. Methodology

This report utilises both qualitative and quantitative measures to help better understand the status of traditional paddy cultivation in East Malaysia.

It uses primary data collection through focus group discussions with farmers and organisations, which is mostly supported by secondary data sourced from published databases and literature. It also teases out key literature within specific fields of study, summarising them through a bird's eye view of the industry. All this knowledge was then used to craft recommendations for improving current regulations and legislation related to the paddy industry.

For example, key indicators were used to better understand the latest food security status of Sabah and Sarawak. Historical data and literature reviews were used to elucidate the historical context of regional rice policies and the importance of paddy farming from the cultural context. Scientific laboratory genetic studies were subsequently compiled and evaluated to unravel the overall status of species diversity of East Malaysia's local paddy varieties. Field visits were also conducted in both Sabah and Sarawak, involving interviews with 79 individuals including heirloom/traditional paddy farmers, various government organisations, NGOs, MSMEs, and SEs (Figure 1.5). The knowledge and insights were then used when studying Act 522 and all its supporting legislations, to see how it can be improved for the specific interest of spurring the production, marketing, and export of artisanal rice. Upon completion, the report was peer-reviewed by specialists from each field, as noted in Table 1.2.

Figure 1.5: List of Stakeholders Engaged for this Report



Source: KRI illustration

1.1.6. Output

This report has six chapters, each focusing on different disciplines but all sharing the same theme: paddy cultivation in East Malaysia. The following are descriptions of each chapter, the author's background, and the respective subject matter expert external reviewers.

Table 1.2: Chapter Description and Background Information

Chapters	Title	Discipline	Chapter Objectives	Authors	External Reviewers
Chapter 1	Introduction	Overview		**Dr Sarena Che Omar** from KRI with a DPhil from the University of Oxford in plant genetics, and 8-year experience in agricultural policy, the project lead for this report	**N/A**
Chapter 2	Paddy and Rice Statistics in East Malaysia	Industry Statistics	To provide an overview of the paddy and rice situation from the world, regional, and national levels, with an emphasis on the current paddy and rice situation in East Malaysia.	**Dr Sarena Che Omar** **Nik Syafiah Anis** from KRI, with a MSc in Food Security from the University of Edinburgh **Isabelle Koh Yue Sze,** research assistant from KRI	
Chapter 3	Status of Food Security in East Malaysia	Food Security	To show the state of food security in East Malaysia and provide an overview through relevant indicators to further strengthen the economic, biological, cultural, and regulative aspects of specialty rice industry in subsequent chapters.	**Nik Syafiah Anis**	**Prof. Dr Shaufique Fahmi** from Universiti Putra Malaysia, an Economics Professor at the School of Business and Economics with expertise in food-related policy research

Chapters	Title	Discipline	Chapter Objectives	Authors	External Reviewers
Chapter 4	Rice Cultures of East Malaysia	Anthropology	To give an overview of the historical and socio-cultural context of the status of rice in East Malaysia through the historical development of rice cultivation in the region and a comparative literature review of socio-cultural practices of rice farming in selected indigenous groups.	**Khoo Wei Yang** from KRI, with a Bachelor in Anthropology and Sociology from UNIMAS	**Dr Elena Gregoria Chai** from Universiti Malaysia Sarawak, an anthropologist based in Sarawak.
Chapter 5	Characterising Paddy Varieties in East Malaysia	Botany: Genetics & Plant Physical Characterisation	To provide an understanding of the diverse types of paddy plants available in Sabah and Sarawak. By appreciating the diversity and rarity of our paddy varieties, it is hoped that we can underscore the importance of preserving our genetic seeds and tap into the potential of this segment as a driver in improving the economic status of our rural inhabitants.	**Dr Sarena Che Omar** from KRI **Prof. Dr Abdul Hamid** from Universiti Malaysia Sabah **Dr Januarius Gobilik** from Universiti Malaysia Sabah	**Dr Chee Foong Tyng** from the University Malaysia Sabah, a senior lecturer with expertise in Plant Technology (Plant Genetics) and 10 years of experience in rice genetics
Chapter 6	Understanding Act 522 and its Legislations	Regulatory	To identify regulatory areas requiring updating and changes made to allow the ease of business with regards to spurring the artisanal, specialty paddy cultivation in Malaysia.	**Dr Sarena Che Omar, Nik Syafiah Anis, and Dr Teoh Ai Ni** from KRI	**Assoc. Prof. Dr Zahira Mohd Ishan**, from Universiti Putra Malaysia, with legal background and then Deputy Director for Intellectual Property Division, Putra Science Park, Deputy Vice Chancellor (Research & Innovation)'s Office.

1.1.7. Scoping and Caveats

This report does not aim to provide complete solutions to fully solve food insecurity or poverty in East Malaysia. Instead, it aims to alleviate and improve where possible. This is done by identifying and leveraging the competitive advantages that the locals already have in their backyard that have both economic, biological, and cultural significance (Chapters 3, 4, and 5). In this case, local heirloom/specialty paddy cultivation is an example of a competitive advantage that East Malaysia possesses, whereby focusing on this segment may not only help improve the livelihoods of the locals but concurrently support, in some ways, the other dimensions of food security (Chapter 3). The report also studies current Acts and regulations related to paddy cultivation (Chapter 6) to see if any changes are needed to help East Malaysia spur the export segment of artisanal premium rice. It does not aim to address the overall regulatory challenges related to food import and export nor any biological Acts and regulations related to the movement of live plants and processed food in and out of East Malaysia. Finally, this report does not aim to conduct a market gap or cost-based analysis regarding the sale of specialty rice both in the local and international markets as it is beyond the scope and expertise of the authors involved.

Chapter 2 and Chapter 3

Chapter 3 intends to provide an overview of Food Security in East Malaysia. It does not intend to indicate that specialty rice alone can solve the region's food security but it can help improve the status from various angles.

Chapters 2 and 3 rely heavily on secondary data from relevant government agencies, including but not limited to the data published from the Department of Statistics Malaysia (DOS), the Ministry of Agriculture and Food Industries (MAFI), and the Institute for Public Health (IPH). As food security can be measured through various indicators, these indicators were chosen based on available online data. State-level comparisons (13 states in Malaysia not including federal territories) were used for some of the indicators chosen to showcase the current food security situation in Sabah and Sarawak as compared to other states that are more developed or states in similar situations.

Chapter 4

The chapter will cover a period from pre-colonial (pre-1840) to modern practices of rice cultivation (1840 – 2000). The scope includes past government policies in the rice sector, historical trends in the rice sector, and cultural practices of rice cultivation, covering major rice-growing indigenous groups of Sabah and Sarawak.

The chapter uses secondary sources, e.g., government-published gazettes, annual reports, statistical bulletins and reviews, ethnographic texts, and scholarly articles. Some gaps in data are present due to the lack of sources. Owed to the interpretive nature of ethnography, cultural descriptions should be understood as informed interpretations of ethnographers, and not to be treated as living facts, as many of the social patterns described have gone out of practice or have undergone change since the original time of record.

The chapter does not offer a detailed account of history but seeks to offer the historical context in which the status of the rice sector in East Malaysia arises. The chapter also does not provide value judgement of the inherent merit of indigenous or specialty rice cultivation but offers a cultural perspective from which policymakers may benefit.

Chapter 5

Chapter 5 is a technical paddy variety chapter that summarises available published scientific studies, combined with engagements with local researchers and officials.

Chapter 6

Chapter 6 is a regulatory chapter that is based on national Acts, legislations, and gazettes coupled with interviews with the relevant enforcement officers, regulators, industry players, and information available on government websites.

1.1.8. Research Limitations

This research was initiated in 2021, during the COVID-19 pandemic outbreak. As such, most of the data and material used were available literature, secondary databases, as well as web-based interviews. It is unfortunate, but **due to the safety of the authors and the villagers (who are mostly ageing farmers), physical field visits to East Malaysia were conducted minimally**. When conducted, it was under strict standard operating procedure (SOP) compliance such as conducting antigen rapid test kit (RTK-Ag) testings before departure from Kuala Lumpur, RTK-Ag testings on the farmers, 5-day quarantine post-visit, as well as getting booster vaccination for the interviewers.

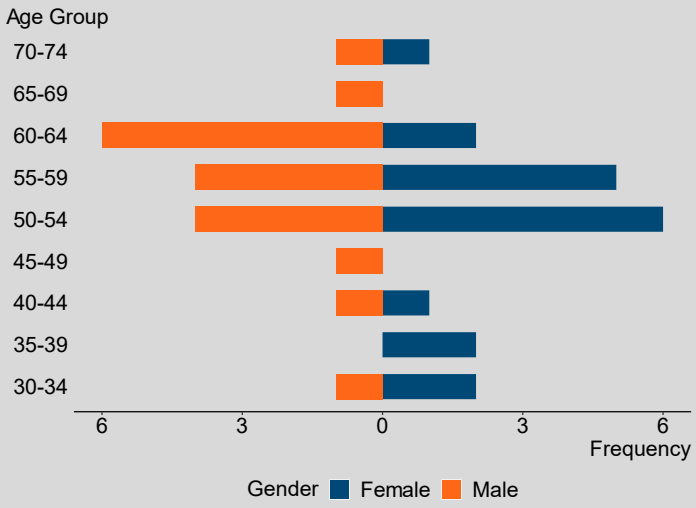
Box 1.1: KRI Field Work

A total of 38 rural paddy farmers were interviewed in both Sabah and Sarawak under research limitations stated in Section 1.1.8. We take note that this is not a representative sample but is instead used as a case study to support other resources that are presented in this report. A separate, more detailed discussion paper is hoped to be published in the future, incorporating additional survey data from partner organisations that then form a more representative sample of both Sabah and Sarawak.

The team were grateful to be able to meet farmers in Ba'kelalan (Sarawak), IADA Kota Belud, and Tuaran (Sabah). This was made possible through the kind support from local partners, specifically WWF Malaysia – Ba'kelalan Systems of Rice Intensification (SRI) programme, IADA officers at Kota Belud, and Forever Sabah in Tuaran.

The biggest ethnic groups represented were Lun Bawang (Sarawak) and Dusun (Sabah). Most farmers were aged between 50 – 65 years old (Figure 1.6). An interesting observation is that there is an almost equal representation of female and male farmers. This is different from Peninsular Malaysia paddy farmers who are mostly men.

Figure 1.6: Age and Gender Distribution of the Paddy Farmers



Source: KRI interviews with Ba'kelalan, Tuaran, and IADA Kota Belud farmers in 2022, KRI illustration

Another interesting finding is that more than 90% of the farmers choose to continue to cultivate paddy because it is an ancestral activity with a preference for the taste of local varieties as their main reasons. It is also worth noting that more than 90% of the farmers interviewed are able to produce paddy in excess and sell it for additional profits, but many claimed that they have difficulty selling their extra harvest. The main challenges here are the lack of access to market.

"Saya tanam padi tradisional sebab saya suka rasa beras yang saya tanam"
KRI-interviewed farmer

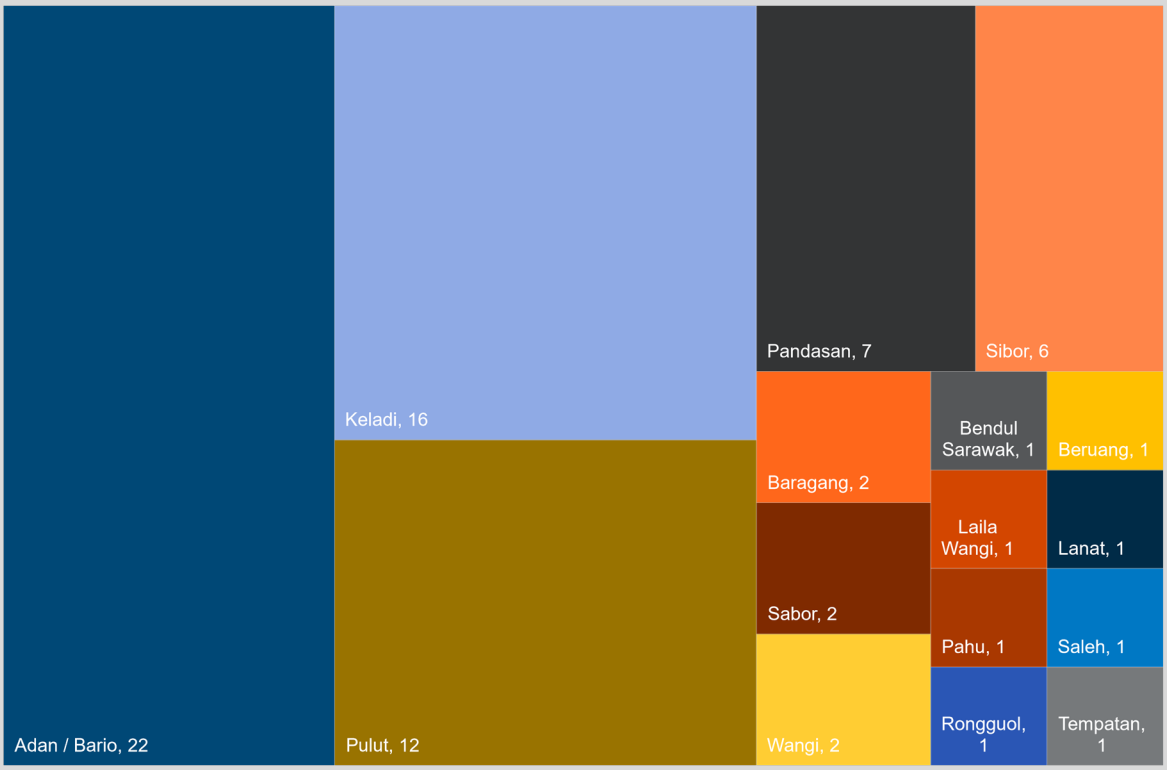
"Padi saya dari turun temurun. Ada Adan, Putih, Merah."
KRI-interviewed farmer

What this implies is that cultivation of local paddy varieties continues to be a personal preference for these local communities. It is mainly cultivated for their own consumption, with the potential that their excess produce can be sold at a premium price with the help of SEs and MSMEs. However, seed and genetic preservation continues to be informal and poorly conducted as there is a high chance of on-field crossbreeding and the use of poor-quality seeds may lead to lower harvests. Our field study showed that there are about 17 named varieties in just these two locations, with Adan and *pulut* being the most commonly planted variety (Figure 1.7). However, we notice that the naming of these types of paddy plants is informal and, in some cases, different names or spellings could refer to the same genetic variety.

"Bila saya tanam padi pulut dan adan bersebelahan, saya dapati hasil anak benih ada sifat campuran"
KRI-interviewed farmer

In summary, an effective policy that we are exploring is a policy that can allow local communities to continue their way of life and preferences while being able to make a significant economic benefit from it at the same time. This is different from some historical attempts of getting communities to plant new crops or expecting urbanisation or adopting non-rural work as the only path out of poverty.

Figure 1.7: Types and Frequency of Paddy Varieties Planted by the Farmers



Source: KRI field study, KRI Illustration

Figure 1.8: Photos Taken from KRI Field Trip to Tuaran, Sabah in 2021

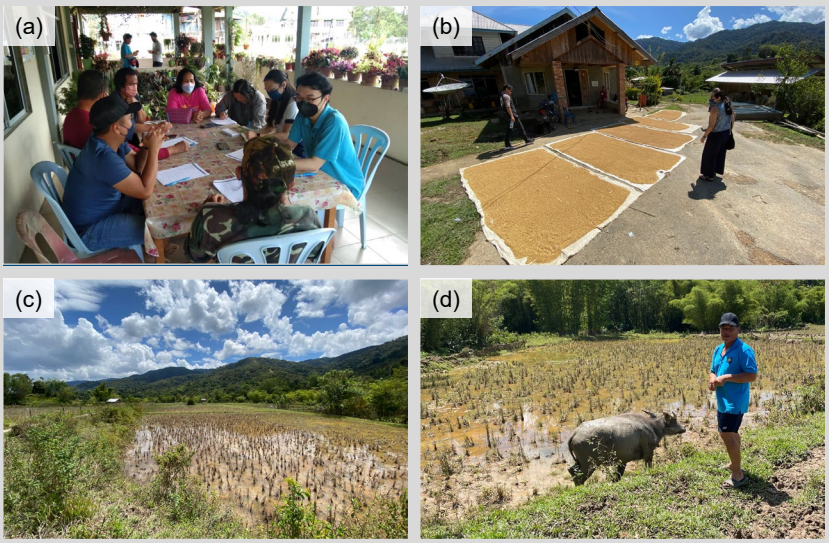
(a) Dr Sarena Che Omar interviewing paddy farmers in KampOng Campus, Tuaran.

(b) A farmer showing one of the paddy varieties planted.

(c) Walking through a paddy field in Tuaran, Sabah.

(d) The Rice team, Forever Sabah team, and farmers from Tuaran, Sabah.

Figure 1.9: Photos Taken from KRI Field Trip to Ba'kelalan, Sarawak in 2021



(a) The Rice team interviewing farmers in Ba'kelalan, Sarawak.

(b) Process of drying rice.

(c) Paddy field in Ba'kelalan (post-harvest).

(d) A paddy farmer in Ba'kelalan with his buffalo.

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Source: KRI, a rice mill in Sekinchan, Selangor (2019)

CHAPTER

02

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CHAPTER 2

PADDY AND RICE STATISTICS IN EAST MALAYSIA

By Dr Sarena Che Omar, Nik Syafiah Anis, and Isabelle Koh Yue Sze

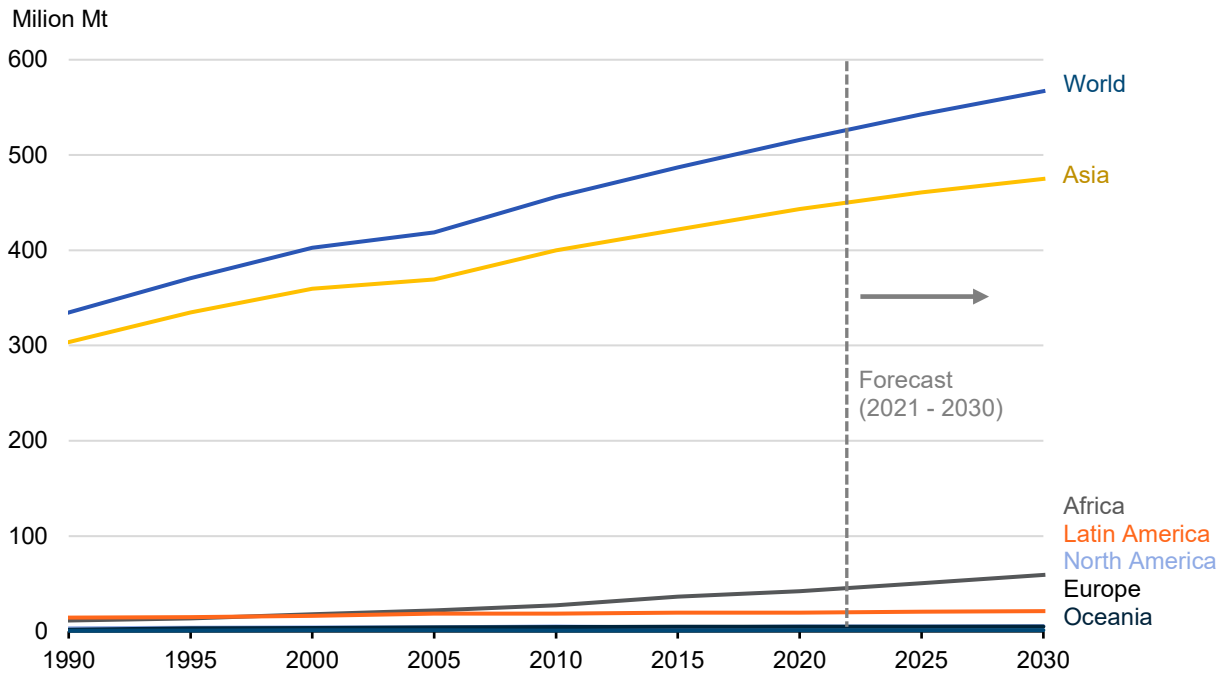
2.1 Introduction

Rice is considered a staple food in most Asian countries, including Malaysia. This chapter provides an overview of the historical trends of the paddy and rice industry at three different levels – world, regional and national. This chapter will also bring some focus towards the paddy and rice industry statistics in East Malaysia.

2.2 World Trend on Rice Statistics

The global population is expected to increase as the years progress. The United Nations estimated that the total world population would reach roughly 7.9b in 2021, where nearly 60% (approximately 4.68b) of the world's population is in Asia [7]. Rice is the staple food for approximately half of the world's population and the world's second most important crop, coming after wheat. As such, as the population continues to grow, the future demand for rice is also expected to increase (Figure 2.1). This inevitably puts pressure on increasing rice production to meet this growing demand and to do so sustainably, particularly in Asia where about 90% of the world's rice is produced (Figure 2.2).

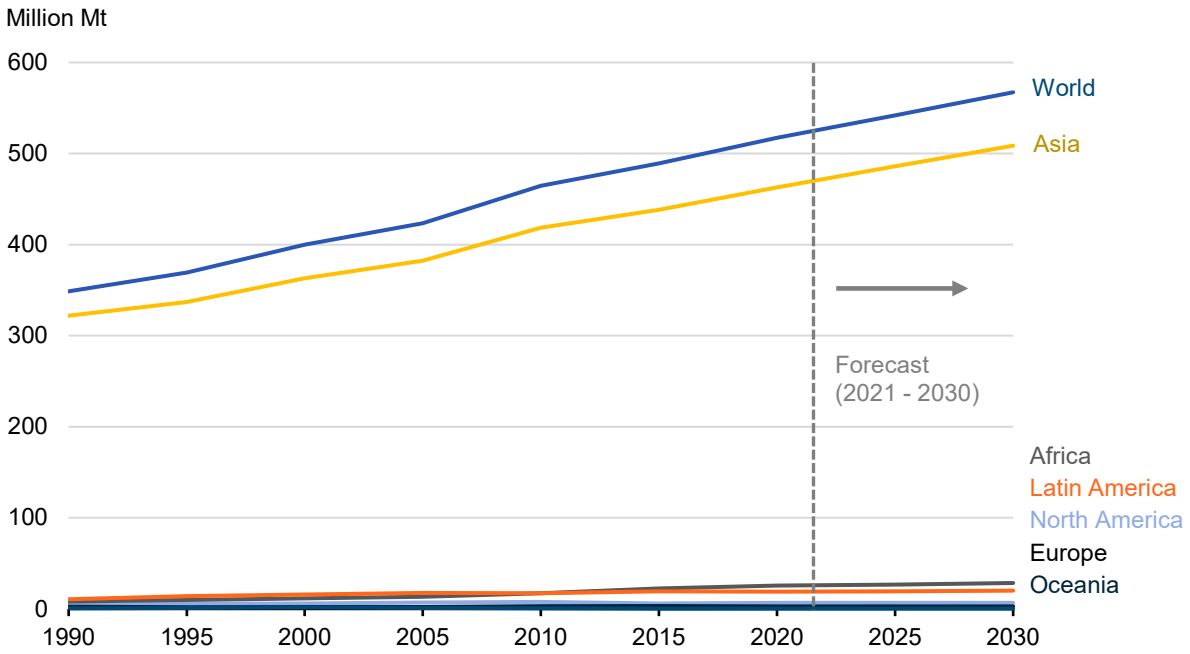
Figure 2.1: Trend Projection of Rice Consumption by Region, 1990 – 2030



Source: OECD and FAO (2021)

[7] United Nations (2022)

Figure 2.2: Trend Projection of Rice Production by Region, 1990 – 2030



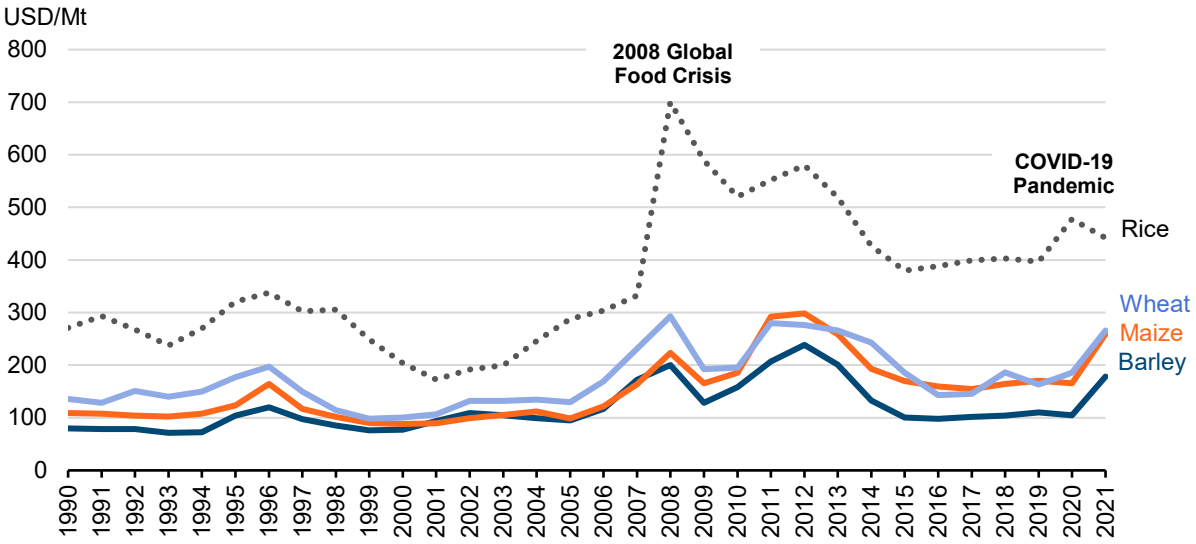
Source: OECD and FAO (2021)

From 1990 to 2020, the global price of rice experienced spikes in prices (Figure 2.3). The spikes in rice prices are due to various factors such as weather, geopolitics, and supply chain disruptions to name a few. During the 2008 global food crisis, the rice price shot up primarily due to knee-jerk policies such as temporary export bans, restrictions, and taxes by several rice exporting countries. This is further worsened by panic buying by several major rice-importing countries in an attempt to stabilise and secure domestic stocks and prices, as well as other factors such as the sharp decline in the value of US Dollars, depletion of excess global rice stocks, and weather-related problems (i.e., El Nino) in several rice production areas[8].

Recently, the COVID-19 pandemic disrupted local and worldwide food supply chains, resulting in an all-time high in food prices in 2022[9]. For instance, due to the pandemic, temporary export bans were imposed by rice-exporting countries like Vietnam and Myanmar[10], contributing to the spike in rice prices at local and global levels, along with international markets.

[8] Childs and Kiawu (2009)
[9] FAO (2022)
[10] Durand-Morat and Bairagi (2021)

Figure 2.3: Yearly World Cereal Prices by Commodity, 1990 – 2021

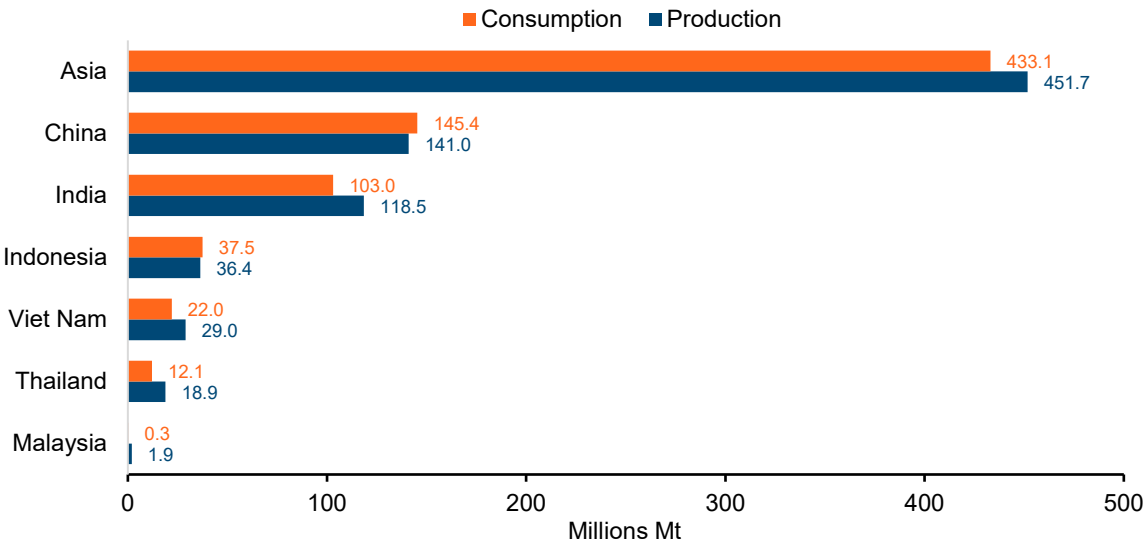


Source: IMF (2021)
Notes: The full description for the displayed commodities are as follows: Barley, Canadian no.1 Western Barley, spot price; Maize (corn), U.S. No.2 Yellow, FOB Gulf of Mexico, U.S. Price; Rice, 5 percent broken milled white rice, Thailand nominal price quote; and Wheat, No.1 Hard Red Winter, ordinary protein, Kansas City.

2.3 Regional Trend in Asia

As aforementioned, most of the rice production and consumption is cultivated in Asia, with China producing 141m metric tonnes (Mt) or 31.2% of Asia's total rice production and is also the biggest consumer of rice (Figure 2.4). In Asia, some countries are rice exporters (e.g., Thailand, Vietnam, and India) and some are importers (e.g., The Philippines and Malaysia).

Figure 2.4: Producers and Consumers of Rice, by Region and Country, 2019



Source: FOASTAT (n.d.)
Notes: The latest data on FAOSTATS is up to 2019. Based on OECD-FAO Agricultural Outlook 2021-2030, the consumption of rice in Asia and China are 443m Mt and 150m Mt, respectively. While OECD-FAO Agricultural Outlook 2021-2030 offers data up to 2020 and forecasted data till 2030, not all countries are covered.

Looking at the ASEAN countries, there are indeed some countries that rely on rice imports to meet their domestic demand, mainly Malaysia, Indonesia, Brunei, and the Philippines. According to the ASEAN Agricultural Commodity Outlook (Table 2.1), Brunei has the lowest ratio of domestic utilisation over production at just 8.0%, followed by Malaysia at 55.4%[11]. Does this mean then, that Malaysia should aim for 100% domestic use over production? Rice production alone, is not sufficient to measure food security, as there are many other influencing factors (Chapter 3). Having said this, Malaysia should continue its efforts to increase production to continue to meet increasing demand, but a policy target of domestic production meeting 100% of the domestic demand at all costs, is not necessarily a strategic objective. Rather, self-sufficiency may be maintained above 50% (not 100%) for example, but at the same time, farmers earn comfortably from their produce, and the rice is produced according to good agricultural and sustainability practices. This is elaborated more in Chapter 3 of this report and in the 2019 KRI report named "The Status of the Paddy and Rice Industry in Malaysia"[12].

[11] Figure is not the same as the SSL published by DOS as it uses a different formula.
[12] KRI (2019)

Table 2.1: Ratio of Rice Production to Domestic Utilisation in ASEAN Countries (Self-sufficiency Ratio), 2020 – 2022

Country	2020			2021			2022		
	Production (t)	Domestic Utilisation (t)	Ratio (%)	Production (t)	Domestic Utilisation (t)	Ratio (%)	Production (t)	Domestic Utilisation (t)	Ratio (%)
ASEAN	120,174,912	107,548,121	111.7	122,695,085	108,551,794	113.0	124,573,413	109,496,270	113.8
Brunei	2,511	30,517	8.2	2,637	32,777	8.0	2,769	33,813	8.2
Cambodia	6,998,796	3,222,129	217.2	7,012,794	3,985,561	176.0	7,026,819	4,210,657	166.9
Indonesia	34,286,909	35,334,107	97.0	34,842,316	34,443,617	101.2	36,044,021	34,944,947	103.2
Lao PDR	2,104,087	2,193,344	95.9	2,290,074	2,283,640	100.3	2,445,953	2,258,017	108.3
MALAYSIA	**1,485,847**	**2,640,007**	***56.3**	**1,468,033**	**2,650,000**	***55.4**	**1,476,401**	**2,650,000**	***55.7**
Myanmar	16,581,400	14,829,880	111.8	16,405,684	14,817,485	110.7	16,231,688	14,810,679	109.6
Philippines	12,618,000	15,060,000	83.8	13,121,000	15,080,000	87.0	13,317,815	15,100,027	88.2
Singapore	-	295,960	-	-	266,374	-	-	281,167	-
Thailand	18,601,666	12,822,250	145.1	19,377,284	13,612,505	142.4	20,019,569	13,696,600	146.2
Vietnam	27,495,695	21,119,927	130.2	28,175,264	21,379,836	131.8	28,008,379	21,510,363	130.2

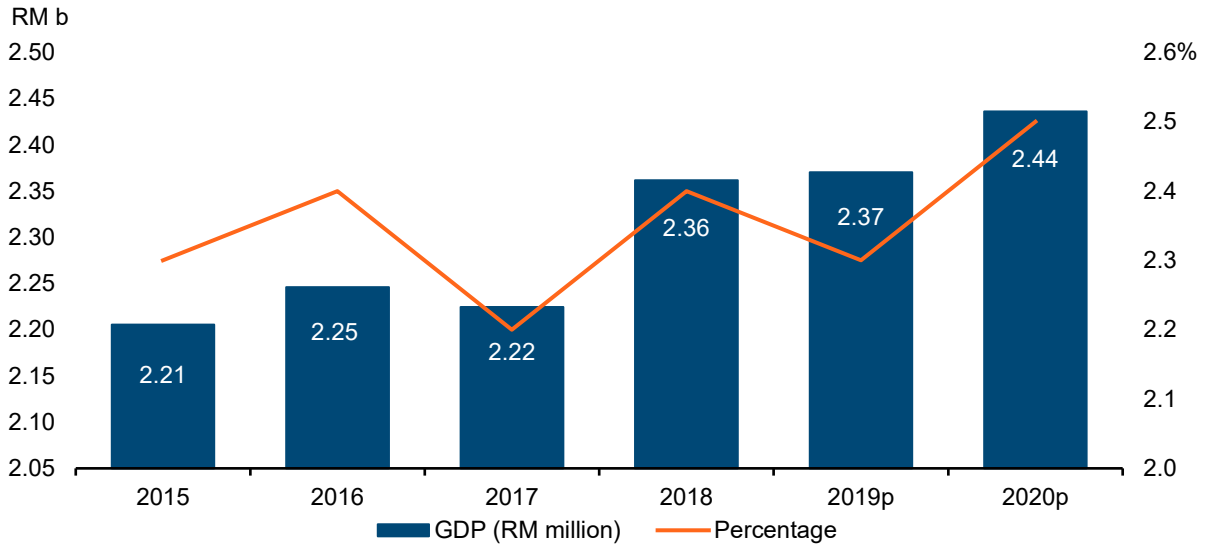
Source: AFFSIS (2021)
Note: Data are calculated by ASEAN Agricultural Commodity Outlook and do not reflect Malaysia's actual SSL numbers as released by DOS Malaysia.

2.4 Rice Situation in Malaysia

In Malaysia, paddy is seen as an important crop in the food subsector, as rice is a staple food for the majority of the population. Malaysians consume rice daily, in which rice is either eaten as cooked rice or indirectly in the form of rice flour. Dishes such as *nasi lemak*, *nasi biryani*, *kuih apam,* and *bihun goreng* are some of the many popular rice-based foods consumed by Malaysians. Taking into account the abundance of rice-based dishes in Malaysia, it comes as no surprise that the average rice consumption per capita is 79kg per year in 2021[13].

In 2020, Malaysia's gross domestic product (GDP) was RM1.34 trillion (in constant 2015 prices), whereby the agriculture sector contributed approximately 7.4% or RM99.4b[14] to Malaysia's total GDP. Meanwhile, the paddy sector contributed a small percentage of 2.5% or RM2.4b (2020)[15]. The paddy industry's GDP contribution has remained relatively constant in the range between 2.2% and 2.5% yearly (Figure 2.5). Albeit a small percentage of GDP contribution, paddy and rice remain a key food item that warrants attention due to its food security role.

Figure 2.5: Annual GDP of Paddy, 2015 – 2020



Source: DOS (2021a)
Notes: p = provisional. The GDP value is at 2015 constant price.

[13] MAFI (2021)
[14] DOS (2021c)
[15] DOS (2021a)

Table 2.2 shows the estimated number of paddy farmers in each state in 2020. As expected, Kedah, the "rice bowl" of Malaysia, stands at the highest with 56,964 paddy farmers. Interestingly, the second largest number of paddy-related farmers is in Sarawak with over 33,000 in number.

Table 2.2: Estimated Number of Farmers in Paddy and Rice Sector, by State, 2020

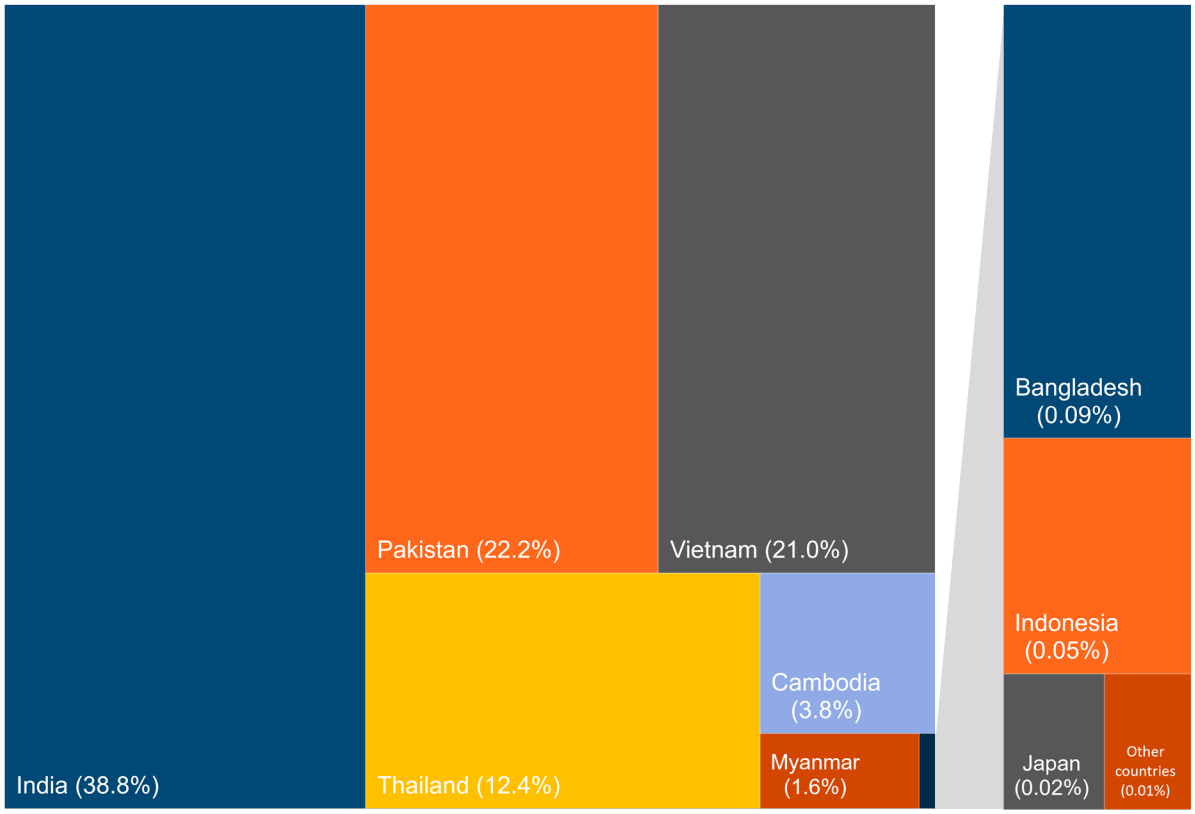
State	No. of Farmers
Johor	1,015
Kedah	56,964
Kelantan	23,319
Melaka	952
N. Sembilan	1,070
Pahang	4,837
Perak	22,378
Perlis	13,371
P. Pinang	6,272
Selangor	9,733
Terengganu	6,008
Peninsular Malaysia	145,919
Sabah	**9,986**
Sarawak	**33,595**
W.P Labuan	-
Malaysia	**189,500**

Source: DOA (2021)
Note: The estimated number of farmers above is an estimate of the number of entrepreneurs practising paddy cultivation. There is the possibility that one farmer cultivates more than one commodity (Example: a farmer may cultivate rice and fruit which is considered a farmer in each category).

Malaysia is not self-sufficient in rice production. The latest statistics noted that Malaysia is 65% self-sufficient in rice[16]. If we look at this, it means that in 2021, Malaysia imported around 1.15m Mt of rice from more than 13 countries (Figure 2.6). However, import is not the only measure of food security as explained in greater detail in a recent KRI discussion paper titled "Deconstructing Malaysia's 2021 Food Import Bill: It is Not the Only Measure of Food Security". For more description of the paddy industry's statistics in Malaysia, refer to KRI's report titled "The Status of the Paddy and Rice Industry in Malaysia"[17].

[16] MAFI (2021)
[17] KRI (2019)

Figure 2.6: Origins of Imported Rice in Malaysia



Source: UN-COMTRADE (n.d.); KRI illustration

2.5 Background: Sabah and Sarawak

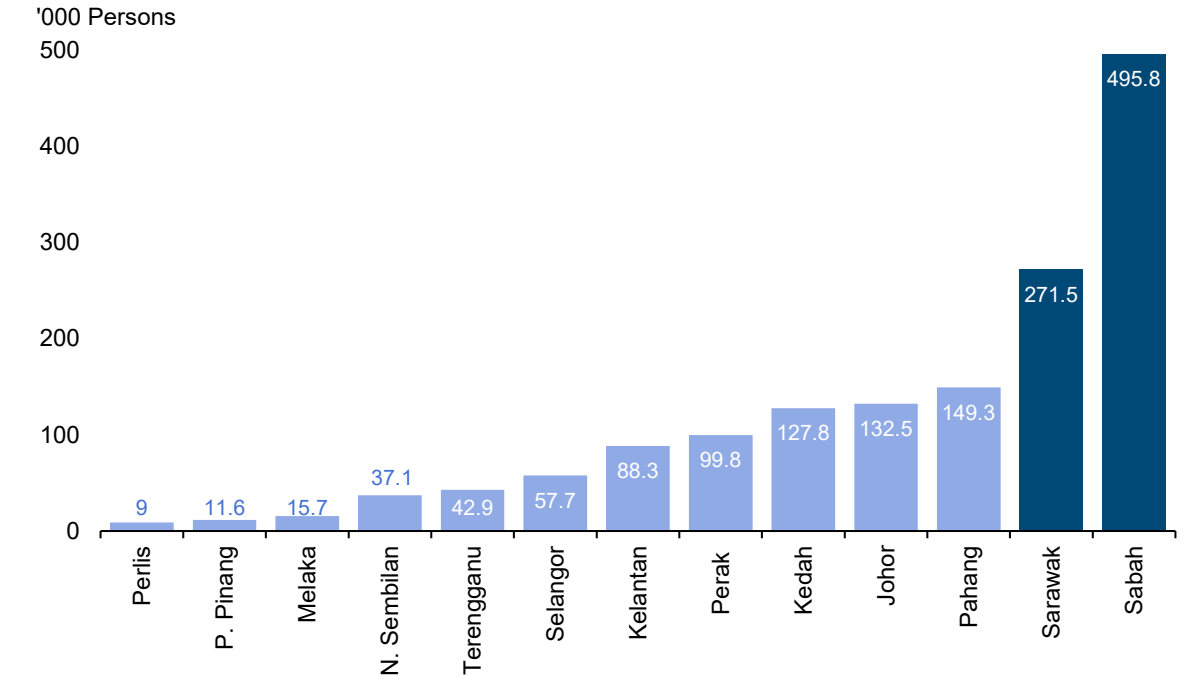
East Malaysia, comprising Sabah, Sarawak, and federal territory Labuan is situated on the east of Peninsular Malaysia and the northern and north-western coast of the island of Borneo. By size, Sarawak and Sabah are the largest and second-largest states in Malaysia covering an area of 124,450km^2 and 73,620km^2 accounting for approximately 60% of Malaysia's entire landmass and holding a population of 4.0m and 2.9m people respectively[18]. With a forest cover of more than 50% in both states, East Malaysia is rich in biodiversity and underexplored natural resources. Annually, the region receives rainfall of 2,000mm to 4,000mm, in combination with the humid climate, making both Sabah and Sarawak a thriving land with massive agricultural potential.

Agriculture is an important economic activity in East Malaysia with GDP contributed by the sector being the highest compared to other states in Malaysia, valued at RM12.5b and RM14.4b for Sabah and Sarawak respectively in 2021[19]. This is reflected by the high employment rate in agriculture where both states have a far higher agricultural labour employment of 272,000 and 496,000 people in Sarawak and Sabah respectively in comparison to other states (Figure 2.7). The agricultural added value is also one of the highest in Malaysia with Sabah and Sarawak contributing RM12.8b and RM14.9b respectively in 2020[20], as depicted in Figure 2.8.

East Malaysia's agriculture sector has been one of the biggest in Malaysia mainly due to its vast arable agricultural land. Currently, Sabah and Sarawak's agricultural land use are at 1.6m Ha and 6.4m Ha respectively, which only utilises an average of 70% of total land that is deemed suitable for agriculture[21]. Agricultural land use in both states, however, is largely dominated by palm oil plantation where Sabah, being the largest palm oil producer in Malaysia has 88% of agricultural land use dedicated to palm oil production while Sarawak's palm oil agricultural land use stood at 63%[22]. East Malaysia's agricultural land development has been very much influenced by the colonial and post-colonial era, including the First to Third Malaysia Plan as well as the New Economic Policy (NEP) which is discussed more in Chapter 3.

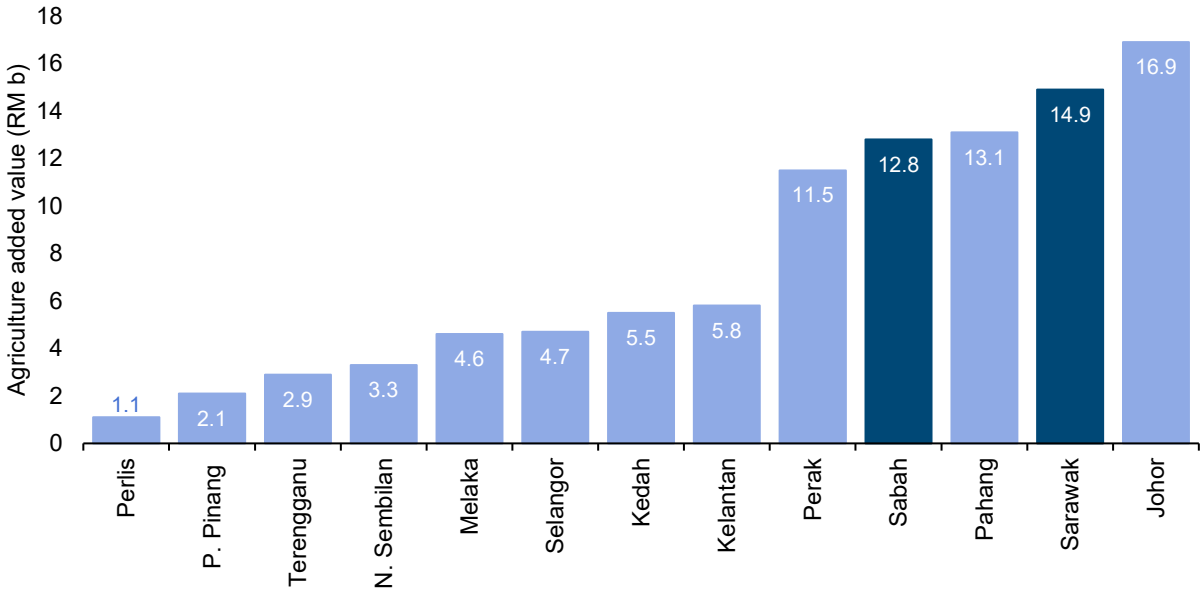
[18] DOS (2021e)
[19] DOS (2022)
[20] DOS (2021b)
[21] DOA Sarawak (n.d.); MAFI Sabah (2017)
[22] Ibid.

Figure 2.7: Persons Employed in Agriculture by State, 2020



Source: DOS (2021d)

Figure 2.8: Agriculture Added Value by State, 2020



Source: DOS (2021b)

The domination of industrial crops such as palm oil and rubber coupled with rapid urbanisation and city development has caused a slow diminish of arable land available for paddy production, which is now further exacerbated by the dietary shift from carbohydrate to protein-rich foods among Malaysians[23].

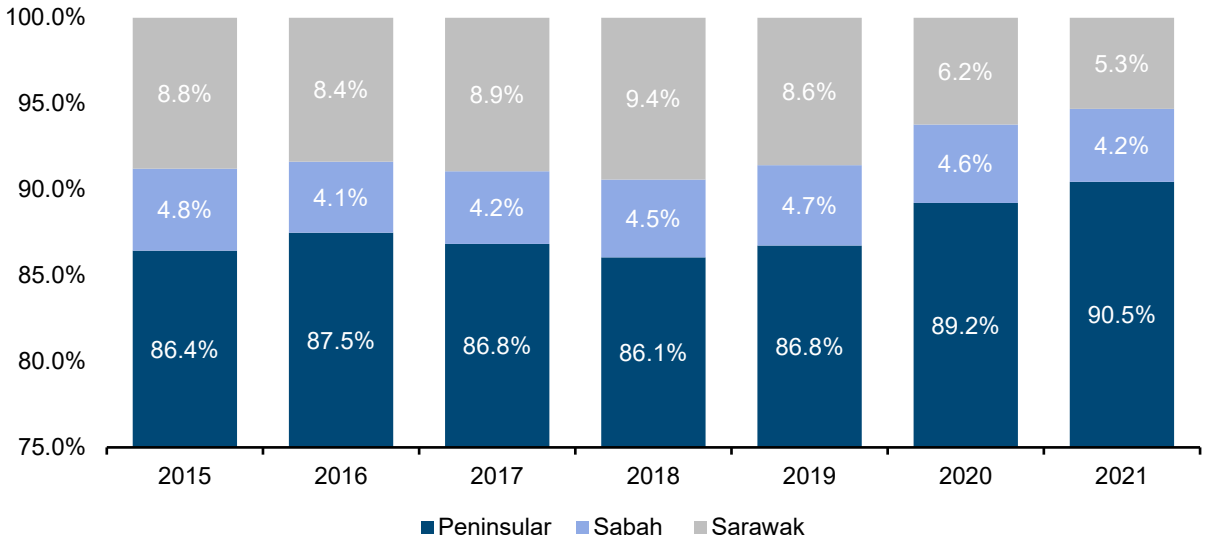
In a further breakdown of the agricultural land use, Sabah agriculture is dominated by palm oil (88%), followed by rubber (5.4%), paddy (2.8%), coconut (1%), cocoa (0.4%), and other food crops (1.7%)[24]. As Sabah's soil is suitable for industrial crops, palm oil plantation has continued to grow over the years although rubber and cocoa plantation experienced a slow growth rate due to unstable market price and driven by state policies to plant other food crops. Similarly, Sarawak's industrial crops include palm oil, rubber, cocoa, and pepper. Industrial crops that showed an increasing growth rate in Sarawak are oil palm and rubber as these plantations are made for export and there is demand from importing countries such as China. The plantation for cocoa and pepper, however, showed a decline due to low market prices and high production costs[25].

[23] Olaniyi et al. (2013)
[24] MAFI Sabah (2017)
[25] DOA Sarawak (n.d.)

2.6 Current Paddy and Rice Statistics in Sabah and Sarawak

In terms of rice production in volume, East Malaysia is not a significant contributor to domestic production. In 2021, Malaysia's rice production amounted to a total of 1.68m Mt, in which a majority of produced rice was contributed by Peninsular Malaysia (90.5%), followed by Sarawak (5.3%) and Sabah contributing the lowest (4.2%)[26] (Figure 2.9).

Figure 2.9: Production of Rice by State, 2015 – 2020

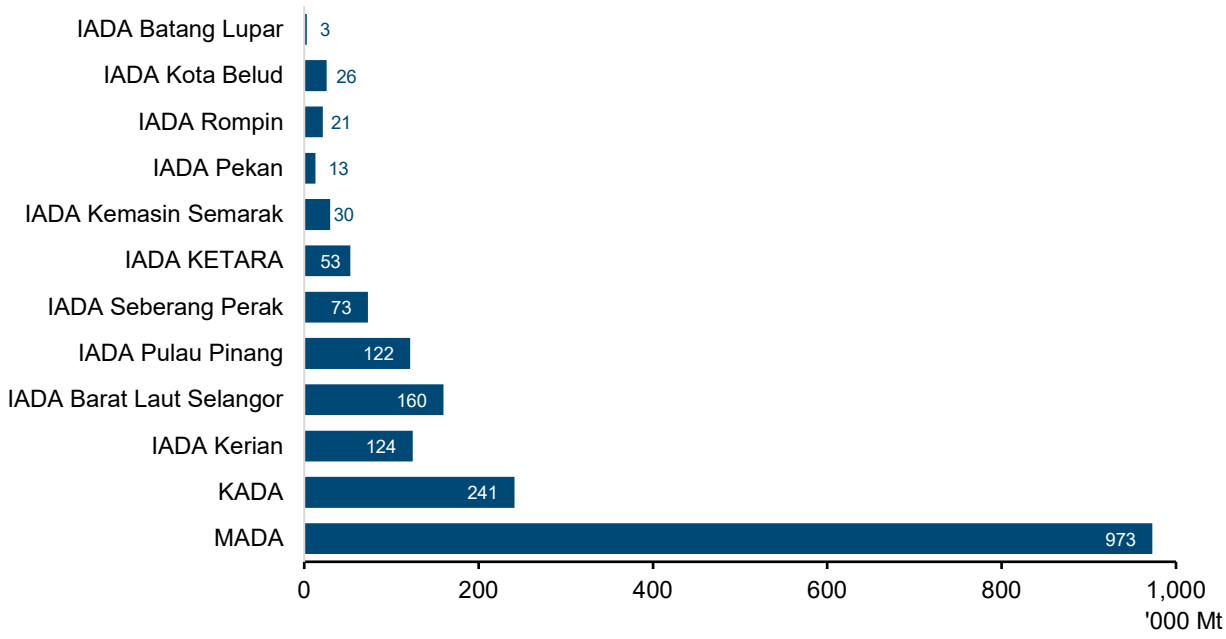


Source: MAFI (2020); (2021), KRI calculations

As mentioned earlier, most of the paddy production is concentrated in granary areas in Peninsular Malaysia, accounting for 98.4% of the total paddy production in 2020 (Figure 2.10). Among the 12 granary areas, the Integrated Agriculture Development Areas (IADA) of Kota Belud (Sabah) and Batang Lupar (Sarawak) have relatively more minor contributions of 1.4% and 0.2% of the total rice produced in the granary area (Figure 2.10 and Table 2.3). Paddy cultivation in these areas comprises high-yielding, cheaper, medium-grained plain rice varieties, mostly developed by Malaysian Agricultural Research and Development Institute (MARDI) to increase SSL in both states.

[26] MAFI (2021)

Figure 2.10: Production of Paddy by Granary Area, 2020



Source: MAFI (2021)
Note: KADA = Kemubu Agricultural Development Authority; MADA = Muda Agricultural Development Authority.

Table 2.3: Production of Rice by Granary Area, 2016 – 2020

	2016	2017	2018	2019	2020	2021[p]
MADA	691,111Mt	633,352	668,763	645,584	681,041	590,763
KADA	161,312	156,319	163,897	131,958	168,725	179,407
IADA Kerian	107,268	111,304	107,764	97,605	87,033	99,181
IADA Barat Laut Selangor	144,321	107,621	113,380	113,158	111,675	108,942
IADA Pulau Pinang	96,393	95,329	86,864	83,282	85,116	95,843
IADA Seberang Perak	67,202	57,329	61,610	51,925	51,070	48,107
IADA Ketara	35,643	32,785	33,907	32,718	36,911	35,621
IADA Kemasin Semerak	17,846	17,509	18,300	18,351	20,860	21,502
IADA Pekan	8,726	6,686	11,169	11,372	9,028	9,698
IADA Rompin	9,384	11,069	9,591	7,878	15,007	17,014
IADA Kota Belud	**-**	**14,367**	**18,961**	**16,126**	**16,268**	**15,816**
IADA Batang Lupar	**-**	**1,351**	**1,676**	**1,852**	**1,748**	**1,932**
TOTAL	**1,339,206**	**1,245,021**	**1,295,882**	**1,211,809**	**1,284,482**	**1,223,826**

Source: MAFI (2021)
Note: p = provisional. Report of rice production of IADA Kota Belud and IADA Batang Lupar started from 2017 onwards.

However, albeit in lower volumes, this does not mean that the paddy industry is not essential in East Malaysia. Instead of increasing in quantity per se using modern, high-yielding varieties, East Malaysia can also tap into the artisanal, premium rice segment. Chapter 5 delves deeper into this potential and discusses it in greater detail. In fact, the estimated value of specialty rice in East Malaysia is not far from the cheaper, medium-grained rice grown in large quantities.

If we assume that lowland, cheap, high-yielding medium-grained rice is produced by both IADA Kota Belud and IADA Batang Lupar, we can roughly calculate the amount of hill rice or lowland rice produced traditionally in non-granary areas. For example, in 2021, Malaysia produced a total of 1,677,475Mt, whereby 1,517,394Mt was produced in Peninsular Malaysia, and the remaining 160,081Mt was in East Malaysia[27]. IADA Kota Belud and IADA Batang Lupar produced 15,816Mt and 1,932Mt respectively, totalling 17,748Mt[28]. Therefore, we can then calculate:

Total amount of traditional rice produced in East Malaysia (in Mt)	=	*Total Rice in Malaysia – Total Rice in Peninsula – Total Rice in (IADA Kota Belud + IADA Batang Lupar)*
	=	*1,677,475Mt - 1,517,394Mt - 17,748Mt*
	=	*142,333Mt*

If, through effective marketing and product branding, top-quality traditional rice can be sold at RM22/kg, the total value (in 2021) of the premium segment could be RM3.1b.

Total amount of traditional rice produced in East Malaysia (in kg) x average traditional rice price (after rebranding) (RM/kg)	=	*142,333,000kg x RM22 =* ***RM3.1b***

This is not too far from the medium-grained rice valued at RM3.3b even though the latter comprises more than 90% of the total rice produced in Malaysia!

Total amount of rice produced in Peninsular Malaysia + IADA Kota Belud + IADA Batang Lupar (in kg) x average medium-grained rice price (RM/kg)	=	*(1,517,394,000kg + 17,748,000kg) x RM2.20*
	=	***RM3.3b***

[27] MAFI (2021)
[28] MAFI (2021)

2.6.1. Subsidy Programmes

With SSL and production in volumes being used as the yardstick to measure the industry's performance, various efforts were taken to encourage paddy cultivation and improve yields. For example, the *Skim Baja Padi Kerajaan Persekutuan* (SBPKP) [29] was introduced to ensure that paddy farmers throughout the country receive adequate quality and supply of fertilisers for paddy cultivation. The scheme was initially introduced under *Skim Subsidi Baja Padi* (SSBP) in 1979 but was later re-introduced as SBPKP in 1998. In May 2002, the SBPKP was then expanded to Sabah and Sarawak. The allocation under SBPKP consists of two types of fertilisers; (1) twelve bags of compound fertiliser, and (2) four bags of urea fertilisers, for a hectare of land and is given out for a maximum of 10Ha of land per farmer per season [30] (Table 2.4).

Table 2.4: SBPKP Incentive per Hectare of Land for Paddy Farmers in Sabah and Sarawak

Type of Fertiliser	Quantity (unit)	Price per unit		
		Before 2009	2009-2012	2013 Onwards
Compound	12 (20 kg/unit)	RM29.90	RM29.97	RM47.31
Urea	4 (20 kg/unit)	RM25.75	RM25.76	RM44.90

Source: Farmer's Organisation Authority (n.d.)

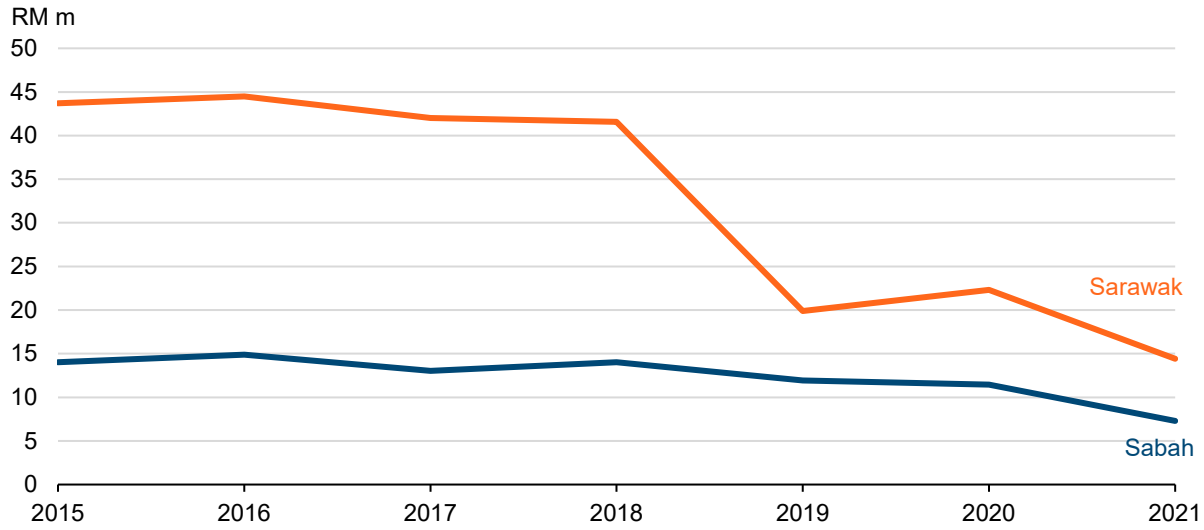
As of 2020, the total SBPKP allocated to Sarawak is RM29,581,916.65, with RM22,204,711.95 spent for 469,345 bags of compound fertilisers and RM7,377,204.70 for 164,303 bags of urea fertilisers [31]. However, the total SBPKP in 2020 is considerably lower when compared to 2019 and 2018. The lower subsidy could be due to the Movement Control Order (MCO) lockdown initiated in 2020.

Additionally, *Skim Subsidi Baja dan Racun Padi Bukit/Huma* (SBRPB) was introduced by the government in 2015 to help farmers increase and stabilise their paddy yield whilst improving their income. The SBRPB mainly targets dryland paddy or hill paddy farmers, typically from Sabah and Sarawak. It assists in the forms of compound fertilisers, urea fertilisers, and poisons for a maximum land area of 4.04Ha. In the context of this report, more focus will be given to SBRPB to understand the assistance received by the farmers in Sabah and Sarawak for paddy cultivation.

[29] NAFAS (n.d.)
[30] World Bank Group and Ministry of Economic Affairs (2019)
[31] DOA Sarawak (2020b)

A declining trend is seen for the disbursement of SBRPB to Sabah and Sarawak, as shown in Figures 2.11, 2.12, and 2.13. There are several possible reasons for this. The authors could not obtain published paddy data specifically on the timeline production of traditional/hill rice, therefore, assumptions can only be made based on other data collected. One possibility is that more farmers are converting their paddy farms to other crops, therefore no longer needing the SBRPB products. Two previous KRI publications titled "Implications of the Dominant Shift to Industrial Crops in Malaysian Agriculture" Phase I[32] and Phase II[33] showed the decline in the total paddy area and the increase in area for industrial crops such as oil palm. Another possible reason is the growth of organic farming and sustainable agriculture that utilises little to no chemical fertilisers, driven by NGOs and SEs [34]. These NGOs and SEs work with rural communities that usually cultivate heirloom/specialty varieties.

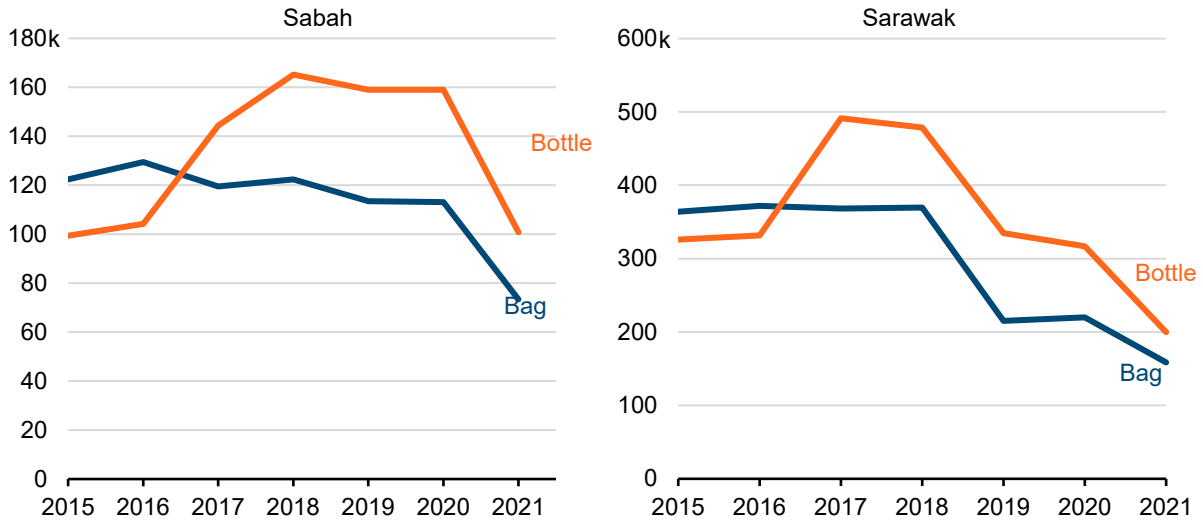
Figure 2.11: Total Value of SBRPB Allocated for Farmers in Sabah and Sarawak, 2015 – 2021



Source: MAFI-IPB (2022)

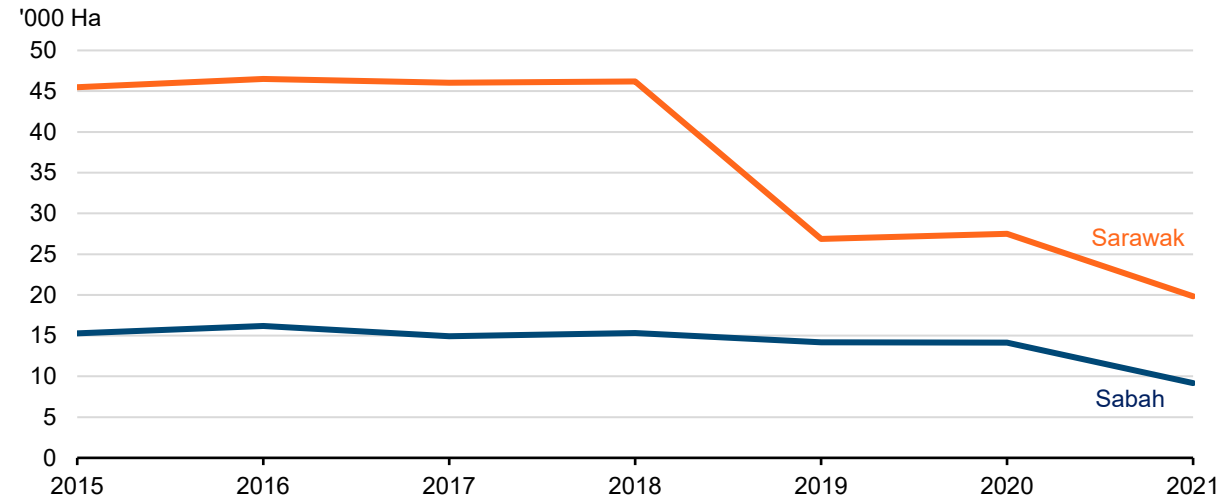
[32] Arshad et al. (2020)
[33] Arshad et al. (2020)
[34] KRI focus group discussions and interviews with stakeholder in 2022

Figure 2.12: Quantities of Subsidised Fertilisers Provided to Hill Paddy Farmers in Sabah and Sarawak, 2015 – 2021



Source: MAFI-IPB (2022)

Figure 2.13: Total Land Area Benefitted from SBRPB in Sabah and Sarawak, 2015 – 2021

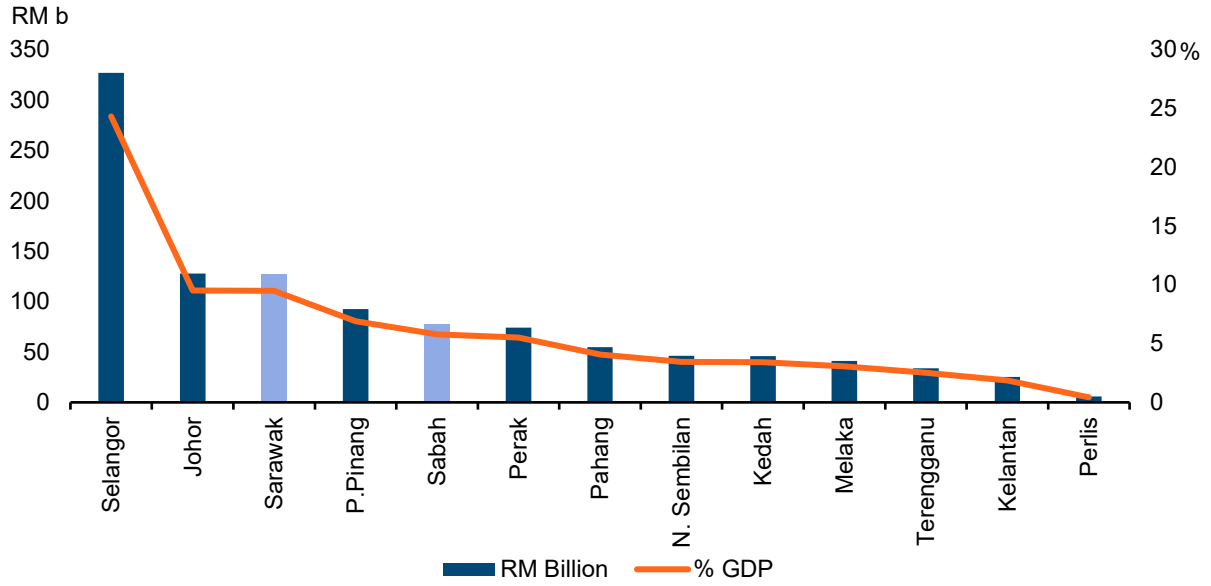


Source: MAFI-IPB (2022)

2.6.2. Paddy and Rice Industry in Sabah

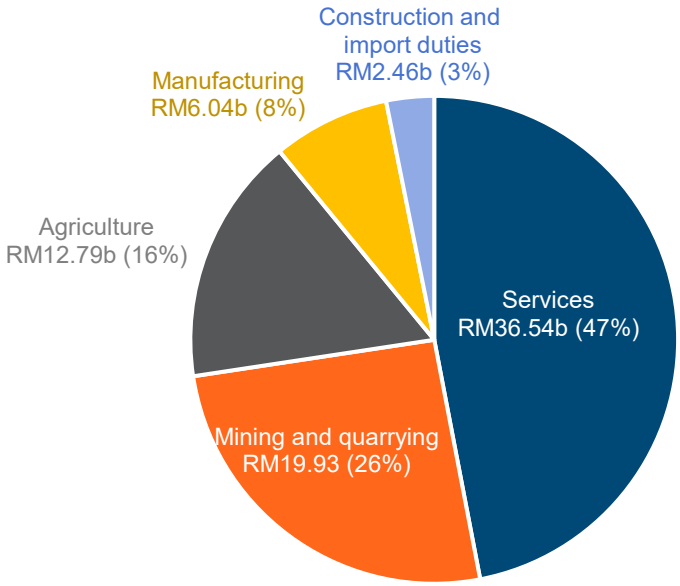
As shown in Figure 2.14, Sabah is one of the major contributors to the national economy, recording an added value of RM77.8b or 5.8% of the country's GDP in 2020. Its agriculture sector was valued at 16.5% out of the state's GDP. Although the agriculture sector in Sabah constituted a smaller proportion of economic value relative to the services as well as the mining and quarrying sectors, the GDP still high at 16% out of the state's total GDP (Figure 2.15). This implies that the agriculture industry in Sabah is one of the core economic activities within the state and more significantly, a key contributor to the nation's economy.

Figure 2.14: GDP by State, 2020



Source: DOS (2021c)
Note: The GDP is at 2015 constant prices.

Figure 2.15: GDP for Sabah by the Type of Economic Activity, 2020



Source: DOS (2021c) GDP by state
Note: The GDP is at 2015 constant prices.

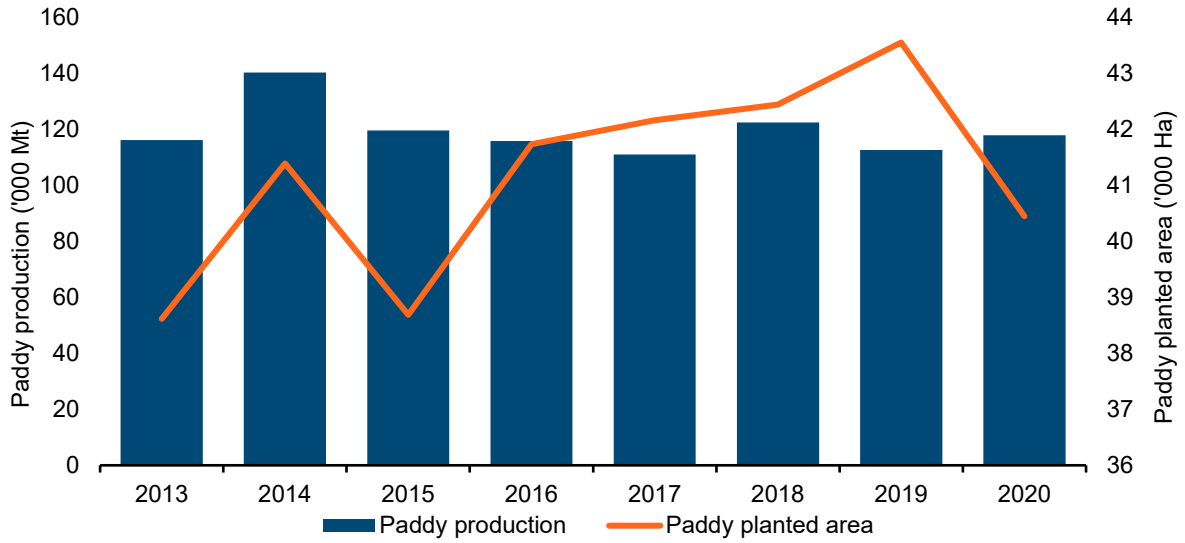
To date, there is little published information available regarding the paddy industry in Sabah and Sarawak. The following are some data gathered.

In Sabah, there has been a general increase in paddy planted area from 38,000Ha in 2013 to 43,000Ha in 2019 before a steep decline in 2020 (Figure 2.16). On the other hand, the paddy production in Sabah has been relatively stable, hovering between 110,000Mt to 140,000Mt. As of 2019, Sabah produced 112,569Mt of rice[35]. It is interesting to note that despite a steep decline in planted area for the year 2020, Sabah is still able to maintain production, suggesting a possible improvement in yield.

Although the population in Sabah has continued to rise, rice production does not show parallel growth. This is reflected in the falling trend of Sabah's self-sufficiency level (SSL) over the years (Figure 2.17).

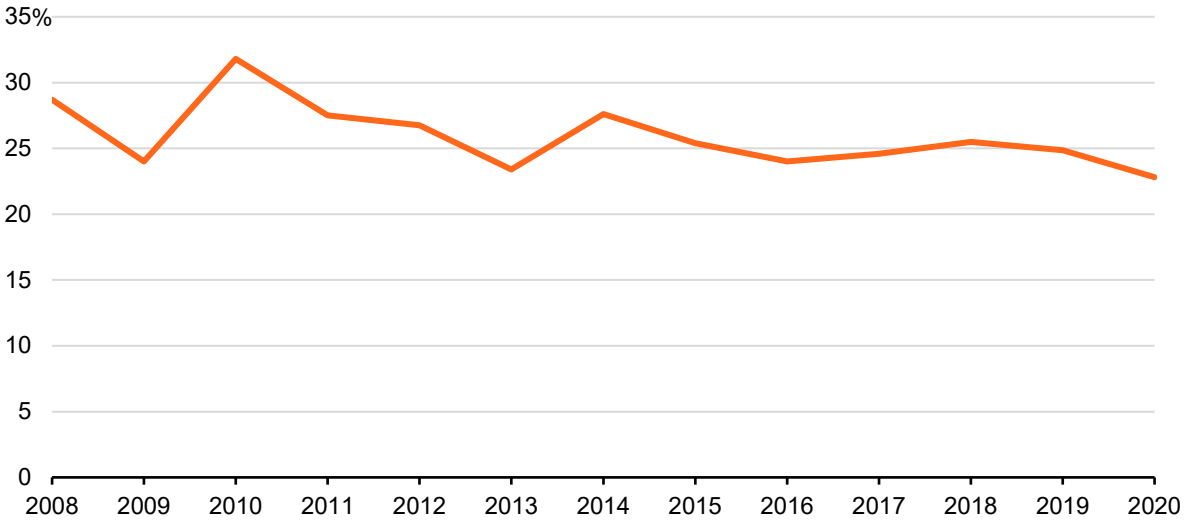
[35] MAFI (2019)

Figure 2.16: Paddy Production and Paddy Planted Area of Sabah, 2013 – 2020



Source: MAFI (2018); (2019); (2020)
Note: The data of the figure include both main season and off season.

Figure 2.17: Rice SSL of Sabah, 2008 – 2020



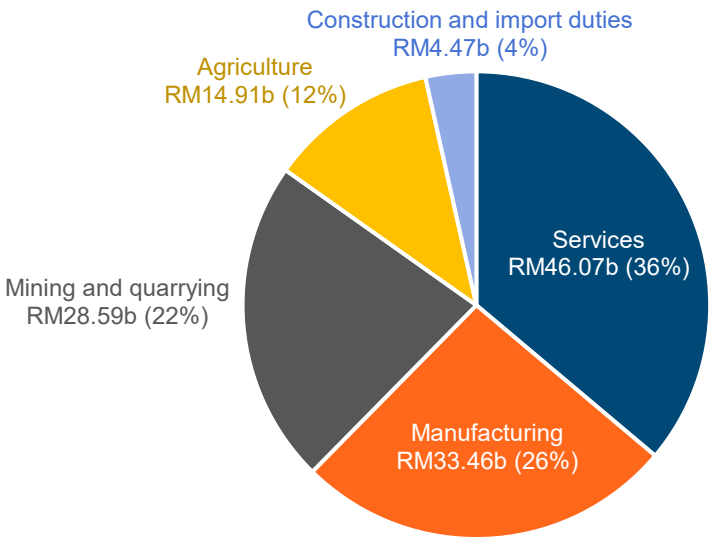
Source: MARDI Sabah (2022)
Note: p = provisional

2.6.3. Paddy and Rice Industry in Sarawak

Being the largest among the 13 states in Malaysia, Sarawak is the fourth biggest contributor to the national GDP in 2020, ranked after Selangor, Kuala Lumpur, and Johor (Figure 2.14). Out of the RM127.5b or 9.5% of its national GDP contribution, a larger proportion came from the services sector, followed by manufacturing, mining and quarrying, and the agriculture sector (Figure 2.18). The economic value generated by the agriculture sector in Sarawak was 11.7% relative to the state's GDP, lower than that of Sabah (16.5%). However, it is noteworthy that Sarawak's agriculture sector is the second biggest contributor to the national GDP, indicating its economic significance to the country.

For the paddy and rice industry, a total area of 109,260Ha were used for paddy planting in twelve districts in Sarawak in 2019[36], which contributed 15.9% towards Malaysia's total area of planted paddy (Table 2.5).

Figure 2.18: GDP for Sarawak by the Type of Economic Activity, 2020



Source: DOS (2021c)
Note: The GDP is at constant 2015 prices.

[36] DOA Sarawak (2019)

Table 2.5: Paddy Production in Sarawak, by District, 2019

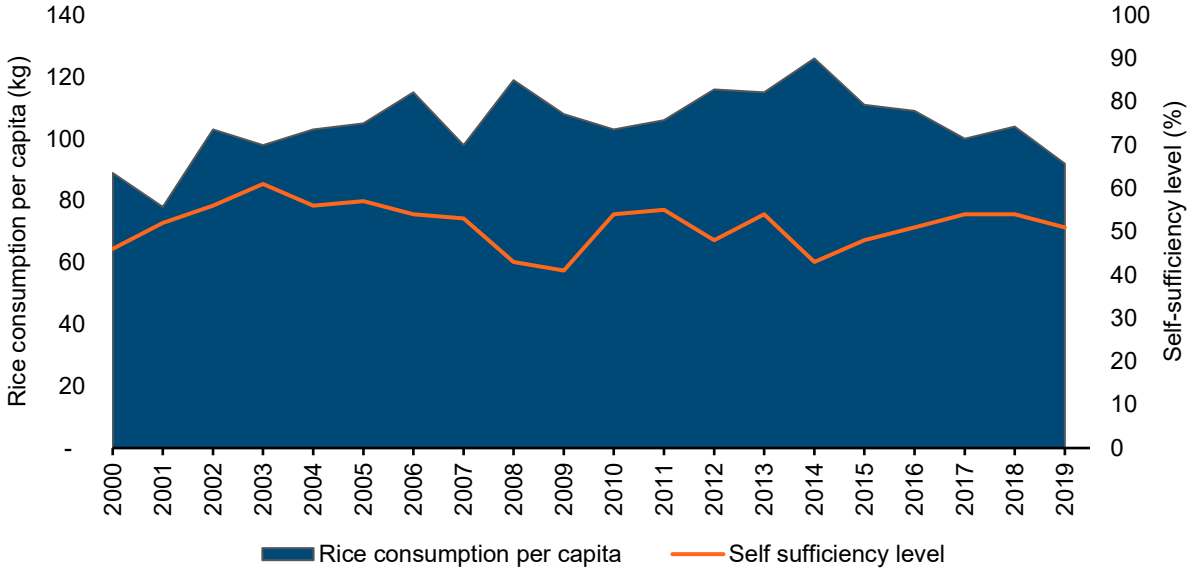
Division	Production
Sri Aman	14,461
Sibu	11,707
Kapit	15,982
Serian	11,417
Sarikei	13,422
Miri	12,726
Betong	9,791
Mukah	5,596
Bintulu	787
Samarahan	2,074
Kuching	4,685
Limbang	6,612
Total: Sarawak	**109,260**
Total: Malaysia	**685,548**

Source: DOA Sarawak (2019), DOA (2021)

As of 2019, Sarawak's rice consumption per capita was 92kg, while the SSL stood at 51% (Figure 2.19). Interestingly rice consumption per capita in Sarawak has been on a general increasing trend up to 2014, before it began to decline by 2019, with the SSL hovering between 40-50% since 2009. Paddy production have been relatively stable throughout the 2000s and only started declining from 2018 onwards. This decline in production is consistent with the declining trend in paddy planted area (Figures 2.20 and 2.21). This could be attributed to re-purposing of paddy area to the planting of other crops or for other developments[37].

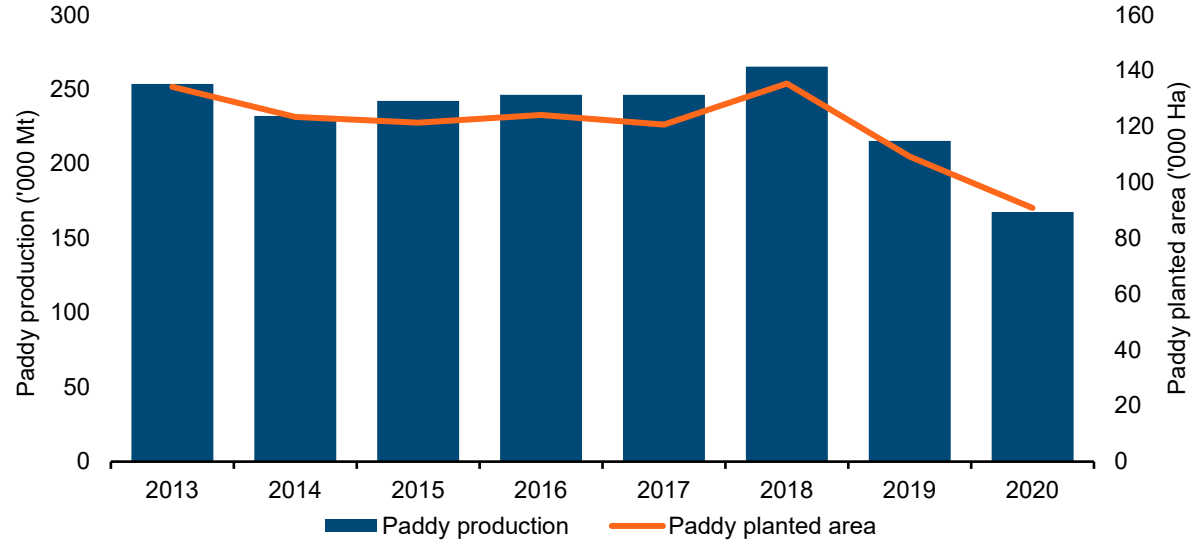
[37] De Koninck, Bernard, and Bissonnette (2014)

Figure 2.19: Rice Consumption per Capita and Self-Sufficiency Level of Sarawak, 2000 – 2019



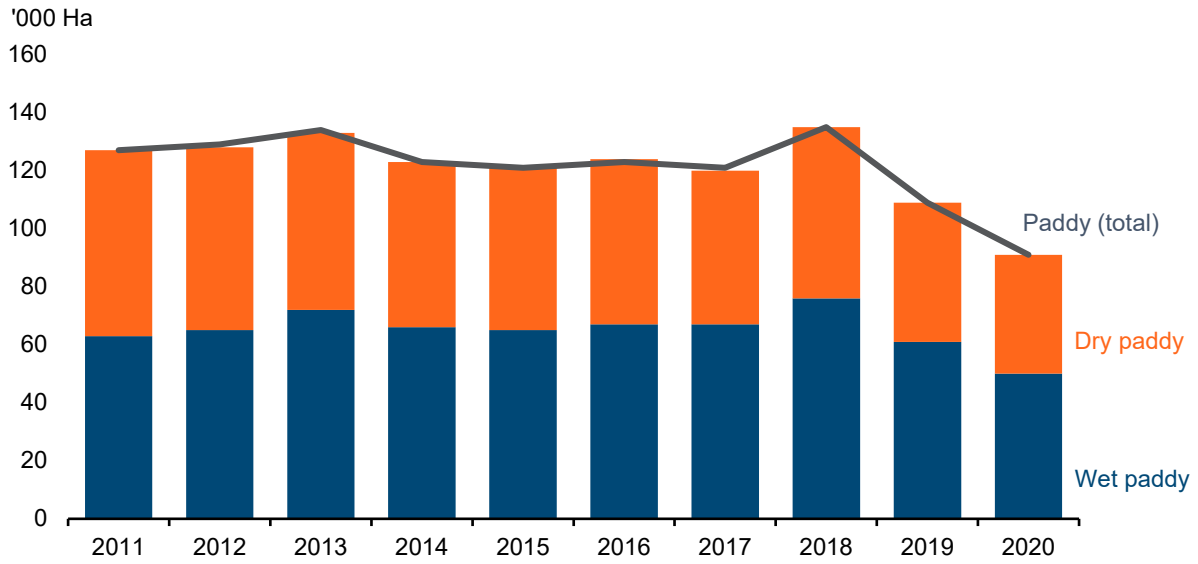
Source: DOA Sarawak (2020b)

Figure 2.20: Paddy Production and Paddy Planted Area of Sarawak, 2013 – 2019



Source: DOA Sarawak (2020b)
Note: The data of the figure include both main season and off season.

Figure 2.21: Estimated Area of Paddy in Sarawak, 2011 – 2020



Source: DOA Sarawak (2020a)

2.7 Chapter Key Takeaways

- Rice continues to be an important source of energy for a large part of the world's population.
- Malaysia is not 100% self-sufficient, and while increasing production is still a good target to have, having a 100% self-sufficiency policy to be achieved at all costs may not be the way forward. A national SSL of 60-65% is a comfortable figure.
- Nonetheless, Sabah and Sarawak's rice self-sufficiency are below 60%. Despite their large land areas, both states are experiencing a declining trend in the paddy planted area which contributes to their lower rice SSL performance.
- Sabah and Sarawak both contribute a smaller fraction of the total rice produced in Malaysia. However, instead of focusing on just high-yielding medium-grained plain rice to increase their SSL, perhaps the focus can be towards the cultivation of higher quality, more premium specialty rice that may not be produced in large quantities as per Peninsular Malaysia, but can be sold at a premium and enable farmers to make a good profit. At the same time, improvements in the yield of these traditional varieties due to better agricultural practices can help increase the state's rice SSL levels.

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CHAPTER

03

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CHAPTER 3

STATUS OF FOOD SECURITY IN EAST MALAYSIA

By Nik Syafiah Anis

3.1 Introduction

This chapter aims to holistically analyse the food security status in East Malaysia by assessing food availability, accessibility, utilisation, stability, and sustainability dimensions using selected indicators. It provides an overview of food security in East Malaysia before exploring the biological and cultural aspects of specialty rice industry in the subsequent chapters.

3.2 Food Security Concepts and Indicators

By definition, food security carries the meaning of "all people, at all times, have physical and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences to lead an active and healthy life"[38]. Fundamentally, there are four pillars of food security;

- ***Food availability*** refers to the physical presence of food contributed by domestic production, food import or export, and is often associated with SSL.
- ***Food accessibility*** is defined as access to adequate resources (physical/economic) to acquire nutritious food and is often affected by poverty and food prices.
- ***Food utilisation*** is the appropriate use of food through a healthy diet, proper sanitation, clean water, and adequate health care.
- ***Food stability and sustainability***, where stability is a measure of food system resilience towards shocks (economic/climatic) in ensuring individuals, households, and populations have access to adequate food at all times. Food sustainability is development in the food and agricultural industry that meets the needs of both present and future generations with emphasis on environmental, economic, and social dimensions[39].

[38] FAO (2006)
[39] Guiné et al. (2021)

Food security measurement is a subjective concept and may be widely assessed in multiple ways based on available data. The Global Food Security Index (GFSI), which is an index developed by the Economic Intelligent Unit (EIU) measures food security through multidimensional indicators which are inclusive of, but not limited to, food production, food loss, change in food cost, dietary diversity, food import dependency, and impact of climate change. Similarly, The Food and Agricultural Organisation (FAO) has long developed its food security assessment indicators measuring dietary energy supply, the prevalence of undernourishment, safe food storage ability, and per capita food production variability, among many others. Apart from that, some countries and organisations have also established a primary-data assessment method through national surveys and questionnaires. This includes the Household Food Security Survey Module (HFSSM) by the United States Department of Agriculture (USDA), Food Insecurity Experience Scale (FIES-SM) by FAO, and Food Security and Nutrition Assessment by the United Nations Children's Fund (UNICEF). All of these assessments collectively provide information on food insecurity, poverty, and nutrition status at an individual and household level[40].

Despite many indicators and assessments that have been developed by individuals or organisations on ways to measure food security, **there has been no consensus on which dimensions (availability, accessibility, utilisation, stability, and sustainability) or levels (individual to global) these indicators are meant to represent. In other words, there is no single guideline to measure food security.**

Therefore, for this chapter, food security is assessed through multiple indicators utilising various international guidelines to provide an overview of the status of food security in East Malaysia and the importance of specialty rice in eradicating poverty and elevating food security in the region by using available secondary state-level data. Data is mainly sourced from DOS and several government agencies including the DOA, the Department of Veterinary Services Malaysia (DVS), the Department of Fisheries Malaysia (DOF), and the IPH, as shown in Table 3.1.

[40] Kirkendall et al. (2013); WFP (2014)

Table 3.1: Selected Food Security Indicators and Their Data Source

Food Security Dimensions	Indicators	Data Source
Availability	Average quantity of food production	DOA
	Average protein supply	DVS, DOF
	Value of food trade	DOS
Accessibility	Incidence of absolute poverty	DOS
	Change in average food costs	DOS
	Household consumption expenditure	DOS
	Urban/rural population	DOS
Utilisation	Prevalence of moderate and severe malnutrition	DOS
	Prevalence of obesity	IPH
	Prevalence of anaemia	IPH
	Prevalence of NCDs	IPH
Stability & Sustainability	Population growth	DOS, CEIC
	Sustainable farming practices	DOA

3.3 Food availability

3.3.1. Overview of Food Production in East Malaysia

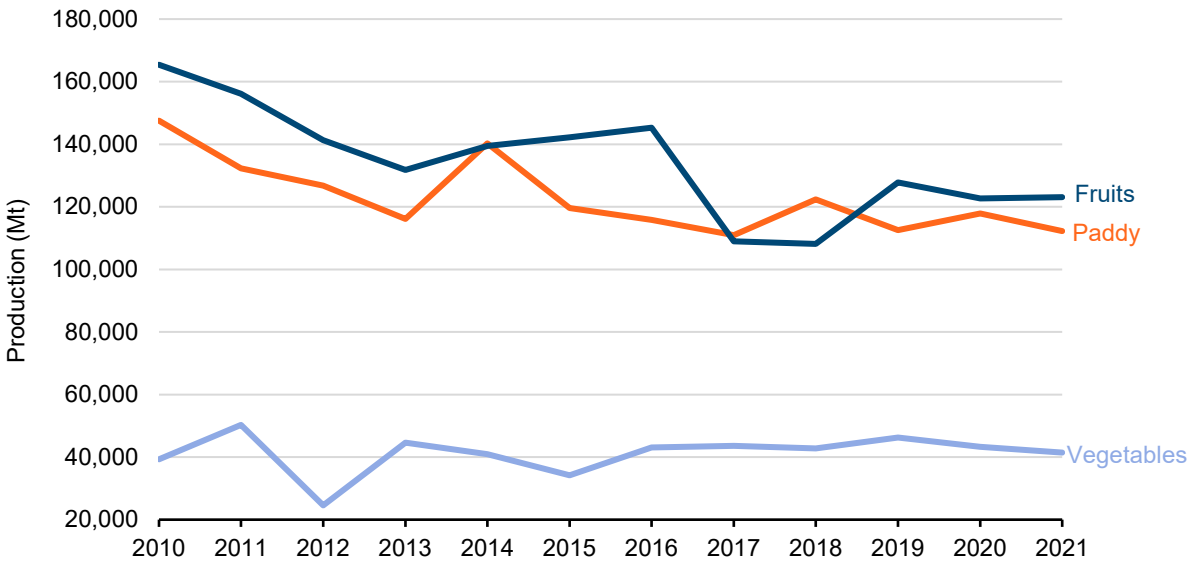
Food availability takes into account of the production and trade of key food items. Examples are carbohydrates (rice), animal-based proteins, fruits, and vegetables discussed in subsequent section.

In 2021, Sabah and Sarawak produced 112,284Mt and 148,903Mt of paddy respectively. Sabah's trend of paddy production has been fluctuating for the past 11 years but production has been kept at an average of 123,000Mt per year (Figure 3.1). On the other hand, Sarawak's paddy production accounts for 11% of Malaysia's total paddy production (Figure 3.2). From 2010 – 2018, Sarawak showcased an increasing trend in paddy production with an average production of 243,000Mt per year, whereby the average increase has been recorded at 3% annually. However, in 2019, paddy production in Sarawak decreased by 19% compared to 2018. Paddy production has been decreasing at an average rate of 17% from 2019 to 2021. A more detailed explanation on East Malaysia's paddy industry may be found in Chapter 2.

In terms of fruit production, both Sabah and Sarawak are large producers of tropical fruits where fruits such as bananas, durian, and pineapple make up a substantial portion of fruits production in both states. The trend for fruit production over the last decade has been fluctuating for both states, but overall, East Malaysia has been steadily producing an average of 18% annually of Malaysia's fruit production for the past 11 years. On the other hand, vegetable production has been recorded at an average of 41,000Mt for Sabah and 50,000Mt for Sarawak for a period of 11 years from 2010 to 2021[41].

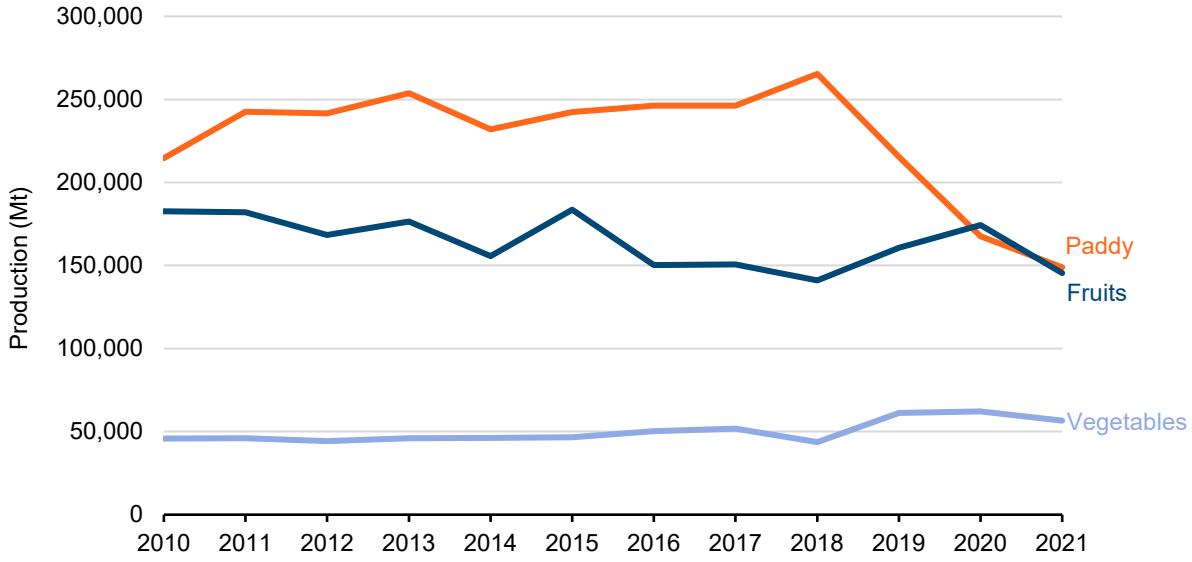
[41] MAFI (2015); (2021)

Figure 3.1: Production Trend of Paddy, Fruits, and Vegetables in Sabah, 2010 – 2020



Source: MAFI (2015); (2021)

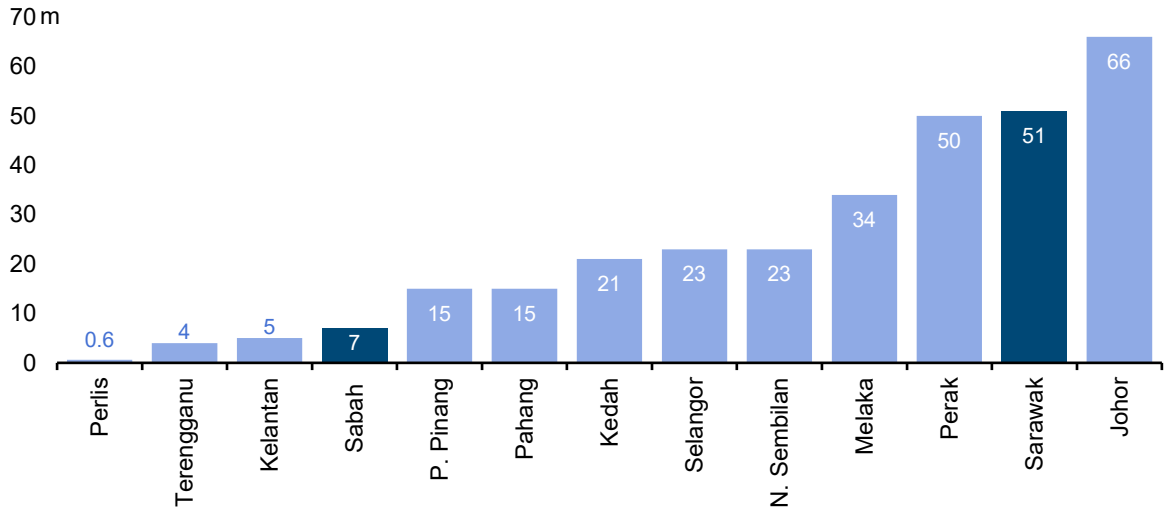
Figure 3.2: Production Trend of Paddy, Fruits, and Vegetables in Sarawak, 2010 – 2020



Source: MAFI (2015); (2021)

On the spectrum of food availability, specifically looking at livestock and fishery production, East Malaysia, particularly Sarawak, has a notable livestock industry, producing approximately 7m and 51m livestock for Sabah and Sarawak respectively in 2019 (Figure 3.3). Chicken makes up the largest portion of the state's livestock production, with Sabah supplying 6,858,731 and Sarawak supplying 35,287,926 chickens in 2019. Sarawak is the third biggest producer state for poultry with its production accounting for 11% of Malaysia's total poultry production. In terms of swine production, Sarawak has a notable swine industry, contributing about 332,940 swine in 2019 which accounted for 17% of the nation's swine production. Although falling behind in terms of overall livestock production compared to other states, Sabah is one of the highest-producing states for buffalo, cattle, goat, and sheep, producing 155,767 out of the 1,193,350 total ruminants produced in the country in 2019[42].

Figure 3.3: Livestock Count by State, 2019

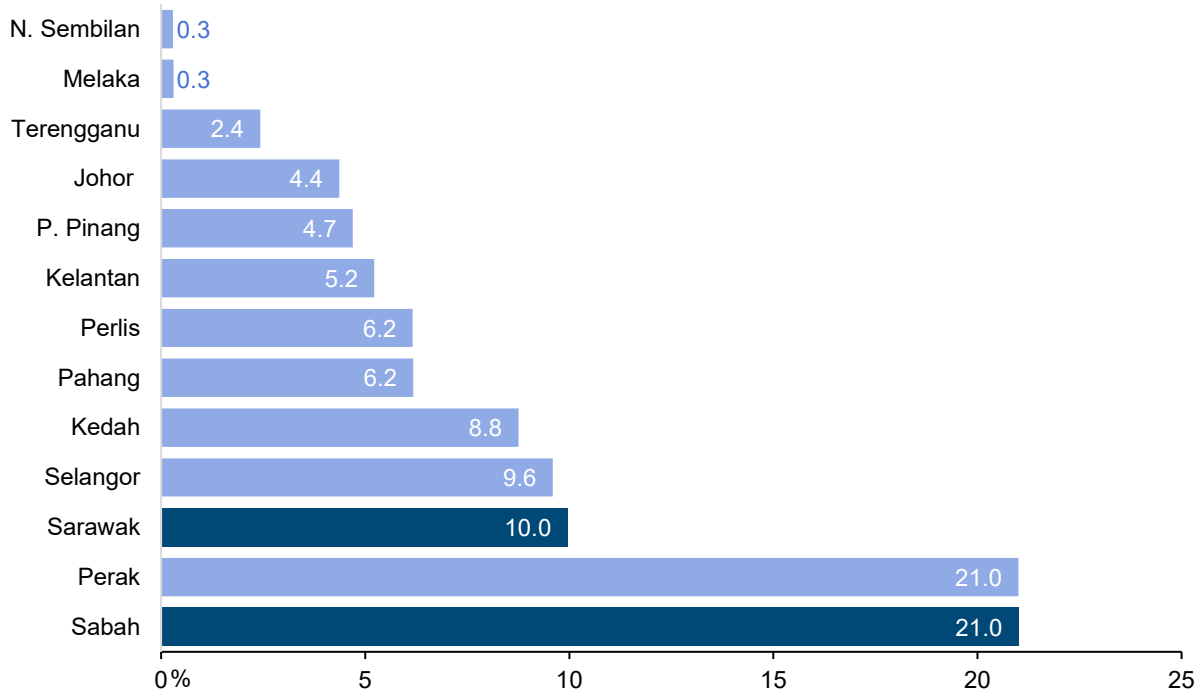


Source: DVS (2021)

In 2020, Sabah and Sarawak produced 389,101Mt and 184,380Mt of fish which equates to RM4.13b and RM1.96b respectively, as shown in Figure 3.4. Sabah showed an increase of 9.8% compared to the previous year while Sarawak recorded a decrease of 3.1% for fishery production[43]. Sabah's notable fishery industry is mainly contributed by the high landing of the inshore fishery as well as brackish water aquaculture whilst a majority of Sarawak's fishery production is contributed by the landing of the deep-sea fishery. Sabah remains one of the biggest contributors to Malaysia's fishery production, mostly due to its location that is surrounded by South China, Sulu, and the Celebes Sea on its three ends, making fishery a significant socio-economic activity[44]. Sarawak, on the other hand, is the highest-producing state for deep-sea fishery next to Perak with Miri being the most prominent fishing hub. The sizeable fishery industry in East Malaysia is also translated to the high number of fishermen, whereby there was a total of 43,186 fishermen in East Malaysia or 51% of the total fishermen in Malaysia in 2019[45].

[42] DVS (2021)
[43] DOF (2020)
[44] Abdul-Hadi et al. (2013)
[45] DOF (2020)

Figure 3.4: Share of Fishery Capture by State, 2020



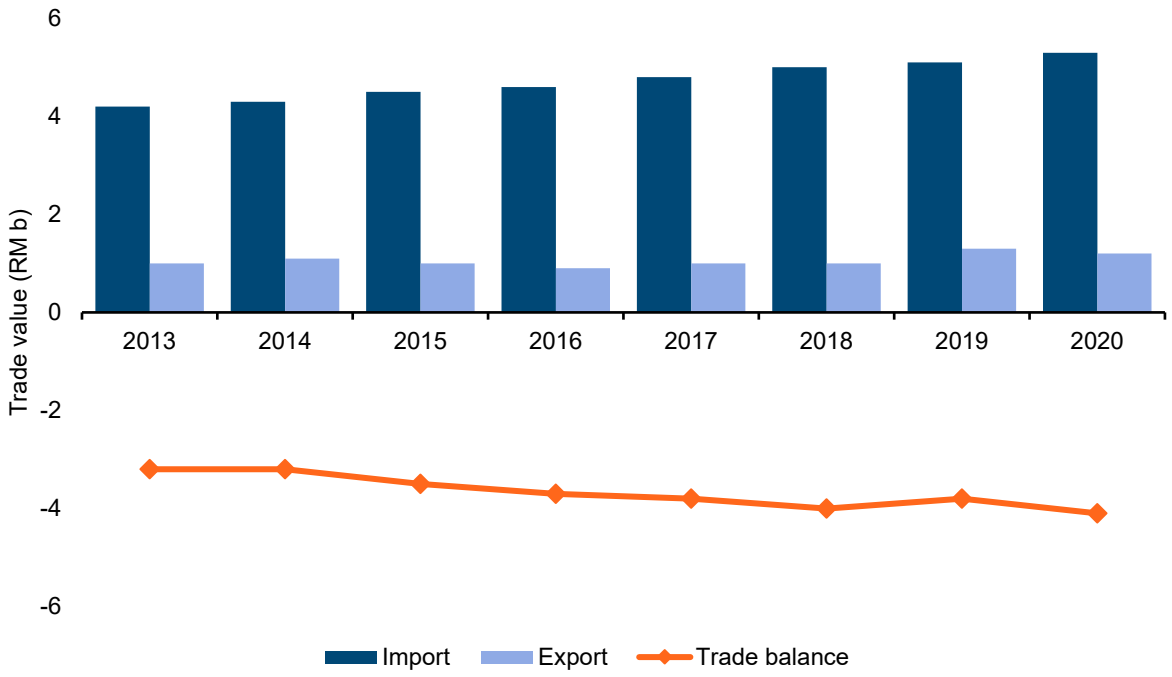
Source: DOF (2020)

3.3.2. Food Availability Through Import and Export

In 2020, Sabah recorded a total import of RM38.1b, in which food import comprised 12.9% of the total imports (Figure 3.5)[46]. Sabah's food import has been showing an increasing trend over the last decade with an average of 3.9% increase each year[47]. On the other hand, Sarawak's imports were valued at RM40.9b in 2020, showing a decrease of 8.3% from the preceding year, as illustrated in Figure 3.6. Similar to Sabah, food imports in Sarawak make up 12.6% of the total food import with an average increase of 4.3% since 2013[48]. Overall, edible food commodities that record the highest import for both Sabah and Sarawak are cereal, where import value has steadied at over RM1b annually since 2013. In addition, despite having a high SSL for fruits and vegetables, Sabah and Sarawak still record a high import value for fruits and vegetables which is kept at above RM450m annually[49]. It is noteworthy that the imported fruits and vegetables are mainly temperate and premium types which cannot be grown in East Malaysia's climate. Similarly, Sabah and Sarawak have considerably high import values of rice at RM370m and RM270m respectively as well as other food products such as meat and dairy products, indicating high import dependency towards major food items[50].

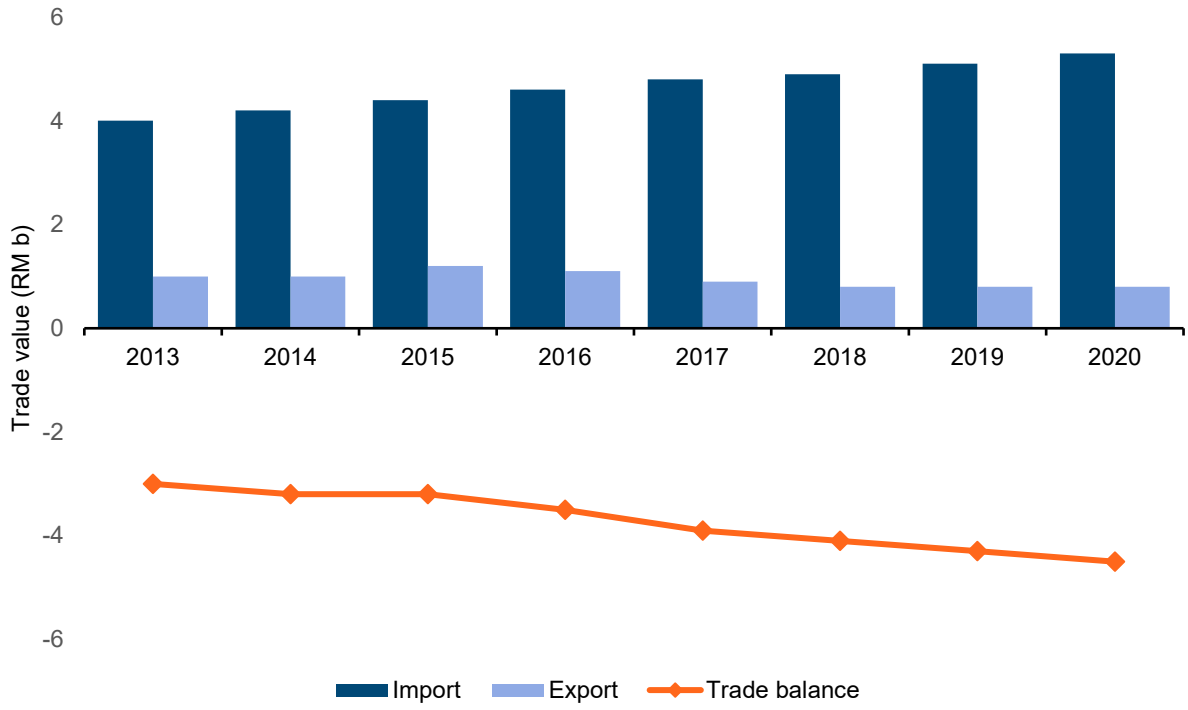
[46] DOS (2021b)
[47] Ibid.
[48] DOS (2021c)
[49] DOS (2021b); (2021c)
[50] Ibid.

Figure 3.5: Sabah Food Import and Export Trend, 2013 – 2020



Source: DOS (2021b), KRI Calculations

Figure 3.6: Sarawak Food Import and Export Trend, 2013 – 2020



Source: DOS (2021c), KRI Calculations
Note: Food import and export constitutes food products with HS 2-digit code 01-04, 07-10, 12, 16-19, 21-22 following the Harmonised Commodity Description and Coding Systems 2017 (HS2017)

As for export, Sabah and Sarawak's total export value stood at RM41.3b and RM77.2b in 2020 respectively with food export constituting only 3.9% and 1.3% of the total export[51]. As mentioned earlier, East Malaysia has a large palm oil industry and production. Therefore, its export is dominated by palm oil, constituting 31.2% and 21.2% of the total export[52]. Generally, the export of food products such as rice, fruits, and vegetables has been low compared to the import of the same food commodities. Export for seafood products, however, remains at an average of RM700m and RM300m respectively for Sabah and Sarawak, indicating a vast potential of the fishery industry in uplifting East Malaysia's food security[53]. Generally, as food imports are significantly higher than food exports, both Sabah and Sarawak have been experiencing a high food trade deficit of RM4.7b and RM3.7b respectively since 2013[54].

It is worth noting that trade in East Malaysia suffers from trade bias as most shipping companies prefer Port Klang over the ports in East Malaysia. This is partly contributed by the lack of backhaul cargo as most containers coming from East Malaysia to Peninsular Malaysia are returned empty, which causes shipping companies to double their goods charges to cover the freight rate, making the trade to East Malaysia less favourable[55]. The stringent requirements of obtaining a permit to transport certain types of food (e.g., rice) from Peninsular Malaysia to East Malaysia and vice versa further add to the trade bias issue as it makes the transport of food more tedious (Chapter 6). Besides that, companies are also imposed carriage charges due to the port's poor infrastructure as well as high insurance owing to the instability of maritime security, especially in Sabah[56].

"It is easier to import directly from another country like Vietnam, than to move rice from Peninsular Malaysia"[57].

[51] DOS (2021b); (2021c)
[52] Ibid.
[53] Ibid.
[54] Ibid.
[55] Mhd Ruslan and Mokhtar (2020)
[56] Ibid.
[57] Quoted from an East Malaysia industry player interviewed by KRI in 2022

3.3.3. Potential of Specialty Rice and Other Indigenous Crops in Improving Food Availability in East Malaysia

Overall, East Malaysia's agriculture is very much concentrated on industrial crop production which dominates most of the region's arable land. In addition, fluctuating staple food production as well as a high trade deficit can potentially drive the region to food insecurity in times of crisis. As there is a large population of indigenous communities in East Malaysia associated with having their unique indigenous crops, it certainly provides a window of opportunity for the discovery of high-value underutilised crops such as specialty rice in the region.

With hundreds of varieties of specialty rice that are mentioned in this report (Chapter 5), specialty rice's **role in improving food availability in Sabah and Sarawak must not be overlooked. This is because it could potentially make up for low rice SSL** (Chapter 2), particularly rice SSL **among the rural population, and at the same time reduce an over-reliance on rice import in the region.** Furthermore, ramping up specialty rice's production will also allow for **more of the products to be exported to Peninsular Malaysia and the neighbouring countries, allowing trade balance, reducing the trade deficit, as well as increasing the income of the local communities.**

The potential of the indigenous crop towards improving food availability is not only limited to specialty rice but also other indigenous crops as East Malaysia is rich in indigenous fruits and vegetables such as dabai (*Canarium odontophyllum*), tarap (*Artocarpus odoratissiumus*), and bambangan (*Mangifera pajang*), among many others, which are also considered as high-value due to their touted superior nutritional properties. This will be further elaborated in this chapter under *Food Utilisation.* It is reported that out of approximately 370 fruit species in Malaysia, 95% are classified as 'indigenous' and **responsible exploration of these underutilised crops may result in a more diversified and resilient food system that could benefit the local communities tremendously**[58]. Currently, a few of these indigenous crops (e.g., dabai, bario rice, beras biris, beras bajong, and terung asam) have been awarded Geographical Indication (GI)[59] protection certification by Malaysian Intellectual Property Corporation (MyIPO). This is important in ensuring the authenticity of the products and at the same time, creating more demands and awareness of the existence of these indigenous crops, especially among the urban communities who typically have higher purchasing power.

Overall, with the right intervention strategies in incorporating indigenous crops, particularly specialty rice as part of East Malaysia's plan in improving the region's food security, a holistic approach must be taken to avoid exploitation of the indigenous communities. **Although targeting specialty rice alone may not fully address food insecurity in East Malaysia, improving this particular industry by increasing yield may see some improvements and benefits to the rural community's food security status by promoting the availability and accessibility of a commonly consumed food among the local communities.**

[58] Massawe et al. (2015); Kasron, Nik Masdek, and Saari (2020)
[59] Indication used on products with specific geographical origin and possesses unique qualities and characteristics, novel to the place of origin.

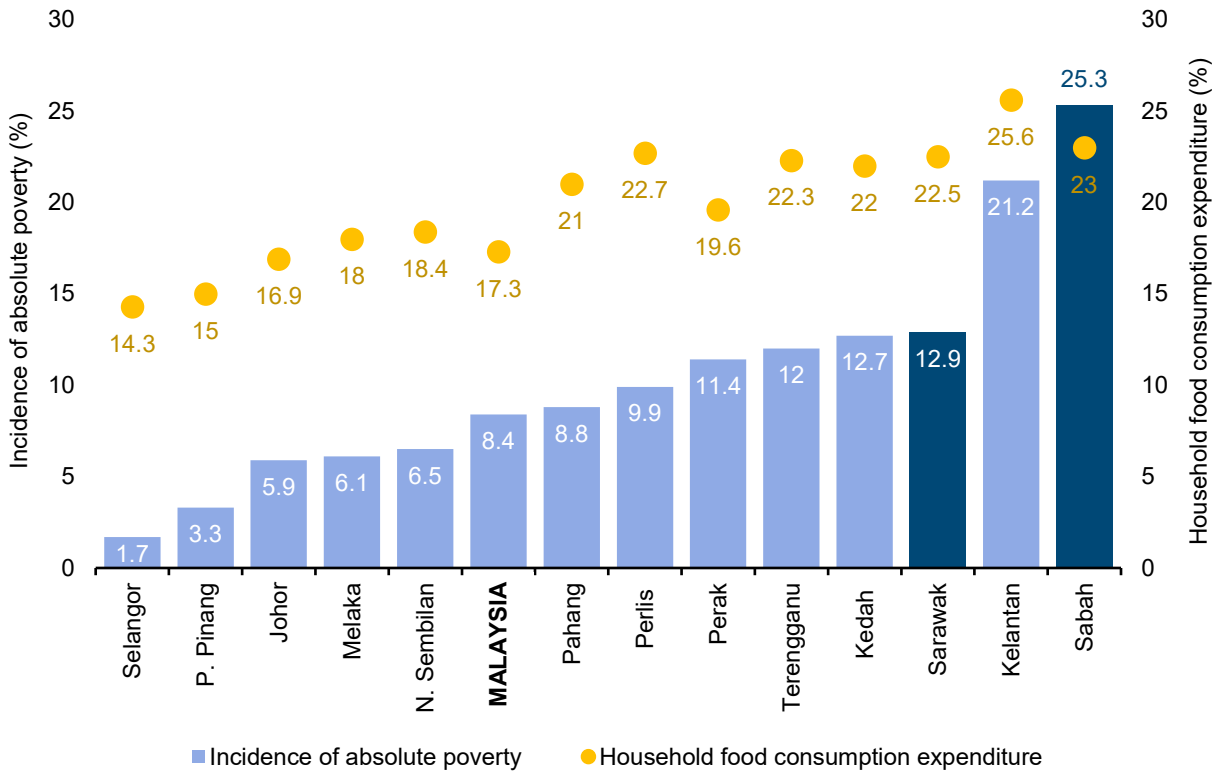
3.4 Food Accessibility

Food accessibility typically measures economic and physical access to food and is often affected by food prices, household income, employment opportunities, and resources such as labour, capital, and capability. It involves establishments providing food as well as household capability to secure food from available resources i.e., marketplace through the provision of income or other means such as food aid or cash transfers.

3.4.1 Economic Accessibility

Incidence of absolute poverty is defined as the percentage of households[60] with gross monthly household income lower than Poverty Line Income (PLI), which is predetermined at RM2,208. A household is termed as hardcore poor if their gross monthly income is below the Food PLI of RM1,169 which deemed the household as being unable to acquire basic and nutritious food items according to Ministry of Health (MOH) nutritional guidelines. According to the incidence of poverty by state, poverty in Sabah and Sarawak remain among the highest compared to other states in Peninsular Malaysia. In 2020, Sabah and Sarawak's poverty rates were recorded at 25.3% and 12.9% respectively, higher than the national average of 8.4%[61] (Figure 3.7).

Figure 3.7: Incidence of Absolute Poverty and Household Food Consumption Expenditure in Malaysia by State, 2020



Source: DOS (2021a)

[60] Household with an average size of 3.9 persons
[61] DOS (2021a)

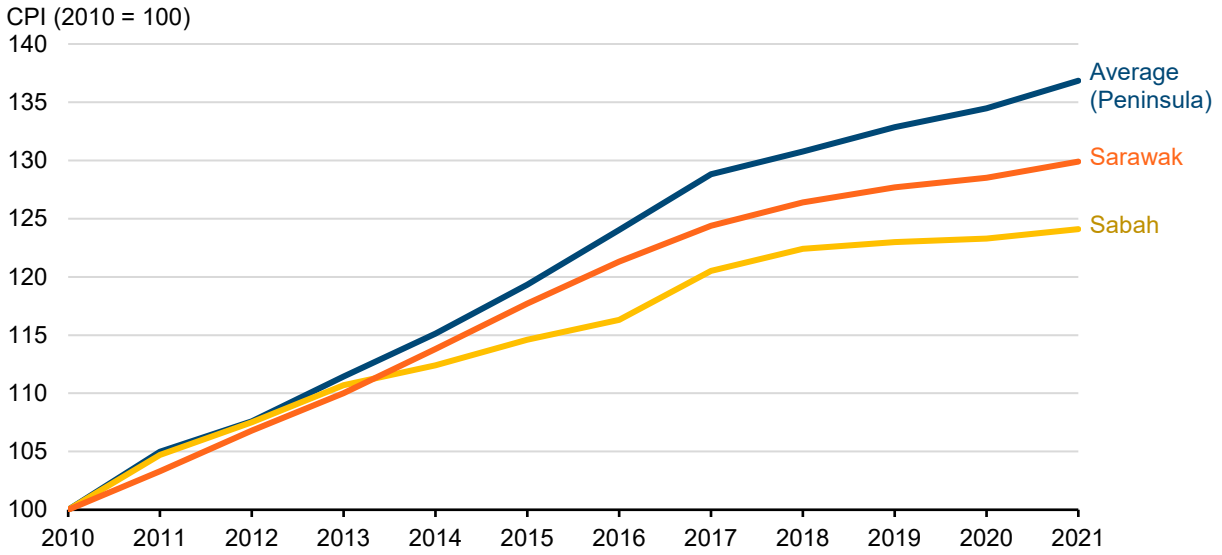
Factors contributing to the high poverty rate in East Malaysia include high rural population, low-skilled occupation, low education level, single-income households, poor access to basic infrastructure, and geographical inaccessibility[62]. With a high average rural population of 46.1% in East Malaysia where their main economic activity is concentrated towards agriculture, poverty remains high in both states, especially Sabah. Besides that, as Sabah and Sarawak are sparse in terms of their demographic and geographical placement, eradication of poverty is more difficult to achieve as some ethnics or regions have limited access to basic needs such as roads, piped water, and electricity, which significantly hinders the potential of East Malaysia to become a high-income state. According to the Economic Planning Unit (EPU), out of the 10 poorest districts in Malaysia, eight (Kota Marudu, Kota Belud, Kudat, Pitas, Beluran, Tongod, Telupid, and Nabawan) are situated in Sabah and one (Pusa) is located in Sarawak. A common factor that contributes to poverty in these districts are low-value economic activities such as fishing and farming.

With regards to household food consumption expenditure, there is a noticeable trend whereby states that have a high poverty rate tend to have higher household food consumption expenditure. Sarawak's and Sabah's household food consumption expenditure stood at 22.5% and 23% respectively, higher than the national average of 17.3%[63]. This trend is parallel to Engel's law which states that the proportion of income allocated for food will decrease as income increases. Households with lower income tend to spend a large portion of their earnings on basic necessities such as food, education, and housing, while also having a low disposable income. With regards to food choices, low-income households might also have a less diversified diet compared to the more affluent consumers, and their food basket will typically consist of cheaper options of carbohydrate-rich foods, therefore making these households more vulnerable towards food insecurity due to less diet diversification.

Looking at food prices as one of the factors that hinders food accessibility, Food Consumer Price Index (CPI) in Malaysia showed a gradual increase over the past decade. As depicted inFigure 3.8, the average prices of food in Peninsular Malaysia rose steadily, higher than that in Sabah and Sarawak. Sarawak indicated a greater rise in prices compared to Sabah. Lower purchasing power is reflected by rising CPI, adversely impacting the consumption pattern of the poorest households resulting in a reduction in the standards of living in both states.

[62] Ationg et al. (2020); EPU (2021)
[63] DOS (2020)

Figure 3.8: Food Consumer Price Index (2010 = 100), 2021

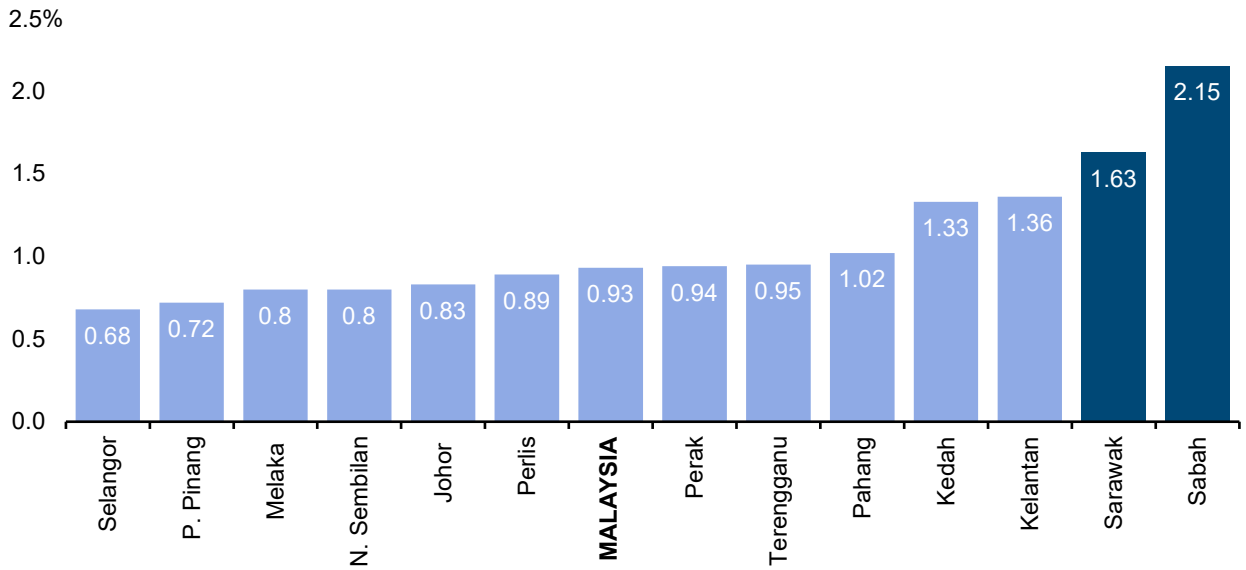


Source: DOS (2022), KRI calculations

In addition to high poverty and the rising food CPI, Sabah and Sarawak are the two states with the highest monthly household rice expenditure, spending around 2.2% and 1.6% of their income or equivalent of RM60 and RM56 respectively compared to the national average of RM42[64] (Figure 3.9). There is a close relationship between income and rice consumption. Households with a higher income tend to move away from rice consumption, replacing it with other higher value-added foods[65]. Therefore, since Sabah and Sarawak's rural population is high coupled with high poverty, this is reflected in the high consumption and expenditure on rice as it remains the main source of energy, especially among vulnerable households. Historically, poorer households spend a larger proportion of their income on staple food such as rice as part of their consumption expenditure[66]. Hence, the decline in income could cause the accessibility of food to become more acute for the bulk of households.

[64] DOS (2020)
[65] Mottaleb and Mishra (2016)
[66] Haq and Arshid (2009); Bouis, Eozenou, and Rahman (2011)

Figure 3.9: Household Mean Rice Consumption Expenditure by State, 2019



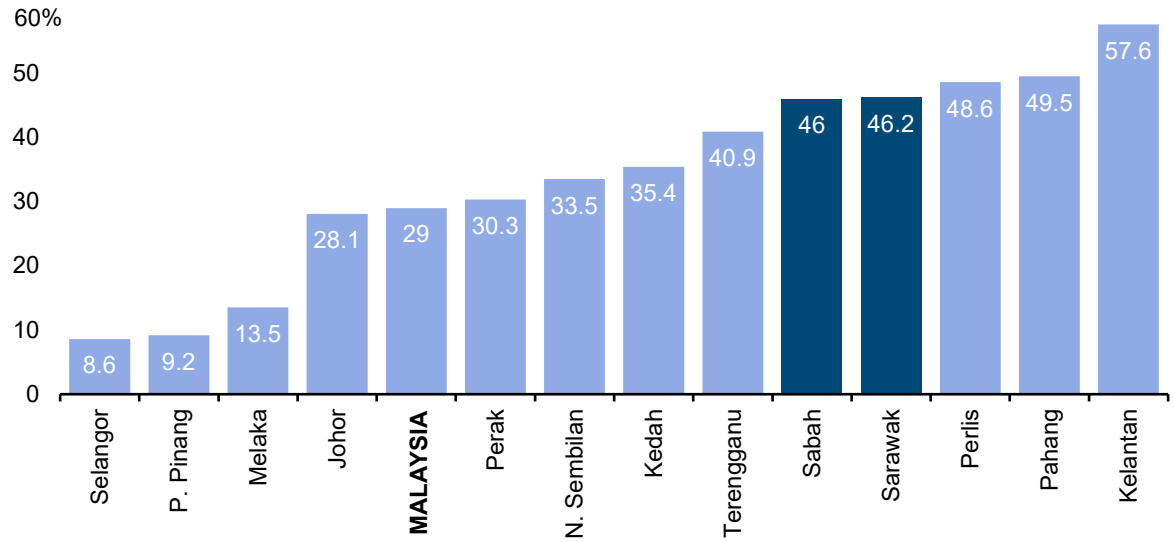
Source: DOS (2020)

3.4.2. Physical Accessibility

Apart from economic accessibility, physical access to the market is also another factor affecting the food accessibility dimension of food security, which is mostly affecting rural communities. Sabah and Sarawak rural populations are as high as 46% and 46.2% respectively, which significantly surpasses the average value of Malaysia's rural community of 29% (Figure 3.10). For a period of 40 years from 1970-2010, the rural community in East Malaysia has been declining at an average rate of 0.9%, but the figures remain high compared to most states in Malaysia[67]. As pointed out by Ahmadi Dehrashid et al. (2021), remoteness is the major constraint on development in rural areas because it restricts the understanding of the nature of rural poverty and also because there is a lack of access to basic resources and facilities, as are commonly found in the urban areas[68]. The absence of proper infrastructure such as roads is one of the major constraints for poverty alleviation as it limits diversification of income and hinders potential in increasing agricultural production as farmers are not able to sell their produce, hence causing rural households to be more vulnerable to food insecurity[69].

[67] DOS (2010)
[68] Ahmadi Dehrashid et al. (2021)
[69] Windle and Cramb (1997)

Figure 3.10: Malaysia Rural Population by State, 2010



Source: DOS (2010)

To improve food security in rural areas, the government initiated the 'Community Drumming' programme to keep the costs of essential food items such as rice, cooking oil, flour, and sugar at a low and subsidised price. As high transportation, marketing, and distribution costs are one of the major contributing factors of high food prices in rural areas of East Malaysia, the government's initiative in absorbing these contributing costs has resulted in lowered essential food prices since its initiation in 2009. Prior to its inception, communities in rural areas have experienced food costs that are almost double the food cost in urban areas, particularly due to the inaccessibility of food delivery services to these areas, with some areas taking almost 6 hours to reach via logging routes[70].

3.4.3. Specialty Rice as Means for Poverty Alleviation Among Rural Communities

The volatility of weather variables, climate change, and changes in production and consumption patterns influence food prices, subsequently affecting rural affordability. With rising food prices and increased dependency on food imports to meet domestic demand, this could further aggravate food security. Although food availability is projected to increase due to the rise in capacity of global food production, this does not necessarily mean that the poorest and most vulnerable will have equal economic access to staple foods such as rice.

[70] Edward (2021)

To help Sabah and Sarawak farmers attain comfortable earnings from their otherwise subsistence farming, the commercialisation of their traditional rice cultivation is suggested. This can be done by cultivating and increasing the output of underutilised local varieties for the production of high-value premium products with the help of NGOs or SEs. **This will lessen the reliance on rice imports as well as improve the income of rural communities as they can consume their own harvests and sell off the excess as premium products.** Farmers must also pay attention to the quality of rice produced and focus on adopting and maintaining good and sustainable agricultural practices which can help to increase farmers' incomes and help care for the environment.

Box 1.2: Economic Impacts of Geographical Indication (GI) – Case Studies from Developing Countries

Geographical Indication (GI) as defined by the 1994 Trade-Related Aspects of Intellectual Property (TRIPS Agreement) of the World Trade Organisation (WTO) as the "indications which identify a good as originating in the territory of a Member, or a region or locality in that territory, where a given quality, reputation or other characteristics of the good is essentially attributable to its geographical origin"[71].

Essentially, GI offers distinction to products with regard to their characteristics, qualities or reputation which is linked specifically to a geographical origin and may be influenced by natural and human factors such as soil, climate, indigenous knowledge, or traditions. Currently, the trade value of GI is at USD50b with more than 10,000 GI products globally[72]. Some of the prominent GI products include Parmigiano-Reggiano Cheese, Idaho Potatoes, Darjeeling tea, and Champagne. Although a majority of GI products originated from OECD countries, there has been recent interest in GI from developing countries, and there have been many studies on the socio-economic impact of GI, especially on rural communities[73].

Case Study 1: Cao Phong Orange, Vietnam

The Cao Phong orange originates from Cao Phong, a rural district located in the Northwest region of Vietnam. The Cao Phong orange is deemed as one of the most popular orange varieties in Vietnam due to its distinctive taste, largely contributed by the geographical characteristics of the origin area which is described as mountainous, rich in Feralit soil, yielded on either yellowish-brown magma or limestone and is appropriately humid. Production of Cao Phong oranges started to grow in the 1970s as the product began to be exported to Soviet Union and several Eastern European countries. However, production only began to surge in the 1990s as a result of supporting policies from the Vietnam central government. In 2014, the GI certification for Cao Phong oranges was made official which resulted in the average daily consumption of the product to increase from 50kg/day to almost 500kg/day, and the market for the product also expanded due to increased demand from neighbouring provinces.

[71] FAO (2018)
[72] Giovannucci et al. (2009)
[73] Rangnekar (2004)

In terms of the economic impact of the GI certification on the rural communities, farmers noted that the price of Cao Phong oranges increased significantly. With an initial price point of Vietnamese Dong (VND) 5,000/kg to VND7,000/kg, the product is now priced at VND30,000/kg to VND35,000/kg and may go up to as high as VND60,000/kg at any point in time. As the average crop yield is 50tons/Ha, a household can earn up to a total revenue of almost VND1b/Ha, which could generate VND700m/Ha in profit. It is also noted that the average income of Cao Phong orange farmers doubled from VND300m/hectare in 2012 to VND600m/Ha in 2019[74].

Case Study 2: Darjeeling tea

Darjeeling is a small district in the extreme north of India's West Bengal state, located in the Himalayan foothills. Characterised by high altitude rainfall variability and humidity, and favourable wind speed, Darjeeling is an excellent location for tea plantations as tea planted in this area has a distinct characteristic influenced by local environmental factors. Tea manufacturing is the main economic activity in the area with tea plantations covering 17,542Ha with a total of 87 estates.

Local know-how is also another factor that contributes to the uniqueness of Darjeeling tea as planting and plucking methods are passed down through generations. Additionally, productivity is very much influenced by a specific plucking technique known as 'two-leaves-one-bud-shoots', a technique that is not commonly seen in other tea-growing areas in India. Despite having a massive growing area and favourable yield, Darjeeling tea is mainly produced for the export market whereby 70% of production is exported.

In 2004, Darjeeling tea became the first Indian product to be registered under the Geographical Indication of Goods (Registration & Protection) Act of 1999. As a result, the quality, productivity, and price of Darjeeling tea increased significantly. In 2002, the production of Darjeeling tea reached 9.18m kg and was priced at Rs128.52/kg but in 2008 after GI registration, production increased to 11.59m kg and the tea's price rose to Rs204.88/kg[75].

[74] Le et al. (2020)
[75] Datta (2010)

3.5 Food Utilisation

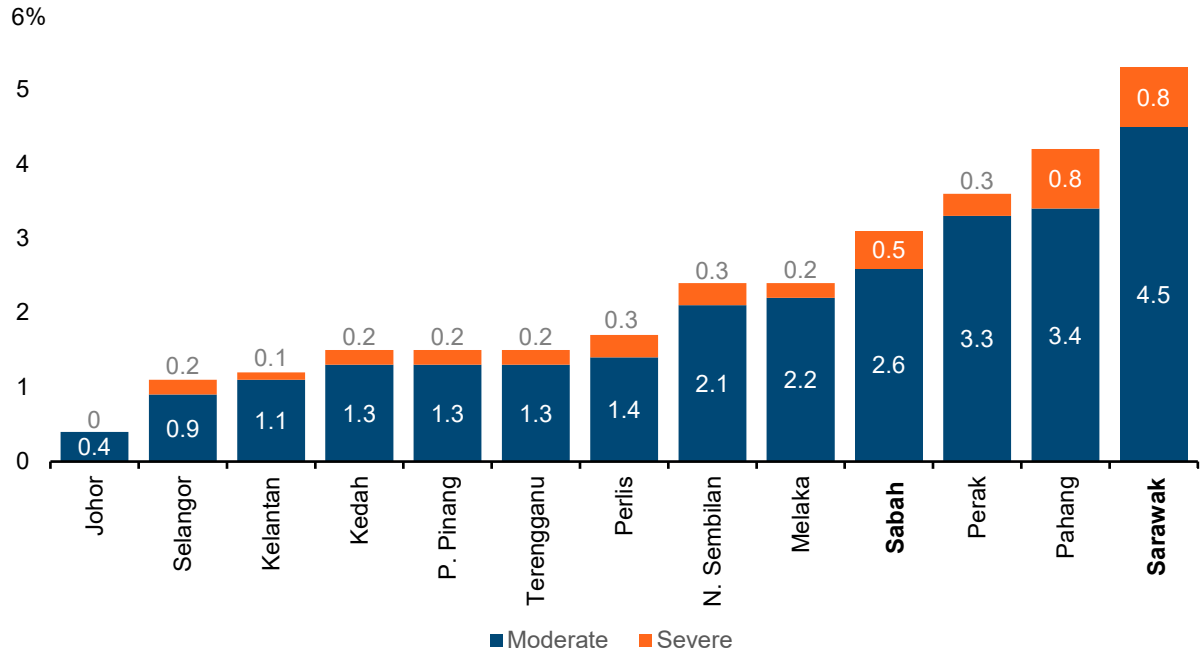
The third dimension of food security measures the ability of a human to physically absorb safe and nutritious food that is essential for nutrition. Apart from the consumption of healthy food, the utilisation dimension is closely related to a person's overall health status which may be affected by many non-food factors such as access to clean water and sanitation, access to proper health and childcare, food safety, adequate nutritional knowledge, and proper application of such knowledge [76]. Indicators of food utilisation include, but are not limited to, the prevalence of malnutrition and non-communicable diseases (NCDs) among children and adults, household access to safe drinking water, the establishment of national dietary guidelines, and the existence of national nutrition monitoring and surveillance programmes.

3.5.1 Prevalence of Malnutrition in East Malaysia

Looking at the prevalence of malnutrition among children in East Malaysia, both Sabah and Sarawak record among the highest prevalence of moderate [77] and severe [78] malnutrition, with Sarawak being the highest compared to other states in Malaysia (Figure 3.11). Moderate malnutrition is distinguished from severe malnutrition through the difference of weight-for-height z-score (WHZ)[79]. Many factors might contribute to the high level of malnutrition among children in East Malaysia which may include socio-economic and demographic factors where household income and household size might limit a child's access to nutritious food[80]. Financial limitations will limit the ability to acquire safe, sufficient, and nutritious food whereby households experiencing poverty tend to prioritise their expenditure on necessities (e.g., rent, electricity bill, essential food items)[81]. The importance of consuming a nutrient-dense food is often overlooked which leads to children growing up in these households experiencing macronutrient and micronutrient deficiencies. Protein deficiencies will also be more apparent as animal-based food is seen as luxurious food items and food expenditure will focus on obtaining energy-dense food. Furthermore, a study by Tan et al. (2020) also noted that lack of access to clean water and sanitation as well as health and biological factors such as frequent illness, especially for children residing in rural areas are also among the factors contributing to a high prevalence of malnutrition as nutrition cannot be effectively absorbed[82].

[76] Gibson (2012)
[77] WHZ between 2 and 3.
[78] WHZ >3, arm circumference <110mm, or with the presence of nutritional oedema.
[79] The standard deviation of a child's weight from the median weight of a child with the same height within a reference data.
[80] Wong et al. (2015)
[81] Siddiqui et al. (2020)
[82] Tan et al. (2020)

Figure 3.11: Prevalence of Moderate and Severe Child Malnutrition in Malaysia, 2018

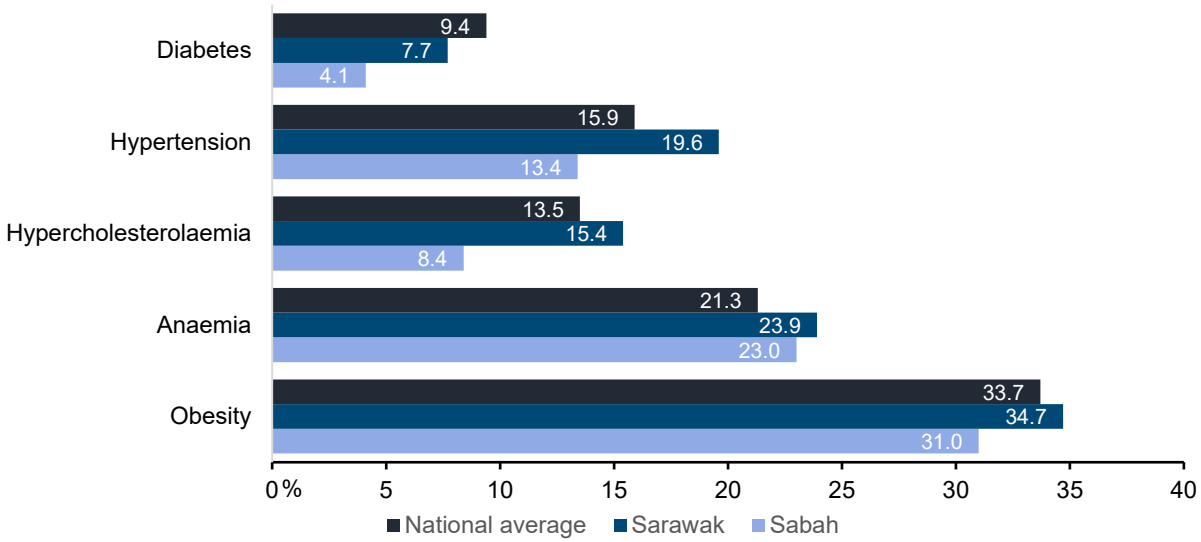


Source: DOS (2018)

In terms of the prevalence of malnutrition among adults (Figure 3.12), Sabah and Sarawak's prevalence of obesity stood at 31.0% and 34.7% respectively, whereby Sarawak's prevalence of obesity is higher than Malaysia's average of 33.7%[83]. As for the prevalence of anaemia among women of reproductive age, both Sabah and Sarawak recorded a prevalence of anaemia higher than Malaysia's average at 23.0% and 23.9% respectively[84]. Obesity and anaemia may be viewed as an indicator of overnutrition and undernutrition respectively. Poverty is often associated with obesity as overweight or obese adults tend to consume food that is low cost and high in energy in order to stay full longer. Overconsumption of high-calorie food that is high in salt, sugar, and trans fatty acids will subsequently lead to excessive weight gain [85]. On the other hand, the high prevalence of anaemia is contributed mainly by iron deficiencies alongside the lack of other vitamins and minerals such as folate, vitamin B12, vitamin A, and copper in daily diet[86]. Food with high iron includes red meat, poultry, legumes, and dark green leafy vegetables. These foods may be inaccessible to some households, especially households that have limited disposable income.

[83] IPH (2020)
[84] Ibid.
[85] NCD Alliance (2021)
[86] McLean et al. (2009)

Figure 3.12: Prevalence of Adult Malnutrition in East Malaysia, 2019



Source: IPH (2020)

Food utilisation may also be assessed through the prevalence of NCDs such as hypertension, diabetes, and hypercholesterolemia. Sabah recorded the lowest prevalence of hypercholesterolemia and diabetes with only 8.4% and 4.1% respectively[87]. Sarawak has a fairly average prevalence of hypercholesterolemia and diabetes with 15.4% and 7.7% respectively[88]. As for the prevalence of hypertension, Sabah and Sarawak stood at 13.4% and 19.6% respectively[89]. Although the prevalence of NCDs mentioned above may not be as high for both Sabah and Sarawak, there are still some risks of the increasing prevalence of these diseases due to the high prevalence of obesity. As aforementioned, foods associated with obesity include high sugar, high salt, and high fat foods. Similarly, these foods also contribute to NCDs.

3.5.2. Potential of Specialty Rice to Alleviate Malnutrition

With regards to addressing malnutrition issues faced by the people in East Malaysia, specialty rice may not solve malnutrition, but have the potential of lowering the prevalence of some common nutritional issues. With the wide range specialty rice varieties including pigmented rice, many studies have proven the nutritional benefits of specialty rice including high antioxidant activity, low glycemic index (GI)[90], and a good supplementary source of protein[91]. For generations, pigmented rice has been showcasing a potential in contributing to health benefits among rural communities in other countries.

[87] IPH (2020)
[88] Ibid.
[89] Ibid.
[90] A value assigned to foods based on how quickly and how high carbohydrate-containing foods raise blood glucose level after consumption.
[91] Rathna Priya et al. (2019); Pillai, Faseela, and Thampi (2020); Kowsalya, Sharanyakanth, and Mahendran (2022)

In India, for example, traditional rice varieties are known to have high phenolic contents[92] that may help in protecting against degenerative diseases. Similar studies have also been conducted on the nutritional value of upland rice in Luang Prabang Province in Lao People's Democratic Republic which also showed a strong association of pigmented rice with higher levels of anthocyanin which is a compound that is reported to have successfully lowered NCDs such as hypertension and diabetes[93]. Another study in South Korea by Kim et al. (2008) also showed the potential of pigmented rice, particularly brown and black rice in the reduction of weight, body mass index (BMI), and body fat due to its lower GI compared to normal rice varieties[94].

Overall, pigmented rice is associated with having health-related properties due to the presence of phenolic compounds, tocopherol, flavonoids, anthocyanin, and phytic acid[95]. Comparing pigmented rice to the conventional white rice that is mostly sold in the market, pigmented rice is beneficial in its nutritional qualities due to the presence of the outer bran layer on the cereal grain. Typically, the production of white rice requires the removal of the outer bran through milling and dehulling processes, which in turn removes a significant amount of micronutrients, antioxidants, and fibres that are essential in reducing the issues of malnutrition[96].

Although limited studies have been conducted on the nutritional benefits of indigenous rice in Malaysia, a study that is focused on Bario rice has shown that the rice varieties have a moderate GI (range of 55 – 69)[97]. Food with low or moderate GI has been reported to lowering blood sugar levels while at the same time lowering risk of diabetes and the risk of cardiovascular diseases[98]. Apart from having moderate GI, indigenous rice also may serve as a good supplementary source of protein. The same study by Nicholas et al. also proved the protein content of pigmented indigenous rice to be around 5.9 – 7.3%, which classify the rice variety to have a good source of protein[99]. Although the protein content of pigmented rice may not be as superior as compared to protein from animal-based food or pulses, it can help improve the nutrition intake among rural communities that are already food insecure due to the lack of access to protein-rich foods.

Specialty rice may be important in filling in the nutrition gaps among rural communities, provided there is rigorous research done on the nutritional benefits of these heirloom/specialty rice**. With abundant varieties of specialty rice, in which most are still undiscovered, there are very few studies that have been conducted on East Malaysia's specialty rice, therefore, making it difficult to conclude whether its nutritional benefits are superior compared to the normal variety. However, the limited evidence available does point towards the potential benefits.** It is an area that is worth exploring as the prevalence of malnutrition among Malaysians is currently rising and specialty rice might be able to fill some gaps to improve the nutrition status of all Malaysians, not just for the people of East Malaysia.

[92] Anuprialashmi et al. (2019)
[93] Xiongsiyee et al. (2018)
[94] Kim et al. (2008)
[95] Kim et al. (2008); Xiongsiyee et al. (2018); Anuprialashmi et al. (2019)
[96] Mbanjo et al. (2020)
[97] Nicholas et al. (2014)
[98] Ibid.
[99] Ibid.

It is also important to note that specialty rice will not displace the importance of a healthy balanced diet, nor does it outweigh the superiority of other staple food, but instead its role is important in supplementing the diet of Malaysians by providing essential nutrients that might be lacking in everyday food intake. Lastly, as rigorous plantation of specialty rice improves income among rural farmers, this will provide income security which will subsequently lead to these farming households having more disposable income to buy healthy food from other food groups (protein and vegetables), hence improving overall nutrition.

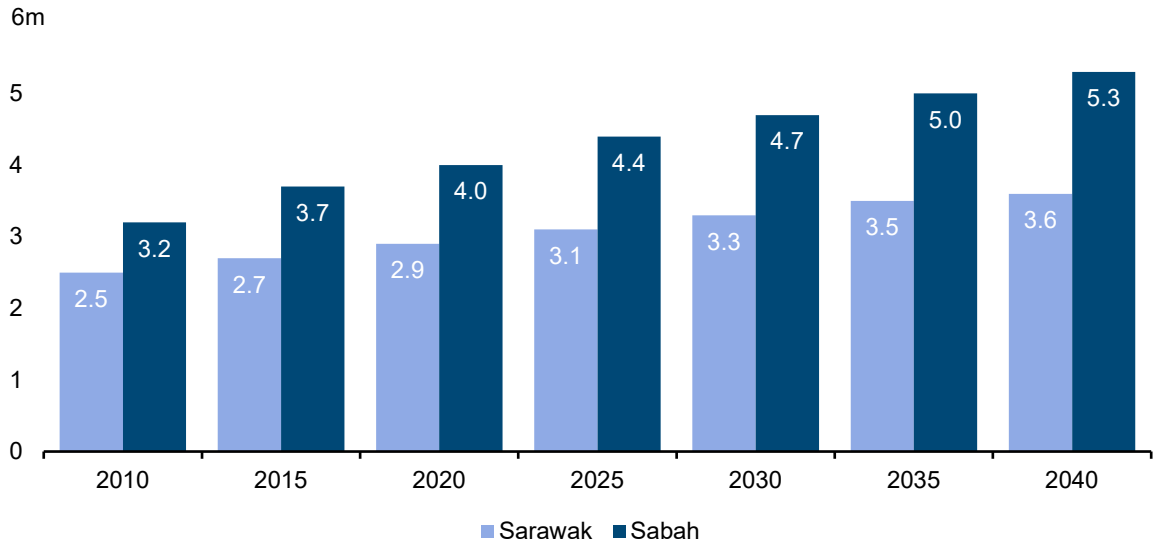
3.6 Food Stability and Sustainability

Food stability is a measure of food system resilience and must be present at all times in regard to food availability, access, and utilisation for food security to exist. Food stability is vulnerable to many factors including, but not limited to political instability, climate shocks, and rapid population growth. On the other hand, the term 'sustainability' carries the meaning of **'development that meets the needs of the present without jeopardising the ability of future generations to meet their own needs'**[100]. Generally, there are three pillars of sustainability which are environmental, economic, and social sustainability. These three pillars keep the balance of the earth's environmental system and at the same time maintain human access to financial resources or other means to meet their needs while ensuring universal human rights and basic necessities are attainable. Therefore, food sustainability incorporates the three elements of sustainability across all levels of the food supply chain to create a safe food system that caters to the current population and produces food at a rate where resources can replenish themselves for the sake of the future generation.

As the global population is increasing at a rate of 1.3% annually, Malaysia is no exception in the race for rapid population growth. Focusing on East Malaysia, Sabah's and Sarawak's population growth is expected to increase by 23% and 30% with annual growth of 0.8% and 1% respectively by the year 2040 in comparison to the current population[101] (Figure 3.13). Population growth is an important measure of food stability and sustainability as it naturally increases food demand which subsequently results in additional use of arable land and water which will overall put pressure on Earth's natural resources.

[100] Brundtland (1987)
[101] CEIC n.d.

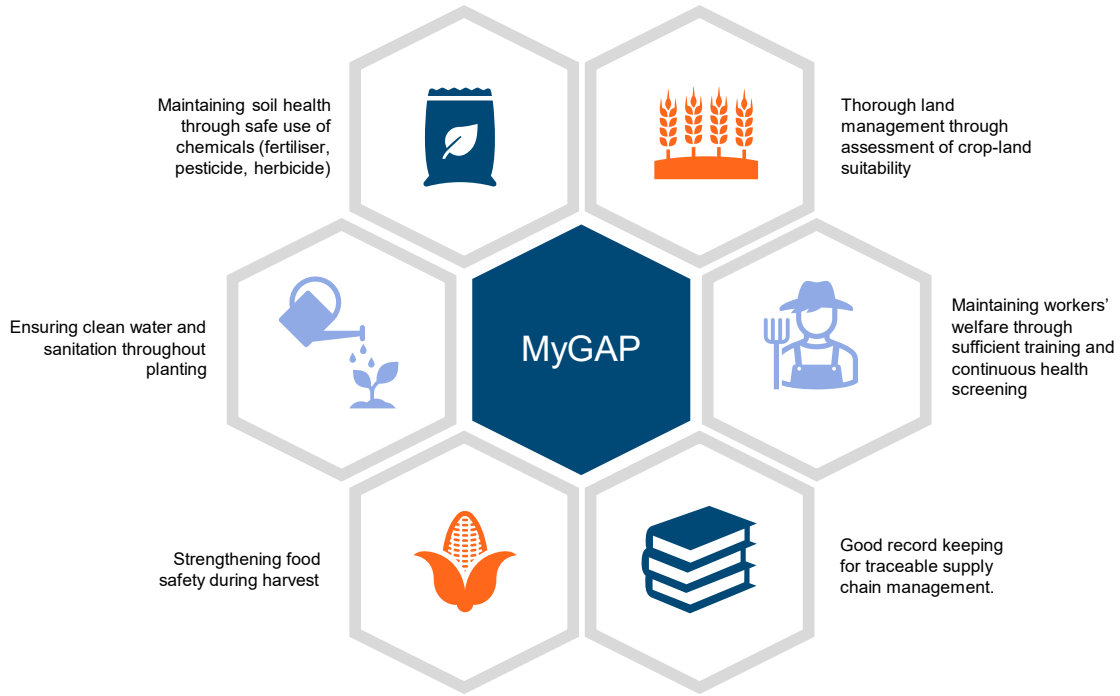
Figure 3.13: East Malaysia Current and Projected Population Growth, 2010 – 2040



Source: DOS (2010), CEIC (n.d.)

Currently, Malaysia is practising a sustainable certification system called Malaysia Good Agricultural Practices (MyGAP) which was established in 2002 as one of the efforts to encourage farmers in the agricultural, aquaculture, and livestock sector to adopt safer and sustainable farming methods while maintaining the quality of food production and ensuring workers' welfare. MyGAP is a comprehensive sustainable certification system that incorporates multi-dimensional criteria as listed in Figure 3.14;

Figure 3.14: Multidimensional Criteria of MyGAP



Source: DOA (n.d.), KRI illustration

Throughout Malaysia, there is a total of 5,117 agricultural farms (not including livestock/fisheries) that have received MyGAP certification and only 372 (7%) of those farms are situated in East Malaysia [102]. In Sabah, there are 47 paddy farmers with MyGAP certification which covers approximately only 105.8Ha of land while in Sarawak, there are 24 paddy farmers that have received MyGAP certification which covers an area of 17.59Ha [103]. It is also noted that paddy farmers that have received MyGAP certification are farmers producing wet paddy that are meant for commercialisation and there is a limited number of upland rice farmers that have applied for this certification, which shows the **underexplored potential of upland rice farmers who might already be in the practice of sustainable farming.**

The concept of sustainable agriculture has been practised long ago among the indigenous community through agroecology practices. The term agroecology refers to a collective approach that incorporates ecological and social concepts and principles into the design and management of food and agricultural systems to achieve a balance between plants, humans, animals, and environments, and also taking into account the social and welfare elements towards a sustainable and fair food system [104].

Currently, sustainable agriculture is centred towards the use of technological innovations such as vertical farming and precision agriculture which aim to reduce environmental impact and ecological footprint through reduced use of natural resources. However, agroecological practices have always been embedded among indigenous communities throughout the globe using local varieties, seed-saving methods, soil conservation measures, and the production of compost from local organic material for fertilisation purpose [105]. All of these methods are also effective in protecting the environment from suffering agricultural-induced impact, which may lead to climate change. The role of indigenous people in the fight against climate change is also well established as their possessed knowledge in climate, botany, ecological, and spiritual aspects create resilience as a result of coping, adaptive, and transformative mechanisms which will then lead to transformational responses in the face of environmental degradation [106].

[102] DOA (2022)
[103] Ibid.
[104] FAO, n.d.
[105] Ibid.
[106] Ford et al. (2020)

In the highlands of East Malaysia, sustainable farming practices such as SRI (Box 1.3) have been practised among rural farmers in the production of specialty rice. This is an example of agroecological farming practices applied on a small scale. The potential of the agroecological farming system has been well documented throughout the globe and has been proven to produce high yields for staple crops like rice, beans, maize, and potatoes which have benefited millions of households[107]. It is also noted that successes in agroecological farming systems are also heavily reliant on collective initiatives between farmers and the right support from the government, NGOs, and research organisations to fully develop the potential of agroecological farming systems in producing high-yield crops. **A few notable NGOs and SEs such as World Wildlife Fund (WWF) Malaysia and Forever Sabah have started initiatives of helping the rural communities in Sabah and Sarawak to farm sustainably and at the same time market their products to Peninsular Malaysia and other countries.** By leveraging on issues such as unsold excess produce and low income among farmers, these organisations procure the excess specialty rice at a fair price (i.e., through direct trade) and subsequently help in gaining market access through attractive packaging, proper preservation methods, and tedious regulatory processes. Profits will then be reinvested to farmers in capacity building such as efficient farming machinery and relevant training in order to retain the cycle of sustainable practices that rural farmers are accustomed to.

Overall, sustainable agricultural practices such as MyGAP should be more widely applied to replace the current unsustainable agricultural practices that are being applied for the food system to be more resilient and environmentally friendly. As food production is expected to increase to cater to population growth and increasing food demand, sustainable farming practices can cushion some of the impacts of global warming and land deterioration that are brought by the intensification of food production.

[107] Altieri, Funes-Monzote, and Petersen (2012)

Box 1.3: Systems of Rice Intensification

Systems of Rice Intensification (SRI) is a set of sustainable farm management practices that originated from Madagascar in the 1980s and has been adopted in over 60 countries including China, India, Cambodia, Indonesia, the Philippines, and Brazil. Globally, rice production is responsible for 11% of nitrous oxide (N_2O), and 30% methane (CH_4) emission. With water shortages, land degradation, land shortages, and climate change issues that are recently on the rise, SRI provides a solution that can potentially reduce the environmental impact of rice production and subsequently improve farmers' income and food security[108].

Essentially, SRI does not involve high-cost technological innovation but instead utilises scientifically proven methods, effective plant, water, and nutrient management as well as indigenous agroecological knowledge in order to create a system that enables farmers to gain more output with significantly less input[109]. A comparison between SRI and conventional method may be found in Table 3.2.

Core Principles of SRI

1. Preparation of land through intensive ploughing, puddling, levelling, and raking.
2. Developing nutrient-dense and chemical-free seedbeds.
3. Transplanting young seedlings singly with a depth of only 1-2cm with roots and seed sac still intact.
4. Usage of organic fertilisers (compost/manure).
5. Adequate spacing between plantings.
6. Moist and unflooded soil.
7. Frequent weeding.

Table 3.2: Comparison between SRI and Conventional Rice Farming Method

Management system	SRI	Conventional
Planting method	Only 1-2 seedlings per square pattern with a spacing of 20-30cm apart.	6-8 seedlings planted randomly with a spacing of 10-15cm apart.
Seedlings maturity	Young seedlings are typically 8-12 days old.	Old seedlings are typically 21-40 days old.
Type of fertiliser	Organic	Inorganic
Watering system	Intermittent water application (soils are not flooded). 1-2cm water.	Continuous flooding. 5-15cm water.
Weeding	Manual	Automatic

Source: Uphoff (2012), Thakur, Uphoff, and Stoop (2016), G. Sun et al. (2021)

[108] Sun et al. (2021)
[109] Thakur, Uphoff, and Stoop (2016)

Although there is limited scientific evidence on the effectiveness of SRI as compared to the conventional rice farming method, there have been numerous case studies that have proven SRI to be economically beneficial to farmers. Through collective SRI principles, farmers are able to save water by 50%, reduce seedlings usage by 80-90%, reduce farming cost by 23%, and increase yield by 20-40% which subsequently increased income per hectare by as high as 70%[110].

Furthermore, SRI has also been proven to improve yield quality as rice produced using the SRI method is said to have stronger tillers, thicker leaves, deeper, and thicker root mass with improved photosynthesis efficiency. Rice is also more resilient towards drought, storm, pest infestations, and diseases which will subsequently reduce yield loss. As productivity increases and farmers can earn more income, this could potentially serve as poverty alleviation for farmers as they would have more disposable income for other expenses such as children's education and medical bills, which automatically improves food security in the long run.

Relevance of SRI for Environmental Sustainability

a. Addressing Water Scarcity Issue

Globally, irrigated rice utilises 24 – 30% freshwater resources as producing 1kg of rice would typically require an average of 1,432L of water[111]. With the current method of irrigation, it is estimated that water usage for agriculture needs to increase by 50% in 30 years. However, the amount of water withdrawal from agriculture can be reduced to as low as only 10% through rapid technological adoption and sustainable farming practices by 2050[112].

b. Reduce Greenhouse Gas (GEG) Emission

Rice production contributes to about 1.5% of the total global GEG emissions from the release of methane gas into the atmosphere. Methane gas is said to be 25% times more potent than carbon dioxide and is able to trap more heat in the atmosphere, causing rapid temperature rise. Methane gas is produced due to the flooded nature of the paddy production system as water traps oxygen from penetrating the soil, which leads to a conducive environment for methane. As the SRI method allows for intermittent flooding, this could significantly help reduce methane production by approximately half in the next 10 years[113].

[110] Uphoff (2012)
[111] Chung (n.d.)
[112] FAO (2017)
[113] Jain et al. (2014)

c. Reduce the Use of Synthetic Fertilisers

Rice is one of the crops which uses the highest amount nitrogen fertiliser in its production after maize and wheat. By 2050, nitrogen pollution level is expected to skyrocket to 150% compared to the 2010 level. The agriculture sector contributes to approximately 60% of nitrogen pollution with rice production accounting for 16% of the environmental impact. Nitrogen fertilisation is particularly detrimental because it is estimated that only half of nitrogen is utilised by plants while the remaining half is lost to the environment through volatilisation, run-off, and leaching which will cause soil acidification, water pollution, as well as biodiversity reduction[114].

SRI Adoption in East Malaysia

For over a decade, SRI has been practised by upland rice farmers in East Malaysia through collaborative support from the government and private organisations such as WWF Malaysia. Specifically in Ba'kelalan, SRI has been successful in increasing rice yield from 140kg to 280kg per year for 1 plot of land which is seen as a positive improvement among highland farmers as low yield has been one of the major constraints in the production of their specialty rice (Adan)[115]. With only 12 farmers adopting the system in the first year, there are currently 32 farmers utilising the SRI method as their main farming practice and have successfully produced over 2 tonnes of yield during the last harvest[116].

Through the provision of tools and training from WWF Malaysia and several other organisations, SRI is also seen as socially beneficial as farmers may pass down SRI farming knowledge to other farmers, which will subsequently result in more farmers adopting this sustainable-friendly method. As heirloom/specialty rice yield increases, farmers are able to market more of their products which will increase their income and currently, Ba'kelalan farmers has been engaging with companies such as Bario Ceria to market Adan rice to Peninsular Malaysia and other countries as well. However, marketing specialty rice remains a challenge due to the lack of accessibility to the highland areas. Remoteness and lack of proper infrastructure have been a major setback for the marketability potential of some specialty rice and this is also coupled with competition from other specialty rice such as the Kalimantan version of Adan rice that is currently sold in Lawas at a much cheaper price[117].

[114] Gathorne-Hardy et al. (2013); Martínez-Dalmau, Berbel, and Ordóñez-Fernández (2021)
[115] Findings from KRI interview with Mr McKenzie A. Martin previously from WWF Malaysia in 2022.
[116] Ibid.
[117] Ibid.

SRI Constraints

Despite numerous potentials of the SRI method in increasing farmers' income and reducing environmental impact, the adoption of this method remains a challenge as farmers, which typically consists of the elderly generation finds the method to be tedious and requires high labour as land needs to be ploughed and weeded constantly. This would lead to higher labour costs which would seem unattractive to some farmers. Although high yield is achieved as a result of intensification, SRI may not be easily acceptable to some communities that are not already in practice of this method[118]. As a result of the high labour demand, its adoption and upscaling can be challenging.

SRI in other Countries

SRI has been practised in many countries throughout the globe and has received many positive feedbacks from farmers. In Vietnam, SRI has been adopted by more than 1m farmers on 185,000Ha of paddy production fields, spreading across 22 provinces. Out of these 1m farmers, 70% of farmers adopting SRI in Vietnam are female farmers[119]. Neate (2013) also discovered that female farmers are more open in sharing knowledge on SRI compared to men[120]. In the Thai Nguyen province of Vietnam, SRI has successfully saved 23% of energy inputs while energy output increased by 11%, whereas the overall income of farmers has risen by USD364/Ha. Rotational cropping with potatoes is also practised in this province which has shown yield and income increases. This income increase is deemed significant and has improved Vietnam's farmers' livelihood as it is estimated that almost 9m farmers in Vietnam own less than 0.5Ha of paddy rice land[121].

In India which is the second-largest rice-producing country after China, SRI adoption has started back in 2000 and to date, this method has been adopted by 600,000 farmers on 1m Ha, across 564 rice-growing districts. Yield increases as high as 68% are recorded in rice-growing areas such as Tamil Nadu. It is also noted that SRI has given Indian farmers a glimmer of hope during the drought season. Previously by using the conventional method during the normal cropping season, farmers are able to produce 2.3tonnes of rice per 0.4Ha. However, the SRI method has enabled farmers to produce 2.7tonnes of rice per 0.4Ha even during dry weather conditions. Apart from rice, the method is also applied to other crops like sugarcane and scientists in India are also currently leveraging the potential of this sustainable method for other key crops in India such as wheat, finger millet, mustard, and sesame[122].

[118] Narbaria et al. (2015)
[119] Neate (2013)
[120] Ibid.
[121] Ibid.
[122] Africare, OXFAM, WWF-ICRISAT project (2010)

3.7 Overall Observations and Policy Implications

Overall, East Malaysia's food security is an area that is still underexplored and may be assessed more thoroughly by using various indicators that currently exist. As East Malaysia's population is expected to expand in the next two decades, strengthening local food production is extremely crucial in meeting the growing food demands. It is suggested that policies should be formulated by emphasising the local indigenous crops to make up for the limited food commodity production in East Malaysia. As industrial crops dominate, leaving limited arable agricultural land for other food commodities, land-saving, and sustainable farming practices must be emphasised so local farmers may benefit from these practices. This will then improve their income and livelihood through increased yield productivity.

As Research and Development (R&D) on indigenous crops is also limited, there should be more initiatives to enable more research institutions, public, and private universities to undertake studies to understand and fully develop the value of indigenous, underutilised crops, especially specialty rice through research grants and incentives. Currently, yield remains one of the biggest issues when it comes to indigenous crops' production. Through vigorous research, it could potentially address some of these issues which subsequently helps these local crops to thrive both in the local and foreign market. This may allow for the rapid development of rural communities as outlined in the 12th Malaysia Plan.

Furthermore, considering that malnutrition is a predominant issue in East Malaysia, there is still a lack of clear indication of how prevalent it is among the rural communities as compared to the urban communities. As the population of rural communities are high in Sabah and Sarawak, a comprehensive nutrition monitoring system should be developed. This is to ensure the inclusivity of nutrition intervention programmes that are taking place, hence reducing the impact of poverty and geographical remoteness on child and adult malnutrition. As specialty rice (as well as other indigenous crops) may potentially address some of the malnutrition issues, especially among households that practice subsistence farming, it is also important to ensure that these crops are accessible to other non-farming households to fully reap the benefit of these local produce, especially as a medium of nutrition intervention.

Finally, it is also important to note that development among the rural communities should put forth the element of conservation and sustainability as these communities have preserved their indigenous crops for decades and generations, therefore specific approaches must be taken to avoid exploitation. A multidisciplinary approach and synergistic collaboration involving government, NGOs, SEs, research institutions, and private organisations should prioritise farmers' welfare, to improve their living standards and livelihood.

3.8 Chapter Key Takeaways

- Specialty rice may potentially improve rice SSL in East Malaysia and reduce reliance on imports. This is possible through an increase in production and expansion beyond subsistence farming for the rural communities. An increase in the export of specialty rice might also reduce the issue of trade bias and food trade deficit that the region is currently facing.

- High incidence of absolute poverty in Sabah (25.3%) and Sarawak (12.9%) is worrying, especially when both states have one of the highest household food and rice consumption expenditures in comparison to other states in Malaysia. Market expansion of specialty rice could also potentially be a source of poverty alleviation, especially among rural communities. This is because the excess rice cultivated, can be sold at a premium price, thereby giving the rural communities extra income.

- Subsequently, income improvement could potentially address the high prevalence of malnutrition in East Malaysia. Having higher disposable income will enable farming households to purchase more nutritious foods which allows them to diversify their diets.

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CHAPTER

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CHAPTER 4

RICE CULTURES OF EAST MALAYSIA

By Khoo Wei Yang

4.1 Introduction

"The rice plant in Island Southeast Asia lives and thrives in a singular duality as a sacred and secular plant, a symbol of status, wealth, and social stratification"[123]

Rice is indispensable to Bornean society as it is to Southeast Asia, the significance of this staple food reaches beyond its nutritional, gastronomic, and economic value, particularly for the native groups who have had a long history of cultivating it. Consumption and production of rice are central to the historical ethnic ways of life that it forms a substantive part of their identity. It is therefore essential that discussions of rice in East Malaysia pay regard to the indigenous rice cultures of the region, for the island is home to a host of rice farming cultures.

The chapter intends to provide the **historical and socio-cultural context** of the status of rice in East Malaysia through a brief sketch of the historical development of rice cultivation in the region and a comparative literature review on the socio-cultural practices of rice farming in selected indigenous groups. Here we use heirloom, indigenous, and specialty rice interchangeably to refer to rice varieties that are grown by indigenous groups of Sabah and Sarawak.

[123] Barton (2009)

4.2 Historical Development of Rice in East Malaysia

This section is presented according to the following timeline:

- Pre-modern rice cultivation (pre – 1840)
- Modern rice cultivation
  i. Colonial development (1840 – 1963)
  ii. Malaysian development (1963 – 2000)

4.2.1. Pre-modern Rice Cultivation, pre-1840

Rice was a prevalent food crop in Borneo before the advent of colonial history, with a prehistory that stretches back to the Neolithic period. Archaeological findings from Gua Sireh showed traces of domesticated rice (*Orizya sativa*) dated up to c. 4300 BP[124] and evidence of carbonised rice husk suggested the local processing of rice in prehistorical Northern Borneo[125]. It is widely agreed that rice farming constitutes an indispensable front in Bornean agriculture. Early cultivation of rice was suggested to be supplemented by root crops and sago palm (*Metroxylon sagu*), which served as the main source of starch to prehistorical horticulturalists[126]. The subsequent shift to the widespread adoption of rice cemented the rice culture of the region.

From archaeological evidence and linguistic models, theorists have pulled together notable theories or 'meta-narratives' that hypothesise the origin of rice cultivation in insular Southeast Asia, including Borneo[127]. These theories suggest a concurrence between the development of linguistic groups and rice culture in Southeast Asia. First of which, propounded by Peter Bellwood, described the maritime expansion of Austronesian-speaking Neolithic colonists from mainland China and Taiwan into Southeast Asia between 5000 and 3000 BP, bringing with them were rice cultivation, pottery, and domestic livestock[128]. Bellwood suggested that the colonisation of coastal and riverine Borneo by Austronesian-speaking agriculturalists aligned with the introduction of rice cultivation into the region[129]. The second hypothesis put forth by Wilheim Solheim (1984) argued that the local development of maritime-oriented culture spurred by Holocene sea-level rise has led to linguistic and cultural similarities among local groups in insular Southeast Asia. Heightened connectivity lent to the exchange in material culture, and agricultural resources[130].

Drabble (2000) described the Malaysian premodern subsistence economy as being composed of irrigated wet rice cultivation (*sawah*) and dry or rainfed shifting rice cultivation (*ladang*). While wet *sawah* enjoyed prevalence in the river valleys of Peninsular Malaysia, dry rice cultivation however was the predominant mode of rice farming in Borneo, and historically a major economic activity of many indigenous groups of both Sabah and Sarawak[131].

[124] Datan and Bellwood (1991), BP or "Years Before Present" is a time scale used mainly in archaeology, geology, and other scientific disciplines to specify when events occurred before the origin of practical radiocarbon dating in the 1950s.
[125] Doherty, Beavitt, and Kurui (2000)
[126] Chang (1984); Ellen (2004)
[127] Barker et al. (2011)
[128] Bellwood (1985); (1997); (2004); (2011)
[129] Datan and Bellwood (1991)
[130] Barker et al. (2011); Barker and Richards (2013)
[131] Ranjit Singh (1984); Hill (2012)

The following table lists the definitions of the terminologies used in this chapter (Table 4.1).

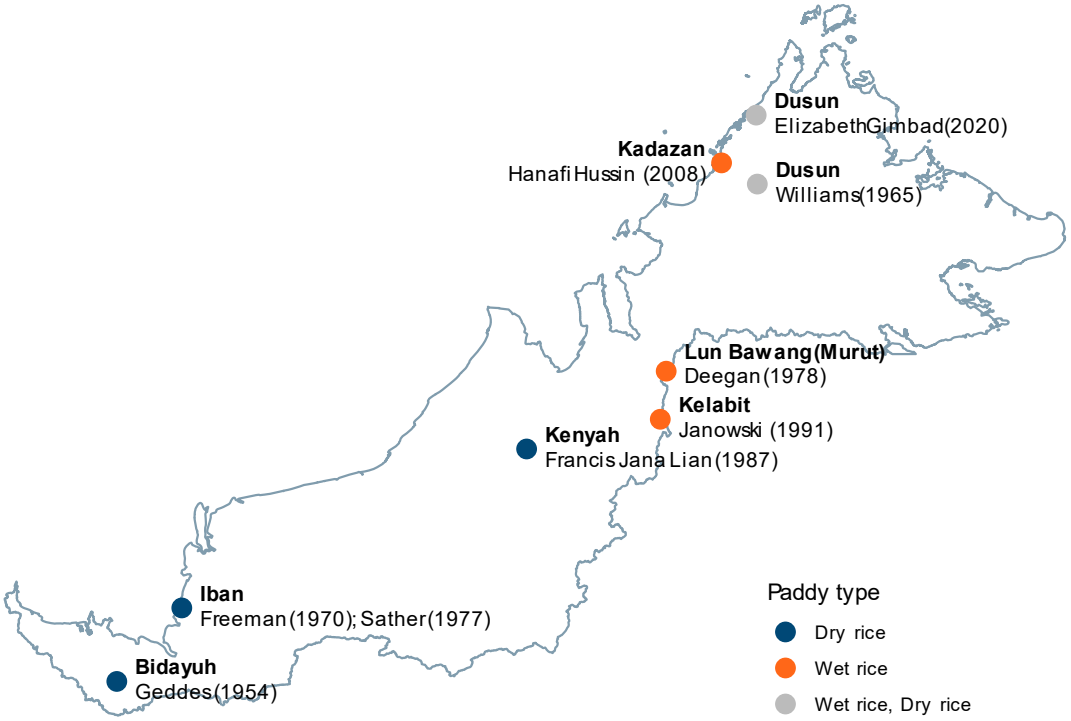
Table 4.1: Definitions of the Terminologies Used in This Chapter

Terminology	Definition
Dry rice cultivation	Rice cultivated with < 800mm of water over the growing season, rice plants are grown above seasonal flood levels[132]. This form of rice cultivation is often found upland, planted along hill slopes.
Wet rice cultivation	Rice cultivated with > 1,000mm of water over the growing season, including flooded, irrigated, and deep-water regimes[133]. Such system is usually practised in lowland basin areas.
Rainfed rice cultivation	Rice cultivated along the spectrum of 600 – 900mm of water over the growing season, ambiguity remains with the definition[134]. The term may refer to farming systems without irrigated schemes, although some form of supplemental water control is known to be used alongside a rainfed system[135].
Shifting cultivation	Any temporal and spatially cyclical agricultural system that involves clearing of land—usually with the assistance of fire—followed by phases of cultivation and fallow periods[136]. Also referred to as swidden agriculture and slash-and-burn farming, this is not to be conflated with dry cultivation, as dry cultivation could be practised in sedentary form. Historically shifting cultivation is often associated with indigenous rice cultivation practises, particularly by the colonial government, however diverse systems exist in indigenous regimes of agriculture.

Production of rice was central to the ethnic life of many indigenous societies. Its cultural prominence bespoke in the ritual life of many pre-Christian indigenous religions. Groups such as the Iban, Bidayuh, Kadayans, and Kenyah of mid to upland Sarawak are historically associated with the farming of dry hill rice[137], whereas Apo Duat-speaking groups in central Krayan-Kelabit highlands were known for their irrigated wet rice farming in the inter-montane basins of central Borneo[138]. Even the coastal Melanaus and Malay communities practice small scale rice growing as a source of sustenance[139]. In the case of Sabah, the Dusuns, Muruts, and Bisaya were also industrious rice farmers[140]. Figure 4.1 illustrates the geographical distribution of traditional rice farming practices ethnographically recorded throughout Sabah and Sarawak.

[132] Kingwell-Banham (2019)
[133] Kingwell-Banham (2019)
[134] Kingwell-Banham (2019)
[135] Harrington and Tow (2011)
[136] World Resources Institute (1997)
[137] Sellato (2002)
[138] Janowski (1991); Cramb (2014)
[139] Cramb (2014)
[140] Ranjit Singh (1984); Elizabeth Gimbad (2020)

Figure 4.1: Ethnic Groups Historically Associated Forms of Rice Cultivation and Their Ethnographic Map



Note: KRI illustration. The map shows ethnographically recorded practice of rice cultivation, the location of their record, and their respective types of rice cultivation systems.

The practice of shifting cultivation, also known as swidden agriculture, was a common feature among rice-growing communities in Borneo of that period. The farming system involves cyclical use of land clearing, followed by cultivation and a fallow period[141]. This form of farming practice is not limited to rice farming but a number of other crops, such as sago, tubers, and root crops, often practised alongside some forms of horticulture, foraging and hunting[142]. Rice cultivation of this nature was largely subsistence-oriented, often with multiple-household workgroup arrangements farming for their own consumption on longhouse community-controlled swiddens[143]. Little output was produced for trade, rather, the surplus was stored to backstop yield shortfall. Thus, rice sustained a minimal presence as a Bornean export in historic maritime trade, outweighed by luxury forest products such as camphor and gutta-percha[144], which remained a key export well into the colonial period[145].

[141] World Resources Institute (1997)
[142] Cleary (1996); World Resources Institute (1997)
[143] Dove (1983)
[144] Gutta-percha is a tree of the genus Palaquium in the family Sapotaceae, the name also refers to the thermoplastic latex derived from the tree.
[145] Cleary (1996)

The forms of rice cultivation are variable to toposequence[146], as a 1979 survey of Iban farmers along the Oya River showed, a progression from swamp rice (*padi paya*) in the lowlands, to flat land dry rice (*padi emperan*) in the midlands, and to hill rice (*padi bukit*) in the uplands can be found moving upriver[147]. Nonetheless, permaculture of wet rice is found in both coastal Sarawak and inner-montane range, notably in the valleys of Apo Duat Range (Kerayan-Kelabit highlands). Hill and dry rice are also grown in the western cordillera to the eastern lowlands of Sabah, whereas a large swathe of wet fields can be found in the coastal western lowlands[148].

Cramb (2014) argued that the expansion of swidden rice agriculture grew parallel to the migratory patterns of ethnic groups. Owing to the extensive forest land use and long forest-fallow period of the swidden system, central and northern Sarawak saw the expansion of hill rice farmers into the interiors in the second millennium Anno Domini (AD). Iban and Kayan migration is purported to have ushered in the spread of rice cultivation into the interiors of Sarawak from the 15th century[149]. This phase of agrarian transition was argued to have been fueled by population and land pressure, as the carrying capacity of cropland exhausts at the upper limit thus shifting cultivators were compelled to seek out larger unexhausted plots to support increased cropping[150].

However, it is unclear to which reason the adoption of rice cultivation over other forms of starch was preferred. The rice crop is shown to be, in many cases, a less economic option, due to its intense labour requirements and highly variable yield[151]. Theorists argued that the adoption of dry swiddening and corresponding inward expansion of Dayak groups may be ascribed to socio-political factors, i.e., evading subjugation by coastal ruling elites[152]. Some also suggested a cultural explanation, wherein the transition to a dependence on rice owes partly to the association of prestige with rice[153].

[146] A sequence of soils in which distinctive soil characteristics are related to topographic situation.
[147] Cramb (2014)
[148] Ranjit Singh (1984)
[149] Vayda (1961)
[150] Boserup (1965)
[151] Janowski (1991)
[152] Helliwell (1991)
[153] Janowski (1991)

4.2.2. Modern Practice of Rice Cultivation, 1840 – 2000

Colonial Development (1840 – 1963)

"Throughout the colonial period, official agrarian crop projects, particularly those involving transplanted seeds and plants, tended to be actively contested by local peasant communities who much preferred the continued cultivation of known, familiar crops over which they had control, rather than risking damage to or loss of their domestic livelihoods and health."[154] By the late 19th century, the colonial government had established a stronghold over Borneo and engaged actively in the management of its resources. The Brooke Raj of Sarawak, since its foundation in 1839, aimed "to develop the resources of a large country"[155], suggesting the colonialist ambition at exploiting the riches of the land, and therefore transforming the economy of Borneo. The North Borneo Chartered Company approached its reign over British North Borneo, or modern-day Sabah, in a similar vein, where the development of the local economy was predicated on resource exploitation[156].

Cleary (1996) noted that the concerted economic interventions by Europeans in the region had gradually shifted the trading patterns within the mercantile network, from a predominance of unprocessed luxury forest products, e.g., rattan, gutta-percha, and camphor, to core-like exports indispensable to European interests, e.g., rubber, gambier, sago, and pepper.

Thus, as the economic structure of Bornean society transformed under colonial regimes, so did the native, traditional forms of agriculture, socio-cultural systems, and along with it the attached meaning to the production of food crops.

Brooke Sarawak was not unique in its treatment of the colonial economy with policies geared towards the extraction of primary resources, in particular minerals such as antimony, coal, and gold[157]. Agricultural development experienced a relatively slow onset, beginning with the state seizure of the sago industrial complex, which composes a major part of pre-colonial trade, and subsequently moved on to the introduction of commercial cash crops, including rubber, pepper, and gambier, mooted by Charles Brooke's liberal land and labour policies at transforming indigenous shifting cultivators into "settled peasant proprietors"[158]. The paddy industry however did not receive equal attention from the colonial government until the 1900s, when the Brooke government brought in Foochow Chinese settlers to expand wet rice production in the Rejang delta, which declared failure due to inferior yields and Chinese farmers' subsequent turn to rubber[159].

[154] Hazareesingh and Maat (2016)
[155] Mundy and Brooke (1848)
[156] Doolittle (2004)
[157] Kaur (1995)
[158] Kaur (1995); (1998)
[159] Ooi (1998); Cramb (2014)

Despite earlier intent at invigorating indigenous hill paddy as a commercial industry, attempts prove to have failed under subsequent offices. As James Brooke observed at the early founding of the Raj, "From the known industry of the Dyaks, and their partiality to rice-cultivation, [...] there can be little doubt that it would become an article of extensive export"[160], this proved to be a misreading as hill rice productivity was later considered to be unsatisfactory, the indigenous method deemed "wasteful and destructive", and its extensive territorial appetite at odds with the colonial framework of land commodification and utilisation[161]. Thus, a series of land regulations restricting the expansion of forest land use by shifting cultivators and future creation of customary land was instituted since the Brooke era, and have continued into the present[162]. Nonetheless, attempts to **incentivise the modernisation of the native farming system and their settlement into permaculture of wet paddy** had accomplished little[163]. This is probably attributable to the administration's disregard towards the indigenous agroecological and cultural systems.

Further diminution of the local rice supply alongside the widespread adoption of rubber planting in 1911 - 1912, where the cash crop percolated into the native agricultural cycle, inter-planted with rice[164]. The extent to which such uptake disrupted native agriculture was evident in 1926, when government officials reported the low native involvement in rice output due to a preference for rubber[165]. By the 1920s, migration of natives was heavily patrolled as movement outside of designated districts were regulated for Dayak groups, effectively stifling the expansionary forest-fallowing practice that supports the swidden system[166].

The negligence of rice as a local productive industry by Brooke administration owed partly to the pre-existing complex of subsistence economy, which supported the bulk of rural rice consumption, and the partiality of the Brooke government to other more lucrative pursuits and commercial crops such as rubber which the Raj traded to pay for rice imports[167].

This sustained dependency on imports for staple foodstuff such as rice has led to deleterious effects during the Rice Crisis of 1919, where a shortage in rice disrupted the food supply of the state, particularly in the urban areas where rice was largely imported. The crisis resulted in the setting up of the Department of Agriculture and Food and Supply Control Committee, in an *ex post facto* attempt to redress the self-sufficiency of the state[168]. Towards the end of 1930s, the state saw a pickup in rice production with a renewed emphasis on intensive irrigated wet rice farming, primarily through elaborate planning of controlled drainage schemes for wet paddy and agricultural stations in Kanowit and Rantau Panjang. In spite of rising imports, the state was geared towards achieving self-sufficiency in rice production as a response to the breakout of war in Europe.

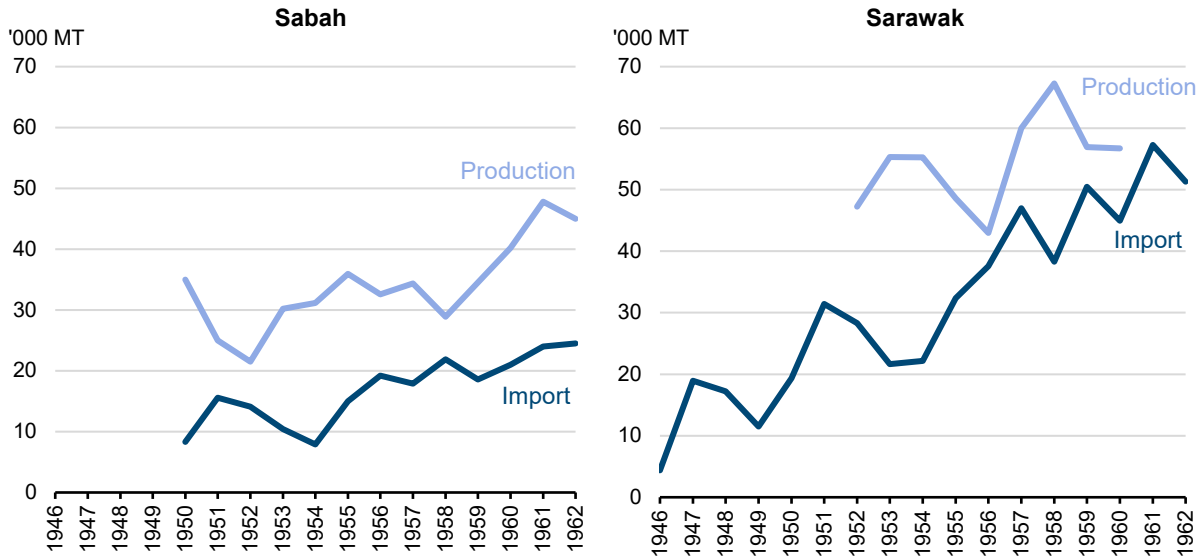
---

160 Mundy and Brooke (1848)
161 Hoover (1919); 'Agriculture: Rubber versus Rice' (1926)
162 Dimbab Ngidang (2005), For the history of customary land codes see King (1986); Cleary (1992); Sutton and McMorrow (1998)
163 see Brooke (1866), 359
164 Cramb (2014)
165 'Agriculture: Rubber versus Rice' (1926)
166 Kaur (1995)
167 Ooi (1998)
168 Ooi (1998)

During the Japanese occupation from 1941 – 1915, the military regime's preoccupation in agriculture was the attainment of self-sufficiency in terms of food production. Areas under paddy cultivation experienced an annual increase under a two-pronged strategy to boost food production, i.e., (1) agricultural stations and (2) subsidised settlement schemes[169]. Efforts at achieving self-sufficiency were a consequence of the shortage in food imports, thus giving rise to a coercive campaign of rice requisitioning and intensive production. However, the impact of such minor boom was felt unequally by different regions of the state, and distributive imbalances had led to shortages, particularly in urban areas; and short of incentive by the native subsistence agriculturalists to produce a surplus for government requisition despite enlistment[170]. In general, attempts to boost domestic production in *Kita Boruneo* (Imperial Japanese Army-controlled Brooke Sarawak and British North Borneo) fell short in spite of expanded acreage, as local population mostly resorted to growing rice and other starches (e.g., cassava) for their own subsistence in Sarawak, the actual measure of nutritional intake was not quantifiable. Self-sufficiency in certain areas such as Bijat and Lower Rejang was short-lived and a result of economic necessity[171].

British-controlled Sarawak remained dependent on imports for rice, despite noticeable efforts at growing local rice production through expanded research programmes and economic schemes for rice planting, such as the Assistance to Rice Planter Scheme inaugurated in 1959[172], as well as government procurement of paddy from 1946 onwards[173]. With rising population pressure and a low success rate of export restrictions (where import trebled from 1950, see Figure 4.2), Sarawak had not achieved self-sufficiency throughout its term as a crown colony[174].

Figure 4.2: Import and Production of Rice in Sabah and Sarawak, 1946 – 1962



Source: H. M. Stationery Office (various years)

[169] Cramb (1998)
[170] Cramb (1998); Ooi (1999)
[171] Ooi (1999); Kratoska (1998)
[172] H. M. Stationery Office (1952)
[173] H. M. Stationery Office (1946)
[174] Jackson (1976); Crocker (2002)

The rice policies of this period intimated an official view in which rice was perceived mainly as a food crop, with an orientation towards reducing import dependencies and bolstering local supply. The state's intent of protecting self-sufficiency of rice supply is seen in the prohibition of exports of rice and unhulled rice product in 1946. The state's bias towards commercial crops can be seen in the allocation for the wet rice sector in the 59 – 63 Development Plan valued at just $250,000 (Malayan Dollar), which accounted for 0.8% (total $30,855,144) of the total allocation for agriculture, and was dwarfed by $21,081,000 set aside for Rubber Planting Scheme[175]. A long-running partiality against indigenous modes of shifting cultivation continued to be adopted by the colonial government. Although there are some recognitions of the indigenous system's capacity in utilising "poor hill land for food production in places where the use of fertilisers is not practicable"[176], the attention was given to the rationalisation and formal control of shifting cultivation practices.

Sabah has followed a similar path in colonial development. Following the grant of the Royal Charter, the Company set on to generate revenue from the riches of the territory. Economic growth was mainly spurred through resource exploitation and plantation agriculture[177], extractive sectors were relatively sombre in North Borneo. However, the expansive forest coverage meant high timber production, which constitutes one of the region's most profitable exports.

Development of agriculture was primed by the introduction of commercial crops in the early 1890s, including tobacco, hemp, and copra and later taken over by rubber, of which plantations were run by immigrant planters on state-leased land[178]. During the period in which tobacco prices soared, liberal land policies were enforced to attract prospective tobacco planters, a boom in land concessions from 1887 to 1890 found large areas of land recognised under native ownership encroached, where unsurveyed native lands were leased to European planters to be alienated for plantations as well as logging[179]. Subsequent legislations saw further restrictions of customary land rights which stifled their economic activities and land-use systems, primarily towards shifting cultivators.

[175] H. M. Stationery Office (1952)
[176] H. M. Stationery Office (1952)
[177] Doolittle (2004)
[178] Cleary (1992); Drabble (2000)
[179] Doolittle (2004)

The development of the rice sector has similarly taken a back burner, where insufficient investments in irrigation and a dearth of technical assistance by the Chartered Company resulted in a low average yield[180]. This is perhaps due to the preoccupation of the administration with revenue-oriented commercial agriculture in addition to the pre-existence of sophisticated indigenous wet-rice cultivation along the west coast, of which production was capable of feeding a large, settled population[181]. Traditional shifting cultivation of hill dry rice was likewise prejudiced against through strict land policies, such as the *Ladang* Ordinance which prohibited felling of primary jungles[182] and a series of land ordinances, which revoked hill rice shifting cultivators' holdings to land with the design of customary land rights conferred upon natives based on inequitable conditions[183,184]. Nevertheless, rice grew as the biggest import towards the end of the 1930s, which prompted the government to reduce import dependency by introducing Chinese rice farmers and land lease terms favourable to rice cultivation, with an exception to shifting cultivation[185].

Sabah recorded a higher level of self-sufficiency throughout the British rule compared to Sarawak, and reported a local production capable of feeding two-thirds of the population[186], however, rice remained a major foodstuff import until the end of British rule[187]. The British administration's effort at improving self-sufficiency in rice supply was notable in the denunciation of import-dependent pre-war policies. This was done primarily through the deliberate improvement of cultivated areas, by introducing drainage and irrigation systems and bringing adjacent land under production[188]. Food Controller was established to administer a quota scheme on the imports of rice to stimulate local production, and agricultural experiment stations were set up to promote research to improve rice yield, albeit partial towards irrigated farming[189]. Other policies include state control on the commodity over local milling and movements of rice since 1948[190]. In the same way, the government sought to boost farmers' revenue by means of a Government Purchase Scheme and the lifting of price caps as well as regulations in 1954 to liberalise local markets, which saw a rise in local production towards the end of 1950s.

[180] Kaur (1998)
[181] Ranjit Singh (1984)
[182] Macaskie (1921); Doolittle (2004)
[183] Kahin (1947); Cleary (1992); Kaur (1998); H. M. Stationery Office (1954)
[184] Provisions of customary tenure obligated land holders to corvee labour premised on "liability to give his labour free [...] for the performance of such works and duties for the benefit of himself and neighbouring land holders as may be prescribed" (see *Annual Report on North Borneo*, 1954)
[185] Kahin (1947)
[186] H. M. Stationery Office (1948)
[187] H. M. Stationery Office (1962)
[188] H. M. Stationery Office (1948)
[189] H. M. Stationery Office (1956); (1957)
[190] H. M. Stationery Office (1954)

Malaysian Development (1963 – 2000)

As the states gained independence in 1963, the newly inaugurated government was left with a largely intact bureaucracy and administrative structure by the departed British. A major shift in the post-war global economic landscape repositioned Malaysia away from its former status as a peripheral economy[191]. Development in this period was reorientated towards the goal of poverty alleviation, within the rural population in particular, of which East Malaysia boasted an over-representation[192]. In terms of rural development, the government had by and large inherited the colonial approach of settling mobile populations through the promotion of permaculture. Rice policy was made in line with the object of "settling hill people and coastal and riverine people, whose lot can be improved by giving them a secure basis on wet *padi* land"[193]. As such, land and agricultural development was carried out with an **explicit aim of poverty eradication in the rural population**. The main strategies deployed in tandem were *in situ* agricultural development which encompassed the improvement of existing crops; development of large-scale export crop estates involving land schemes aimed to boost peasant overturn into commercial agriculture.

National rice policy up to the 1970s was influenced by central planning in the Peninsula, which was predicated upon the principal aims of (1) improving the productivity and income of farmers; (2) achieving self-sufficiency in rice production; and (3) ensuring availability of quality rice to consumers at reasonable prices[194]. Under the New Economic Policy (NEP), the priority of rice policy was shifted from increasing production to raising farm income, mainly through technological innovation and support programmes. Direct measures to develop the rice sector during this period include the continuation of pre-independence policies, i.e., guaranteed minimum price (GMP) system for government paddy purchase, stockpiling, and single rice importer; Integrated Agricultural Development projects were expanded to support irrigation and drainage of farmlands; a Paddy Subsidy Scheme was introduced to include input subsidy such as the SBPKP from 1979 and output subsidy from 1980 onwards[195].

[191] Drabble (2000)
[192] Wee (1992) cited higher incidence of poverty in both Sabah (51.2%) and Sarawak (51.7%) compared to their peninsular counterpart (35.1%) in 1976 (Kelantan records the highest among all states at 59.2%, RMK4).
[193] Economic Planning Unit (1966)
[194] Hatta Solhee (1988); Fujimoto (1991)
[195] For history of rice policies during 1960s to 1970s, see KRI (2019).

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Despite promises of development, practice of rice farming was in decline towards the end of the 1970s and continued into the 1980s, with the rice policy's effect in raising the income of farmers proving to be less substantial compared to other sectors[196]. The slow growth was attributed to (1) technical inadequacies in irrigation projects which led to the deterioration of fields; and (2) rapid economic growth in other sectors which drew labour away to other more bankable wage employment[197]. The National Agricultural Policy (NAP) of 1984 was drawn up to revitalise the agricultural sector which was already being crowded out within the national economy at the time. The policy emphasised structural improvement to resolve problems of technology, scale, and profitability [198] . This meant that measures in place were continued, e.g., infrastructural, technological improvements and extension services, in conjunction with various programs in land consolidation for farm enlargement and management restructuring[199].

Often, **national policies for the rice sector are seen to be focused on the West Malaysian context**, formulated with the interests of Peninsular peasantry in mind. Rice farming outside of the rice bowl areas was largely neglected[200]. The focus has been on the cheaper, high-yielding medium-grained plain rice varieties due to policies targeting higher rice SSLs. As a result, there has been less focus on hill or heirloom paddy cultivation. This approach had implications in the rice sector of East Malaysia, which is seldom considered within national-level indicative planning.

Under the Malaysian constitution, services pertaining to small-scale agriculture, including extension, fall under the purview of the individual state. Thus, despite the existence of the Federal DOA, each state government is still responsible for its agricultural services[201].

Agricultural development in East Malaysia followed two broad approaches, i.e., (1) the improvement of crop quality, management practices, and diversification of farming operations through state-granted subsidies and extension services; as well as (2) land settlement schemes aimed at introducing cash crop cultivation[202]. The period immediately following independence saw the resettlement of poor rural communities to designated "development areas", in particular sparsely settled shifting cultivators[203]. Such integrated resettlement was regarded as a solution to the inaccessibility of rural settlements to public amenities, proper infrastructure, and social services; as well as to make way for hydroelectric projects[204]. The policies pertinent to rice sectors were to a large extent under the influence of larger agricultural development.

[196] Fujimoto (1991)
[197] Ibid.
[198] Ibid.
[199] For the history of national rice policy of Malaysia, see KRI (2019).
[200] Ibid.
[201] DOA (1986)
[202] Kaur (1998); King (1986)
[203] Ibid.
[204] James Masing (1988)

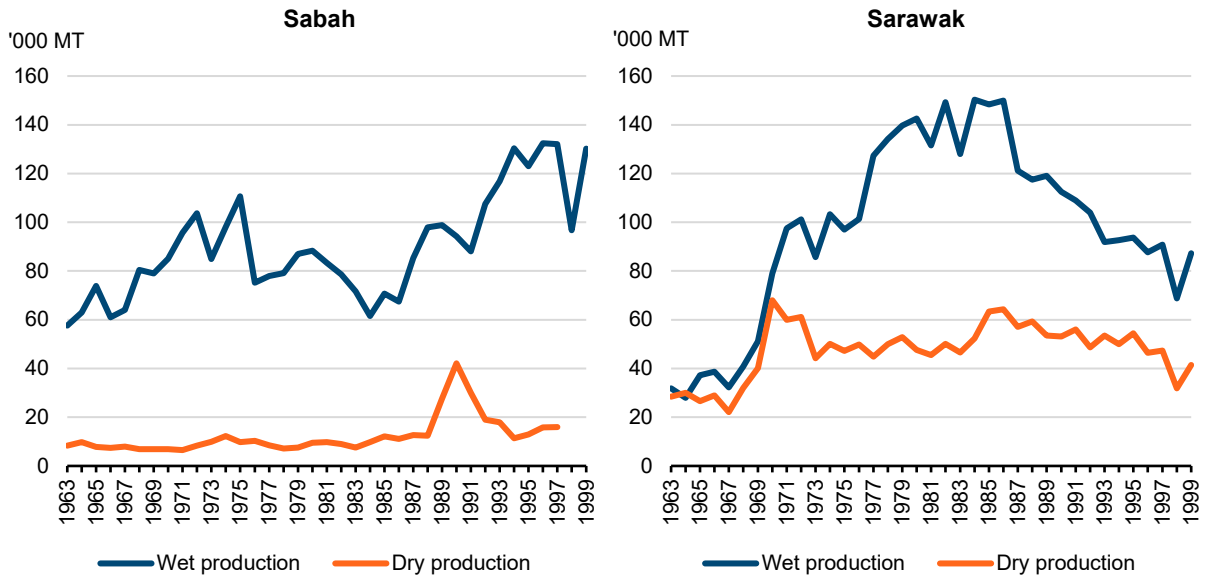
Rice policy in Sarawak generally mirrored its national counterpart, which was predicated on the alleviation of farmers' income, and raising rice production to meet self-sufficiency targets[205]. The measures undertaken by the government include (1) support of *in situ* improvement and (2) opening up state land for intensive paddy cultivation, often with drainage and irrigation schemes. The former constituted the main strategy in alleviating poverty among rural farmers. The provision of input subsidies for fertilisers, herbicides, and pesticides through DOA was preferred as a measure of on-farm support. Output subsidies on prices, integrated programme of credit and extension were less favoured as they were met with various shortcomings with regards to scale and technicalities[206]. The latter formed the basis for production-oriented intensive rice farming aimed at achieving self-sufficiency, beginning with the deployment of Padi Planting Unit (PPU) in 1973 where large tracts of land were identified to be developed for irrigated paddy planting. The scheme showed promising growth in yields which peaked in the mid-1980s (Figure 4.3), however, it was not without social, administrative, and technical problems, especially in relation to land ownership, irrigation designs, and farmers' reluctance[207].

Many of the subsidy programmes, credit and extension services **showed preference towards wet padi farming and have a little effect on dry rice farming which was perceived to be low in productivity**[208]. For example, the Assistance to Padi Planters during the 1980s under DOA was conditional on the changeover to wet rice farming by participating farmers[209]. Alongside this was, among others, rapid economic growth and the burgeoning oil palm estate land settlement schemes driven by the Sarawak Land Development Board (SLDB) and later the Sarawak Land Consolidation and Rehabilitation Authority (SALCRA). Under the twin pressure of competition from land consolidation for cash-cropping purposes and the farm labour shortages consequence of outward labour flow, the progress of rice sector was above all rocky in its course.

[205] Drabble (2000)
[206] King (1986)
[207] Hatta Solhee (1988)
[208] King (1986)
[209] Ibid.

The rice policy in Sabah similarly followed in the national orientation. One primary feature of development in the sector was the setting up of the Sabah Padi Board (SPB) in 1968 to administer paddy production in the state. Unlike Sarawak where shifting cultivation of hill rice composed a substantial part of rice farming, Sabah was relatively developed in wet rice farming (Figures 4.3 and 4.4), albeit a mixture of shifting and settled forms of cultivation existed[210]. The working principles of the board were none other than ensuring self-sufficiency through intensification in production, and this was promulgated in its statute to (1) facilitate farmers' uptake of modern methods of rice cultivation, i.e. farm mechanisation, proper use of farm machinery and farm inputs, and post-planting husbandry; (2) improve production by using short-term high yield varieties with adequate irrigation and drainage; and (3) stabilise market prices for padi produced in Sabah within the local market[211]. Apart from the integrated development of granary areas by opening up land for irrigated rice farming, the agency was actively engaged in the provision of subsidy programs, seed production, and extension services[212]. However, the agency only raised the production so far, as the total production declined towards the end of the 1970s. A Paddy Planter Subsidy Scheme was introduced in 1982 in place of the dissolved SPB with an aim of bolstering local production[213].

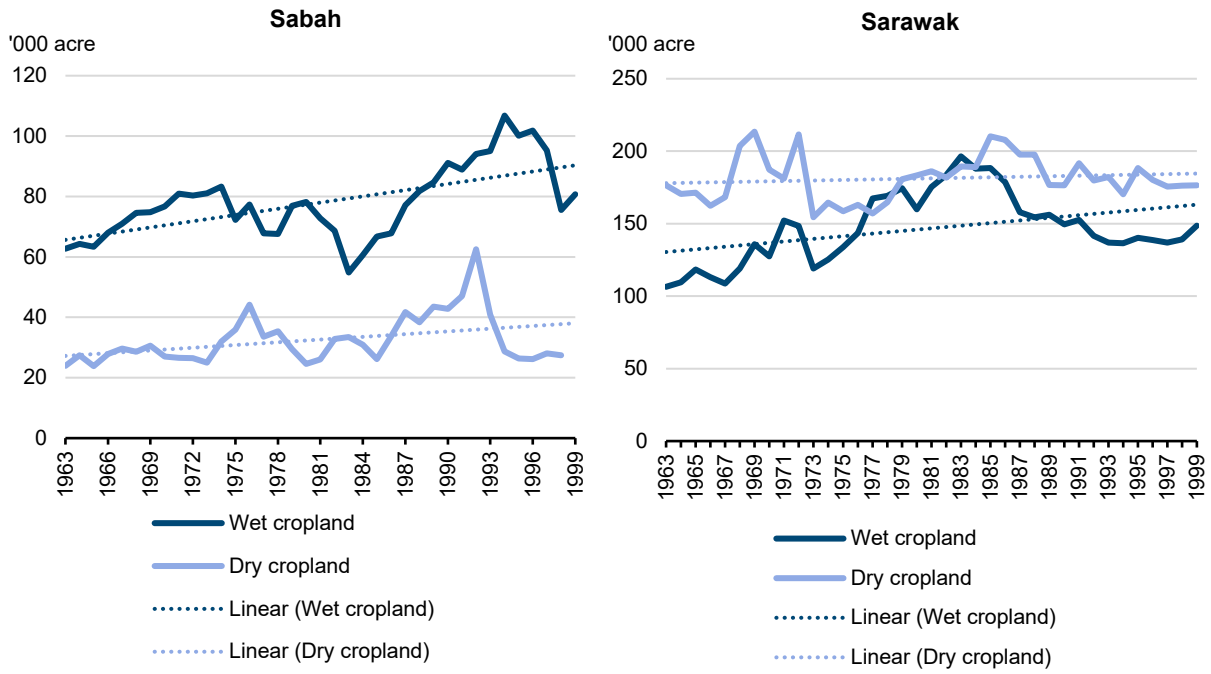
Figure 4.3: Production of Paddy by Type in Sabah and Sarawak, 1963 – 1999



Source: DOS (various years); DOS Sarawak Division (various years)
Note: Chart area is non-stacked. Off-season yield included for Sabah wet paddy production from 1983 to 1999

[210] Ranjit Singh (1984)
[211] 'Appraisal of the National Extension Project' (1977)
[212] 'Project Performance Audit Report: Malaysia National Extension Project' (1988)
[213] Sutton and McMorrow (1998)

Figure 4.4: Cropland of Paddy by Type in Sabah and Sarawak, 1963 – 1999



Source: DOS (various years); DOS Sarawak Division (various years)
Note: R^2 value of trendline <0.40.

Shortly following independence, both states saw growth in irrigated wet paddy production, with Sarawakian production being more pronounced. As shown in Figure 4.3, Sarawakian wet paddy production increased three-fold during the latter half of 1960s from 32,252Mt in 1965 to 51,088Mt in 1969. This bump in production would continue to rise with the formation of PPU in 1973, and finally come to a halt at the end of 1980s. Whereas Sabah inherited a relatively mature wet paddy sector, despite a rockier growth, it nevertheless saw a two-fold growth from 1963 to the end of 1990s. The success in the increase in wetland production was attributable to the SSL policy targets, which focuses less on dry land production/hill rice. In contrast, dry production has been stable throughout the decades leading up to 2000 after independence in both states. This can be attributed to the lower average yield of these varieties, but also the lack of priority towards growing the sector due to SSL-focused policies.

This disparity can also be drawn out in the change in cropland sizes, as shown in Figure 4.4, both states saw a higher rate of increase in wet paddy cropland sizes throughout the period from 1963 to 1999. Whereas dry paddy cultivation areas have been near constant in the same period. In absolute terms however, the Sarawakian wet paddy cropland saw a nosedive after 1985, similar to its production trend. Despite this, average yield of wet paddy remains higher, and therefore production of wet paddy consistently outdid dry paddy, notwithstanding larger variations.

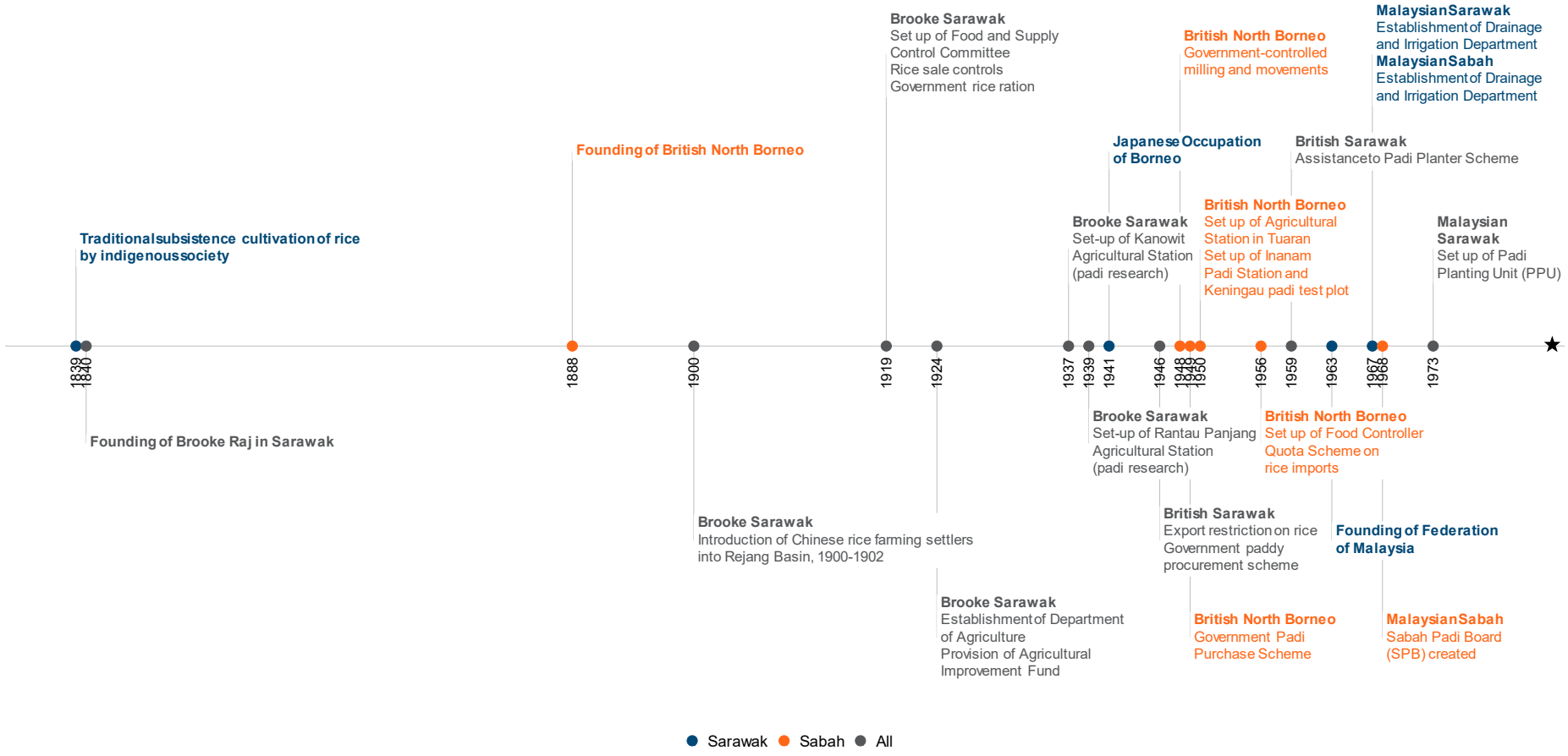
In 2013, two granary areas, i.e., IADA Batang Lupar and IADA Kota Belud were opened in East Malaysia. This came as the main thrust under the 2013 budget to ensure food security. Alongside two other granary areas, the IADAs were projected to produce up to 104Mt. Whereas the Tenth Malaysia Plan sought to address food security by importing strategies and stockpiling, new granary areas were not included in the plan[214].

As profitability and raising the income of rural households were the main concern of policies of this era, a common theme in the agricultural development of East Malaysia was the gradual replacement of traditional production practices, along with the enhancement of economic-sized agricultural activities with the capacity of improving income and productivity[215]. The rice sector, both in its modern intensive or traditional subsistence forms, was lacklustre in its productivity and profitability in comparison. The sector was under stress from the polarised development of large land schemes allocated for industrial cash crops and restructuring policies aimed at transforming farm and land management among native farmers. The partial aim of raising the production level to self-sufficiency had an unequitable impact on traditional rice farming; the outpour of labour from rice farms into other sectors also reduced the vitality of the sector. Ultimately, the potential of the food crop remained largely untapped due to decades of self-sufficiency and food security policies directed at West Malaysian rice industry.

Figure 4.5 shows the major events in the historical development of East Malaysian rice sector from 1840 up to 2000 as described in this section.

[214] Economic Planning Unit (2011), "During the Plan period, strategies to ensure sufficient supply of rice include maintaining rice stockpile at 292,000 metric tonnes or sustained consumption for 45 days, entering long-term contract agreements to import rice with matching agreements to export palm oil or oil, and increasing the productivity of existing granary and non-granary areas through upgrading of infrastructure. No new areas will be developed for paddy cultivation and local production of rice will be set to fulfil a 70% level of self-sufficiency."
[215] Fadzilah Majid Cooke (2012); Cramb (2014)

Figure 4.5: Historical Timeline of Rice Sector Development in Borneo, 1840 – 2000



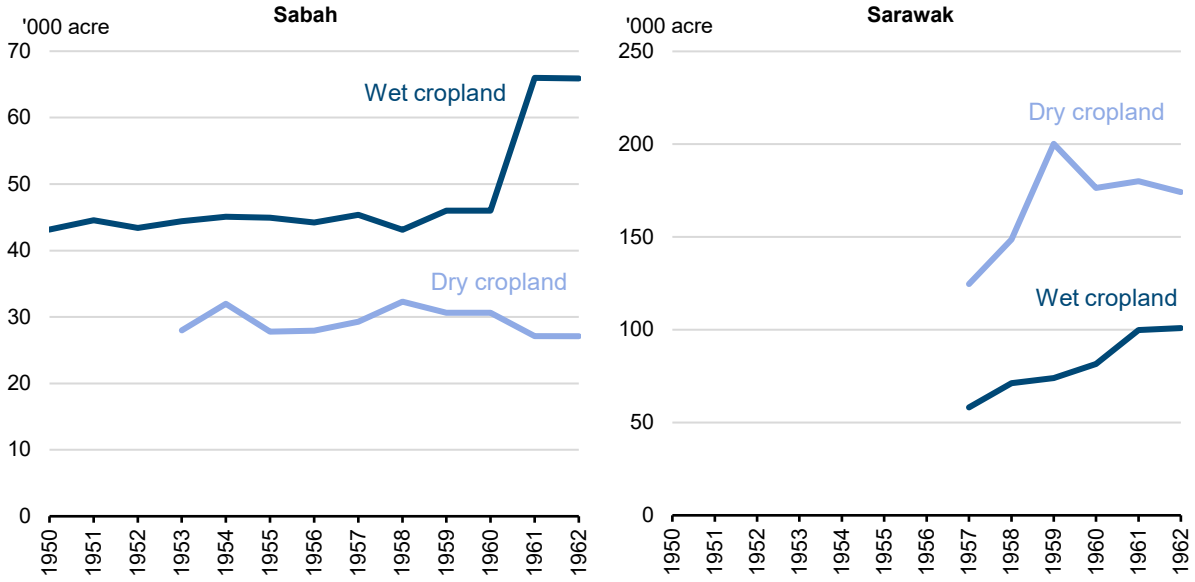
Source: KRI illustration
Note: ★ Historical developments beyond 2000 are not included, nonetheless, significant events such as the opening of IADAs in Batang Lupar and Kota Belud in 2013 are mentioned in text.

4.3 Rice in Bornean Societies

This chapter does not argue that self-sufficiency as the correct policy target, but seeks to examine the historical roots of the policy. The attempt of colonial governments at achieving their self-sufficiency policy targets on a wet paddy base has proven unfruitful, where until the end of British rule in 1963, Sarawak and Sabah remained big importers of rice (Figure 4.2).

While the efforts of fostering the wet rice industry did not pay off, the many valuable dry paddy varieties once considered low yielding along with their farming practices may have been lost at the end of 20th century[216]. Shifting cultivation of dry rice, a major indigenous farming practice was on the decline since the beginning of colonial history, and continued to fall after formation of the federation[217]. This change can be intimated from the change in cropland sizes of hill or dry paddy of which shifting cultivation, a proxy for indigenous farming, largely depended on. Towards the end of British rule, both states saw a drop in dry paddy cropland in contrast to the growing size of wet paddy cropland (Figure 4.6). This change was congruent with the trend across Southeast Asia, where deintensification of indigenous rice farming occur alongside modification of farming practices to accommodate intercropping[218] or were given up in favour of estate plantation or off-farm pursuits.

Figure 4.6: Cropland Sizes by the Type of Paddy in Sabah and Sarawak, 1950-1962



Source: H. M. Stationary Office (various years)
Note: Data points for Sarawak between 1957 to 1960 represents a gap in colonial cadastral survey. Dry cropland could well be underreported and should be treated as incomplete.

[216] Sather (1980); Cramb (2007)
[217] Cramb (2014)
[218] Padoch et al. (2007); Cramb (2014)

The development of market economy prompted by colonialism and thereafter readily adopted by the independent state not only changed the traditional economies of subsistence agriculture and small-scale forest trade, but shepherded the change in native ways of life. This change echoes Karl Polanyi's observation of the emergence of a European market economy in the 19th century, where "institutionally enforced incentive to participate in economic life eroded social and community life"[219]. However, one is to treat delicately Polanyi's notion of "social and community life", as will be shown in the subsequent sections, transitions in indigenous ways of life often involve the willing adoption and sometimes proactive agency of the people. It is therefore imprudent to assume that indigenous people have continuously lived in what Tsing (1993) described as "encapsulated in their own timeless, archaic world".

As shown in the subsequent sections, traditional lifeways, modes of agriculture, and indigenous economy underwent significant change, however, rice remained an integral symbol within Bornean identity. The cultural significance of rice can be traced to tangible and intangible cultures, such as the *Gawai* and *Kaamatan* festivals, rice-based delicacies, and the normative values well-alive in Bornean communities.

This section intends to provide a cross-cultural overview of the symbolic value attached to the production, consumption, and the artefact of rice itself. The last section will also cover the shifts in those values and local responses under change.

Source: zulazhar, Shutterstock

[219] Dalton (1971); see Polanyi (1944)

4.3.1. Socio-cultural Structures of Rice Production

Historically, agriculture constitutes a centre around which ethnic life organises, particularly subsistence growing of rice, which is practised by many Bornean ethnic groups. Dalton (1971) emphasised the role of farming in the ordering of "systematic economic structure", where he argued,

> *The techniques of natural resource-use and acquisition/production of material goods, i.e., horticulture, agriculture, hunting, manufacturing, requires definite institutional arrangements - structured rules of the game.*[220]

Netting (1974) made a similar argument suggesting the utilisation of environment as a function of institutional features such as gendered division of labour, land tenure, family arrangement, group size, and political order. It can be inferred therefore that institutions of indigenous societies before integration into the modern world economy are organised around their rice-growing pursuits, as rice cultivation was a major form of resource utilisation in the rice-growing groups of Borneo.

This sub-section will describe traditional rice cultures of Iban, Kelabit, Kenyah, and Kadazan-Dusun groups before modernisation. Rice is likely to be an important part of other Bornean ethnic groups, but they are not covered here due to limits of written sources or documentation.

Freeman (1970) described Iban's "absorption" in the growing of hill rice (*padi*), where "it is upon skill in farming [of *padi*] that the prosperity, and the very existence of an Iban family depends"[221]. Such centricity give to rice planting is also seen in many other groups of the region (Figure 4.1 4.1). While rice farming in some groups diminished overtime, other areas saw communities carried the practice well into the 21st century, albeit the cultivation of certain varieties such as that of *Padi Adan* and *Padi Dari* are selectively retained, studied, and improved owing to their commercial value, their sedentary modes of cultivation, and historical contingencies. **However, large swathes of indigenous paddy varieties are not well understood, most of which could have been lost in the process of agrarian transition.**

Polanyi (1944) argued that economies of non-market societies are "submerged in [...] social relationships", where the "functions of an economic system proper" are embedded in social institutions unanswerable to economic motivations. Rice production in this sense is not carried out for motive of gain, neither in the economic principles of least effort, nor labour for remuneration. The production of rice primarily follows two purposes, namely that of subsistence and social production. The former suggests a basic production of crops for own consumption, and the latter denotes a social use of goods produced for "prestation, ceremony, and ritual"[222]. It is through the social production of food crops that rice is adorned with social value, integrated into the lifeways of traditional agriculturalists, informing of their dispositions, decisions, and behaviours.

[220] Dalton (1971)
[221] Freeman (1970)
[222] Brookfield (1972)

Among the Kelabits of Pa' Dalih, widely cultivated varieties of *Padi Adan* and *Padi Dari* were produced specifically for sale and reserved for guests. The labour intensity and difficulties involved in the farming of these varieties, which are grown only in permanent wet fields (*late' baa* or *lati' baa*), accorded prestige to the success of rice cultivation. The social status attributed to the ability of planning, managing, and making of rice fields were thus highly valued, outclassing predilections to the other less labour-intensive crops. Therefore, the ability of one to present an Adan rice meal for those outside of the hearth-group was regarded with considerable repute[223].

While the Ibans were known for their subsistence production of hill rice in pre-colonial periods, the extensive use of rice goes beyond consumption. Rice was prominently featured in religious rites and rituals; as oblation to deities; in exchange for valuables; and in accumulation of social prestige[224]. As Jensen (1974) noted, "Rice to the Iban is not just a crop. Hill rice cultivation is their way of life", expressed succinctly in the **Iban idiom "*adat kami bumai*"** (our traditional way of life is clearing land for cultivation of padi). This adage is similarly expressed in the Kenyah term "*udip nguma"* (a livelihood consisting of clearing land for padi cultivation)[225].

According to Cramb (2007), rice cultivation, and by extension the land of which rice was planted, served as a domain on which one exercises individual prowess. As the Iban ethics value highly personal adequacy, self-sufficiency, and self-reliance[226], farming success was the primary measure of social worth. The ability of a *bilek*-family to produce a surplus amount of rice was no mean feat due to its variable yield and labour intensity, therefore celebrated in ceremonial occasions such as the performances of major *gawai* where large surpluses of rice were to be expended[227], capable only to be carried out by formidable *bilek*-families[228]. Where reciprocity is due, rice also functioned as a tradeable, exchanged often for labour in farm work[229], surpluses of rice if available, were traded for valuable prestige items such as ceremonial jars and ceramics, and in turn traded for rice during shortage[230].

[223] Janowski (1991)
[224] Freeman (1970)
[225] Francis Jana Lian (1987)
[226] Uchibori (1988)
[227] 30 to 50 gantangs, see Freeman (1970)
[228] Freeman (1970); Sather (1980)
[229] Freeman (1970)
[230] Ibid.

As the Iban rice production underscores family life and belief system, the ritual complexities surrounding it goes one step further in its minute categories of rice varieties. Specific types of paddy were scrupulously preserved and produced for different purposes[231]. The individual households in seeking prestige were predisposed to innovate through the procurement and possession of *padi pun*, a strain of sacred rice unique to each *bilek*-family, and only planted in the centre of the family plot[232]. This suggests a wealth of genetic diversity within one longhouse community paddy crop, in which further differentiation of rice varieties can be found, preserved through customary categories. As noted in Chapter 5 of this report, genetic diversity is imperative to the security of food crops.

Non-economic institutions underlie the premodern agrarian system, wherein the main governing principle of production and distribution is reciprocity. Labour and goods are exchanged with respect to social codes of redistribution[233]. Systems of production in traditional rice cultivation are intimately related to their social structures, of which kinship and gender play major roles in division of labour, establishments of work relationships, decision-making, and ownership rights.

In East Malaysia, farm work is often organised in units of individuals strung together by kin ties (or household), this pattern finds similes across multiple rice growing communities. Such indivisibility between agriculture and the perdurance of the household, meant that there exists a "functional relationship between household structure and labour needs"[234].

Pa' Dalih Kelabit rice production was organised in basic residential units composed of utrolateral [235] stem families, what Janowski (1991; 1995) termed the "hearth-group" (*tetal* in Kelabit). As Janowski observed, the hearth constitutes a centre of all activities related to the growing, cooking, and consumption of rice revolve. A family who uses and congregates around a hearth identify themselves as a unit, whereby it is within this unit rice is owned, and the core labour on a rice field is distributed. The rice meal (*kuman nuba'*) which took place surrounding a hearth thus embodied a symbolic practice that reinforces identification with kinsmen and a functioning household. Although work-groups were often formed in the fields, labour was reciprocally exchanged between hearth-groups, rice belonging to a hearth-group is not shared except in occasions such as *irau* and *kuman pade bru* feasts of which rice is pooled.

[231] Freeman (1970); Sather (1980)
[232] Freeman (1970), at the time of Freeman's ethnographic work in 1950, of which this paper heavily borrows, commercial agriculture and cash economy has made inroads to Iban communities of Saribas, however Freeman's realist approach at constructing a pristine state of Iban "cultural prototype" (van Maanen, 2011) may have reduced this dimension of Iban lifeways
[233] Polanyi (1944)
[234] Netting (1974)
[235] A system of filiation in which an individual can assume membership of either one's father's or mother's birth group but not of both at the same time (Appell, 2001).

The "explicit separateness of the consumption of rice by different hearth-groups" is a function of prestige associated with rice, as transactions of rice between hearth-groups are fraught with demurral, especially for adults. In this context, the proprietorship of rice harvests serves as an organising principle, where the ability to provide and maintain one's household is measured through the dispense of rice. Nonetheless, occasions where the entire longhouse community do eat together (*kuman peroyong*) are regularly performed, representing commensality of the community as "one substance and eat the same rice"[236].

Iban rice farming was famously organised in units of *bilek*-family, physically demarcated in each apartment of a longhouse. Similar to the Kelabits, where the longhouse is only a corporate group in the restricted sense, the *bilek*-family acted as an independent economic unit, each holding tenure to a piece of farmland portioned from a tract of longhouse territory, and its members working together to produce rice the household requires, dividing labour along gender and age lines[237]. Farm work became the basis of which Iban household life sustains itself. Given the emphasis of individualism in Iban culture, production and distribution were regulated by kin networks, households exchanged labour by forming work-groups (*bedurok*), in which strict axiom of reciprocity prevailed[238]. This form of labour exchange was preferred to wage work pertaining to rice, and its simile was found practised in many rice growing groups up to the present day[239].

The traditional organisation of a rice farming system is therefore an idiom of cultural and moral value of respective ethnic groups, wherein the communal spirit and individual prowess find expressions in the production and consumption of rice.

[236] Janowski (1991); (1995)
[237] Freeman (1971)
[238] Freeman (1970); Cramb (2007)
[239] KRI study in Ba' Kelalan, Sarawak and Kg. Tinuhan, Sabah shows both communities practised forms of communal labour (*gotong-royong*) in rice farming, organised by reciprocal exchange of work or harvests from each other's fields (See Chapter 1).

4.3.2. Significance of Rice in Indigenous Worldviews

A common thread in pre-Christian indigenous worldviews in Borneo is the prevalence of a belief in animacy. The existence of spirit and the enspirited nature of living and non-living things find expressions in different ethnic cosmology. This animic ontology (worldview) informs the relationship between humans and the larger world in which they inhabit, as well as the position one is to assume within this context[240].

Indigenous ontologies in some cases referred to rice as an animated agent, regarded in terms of deference pertaining to some measure of sanctity. In other cases, the enspirited character of rice itself draws symbolic meaning which articulates where humans, its cultivator, exist and their role within the cosmos. This is most pronounced in the Iban rice cycle, which is interwoven with symbol-laden rituals relating all facets of human life, explaining phenomena from reproduction to growth to decay and to death[241]. Rice is in this sense is, to borrow Ingold's coinage, a "knot" in the world of life[242].

As encapsulated in the Iban idiom "Rice is our ancestors" (*Padi aki-ini kami*), Iban cosmology attributed rice an integral role within the lifecycle of mankind, as Sather (1980) noted,

> ***Iban believes that following death, the human soul, after a time in the otherworld (sebayan), eventually turns to dew (ambun) and, as dew, falls to the earth in the early hours of the dawn where it is taken up by the growing rice plants.***[243]

Rice in the Pre-Christian Iban worldview embodied a spiritual existence inextricable from that of humans, signifying genealogical continuity through the nourishment endowed to the living generation, itself worthy of reverence and affection[244]. The sanctimony conferred unto rice was demonstrated in the complex rites interspersed over every stage of the rice cultivation, which articulates the "intimate identification between padi and the family that cultivates it"[245]. It is with this knowledge that rice is spiritually connected to the well-being of a family, as a good condition of the paddy field is reflective of the auspices of the family.

[240] Ingold (2005) refer to animacy as the "dynamic, transformative potential of the entire field of relations within which beings of all kinds, more or less person-like or thing-like, continually and reciprocally bring one another into existence".
[241] Freeman (1970)
[242] Ingold (2015)
[243] Sather (1980)
[244] Ibid.
[245] Sather (1977)

Source: Sharif Putra, Shutterstock

Pre-Christian Kadazan-Dusun beliefs of animic rice find roots in their cosmogony (beliefs about origins of the world), as creation myths across many Kadazan-Dusun subgroups contain versions of narrative relating the presence of rice at the beginning of the cosmos[246]. Common themes which underlie the Kadazan-Dusun mythology related rice as transformations of parts of chief gods and as gifts from powerful spirits to ensure ample food, while some of them sought to explain the phenomenon of mortality[247]. One such example would be the belief of rice spirit "*Bambarayon"* (*Bambarazon* in Rungus Dusun) among Kadazan-Dusun groups[248]. Rice spirits are notable in their benevolent function as "guardian of the rice crop and storehouse"[249], and the sacrimony ordained upon them are espoused in the complex taboos, ceremonies, and rites related to rice-growing; complete with thank-offerings, harvest charms (*rinait*) and riddles (*sundait*). Reciprocity between the spiritual and human realm for mutual benefit are emphasised in the harvest riddles that entail giving (*menundait*) and answering (*mengarait*), as a key procedure in inviting the *Bambarayon*[250]. The context of this mutual reinforcement of humans and spirits places human existence in continuous interaction, what Ingold (2006) referred to as a relational epistemology, where the importance of "maintaining good relationships with non-human persons and entities inhabiting their social and natural world" is prioritised[251].

[246] Low (2012)
[247] Low (2012)
[248] Williams (1965)
[249] Williams (1965)
[250] Low and Lee (2012)
[251] Amster (2015)

In Pre-Christian Kelabit beliefs the living world is perceived to be permeated with cosmic "life-force" (*lalud*) and rice is inhabited with such animic property. Janowski (2015) suggested the Kelabit ethics which value human prowess compelled the group to engage in proactive manipulation of nature, great prestige is attached to success in carving human space within the enspirited landscape, the bending of *lalud* to human will. Rice-growing, a prime performance of such prowess, is highly regarded as a great human achievement in the Kelabit society. Janowski further argues that the syncretic amalgamation of Christianity and some aspects of traditional beliefs coupled with the introduction of air service into the Bario area in 1962, propelled this industrious pattern of Kelabit rice production[252]. Such a continuation in the values of pre-Christian and Christian belief systems, described as moving back and forth between aspects of value systems confers them the opportunity to participate in and negotiate with the wider world[253].

The spiritual and ritual importance conferred upon rice in traditional Bornean religion is all but trivial. Its complexities informed the beliefs, values, ethics, and subjectivities of indigenous agriculturalists. As high modernist development made inroads to Bornean societies, running parallel was the proselytising missions that spread across Borneo throughout the colonial period. The influx of imported values, changing social structures and modernisation of economy had left imprint in indigenous societies, opened their self-contained social space, and eventually led to a transformation in subjective consciousness of ethnic identity[254]. Such change advances at the expense of long-established social values attached to rice, altered them to fit modernist conception of value. Despite vast changes, cultural shifts can take many forms, as the following sub-section shows, flexibilities in cultural forms allow syncretism, where old practices are reappropriated to new meanings.

[252] Janowski (2004); (2015)
[253] Amster (2015)
[254] Uchibori (1988)

4.3.3. Shifting Values

Scott (1998) attributed the misalignment between policy and practice to the simplifying practice of scientific (or modern) agriculture. Often those who steer policymaking undermine the socio-cultural values of agricultural products. This leads them to assume a consensus of goals between local farmers and developmental programmes, measuring in terms of yields and total production. Often eluded from this process of simplification are variations in values, which are radically simplified as "homologous, uniform commodities"[255] in one stroke for the sake of administrative ease. **Paddy varieties peculiar to ritual uses, specific social purposes, and preferred by farming communities for their taste profile, cooking, and properties apart from yield productivity and commercial value tend to be omitted by this homogenising approach.**

As the burgeoning state has fixated on resource development, Sabah and Sarawak saw a rapid growth of the timber and mining sector as well as massive agricultural expansion since 1960[256]. Expansion of commercial agriculture in the colonial era has set in motion the modernisation of traditional economy based on subsistence agriculture. A multitude of economic and political factors, in particular the state-imposed preferential agricultural policies, has brought profound changes to the social fabric of indigenous groups and their agricultural practices.

Transformations in local farming systems meant that household-based subsistence farming gave way to commercial smallholders, and variegated crops are gradually phased out by standardised monocultures, i.e., cash crops[257]. Such modernisation of agriculture requires the adoption of technologies, reform in land use, changes in labour input, as well as new values in farming decisions[258]. In the case of rice, certain farming methods and paddy varieties are favoured, and others deemed unproductive are eliminated.

For wet rice farming of which modern irrigated systems are more readily transposable, notwithstanding ecological constraints, cultivation has been selectively fostered, which led to the possible offset of dry rice supply[259] and ostensible growth of wet fields in granary areas and some highland areas[260]. However, not all indigenous rice farms were fated the same. Dry rice farming predicated on shifting cultivation was particularly hard-hit, along with the diminished cropland size [261] was the loss of local knowledge in regard to ritual and symbolism in rice production[262]. Despite difficulties in gauging the actual decrease in dry rice cropland due to the nature of cadastral survey in Borneo, studies in multiple areas over time has agreed on a decline in cultivation[263].

[255] Uchibori (1988)
[256] De Koninck (2014)
[257] Cramb (2014)
[258] Mellor (2017); Scott (1998)
[259] Cramb (2014)
[260] Janowski (2004)
[261] Arshad et al. (2007); Cramb (2014)
[262] King and Knudsen (2021)
[263] Sather (1977); Cramb (2007); Mertz et al. (2013); King and Knudsen (2021)

To local farmers, rice cultivation holds value beyond the calorific and the economic. Rice assumes functions apart from income generation. Shifts in agricultural practices, however, effectively changed the way local farmers approach rice-growing, the traditional institutions related to their agriculture, and thus the meaning attached to the product of their labour.

Socio-economic changes too altered the values ascribed to rice and rice production in indigenous societies, as development brought off-farm employment opportunities to the rural communities, indigenous population who sought wage work reduced the labour force involved in rice fields[264]. Iban ethnographers noted an increase in the flow of labour outwards to off-farm employment, transformed the custom of *bejalai* from a prestige-seeking expedition, traditionally through collection and trade of forest produce, to waged employment in timber, oil, and construction sectors[265]. A shift in the economic importance of *bejalai* not only changed the primary means of livelihood but also limited the involvement of men in the process of rice production.

Colfer (1991) drew a correlation between the erosion of traditional status attributed to Kenyah women and the introduction of modern technologies, as she noted the capacity of men in manoeuvring technology such as electric chainsaw and outboard motors generated dependency and imbalances in the gender contribution to farm work. Mechanisms of exchange based on reciprocity are also reduced in importance. Lim and Douglas (1998) argued that the traditional practices of cooperative labour (*gotong-royong*) which regulate labour exchange among the Dusun hill rice cultivators in land clearance activities were replaced with cash payment systems. The above illustrate examples of indigenous institutions altered by developments in agrarian change.

Despite the effects modernisation brought upon traditional agriculture of rice, it is imprudent to assume indigenous groups are only passive recipients in the face of development. Scott (1998) argued that local agents are political actors adorned with instrumentality, who can act both in concordance and in resistance to state projects. The Saribas Iban are described to have adopted commercial cultivation of pepper through a "conscious programme of self-modernisation"[266], under the influence of the Brooke administration, missionary programmes, and the proactive appropriation of traditional ethics to modern values, the significance of swidden rice production in the Saribas Iban economy are reduced and replaced in part to the group's own device[267].

[264] Cramb (2007)
[265] Freeman (1970); Sather (1980); Cramb (2007); P. M. Kedit (1988)
[266] Sather (1977)
[267] Sather (1980); Pringle (1970)

In other cases, traditional rice cultivation endured. Gimbad (2020) argued that rice farming emerged as an active form of ethnocultural identity, carried out within the presence of state development plans and performed as a deliberate act to preserve an enclave for national recognition. The Dusuns of Rembituon are one of the groups that embraced traditional rice farming as a mainstay of their rural economy and proactively enhanced it through collaboration with state and non-state agents[268]. The values attached to rice farming, in some cases, are at odds with modern, commercial ones, this is evident in the Dusuns' disapproval of cash-based rent system in favour of sharing a third of their crop with their landlords, which was perceived to eschew communal spirit (*semangat komuniti*), a value absent from cash-crop agriculture[269].

Some communities find flexible means of sustaining rice cultivation. Francis Jana Lian (1987) noted the resilient socio-economic system of Kenyah groups afforded them readiness to "trade-off shifting cultivation for other methods of padi cultivation". According to her, rice cultivation fundamental to Kenyah society is unfettered from its means of cultivation, given the condition, the community find itself prepared to "compromise certain less important parts of their culture in the interests of preserving the basic system"[270]. Such flexibility of agriculturalists in switching up farming regimes is also observed among the Lun Bawang rice-growers of Long Semadoh. Wet rice farming (*sawah*) was not as widespread until the 1980s, when logging activities made inroads to the region and brought with them heavy machineries that made convenient the laying of wet field plots (*lati' ba*), noted a respondent from FORMADAT Long Semadoh. Rice cultivation in the village was hitherto largely swiddened dry hill rice (*padi bukit*)[271]. Communities of the Kerayan highlands have traced the practice of wet rice cultivation back to earlier period[272], however, KRI-engaged farmers in Ba' Kelalan reported a general displacement of dry rice farming by wet rice in recent times, particularly Adan rice, due to higher productivity and commercial interests towards the variety. Farmers also related the acquisition of wet farming methods and sourcing of seeds from Indonesian Kalimantan, picked up by local farmers who were in contact with farmers from across the border, of whom most have kin ties to. These observations intimated that a constant flow of agricultural resources across borders have driven innovations and change in rice cultivation. The malleability of farmers in their agricultural production does not write off the value they ascribe to their product, but suggest an inevitable transformation in the relationship between the farmer and the farmed.

[268] Elizabeth Gimbad (2020)
[269] Ibid.
[270] Francis Jana Lian (1987)
[271] KRI interview with stakeholders in 2022; KRI field study 2022
[272] Schneeberger (1945)

The change in the role of rice within local cultural value systems is not a singular process but one that involves multiple interacting forces, from state intervention to indigenous agency. Rice as a social value is continuously changing, reshaped by local and non-local agents through the transformation of its practices, uses and belief systems. Thus, it is imperative of those entrusted with the will to improve to recognise such values, along with the sensibility afforded to them by such recognition, **policymaking could seek better ways of empowering local communities without compromising their agencies and the right to self-actualisation**.

Source: Nokuro, Shutterstock

4.4 Policy Implications

As a disclaimer, it is not entirely within the modern policymaker's purview that the customary ways of indigenous livelihoods should be the guiding principle of policy designs. Many of the described local knowledge above may have ceased practice, and to move them against the unitary developmental objective of the state will ultimately prove futile in result. Nevertheless, this essay argues for an understanding of local subjectivities beyond state development discourse, a re-evaluation of the ebbs and flows that brought about our present situation is crucial. History provides a domain for reflection, and an awareness of history contributes to the refinement of future policies for local agriculturalists.

It is not the intent of this chapter to provide strict recommendations, but to offer useful questions that may be worthy of consideration for the policymakers whose concern is the improvement of local rice agriculturalists.

The direction of historical and current agricultural policies vis-à-vis the rice sector has always been geared towards consideration of food security from only the self-sufficiency angle. From the dispositions of colonial policies, this standpoint was handed down intact to the Malaysian government, apart from an affixed role of poverty eradication, the rice sector was often relegated to a minor segment of the national economy. Such biases are also insinuated in regional imbalances. Rice cultivation in East Malaysia, being an outlier of the 'rice bowl' area, is usually forgotten at a national level[273]. **Perhaps it is time to re-evaluate the sole self-sufficiency policy targets that fixate on increasing paddy production for local consumption to expand into the premium artisanal specialty rice segment. The latter not only could improve the income of rural households, but maintain the preferred lifeways of East Malaysian rice farmers.**

It is shown that the history of East Malaysian rice agriculture was characterised by the state suppression of shifting cultivation, partial negligence of indigenous farming practices and certain paddy varieties led to the transition into commercial agriculture[274]. In an attempt to follow a predefined pathway of development, a wealth of poorly understood value in indigenous paddy varieties are disavowed. The diversity of specialty rice, or indigenous paddy, are a treasure trove deserved of appreciation (see Chapter 5). The potential of some indigenous rice varieties is also unidentified, and means introduced to improve them demands more be done. As the introduction of new crop management practices such as SRI to indigenous wet rice cultivation works wonder in improving yields, e.g., Ba'kelalan Adan rice farm[275] and Rembitoun *Padi Kampung* farms[276], application of crop improvement method for upland dry rice remains wanting.

[273] Fujimoto (1991)
[274] Cramb (2007)
[275] KRI interviews with WWF Malaysia in 2022, see Chapter 1
[276] Elizabeth Gimbad (2020)

There remain also ethical issues of implementation. It is discussed that colonial agricultural policies had an immense, sometimes deleterious, effect on indigenous socio-cultural systems. The social values imbued in the symbolic complexities of traditional agriculture has been largely eschewed in favour of a mechanised, systemised, and productivity-oriented simplification.

In modernising traditional farming, the state wields the authority to retain or eliminate parts of culture. Policies that assume the best for farmers have the potential in altering their value systems, giving rise to changes in labour systems, and interpersonal relationships. Agricultural development, which is deeply tied to land holdings, also entails large-scale reform in the management of land. This could either result in successful economic improvement of the communities, or in the process, may disrupt communities or causes dispossession in marginal groups. What can be done to protect the livelihood of native communities without threatening their customary rights? What moral obligation does the government assume in making decisions in the farmers' best interest?

The Malaysian paddy regulatory environment today remains biased towards high-yielding wet rice production, which owed its roots to a long history of colonial and developmental policies targeted at self-sufficiency and poverty reduction. **This has hitherto resulted in the negligence of the heirloom/specialty, artisanal rice segment of East Malaysia**, which for a large part of history constituted a significant form of agriculture in Bornean traditional cultures. With the recent pandemic induced movement control order spurring new concerns over local food security, some communities in Sabah saw a revitalisation of paddy farming, along with it a rediscovery of communal spirit and paddy cultures[277].

As the National Agrofood Policy 2.0 made clear intentions of leveraging the potential of specialty rice varieties (Chapter 1), it is time to reappreciate the rice industry of East Malaysia. Apart from its economic potential, it is also important to rekindle the social histories of rice farming in Borneo, as it illuminates non-economic ways of empowering rural communities. Changes in the regulatory environment to make room for growth is only a start, in view of the potential of the specialty rice market. It is a delicate, balancing act of the part of government, entrepreneurs, and local farmers to play in order to harness its full potential.

[277] KRI interviews with Forever Sabah in 2022.

4.5 Chapter Key Takeaways

- Historically, colonial policies focused on lucrative commercial crops that largely neglected the rice sector as a local productive industry in East Malaysia. National rice policies under NEP and NAP gave precedence towards granary areas in its emphasis on self-sufficiency targets, which then unintentionally overlooked East Malaysian non-granary hill/heirloom rice farming.

- Many premodern indigenous societies in Borneo are organised around rice farming, modernisation has changed the economic and social importance of rice farming in these groups, and shifted the values attached to rice. Many indigenous paddy varieties are not well understood and preserved, which could be lost in the process.

- Rice farming can have values other than economic and calorific. Policymaking could seek better ways of empowering local communities without compromising their agencies and the right to self-actualisation.

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Source: Tascha Rassadornyindee, Shutterstock

CHAPTER

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CHAPTER 5

CHARACTERISING PADDY VARIETIES IN EAST MALAYSIA

By Dr Sarena Che Omar, Prof. Dr Abdul Hamid, and Dr Januarius Gobilik

5.1 Introduction

The objective of this chapter is to provide the readers with an understanding of the diverse types of paddy plants available in Sabah and Sarawak. By appreciating the huge diversity and rarity of our paddy varieties, it is hoped that we can underscore the importance of preserving our genetic seeds and tap into the potential of this segment as a driver in improving the economic status of our rural inhabitants.

5.2 Background – Introduction to Domestic Paddy Cultivation

5.2.1. Introduction to Plant Taxonomy

Taxonomy is "The branch of science concerned with classification, especially of organisms…"[278]. For all living beings in this world, we can classify into tiers or levels, from the broadest to the most specific. The most recently accepted taxonomic system has 8 levels, from the highest to the lowest namely: domain, kingdom, phylum, class, order, family, genus, and species.

Therefore, plant taxonomy is a branch of science concerned with the classification and naming of plants. In this case, rice plants belong to the Kingdom Plantae, Phylum Spermatophyta, Class Monocotyledonae Order Poales, Family Poaceae, Genus Oryza and Species *Oryza sativa*[279]. A species is defined as **"A group of living organisms consisting of similar individuals capable of exchanging genes or interbreeding"[280]. So, it can be loosely defined that a species would be organisms that can mate and produce fertile offspring. However, because evolution is a slow and continuous process, there are incidences whereby two closely related species may inter-breed. However, for this report, we shall assume that a single species comprises the said definition.**

The domestic rice plant is scientifically known as *Oryza sativa* (in *Italics*), or the shorter form, *O. sativa*. However, it doesn't stop there. As with most species, there are also characteristic variations within the species. For example, cats, belonging to the species *Felis catus*, has so many breeds such as siamese, minx, bengal, persian and so forth. Similarly, a particular plant species can have many variations within it, and to differentiate these variations, the plant's nomenclature is governed by the International Code of Nomenclature for algae, fungi, and plants (ICN)[281]. These variations within a species can be loosely termed varieties. To further complicate the nomenclature and thanks to human cultivation, there are variations in plants (and animals) within a species that exist solely due to human breeding and artificial selection, as a consequence of domestication.

[278] Dictionary.com (n.d.)
[279] Defined as 'rice', taken from CAB International
[280] Dictionary.com (n.d.)
[281] Turland et al. (2018)

Therefore, to help differentiate varieties of plants that have been bred by humans, within the ICN, there is another naming system called the International Code of Nomenclature for Cultivated Plants (ICNCP)[282]. So while we find variations within a species, those that exist naturally are called varieties or subspecies, and those variations that arise due to human interventions, are identified as cultivars.

For this report, paddy varieties are used to imply, in simple terms, the differences within the paddy species of *O. sativa*. This is because there are still disputes on the origin of the various varieties: caused by human activities, if so, how and when, or due to natural occurrences. As such, we will not explore in detail, the debates over the breeding history of these different varieties.

5.2.2. Introduction to Rice and Origins History

Rice is an important staple food for more than half of the world's population. Given its cultural importance for many ancient cultures, its domesticated origins have a long, complex, and highly debated history. Previously, studies on the origins of rice relied on archaeological artefacts and old manuscripts. With the recent advancement in scientific genetic technologies, the last 20 years have brought about a lot of insights as to the history of rice and its origins. Yet, even with this, it is still highly debated due to the rapidly evolving research arena and discoveries[283]. The genus *Oryza* was thought to exist millions of years ago on Gondawaland. When the supercontinent land broke, the plant followed suit and spread across the tropical humid areas of Africa, South America, South and Southeast Asia, and Oceania[284]. Today, the genus carries about 20 wild species as well as two species that are popularly cultivated, the *Oryza glaberrima* or the African rice, and more commonly, *Oryza sativa,* the Asian rice[285]. *O. glaberrima* first originated in sub-Saharan Africa, being domesticated about 2,000 – 3,000 years ago in the floodplains of the Niger River[286] from the wild ancestor of *Oryza barthii*. It is low yielding but extremely hardy, in contrast to the higher yield, but more sensitive Asian rice.

On the other hand, *O. sativa* was domesticated from the wild ancestor of *Oryza rufipogon*[287]. The spread of the Asian rice across Southeast Asia, is thought to coincide with the ancient migration of the Austronesian people known as the "Out of Taiwan" migration[288]. But this is still hotly debated especially between linguists, archaeologists, and geneticists[289].

[282] Brickell (2016)
[283] Callaway (2014)
[284] Chang (1976)
[285] Ricepedia states only SEA: "The *Oryza* genus is thought to have originated about 14 million years ago in what is now Southeast Asia and the Philippines."
[286] Harlan (2011)
[287] Large-scale DNA polymorphism study of *Oryza sativa* and *O. rufipogon* reveals the origin and divergence of Asian rice
[288] Diamond and Bellwood (2003)
[289] Alam and Purugganan (2021)

Within *O. sativa,* there are two most commonly cultivated sub-species: the indica and japonica. When these two sub-species were domesticated and whether they experienced separate domesticated events, remains strongly debated[290]. What is clear, is that indica can be loosely identified as non-sticky, lowland paddy including Thai Jasmine as well as Basmati, while japonica is associated with sticky rice, mostly in the upland regions such as those for the making of Japanese sushi and Korean rice. Both sub-species have some varieties that are fragrant[291].

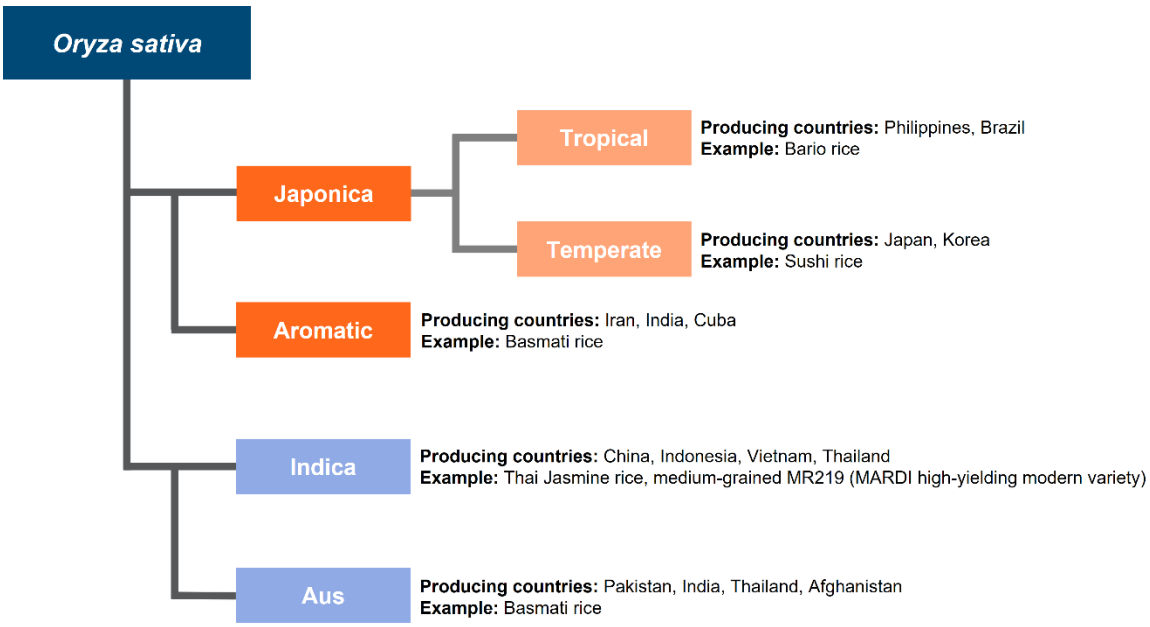
Within both these sub-species, lie hundreds of different cultivars, strains, and varieties, thanks to centuries of natural differentiation and/or human breeding works[292]. In fact, at the International Rice Research Institute's Rice Genebank, there are more than 132,000 rice accessions collected from around the world[293]!

According to a genetic study conducted by Garris et al. (2005), five main groups were identified within *O. sativa:* indica, japonica tropical, japonica temperate, aus and aromatic[294]. It was discovered that aus is more closely related to the main group indica, and the aromatic group with the main group japonica. Figure 5.1 showed the visual summary of the latest findings on the five groups within *O. sativa* and the common rice types associated with it, based on several recent papers[295]. A caution here is that these are recent papers and the outcomes are still highly debated. One reason for the complexity is that since rice has been domesticated for so long, it has differentiated, then moved with ancient cultures and interbred and crossbred with other varieties. As such, it is challenging to discern if a trait is inherited purely from the ancestor line, or acquired from some crossing/breeding with a distant relative. For example, some Basmati varieties can be either the aromatic or the aus groups[296].

The interesting question here is, where would Malaysia's unique varieties sit when compared to these globally important varieties? **There is still a lot of room for research conducted in this field and there is an urgency to characterise our precious specialty rice before the genetic purity gets lost and diluted as a result of human activities. The next section tries to elucidate as much as possible, what recent science understands about East Malaysia's traditional, specialty rice.**

290 Callaway (2014)
291 Matsuo et al. (1997), in Garris (2005)
292 Callaway (2014)
293 'International Rice Genebank' (2019)
294 Garris et al. (2005)
295 Garris et al. (2005); Liu et al. (2016); and Sun et al. (2017)
296 Kovach et al. (2009); Kishor et al. (2020)

Figure 5.1: The Main Groupings of Asian Rice (*Oryza sativa*)



Source: Garris et al. (2005); Liu et al. (2016); Sun et al. (2017), KRI illustration

5.3 Genetic Characterisation of *Oryzae sativa* in East Malaysia

By Dr Sarena Che Omar

Genetic diversity studies are a branch of science that studies the level of similarities and differences between a group of organisms at the deoxyribonucleic acid (DNA) level. Take the example of the human thumbprint, whereby each individual has a unique pattern that can be used to identify a person. An individual's DNA is hundreds of times more detailed than the human thumbprint. It is a unique set of codes that are required to build an individual, and this code is identical between clones or an identical twin, similar to close family members, and becomes more different as it is compared to an unrelated person, further distinct when compared to different species altogether.

Genetic diversity studies are important for both historical as well as future innovation purposes. In terms of history, genetic diversity studies can help explain the origins, ancestry, and migration stories of not just humans, but domesticated animals and crops, as well as those still found in nature. It can provide a story where written records are not present. It is also a tool for the future: In breeding, genetic diversity is the window towards informed breeding efforts, as it allows us to cross-breed organisms of known genetic makeup to generate new cultivars or hybrids. This is important for efforts to produce disease resistance as well as climate-resilient crops and livestock for future generations.

Genetic diversity studies also play a role in allowing us to understand the genetic potential of a given population. For example, conducting a genetic diversity study on native paddy varieties in Sabah or Sarawak, can allow us to know if the varieties are closely related, or extremely variable. High variability is a good indication as it holds the potential for future R&D breeding as well as commercialisation benefits. It also underscores the importance of genetic purity which will be discussed more. **This further emphasises the importance of studying and formally recognising the rich genetic diversity of paddy varieties in East Malaysia and its potential to bring in climate-resilient traits.** Unfortunately, up until recently, genetic diversity studies on paddy varieties in East Malaysia have been scarce relative to the sheer number of varieties found throughout Sabah and Sarawak[297]. **We have only just begun to better understand the value of our heirloom/specialty rice**.

A recent paper by Jasim Aljumaili (2018) tried to study the genetic diversity of 53 paddy samples taken from Peninsular Malaysia, Sarawak, and Sabah[298]. The results showed that the samples can be grouped into 10 clusters based on similarities, as depicted in Table 5.1. In practice, samples within a group are deemed to be more similar than members of a different group. Results showed that Sabah holds the most genetically diverse paddy samples. This is because the paddy samples from Sabah are spread across different clusters/groups while those from the Peninsula are clustered into one group, with Sarawak having an intermediary pattern.

Table 5.1: Genetic Diversity of Paddy in Malaysia

Cluster	Number of accessions	Accessions
I	2	Acc3369, Acc6891
II	7	Acc7155, Acc9037, Acc11816, Acc9936, Acc9636, Acc9958, Acc9971
III	3	Acc10538, Acc9954, Acc9956
IV	29	Acc10006, Acc5101, Acc5103, Acc6049, Acc5105, Acc6288, Acc6674, Acc7129, Acc7508, Acc7507, Acc5080, Acc7516, Acc7565, Acc6009, Acc7583, Acc9866, Acc9873, Acc9894, Acc9930, Acc9959, Acc9968, Acc9963, Acc7540, Acc9962, Acc7543, Acc9965, MRQ74, MR253, MR219.
V	1	Acc7580
VI	3	Acc7529, Acc7571, Acc7560
VII	3	Acc7156, Acc10001, Acc6292
VIII	2	Acc9467, Acc9953
IX	2	Acc9993, Acc10003
X	1	Acc6893

Source: Jasim Aljumaili et al. (2018), KRI illustration
Note: The accessions in Cluster II are mostly of Sarawak (4) and Sabah (3) origin. Cluster IV includes 17 out of 30 accessions of Sabah origin, together with 3 local modern varieties (MRQ74, MR219, and MR253) and all the accessions from Peninsular Malaysia excluding Acc6292. Accessions highlighted in orange are from Sarawak samples; yellow are from Sabah samples; purple are from Peninsular samples; and blue are from modern MARDI varieties.

[297] Goh et al. (2018)
[298] Jasim Aljumaili et al. (2018)

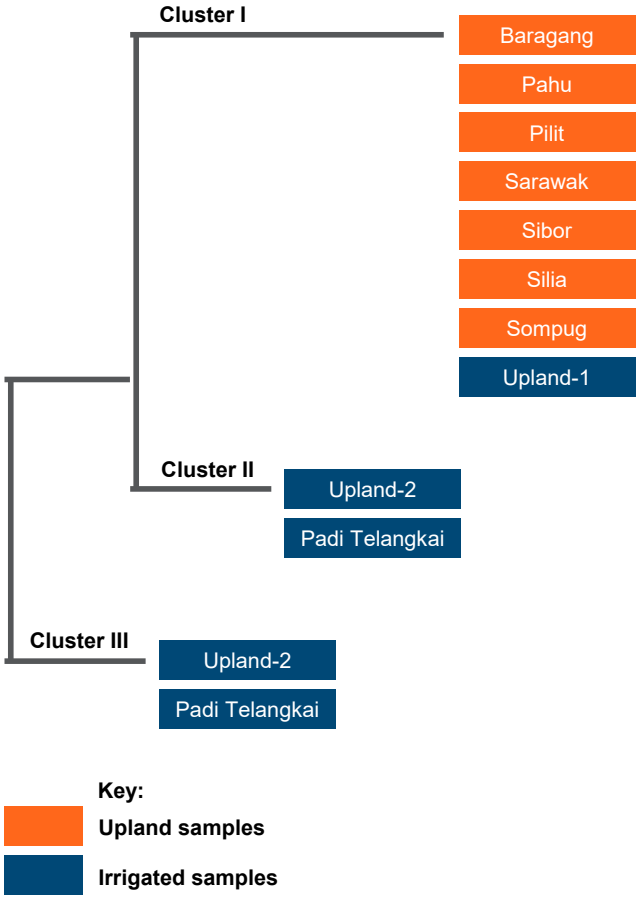
These studies begin to elucidate the richness of our traditional rice, especially in East Malaysia. What is lacking from this and other similar studies, is the genetic comparison between international model rice varieties such as the Thai Hom Mali, Basmati varieties, and the African rice varieties, to our local varieties. This is so that we can see where some of Malaysia's rare specialty rice sits in terms of genetic uniqueness compared to globally commercial varieties.

5.3.1. Paddy Varieties in Sabah

Contrary to Peninsular Malaysia having access to flat plains and water, the topography of Sabah, being deep forests and hills, meant that lowland rice cultivation is not as widespread as the Peninsular counterpart. As a result, upland rice cultivation is more prominent within this region[299] and the isolated nature of each cultivated area, meant that the possibility of genetic diversity due to prolonged isolation and unique local environments. The observation that Sabah has high genetic diversity within its paddy varieties, was also noted by Chong et al. (2018) who sampled 22 Sabah varieties[300]. The paper noted that not only are Sabah paddy varieties found to be genetically diverse but even more so are those within the Interior Division[301]. Additionally, in a recent paper published in 2020, Simon et al. sampled 29 irrigated and upland paddy varieties from Kota Belud and Telupid. Using a genetic tool called Random Amplified Polymorphic DNA, DNA differences between samples were analysed. The authors showed that there were distinct groupings, with the irrigated varieties falling into separate groups from the upland samples, and one group having both irrigated and upland (Figure 5.2). What is missing from this study, again, is the inclusion of common varieties from indica and japonica for comparison purposes, as well as *O. glaberrima* (as the control outgroup). By doing so, we can see how genetically distinct the Sabah's upland and irrigated samples are compared to globally important varieties.

[299] Simon et al. (2020)
[300] Chong et al. (2018)
[301] Ibid.

Figure 5.2: Genetic Diversity of Paddy Varieties Samples from Kota Belud and Telupid



Source: Simon et al. (2020), KRI illustration

5.3.2. Paddy Varieties in Sarawak

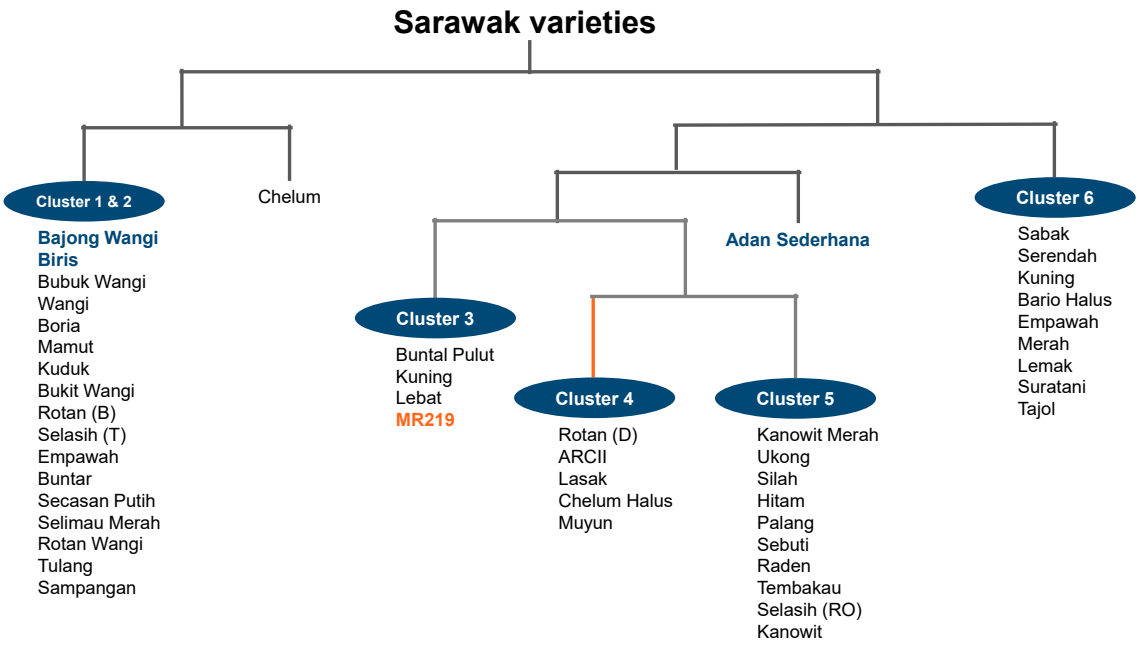
As mentioned previously, Jasim Aljumaili's 2018 paper indicated that paddy varieties in Sarawak are not as genetically diversified as samples from Sabah. This is an interesting observation given that Sarawak is larger with regards to area, with more chances for pockets of physical isolation. However, it is worth noting that this is just a preliminary finding. More studies, sampling from various areas in both Sabah and Sarawak, with well-selected controls are needed to better understand if Sabah is indeed richer in terms of variety than Sarawak. Nonetheless, the varieties found in Sarawak have also been studied within their category, and the following are some interesting findings. While there are many local varieties, the exact number is not known. Some well-known GI registered varieties in Sarawak include Bario (in the Bario highlands), Biris (in Simunjan) and Bajong (in Lubok Nibong)[302].

[302] Teo (n.d.)

A team of researchers sampled 53 locally known cultivars in the areas of Kuching, Sri Aman, Betong, Sarikei, and Bintulu[303]. Using DNA tools, they were able to group genetically similar varieties, forming six distinct groupings. It is very interesting to note that Malaysia's MARDI-developed commercial lowland variety, MR219, which as an indica[304], falls under Cluster 3, while heirloom/specialty varieties such as Bajong, Biris and Adan, were placed into other clusters/groups. This shows how unique and genetically different local Sarawak varieties can be, compared to commercial Peninsular varieties. **This finding underscores the potential and importance of local Sarawak varieties as unique, artisanal rice.** It is interesting to further note that in a separate study, the author identified Bario (Adan Kelabit) variety as tropical japonica[305]. Referring to Figure 5.3, it made sense that MR219 (indica) is clustered differently from Adan Sederhana (assuming it is Adan of the same/similar type). With the inclusion of appropriate control samples, it is possible that some of these Sarawak varieties such as those from clusters 1 & 2, and cluster 6, may be genetically distinct from globally common commercial varieties. Future studies must be conducted to prove this exciting hypothesis.

In conclusion, early attempts at genetic studies of local paddy varieties in Sabah and Sarawak suggest that this region is home to a rich collection of local paddy varieties with very different characteristics.

Figure 5.3: Genetic Diversity of Sampled Paddy Varieties from Sarawak



Source: Adapted from Wong et al. (2011), KRI illustration
Note: MR219 is the MARDI variety commonly grown in the Northern states of Peninsular Malaysia. Varieties from the same cluster are deemed more genetically similar. The further the branching of one cluster to another, the more genetically different the varieties are. Example, Lasak (cluster 4) is most similar to Chelum Halus (cluster 4), somewhat similar to Kanowit Merah (cluster 5), but very genetically different from Bajong Wangi (cluster 1 & 2).
Abbreviations: RO = Roban; T = Tatau; D = DOA Semenggok; B = Betong.

[303] Wong et al. (2011)
[304] Zuraida et al. (2012)
[305] Lestari et al. (2016)

5.4. Morphological Characterisation of Paddy in East Malaysia

By Prof. Dr Abdul Hamid and Dr Januarius Gobilik

The classical interest in studying the morphological[306] traits of rice stand on the aim to classify this plant into the correct species, subspecies, variety, and cultivar. Conventionally, morphological examination is the most convenient method in the field to identify and classify rice plants. With the advancement of molecular technology, however, DNA information is now commonly used for phylogenetic[307] analysis[308] of rice plants as was described in the previous section for rice in Sabah and Sarawak. Morphological trait studies are thus shifted to focus on selecting rice varieties and cultivars for better grain production[309]. This direction is taken partly also because the agro-morphological traits of rice plants depend on the interaction of the environment and genetics. The same rice cultivars are known to show different morphological traits from their typical characteristics as an adaptation to environmental pressure nutrient adversity or variation[310]. Some of the traits are temporary, resulting from counteraction to environmental circumstances rather than genetic factors, but with those characteristics, the rice plants thrive in unfavourable conditions. For high-yielding cultivars, for example, the roots may be developed longer and thicker during drought to increase the root hydraulic properties to uptake more water[311]. That is an environmentally induced root development, which will not happen when the water supply is sufficient, an inherited trait that could make the cultivar drought resilient. Morphological characteristics either genetically or environmentally related are widely known to affect rice yield[312] and thus, genetically and environmentally (or geographically), it is expected that somewhat, historically native rice varieties and cultivars to Sabah, Sarawak and West Malaysia will be having diverse agro-morphological and yield traits.

From a broader perspective, if the yields of the environmentally resilient cultivars are acceptable, they are seen as the better choice to be conserved and improved to sustain rice production. If the grains of these resilient cultivars are also physically and chemically ideal, the market potential can be higher as these cultivars are even more important for the rice industry. Consumers, for example in Malaysia, prefer rice that has less broken grains, lower amylose content, long, fragrant non-sticky grains (especially the local Jasmine type), glutinous rice (especially the imported type, except for the local black glutinous type) and coloured rice (especially the imported type)[313]. As such, even low-yielding rice cultivars or varieties with those traits are thus important and need to be conserved for future breeding works.

[306] Morphology: a branch in Biology that studies the form of living organisms and relationships between these structures
[307] Phylogenetic: The evolutionary relatedness among organisms
[308] Phylogenetic analysis: A work to analyze the output of the systematic study of reconstructing the past evolutionary history of remaining species or taxa, based on the present-day data, such as, morphologies or molecular information.
[309] Rahaman et al. (2015); Wijayawardhana et al. (2015)
[310] Sales et al. (2011); Wang et al. (2019)
[311] Wang et al. (2019)
[312] Li et al. (2019)
[313] Engku Elini et al. (2018)

In Sabah, several cultivars are suggested to be important for further characterisation both genetically and agro-morphologically, of which the grains are aromatic and non-sticky (Padi Keladi Merah), glutinous (Pulut; Pulut Merah), and coloured (Tadong; Ronggitom). In Sarawak, the Bario line is already widely recognised at the national level, but there are many more to be characterised (estimated more than hundreds, as stated in subsequent sections). In Sabah and Sarawak where documentation and characterisation of rice plants are still in their infancy stage, finding many more rice cultivars with the above eating quality will be markedly beneficial.

The complete information about rice morphology and varietal characteristics are described by Chang et al[314]. Morphologically, rice can be divided into vegetative and reproductive phases. The former includes germination, seedling, and tillering stages. The latter includes panicle initiation and heading stages. At germination or the seedling stage, morphological traits are specified by the radicle and coleoptile (embryonic shoot) characteristics. The coleoptile develops to become a seedling. From the seedling tillers will emerge.

Tiller is a vegetative branch of the rice plant. It is composed of roots, culm (stem) and leaves (Figure 5.4). The tiller may or may not develop a panicle. A series of nodes and internodes make up the culm. Nodes are the solid ring of the culms, panicle axis, and panicle branches. Leaves, tillers, and adventitious roots develop on the nodes. Culm node number and internode length determine the height of rice plants [315]. **The internodes vary in length depending on cultivars and environmental conditions**. Each upper node bears a leaf and a bud, which can grow into a tiller. The leaf comprises the leaf blade and leaf sheath (Figure 5.4). At the connection of the leaf blade and leaf sheath, there is a collar and a pair of auricles on the side. Above the auricle is a ligule, a membranous appendage at the top of the leaf sheath. Ordinary roots develop at the base of the plant below the soil surface and grow deeper into the soil.

[314] Chang, Bardenas, and Rosario (1965)
[315] Zhang et al. (2017)

Figure 5.4: The Morphology of a Rice Plant

Source: Author's illustration
Note: Rice morphology. A–E = Tiller. A = Roots. B = Stem or internodes; it is usually hollow. C = Leaf blade. D = Peduncle. E = Panicle. F = Primary (main or nodal) root. G = Secondary (lateral) root. H = Leaf sheath. I = Leaf collar. J = Auricle. K = Node. L = Spikelet.

The rice paniclev (inflorescence; infructescence) attaches to the culm through a peduncle (Figure 5.4). Al-Tam et al. (2013) have described rice panicle (inflorescence; infructescence) into rachis, primary, secondary, and tertiary branches[316]. Spikelets develop on these branches at specific nodes. Spikelet development is explained well in Itoh et al. (2005)[317]. A spikelet attaches to the node via a pedicle. The spikelet consists of glumes, or rudimentary glumes, and floret. There is only one floret (flower) per spikelet. The flower is enclosed in the hull (lemma and palea), which may be either awned or awnless. Like other flowering plants, the components of the flower are stamens and pistils (stigmas, styles, and ovary). After pollination and fertilisation of the embryo, the zygote develops into a grain.

Rice grain consists of the true fruit or brown rice (caryopsis) and the hull (husk; comprises of palea and lemmas), which encloses the brown rice (mainly embryo and endosperm). Layers of differentiated tissues enclose the embryo and endosperm. For indica rice, the palea, lemmas, and rachilla make of the hull. **For japonica rice, the hull also includes rudimentary glumes and a portion of the pedicel.** Rice seed can be characterised by seed or grain size (grain length, width, and thickness), hull surface traits (glabrous, pubescent, smooth or reticulate), hull colour, awn (without or with; short or long) and endosperm colour (Weight is the non-morphological trait of grain).

[316] AL-Tam et al. (2013)
[317] Itoh et al. (2005)

5.4.1. Rice Morphological Traits and Yield

Some key morphological traits that have been of significant interest are related to yield. Technically, yield per se refers to how many grains a rice plant can produce, measured usually in metric tonne/hectare (Mt/Ha). Be it for subsistence farming or commercialisation, a higher yield variety or cultivar is a preferred choice (notwithstanding other favoured characteristics such as flavour and pigmentation which are not discussed here). This is because for the commercialisation of specialty rice, farm yield is important to make the venture economically viable.

Roots, height, leaf, panicle, and grain traits are known to affect the overall yield of rice plants. Cultivars of higher root length and density have higher grain yield due to having a better uptake of nutrients and water[318]. Rice plant height and grain yield are also positively correlated[319]. A 70cm tall rice plant produces 1.3 and 4.8 times more grain yield than 65cm and 55cm tall rice plants, respectively[320]. Tall rice cultivars, however, are susceptible to lodging and stem fall. Long stems fall easily during rainstorms or weaken, bend down and break, destroying the panicles and spikelets[321]. Lodging problem reduces rice yield up to 2t Ha^{-1} and every 2% lodging causes 1% reduction in grain yield[322]. Tall rice plants may also lead to low grain harvesting efficiency. It has been reported that grain yield was highest at a harvesting height of 40cm[323], meaning grains of rice cultivars that are shorter or taller than a particular height may not be maximally harvested with a rice harvester. The use of rice cultivars with strong stems decreases lodging issues and yield loss[324].

The number of tillers also affects grain yield, but this trait is more developmental rather than a morphological factor. Leaf basal, opening and droop angles, leaf length to leaf width ratio, and leaf pillow distance negatively affect rice yield. While leaf width, area, and edge distance positively affect the yield[325]. It has to be noted that if the leaf angles are larger, rice plants of higher leaf width will likely experience a higher shade effect and thus, poor growth and yield. Larger leaf angles are therefore not desired.

Additionally, panicle length and panicle internode length vary between rice varieties[326]. Panicle traits can be genetically or environmentally associated. With higher panicle size, many more grains are produced and the yield is higher[327]. An increment of 1.4 times in panicle length results in an increment of 2.0 times in panicle weight[328]. Long panicles of longer internode length, however, will have fewer nodes and thus lower yield. Grain size, which is determined by grain length, width, and thickness, also affects rice yield[329].

[318] Yang, Zhang, and Zhang (2012)
[319] Zhang et al. (2017)
[320] Mitu, Khan, and Rashed (2017)
[321] Zhu et al. (2016)
[322] Setter, Laureles, and Mazaredo (1997)
[323] Yazdpour et al. (2012)
[324] Setter, Laureles, and Mazaredo (1997); Zhu et al. (2016)
[325] Zhong et al. (2020)
[326] AL-Tam et al. (2013)
[327] Laza et al. (2004)
[328] Lestari et al. (2016)
[329] Yu et al. (2017); Li et al. (2018)

5.4.2. Agro-morphological Study of Rice in East Malaysia and Nomenclature Issues

The growth and yield of rice cultivars in Sabah and Sarawak have been studied to some extent and published in several journals. Information about the morphological traits of the cultivars can be found in the respective publications (e.g., Sohrabi et al., 2012; Sarif et al., 2020; Nur Aini et al., 2020)[330]. Nur Aini et al. (2020) have specifically studied the agronomic traits of 6 upland and 17 lowland rice cultivars in Malaysia. Six of the cultivars were planted in Sabah: Mahsuri, Bokilong, Gonsulak, Pandasan, Taragang, and Tomou.

Mahsuri is a wetland rice variety and the rest are upland. Mahsuri was the tallest at 160.60cm, flowered late (149–151 days), had the highest grain count/plant with 305.40 and better yield/plant with 56.81g, has the lowest 100-grain weight with 1.40g and shortest grain length with 0.71cm, and had just above moderate flag leaf features (39cm long x 1.9cm width). The highest yield of Mahsuri can be associated with having a longer culm. As stated earlier, tall rice cultivars will usually have a higher yield[331], as these cultivars have longer panicle length[332].

Gonsulak and Tomou were the tallest among the upland rice at 162cm and had above moderate flag leaf features (50cm long x 2.1cm width). Gonsulak had the longest panicle at 36.58cm, highest grain count/panicle with 260, and highest yield/plant with 13.27g. Gonsulak has a better yield among the upland rice cultivars, which is expected to be due to the highest culm and panicle length as well as above moderate flag leaf features. Generally, large sized rice cultivars, either lowland (wet) or upland type, have better yield.

In the study by Sarif et al. (2020), the tallest was Tidong Tambunan (119.23cm) followed by Padi Randau (117.92cm), but the latter had the highest yield/plant (50.33g) than the former (40.14g). Padi Randau had a wider leaf with 2.06cm (Table 5.2) indicating that it could have a better photosynthetic rate. Another tall cultivar with a wider leaf width in their study, Tahi Ayam (103.0cm; 1.89cm), had a better yield/plant (45.77g) than the Tidong Tambunan. Generally, the information indicates that tall cultivars with better flag leaf features will have better yield/plant.

Lum et al. (2014) reported that Nabawan, Tenom, and Sintok upland rice cultivars from East Malaysia, at the vegetative (seedling) stage, showed moderate shoot and root length at the highest drought condition, i.e., experienced a moderate reduction in shoot and root development when water supply was limited[333]. These cultivars are thus considered to be moderately tolerant to drought, but the yield information is not available to be related to that advantage.

[330] Sohrabi et al. (2012); Sarif et al. (2020); Nur Aini et al. (2020)
[331] Zhang et al. (2017); Mitu, Khan, and Rashed (2017)
[332] Nur Aini et al. (2020)
[333] Lum et al. (2014)

Table 5.2: Morphological Traits of some Rice Cultivars from Sabah and Sarawak

Cultivars	Traits							
	Plant height (cm)	Flag leaf length (cm)	Flag leaf width (cm)	Leaf area (cm2)	Panicle length (cm)	Grain length (mm)	Grain width (mm)	Grain yield/hill (g)
Tahi Ayam	103.80	36.06	1.89	51.07	27.63	9.76	2.74	45.77
Tidong Tambunan	119.23	35.80	1.79	48.12	24.15	9.16	3.81	40.14
Pulut A	94.31	31.59	1.67	39.64	26.72	9.25	2.84	29.92
Dendam Berahi	87.80	32.27	1.70	41.10	26.01	8.89	2.77	34.09
Samambo	94.49	33.52	1.69	40.15	28.10	8.75	2.94	22.05
Padi Randau	117.92	35.08	2.06	45.31	25.92	9.93	2.46	50.33

Source: Sarif et al. (2020)

Grain traits of 19 rice cultivars in Sabah were studied where 11 were awned, 12 had brown apiculus, 10 with straw lemma colour, 7 of light brown seed coat, and 15 were with some scented traits[334]. The grain length of the 19 cultivars was almost the same, except for the Wangi cultivar, which was longer at 6.61–7.50mm. The grain width ranged from 2.47mm (Tadong Sawah) to 4.0mm (Rahum and Silia). The 100-grain weight ranged from 1.42g (Lahum) to 3.19g (Tadong Bukit). This grain information, however, does not provide a clear trend to associate grain physical size with yield traits (e.g., yield/hill or yield/Ha) of the respective cultivars. In brief, agro-morphological traits of the many rice cultivars in Sabah are still little understood.

As for the national online database, there are many more cultivars to be included and studied for Sabah and Sarawak**. Of the 38 rice cultivars included in the Malaysian Agricultural Research and Development Institute's (MARDI) online database (MARDI AgrobIS, 2021) for Sabah[335], only 13 have more than 25% trait information (the rest have less than 25%).** Of the 13, three have 26%–50%, nine with 51%–75%, and one with 76–100% trait information (Table 5.3). Yield as 1000-grain weight is not reported for the 38 cultivars, making the currently known morphological traits uninterpretable in terms of yield. In addition, the names stated in the database have not included a few cultivars known to be farmed in Sabah, such as Tadong 4 Bulan, Tadong 8 Bulan, Padi Keladi Merah, Padi Keladi Putih, Mahsuri, Planta, Padi Seribu, Kiulu, Taragang, Tomou, Nabawan, Tenom and many more including many of the names mentioned by Sohrabi et al. (2012)[336]. Several of these names were not heard some 30 years ago, indicating that a few of those cultivars have been introduced to the local farmers, for example in the district of Tambunan (Sabah), only recently**. The same database (MARDI AgrobIS, 2021) reports around 1,000 rice accessions (many names are repetitions) for Sarawak, with many of the accessions roughly falling in the category of having less than 25% trait information; these data are important to be analysed in the future.**

[334] Chee, Siambun, and Mariam (2011)
[335] MARDI (n.d.)
[336] Sohrabi et al. (2012)

An extensive published study on agro-morphological traits of rice cultivars in East Malaysia is not yet available. Nur Aini et al. (2020)[337] have not cited many specific studies about previous agro-morphological studies in Malaysia other than Sohrabi et al. (2012) [338] and Zainuddin et al. (2012)[339], meaning little has been studied about this aspect even for West Malaysia rice landraces. To date, the information is found only as part of the data reported in other studies on the growth and yield of rice cultivars in Malaysia, especially for Sabah and Sarawak. Based also on the information stated much earlier, **one major problem encountered is when vernacular names are used in the reports because the same local name mentioned in different publications could be different cultivars or the different local names in the publications could be referring to the same cultivar.**

Vernacular names are not consistent between communities of farmers. The name for example Tadong or Tidong in Sabah can simply mean upland rice, although some farmers use it to refer to upland rice of black or deeply dark purple grain. This issue is further complicated when some of these Tadongs are now planted as wet paddy. Other examples are the Taragang and Tomou cultivars stated in Nur Aini et al. (2020), which simply mean red and green (cultivars) in Kadazandusun language in Sabah, i.e., the common colour of many rice cultivars[340]. Some authors (e.g., Sohrabi et al., 2012) used the official accessions stated in MARDI AgrobIS (2021)[341]. The associated vernacular names of the accessions are stated in the MARDI online database, but the cultivars cannot be verified to be similar genetically to those reported in the other studies where only the vernacular names were used.

An important observation is that there are several hundred rice cultivars claimed to be present in Sabah, but only a few of them (Tables 5.2 and 5.3) are reported formally. When the numbers are combined, 44 names are found. This number is believed to be only part of the cultivars in Sabah because a project by Forever Sabah with rice farmers in Tenghilan involved another 46 rice cultivars[342] (unpublished records) of which around 42 are different vernacularly from those in Tables 5.2 and 5.3. Including that number, there are 86 cultivars known in Sabah. However, rice cultivars are not yet surveyed in many districts in Sabah. So, the actual number is probably much higher than 89 just as is claimed, or much lower than that in the case of misidentification, but clearly to date, little is known and understood about these cultivars, not even their names, and so far, there is a need for more work to document, verify, and publish them.

[337] Nur Aini et al. (2020)
[338] Sohrabi et al. (2012)
[339] Zainudin et al. (n.d.)
[340] Nur Aini et al. (2020)
[341] Sohrabi et al. (2012)
[342] Unpublished records based on the author's engagement with Forever Sabah

Based on the various information mentioned above, it can be said that the key challenges to morphological trait analysis to select the best rice cultivars for better grain production include insufficient research projects and publications on coining morphological traits with grain yield either at the experimental or actual (rice field) production level. In addition, there is an issue with incomplete reporting of agro-morphological analysis and preserving the respective information for public knowledge and review. Moreover, there is also a lack of long-term collaboration between rice-interested parties, either government or non-government agencies, to study and document the agro-morphological information of rice landraces planted by the local farmers. Also, there is an issue with unverified cultivars due to the use of vernacular names in many of the existing reports.

A possible consideration to address these challenges is to establish a form of rice biodiversity centre in Sabah and in Sarawak. This is in line with the policy enablers stipulated in the Third Sabah Agricultural Policy 2015 – 2024. The main function of such a centre is to preserve the dried (herbarium) and living (green-housed) collections of rice landraces farmed locally in these regions. A similar initiative was reported in India to save local rice varieties[343]. Important work in the centre can include agro-morphological and genetic characterisations. That information can then be used as a basis for variety purity certification (e.g., Bonow et al., 2007; Bario Rice Certification Scheme (BRCS))[344]. Once characterised, the seeds of the respective rice cultivars can be sent to MARDI's Gene Bank or IRRI for storage. Another activity is facilitating different parties to form various collaborative projects on rice and supporting a range of programs on Science, Technology, Engineering, and Mathematics (STEM) with secondary schools to enhance and maintain the awareness and interest of young generations about the conservation of rice biodiversity.

In addition, agricultural ecosystem monitoring is carried out to link and understand continuously the relationship between the patterns of weather and climate dynamics, rice-field conditions, farming technology, agro-morphological and genetic characteristics, rice quality and physicochemical traits, and food (rice supply) security index. There could also be improved agritourism activities and specialty rice marketing in collaboration with rural communities for financial sustainability. A centralised body may also keep online-accessible copies of all reports and publications about rice in Sabah, Sarawak and Peninsular Malaysia including unpublished theses by students to ease the review of the literature for rice breeding and farming programs.

[343] Deb (2019)

[344] Bonow et al. (2007); DOA Sarawak (n.d.)

Table 5.3: Morphological Traits of some Rice Cultivars from Sabah based on MARDI Online Database

Cultivars	Characteristics																		
	FLLT	FLWD	FLA	LLT	LWD	LA	BLPB	BLCO	LSCO	LIGLT	LIGCO	LIGSH	CCO	AUCO	CULT	CUNO	CUAN	CUDI	INCO	CUST
Sempipion	30	14	D	46	12	E3	I	DG	G	15	W	AA	PG	PG	81	6.6	E2	3.6	G	–
Katanaan	39	16	D	49	15	E1	I	DG	G	5	W	AA	PG	PG	111	10	E1	4.7	G	SNL
Pulut Hitam	22	15	–	38	12	E2	P	PBG	G	8	PL	AA	P	P	70	7	I1	3.3	–	SNL
Sabah(1)	33	16	D	56	17	E1	P	G	G	22	W	AA	PG	PG	108	5	I1	6	G	SNL
Darawal	33	15	D	47	13	E2	I	DG	G	9.4	W	AA	PG	PG	97	7.6	E2	3.8	G	SNL
Sabah(2)	31	15	E4	45	12	E3	P	G	G	16	W	TC	PG	PG	–	–	I1	–	G	SNL
Labou Wato	36	15	H1	48	14	–	P	–	G	12	W	AA	PG	PG	–	–	I1	–	G	SNL
Bayouh	41	18	D	63	18	E2	P	G	G	21	W	AA	PG	PG	125	7	–	3.7	–	–
Pulut Merah	25	14	–	40	12	E2	I	DG	G	13	W	AA	PG	PG	97	6.8	E2	4.4	–	–
Pulut Tatakin	49	20	–	63	18	–	P	–	G	12	W	AA	PG	PG	102	5.4	E1	4.8	–	–
Papais	44	19	–	45	15	E1	I	DG	G	9	W	AA	PG	PG	–	–	E2	–	–	–
Putihak	27	14	–	39	12	E2	I	DG	G	13	W	AA	PG	PG	–	–	E2	–	–	–
Luluas	–	–	–	–	–	–	I	DG	G	–	W	AA	PG	PG	–	–	E2	–	–	–

Note 1: Sabah rice cultivars in MARDI AgrobIS (2021) with <25% trait information (25 cultivars): Alama; Ampahon; Babalatik; Babaliong; Enil Nosopong; Hahata; Kendinga Semula; Kerayan; Ketambalan; Korolok; Labak Kupait; Lalangsat; Lapang; Lobou Biah; Lubang; Pahoon Apulak; Papayak; Parit (Pahoon Bibisan); Pulut; Pulut Melayang; Sesampipion; Simparatan; Talangkai; Tatalunalis; Tinayaian Dib
Note 2: – = No record; A = Absent; AA = Acute to acuminate; C = Compact; D = Descending; D = Droopy; DG = Dark green; E = Erect; G = Green; H = Heavy; H = Horizontal; I = Intermediate; I = Intermediate; L = Light; LP = Light purple; MWE = Moderately well exerted; P = Pubescence; P = Purple; PBG = Purple blotch (purple mixed with green); PG = Pale green; PL = Purple lines; R = Red.; S = Straw; SNL = Strong no lodging; SPA = Short and partly awned; TC = Two cleft; VE = Very exerted; W = White.
Source: MARDI AgrobIS (n.d.)

Cultivars	Characteristics																			
	PLT	PTY	PEX	PA	BR	AWPR	AWCO	APCO	STCO	LPCO	LPP	SLCO	SLLT	SPKF	GW	GRLT	GRWD	(No info)	(With info)	% with info
Sempipion	20	C1	MWE	D	H	SPA	S	P	P	–	–	–	–	–	–	–	–	9	28	76%
Katanaan	29	I1	VE	D	–	A	–	R	LP	–	–	–	–	–	–	–	–	10	27	73%
Pulut Hitam	24	C1	VE	D	L	A	–	P	LP	–	–	–	–	–	–	–	–	11	26	70%
Sabah(1)	28	C1	–	D	H	A	–	–	W	–	–	–	–	–	–	–	–	11	26	70%
Darawal	29	–	–	D	–	A	–	R	W	–	–	–	–	–	–	–	–	12	25	68%
Sabah(2)	–	C3	VE	D	H	A	S	S	W	–	–	–	–	–	–	–	–	12	25	68%
Labou Wato	–	C1	MWE	D	–	A	–	P	W	–	–	–	–	–	–	–	–	16	21	57%
Bayouh	26	–	–	–	–	A	–	P	LP	–	–	–	–	–	–	–	–	16	21	57%
Pulut Merah	28	–	–	–	–	A	–	–	W	–	–	–	–	–	–	–	–	17	20	54%
Pulut Tatakin	25	–	–	–	–	A	–	P	LP	–	–	–	–	–	–	–	–	18	19	51%
Papais	–	–	–	–	–	A	–	R	P	–	–	–	–	–	–	–	–	20	17	46%
Putihak	–	–	–	–	–	A	–	P	LP	–	–	–	–	–	–	–	–	20	17	46%
Luluas	–	–	–	–	–	A	–	–	LP	–	–	–	–	–	–	–	–	27	10	27%

Note 3: APCO = Apiculus Colour; AUCO = Auricle Colour; AWCO = Awn Colour; AWPR = Awning; BLCO = Leaf Blade Colour; BLPB = Leaf Blade Pubescence; BR = Secondary Branching; CCO = Collar Colour; CUAN = Culm Angle; CUDI = Culm Diameter of basal internode (cm); CULT = Culm Length (cm); CUNO = Culm Number; CUST = Culm Strength; FLA = Flag Leaf Angle; FLLT = Flag Leaf Length (cm); FLWD = Flag Leaf Width (mm); GRLT = Grain Length (mm); GRWD = Grain Width (mm); GW = 1000 Grain Weight (gm); HDG = Number of days from seeding to 50% heading; INCO = Culm Internode Colour; LA = Leaf Angle; LIGCO = Ligule Colour; LIGLT = Ligule Length (mm); LIGSH = Ligule Shape; LLT = Leaf Length (cm); LPCO = Lemma and Palea Colour; LPP = Lemma and Palea Pubescence; LSCO = Basal Leaf Sheath Colour; LWD = Leaf Width (mm); MAT = Maturity or duration from seeding to full heading plus 30 days; PA = Panicle Axis; PEX = Panicle Exertion; PLT = Panicle Length (cm); PTY = Panicle Type; SEN = Leaf Senescence; SLCO = Sterile Lemma Colour; SLLT = Sterile Lemma Length; SPKF = Spikelet sterility; STCO = Stigma Colour

5.5. Chapter Conclusion and Recommendations

Studies described in this Chapter have shown that Sabah and Sarawak are hosts to a rich collection of unique paddy varieties and cultivars both from the genetic and morphological disciplines. Some of which may likely be unique to the rest of the world. **There is therefore an urgency for Sabah and Sarawak to take ownership and stewardship in recognising (with a standardised naming system), saving, and even commercialising these varieties as export premium products.** These efforts can be further assisted through regulatory adjustments to ease the business activities of exporting specialty rice (Chapter 6).

What is critical moving forward, is to continue to identify (genetic studies), characterise (morphological studies), and then formally recognise these unique varieties through national or state-level variety recognition schemes. One such example is the Bario Rice Certification Scheme (BRCS)[345] by the DOA of Sarawak. The BRCS requires the use of certified seeds, farms that are MYGAP certified and the end product certified to be genuine and of a certain standard. It is hoped that similar schemes can be introduced for other varieties in the near future.

In addition to recognition and certification, the seeds of these varieties must be carefully kept in a seed bank as a seed stock, to preserve their genetic purity for many generations to come. This is because with regional development comes increases in the physical movements of people and crops. This means that a unique, rare paddy variety kept isolated for many generations in a rural village, could be exposed to modern varieties and cross-pollinate in recent years, leading to a mix-bred of seeds and thus, losing its uniqueness and global potential as an artisanal premium product.

With this, state agricultural departments in Sabah and Sarawak may want to expedite the formalisation and recognition of these varieties by collaborating with local universities and research institutions. They could also increase collaboration with well-established seed banks such as MARDI's Gen Bank and IRRI to help keep and save these varieties before it is too late. At the federal level, regulations and subsidiary legislations, especially those from Act 522, should be updated to nurture the proliferation of artisanal businesses that can commercialise these varieties and put them on a global pedestal. The next chapter (Chapter 6) will discuss this in greater detail.

[345] DOA Sarawak (n.d.)

Source: Dr Januarius Gobilik (2022). Location: Kampung Katagayan, Tambunan, Sabah
Note: Various varieties of paddy are commonly planted together, risking cross-pollination

5.6. Chapter Key Takeaways

Paddy Cultivars and Varieties

- Preliminary genetic and morphological studies suggest that local paddy varieties in East Malaysia are genetically and morphologically diverse. However:

  i. **Characterisation and Recognition**
  There remains many more cultivars or varieties that are not formally characterised and/or recognised.
  ii. **Nomenclature**
  Several vernacular names could refer to the same varieties, causing confusion and further identity issues.
  iii. **Genetic Preservation**
  The storing of seeds or some form of preservation of the pure lines is crucial

Recommendations

- Sabah and Sarawak may want to expedite the conservation, characterisation, and recognition of these precious varieties before it is lost forever through cross-fertilisation. This includes establishing agro-morphological, genetic, and identity characterisation programmes for all local cultivars or varieties. This could not only prove valuable in identifying unique candidates for GI and specialty products, but also the breeding of climate-resilient and high yielding varieties.

- If infrastructure and resources are a limitation, international seed banks such as MARDI Genbank and IRRI are available to help keep and save these seeds for free.

- At the federal level, regulations and subsidiary legislations may be updated to nurture the proliferation of artisanal businesses that can commercialise these cultivars or varieties.

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CHAPTER

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CHAPTER 6

UNDERSTANDING ACT 522 AND ITS LEGISLATIONS

By Dr Sarena Che Omar, Dr Teoh Ai Ni, and Nik Syafiah Anis

The objective of this chapter is to provide the readers with a close inspection of the current regulations relevant to the paddy and rice industry. This chapter explores and identifies regulatory sections which can be improved or updated to encourage the development of the artisanal, specialty segment of the paddy industry.

6.1 Background

Historically, the paddy industry has been and still is (up to the date of this publication) seen as an industry to be protected to ensure an adequate supply of affordable rice to Malaysian consumers and ensure sufficient income to the farmers.

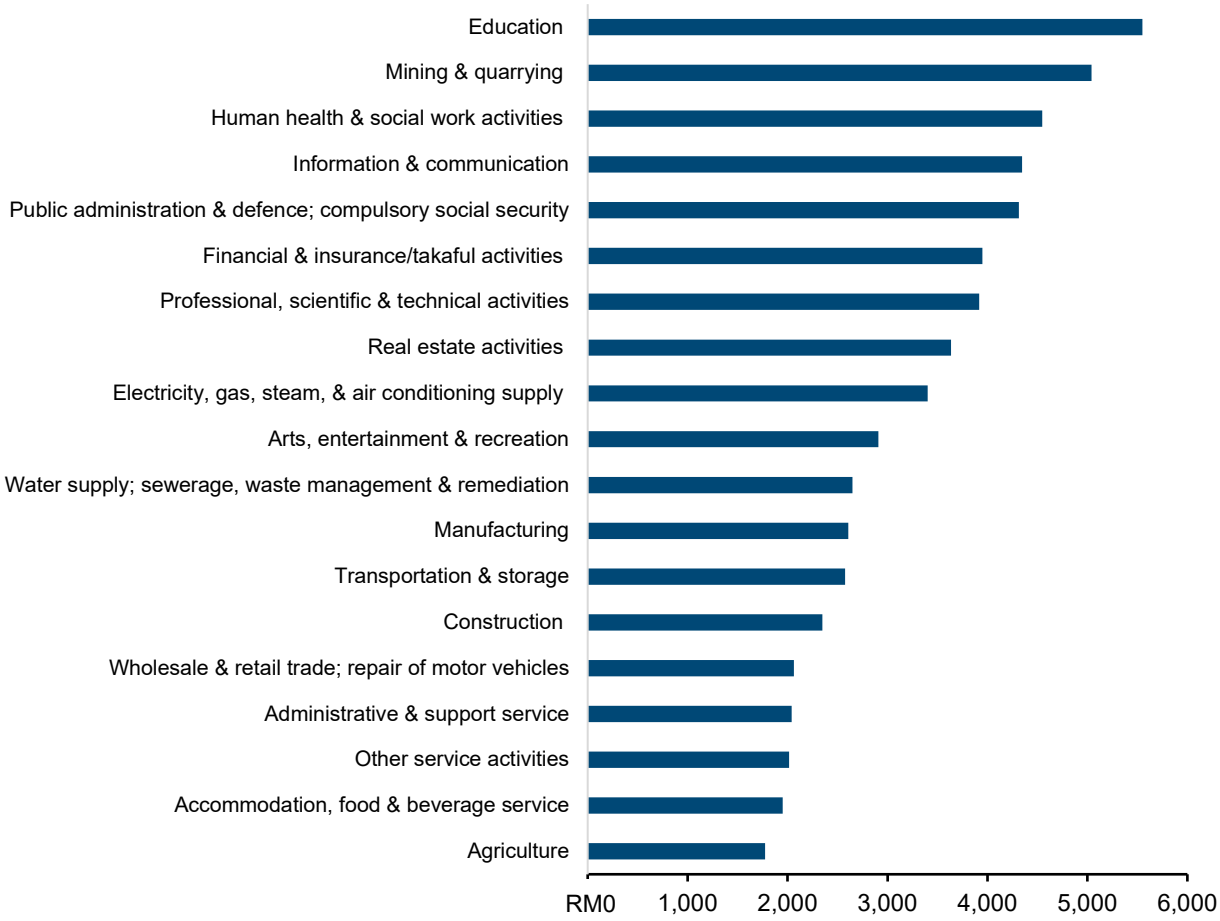
Malaysians have indeed enjoyed a steady supply of rice over several decades and at affordable prices. This is achieved through measures such as export restrictions, price ceilings, and stockpiling. For example, the price ceiling for local *Super Tempatan* 15% (ST15%) has been imposed at a price of RM1.65/kg to RM1.80/kg, ensuring that cheap rice is available to the population (no price ceiling for imported rice)[346]. On the contrary, rice is sold at RM8.30/kg in Singapore, RM3.20/kg in Indonesia, and RM3.74/kg in the Philippines[347].

Furthermore, the supply and demand of national rice have been in balance, coupled with a stockpile of rice enough to feed Malaysia for six months[348]. The success in ensuring an adequate supply of affordable rice is attributed to Act 522, which is acknowledged by the authors.

The other objective is to ensure sufficient income to the farmers, intended through subsidies and Guaranteed Minimum Price (GMP) of the paddy sold to millers. However, there is no recent published information regarding the household income of paddy farmers in Malaysia. As such, interpretations can only be deduced from indirect/partial sources. For example, the income of employees in the agriculture sector remains low relative to other industries (Figure 6.1), despite a 7.4% contribution of the agriculture sector to Malaysia's GDP in 2020[349]. Furthermore, according to KRI's 2019 report, paddy farmers in the MADA area earn around RM2,527 each month as of 2016[350], below the national mean and median household income. As such, less success is seen in terms of the farmers' income for the paddy industry. This outcome is usually a combination of several factors, including low productivity, climate change, and an industry that is heavily regulated across the supply chain. A possible solution to this is addressed in subsequent sections.

[346] The price ceiling for ST15% was gazetted in the Rice (Grade and Price Control) (Amendment) Order 1998.
[347] MAFI (2022a)
[348] KRI (2019)
[349] DOS (2021)
[350] KRI (2019)

Figure 6.1: Mean Monthly Salaries of Employees by Industry in Malaysia, 2021

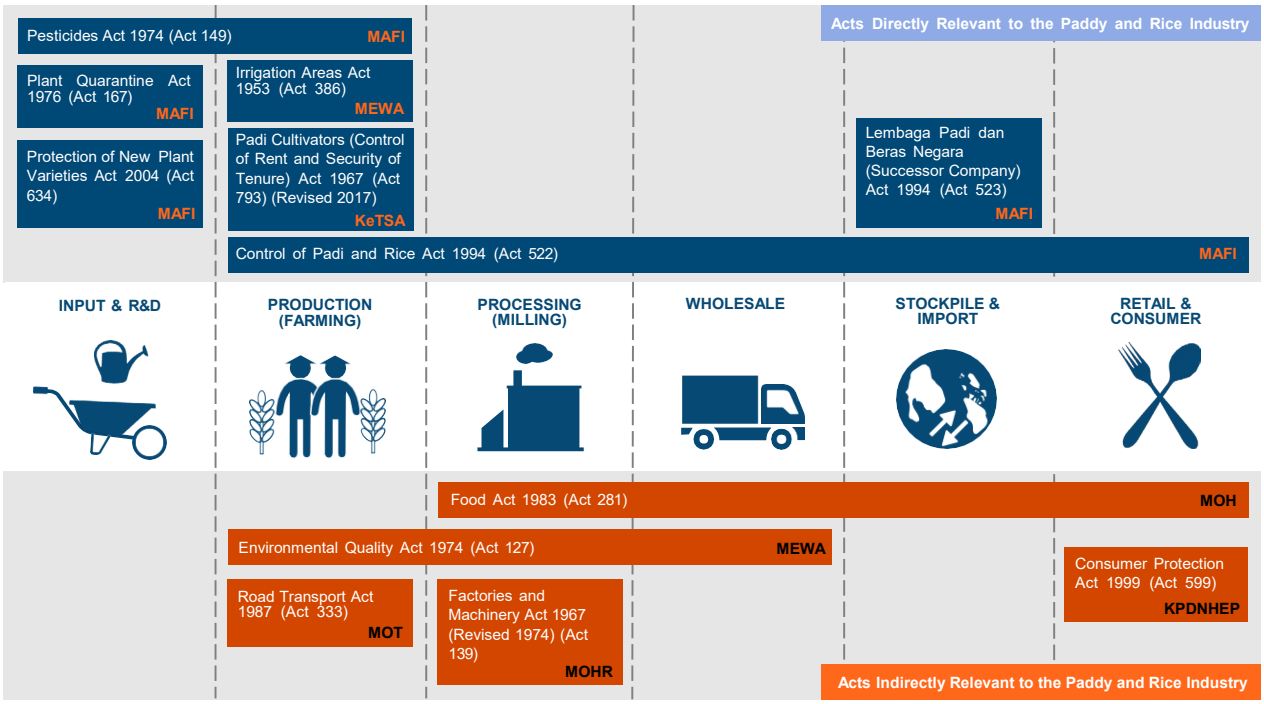


Source: DOS (2021)

6.2 Control of Padi and Rice Act 1994 (Act 522)

When viewed across the supply chain, several Acts are involved within the paddy and rice industry (Figure 6.2). These Acts and legislations are in place to regulate the production, midstream, and retail segments of the paddy and rice supply chain. While recognising the role of these various Acts, this chapter will, however, focus primarily on Act 522 as it is the most important regulation for paddy and rice activities in Malaysia, covering the pricing, licensing, processing, and sale of domestic rice.

Figure 6.2: Legislations at Various Stages of the Paddy and Rice Supply Chain, and the Associated Ministries



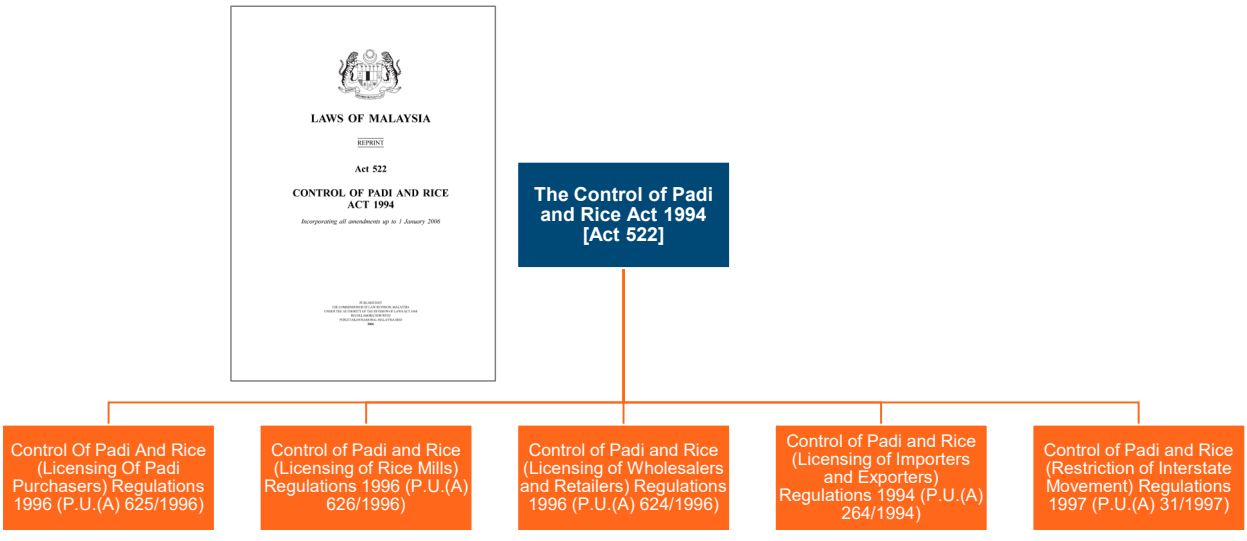
Source: KRI (2019), KRI illustration
Note: KeTSA = Ministry of Energy and Natural Resources; KPDNHEP = Ministry of Domestic Trade and Consumer Affairs; MAFI = Ministry of Agriculture and Food Industries; MEWA = Ministry of Environment and Water; MOH = Ministry of Health; MOHR = Ministry of Human Resources; MOT = Ministry of Transport.

Act 522 was gazetted in 1994 and, since then, has been amended[351]. This Act was introduced for the sole purpose of protecting the paddy and rice industry. Protecting here means ensuring an adequate supply of paddy and rice to Malaysians at affordable prices. Act 522 can be divided into six parts, as per Table 6.1. Under Act 522, five subsidiary legislations are directly related to the paddy and rice industry, as depicted in Figure 6.3. Each subsidiary legislation is in place to regulate and control the activities along the paddy and rice supply chain, from milling, wholesale, retail, import/export, to interstate movements (Table 6.2). Hence, businesses that intend to carry out such activities must obtain the necessary license from MAFI by submitting their applications via the *Portal Rasmi Sistem Lesen Permit Padi Beras* (ELPPB). The general application process is illustrated in Figure 6.4.

Table 6.1: The Six Parts within Act 522

Parts	Title
Part I	Preliminary
Part II	Director General for the Control of Padi and Rice
Part III	Powers Relating to Enforcement, Search, Seizure, Arrest, etc.
Part IV	Offenses, Penalties and Proceedings
Part V	General
Part VI	Repeal, Transitional and Saving Provisions, etc.

Figure 6.3: Act 522 and its Subsidiary Legislations Relevant to the Paddy and Rice Industry



Source: Attorney General's Chamber Malaysia (n.d.); LawNet Malaysia Database (n.d.), KRI illustration

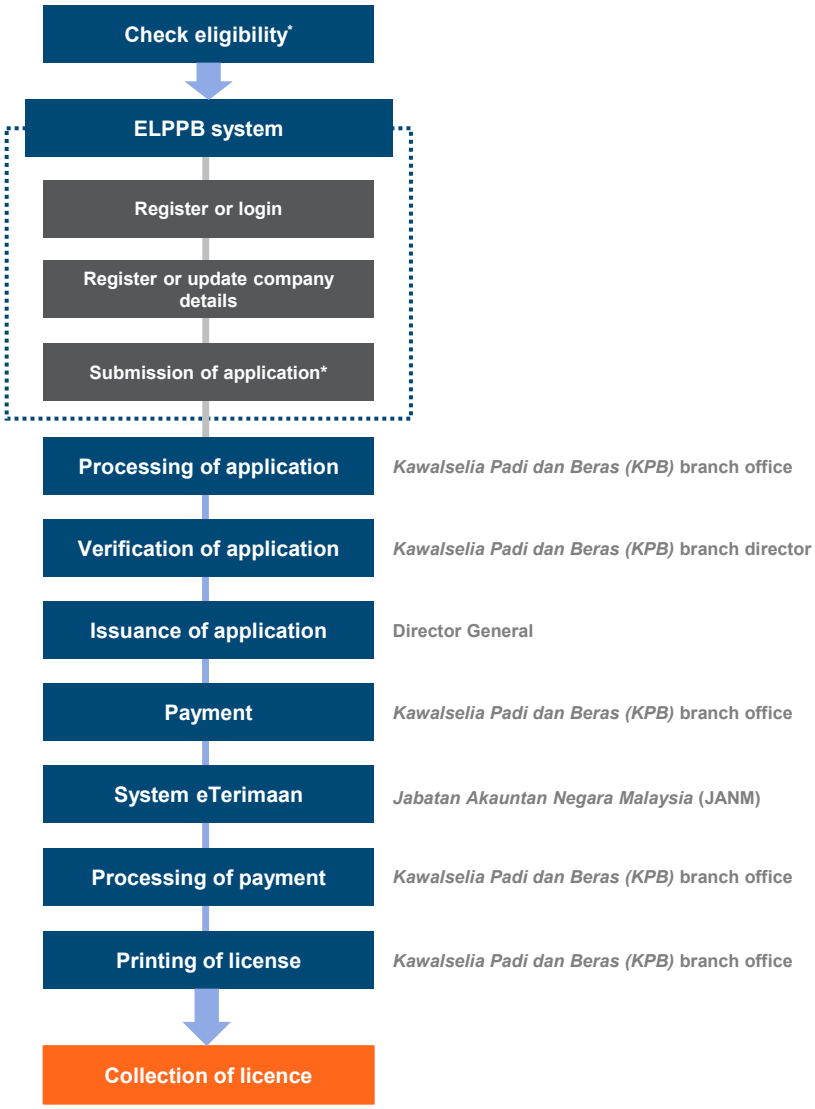
[351] Attorney General's Chamber Malaysia (n.d.); LawNet Malaysia Database (n.d.)

Table 6.2: Subsidiary Legislations Supporting Act 522

Legislation	Objective
Control of Padi and Rice (Licensing of Padi Purchasers) Regulations 1996	To regulate and control the purchase of paddy in Malaysia
Control of Padi and Rice (Licensing of Rice Mills) Regulations 1996	To regulate and control the milling of paddy into rice for commercial purposes or for drying or milling paddy belonging to farmers for their own consumption in Malaysia
Control of Padi and Rice (Licensing of Wholesalers And Retailers) Regulations 1996	To regulate and control the sale and purchase of rice by wholesale or retail in Malaysia
Control of Padi and Rice (Licensing of Importers and Exporters) Regulations 1994	To regulate and control the import and export of rice in Malaysia
Control of Padi and Rice (Restriction of Interstate Movements) Regulations 1997	To regulate and control the movement of rice between states in Malaysia

Source: Act 522 subsidiary legislations P.U.(A) 625/1996, P.U.(A) 626/1996, P.U.(A) 624/1996, P.U.(A) 264/1994, and P.U.(A) 31/1997

Figure 6.4: General Process for Paddy and Rice License Application on ELPPB



Source: MAFI (2022a), KRI illustration
Note: *Eligibility criteria and the documents required upon submission vary by the type of licence.

One important section of this Act 522 is Part II, Section 4 'Duties and functions of Director General'. It is here that most of the power of Act 522 is awarded to (Table 6.3). This includes the power to set ceiling price of rice in the market as well as licensing matters.

Table 6.3: The Power of Director General under Act 522

Part	Section	Description
Part II	4 (1)	The duties and functions of the Director General shall be as follows:
		a) to conserve and maintain an adequate supply of padi and rice;
		b) to ensure a fair and stable price of padi for farmers;
		c) to ensure a fair and stable price of rice for consumers;
		d) to ensure sufficient supply of rice to meet all emergencies; and
		e) to make recommendations to the Government on policies designed to promote the development of the padi and rice industry, and, where approved by the Government, to coordinate and assist in the implementation of the same.
	4 (2)	Subject to the prior approval of the Minister, the Director General shall have power to do all things expedient or reasonably necessary or incidental to the discharge of his functions, and in particular, but without prejudice to the generality of the foregoing—
		a) to implement a guaranteed minimum price for padi;
		b) to enforce the maintenance of a fair and stable price of rice for consumers;
		c) to fix maximum or minimum prices of padi or rice;
		d) to maintain or to require any person to maintain a stockpile in padi or rice for strategic and price stabilisation purposes;
		e) to regulate and control the disbursement of subsidies to padi farmers;
		f) to regulate the marketing of padi and rice particularly through the licensing of wholesalers, retailers, rice millers, importers, and exporters;
		g) to regulate and control the amount of padi or rice that may be kept, stored, or possessed by any person;
		h) to impose rationing in respect of padi or rice and to regulate and control the rationing thereof; to provide for the registration of all or any persons for the purpose of such rationing and for the issue of ration cards or other rationing documents, and to appoint enumerators to enumerate the public or any class thereof for the purpose of rationing;
		i) to requisition stocks of padi or rice belonging to any person and pay adequate compensation therefor;
		j) to regulate and control the milling of padi into rice including the rate and regularity of milling operations;
		k) to conduct surveys and investigations in respect of the padi and rice industry;
		l) to require persons engaged in the production or marketing of padi and rice to register and to give in the manner as the Director General may specify such information as the Director General may deem necessary;
		m) to regulate the production of padi;
		n) to prohibit, regulate or control the movement of padi or rice; and
		o) to require any person dealing in the padi and rice industry to submit reports regarding his activities.

6.3 The Paddy Industry is Dual

Act 522 is an excellent protective act. However, while safeguarding the supply and access to rice, protective measures do not necessarily mean that it is good for competition, commercialisation, and export growth. **These are, in fact, two different objectives requiring different policies and regulations.** If we study Malaysia's paddy and rice industry, it can be divided into two broad segments:

1) High-yielding, cheap medium-grained rice produced in bulk, valued at RM3.3b; and

2) Premium, heirloom/specialty rice grown in smaller quantities, valued at RM3.1b.

6.3.1. High-yielding, Medium-grained Plain Rice in Peninsular Malaysia

The cheaper, medium-grain rice is produced mainly in the Northern states of Peninsular Malaysia, primarily Kedah, Perlis, Pulau Pinang, and Kelantan. More information on this can be referred to in KRI's "The Status of the Paddy and Rice Industry" 2019 report. These are mostly rice sold in the form of *Super Tempatan* (ST15%), *Super Special Tempatan* 10% (SST10%), *Super Special Tempatan* 5% (SST5%), and *beras hancur.* Some notable brands include Cap Rambutan, Faiza, Jasmine, and Jati (Figure 6.5). There is a zone-specific price ceiling of RM1.65 to RM1.80 for ST15%[352]. For SST5% and SST10%, the price ceiling is RM2.60/kg and RM2.40/kg, respectivel[353].

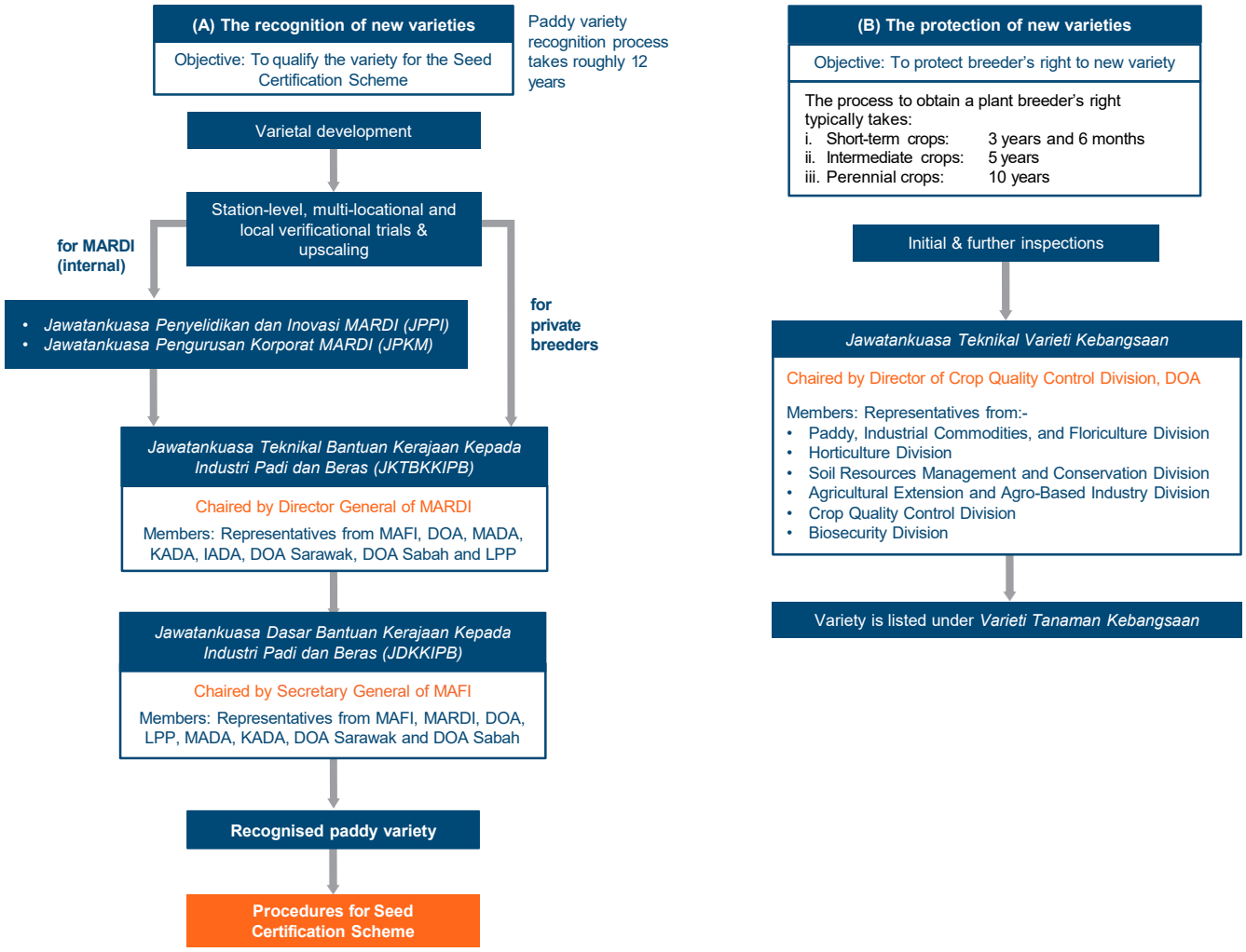
In 2020, the Northern states produced about 65.8% of the total rice produced in Malaysia. It is mainly produced using certified high-yielding MARDI varieties, such as MR 219, MR 297, and MR 220 CL2[354]. In recent years, new paddy varieties, for example, MR 315, MRQ 104, and MRQ 103 were also introduced as a means to increase the country's rice production and improve paddy farmers' income[355]. These varieties have been bred in laboratories for over 10 to 15 years, specially selected for certain characteristics, rigorously tested on the field, and have gone through various certification schemes to be recognised (Figure 6.6). Only when a variety is recognised, will seed producers be able to produce certified seeds for the sale of quality seeds to the farmers[356].

[352] Senarai Gred dan Harga Beras, Senarai Gred Dan Harga Beras – Portal ELPPB (mafi.gov.my) (Accessed 17 Oct 2022)
[353] The price ceiling for SST5% and SST10% was gazetted in the Rice (Grade and Price Control) (Amendment) (No. 4) Order 2008, with effect from 14 November 2008
[354] MAFI (2020a)
[355] MARDI (2021a); (2021b)
[356] KRI (2019)

The following explanation is typical of the seed certification process within Peninsula Malaysia. In Sabah and Sarawak, it is specific to the different states. The authors were able to understand some of the seed certification processes in Sabah (Figure 6.7). In addition, both Sabah and Sarawak use certified varieties from MARDI for cultivation in IADA Kota Belud and IADA Batang Lupar. However, it is important to note that most of the paddy cultivation in East Malaysia is informal and uses heirloom/local varieties that have mostly not been characterised and recognised (refer to Chapter 5) at the state or national level (except for a few, such as Adan-Bario).

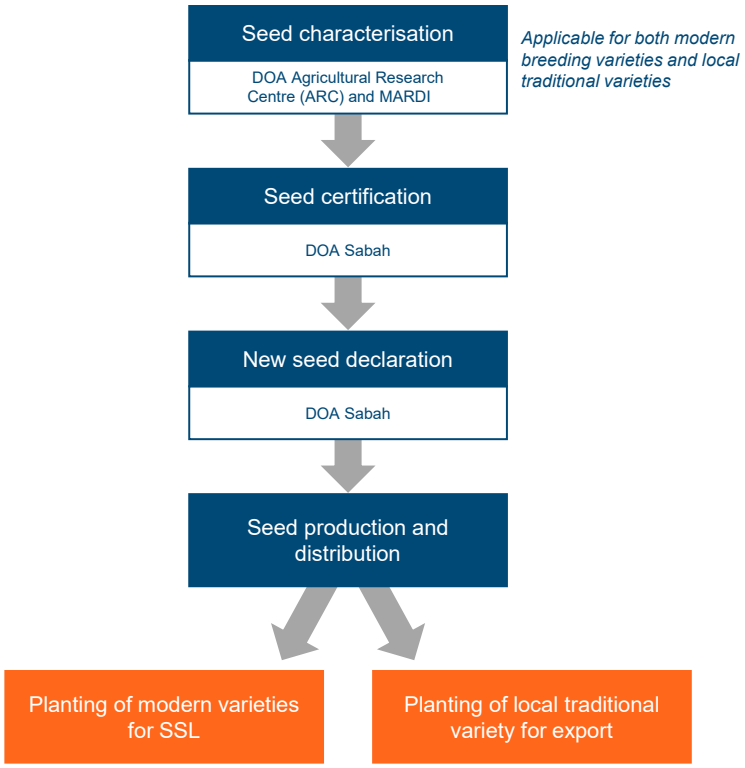
Figure 6.5: Notable Rice Brands in Malaysia

Figure 6.6: The Process Flow for the (A) Recognition and (B) Protection of a New Paddy Variety Associated with Peninsular Varieties



Source: KRI illustration

Figure 6.7: Seed Certification Process in Sabah



Source: DOA Sabah (2022), KRI illustration

6.3.2. Premium Specialty Rice in East Malaysia

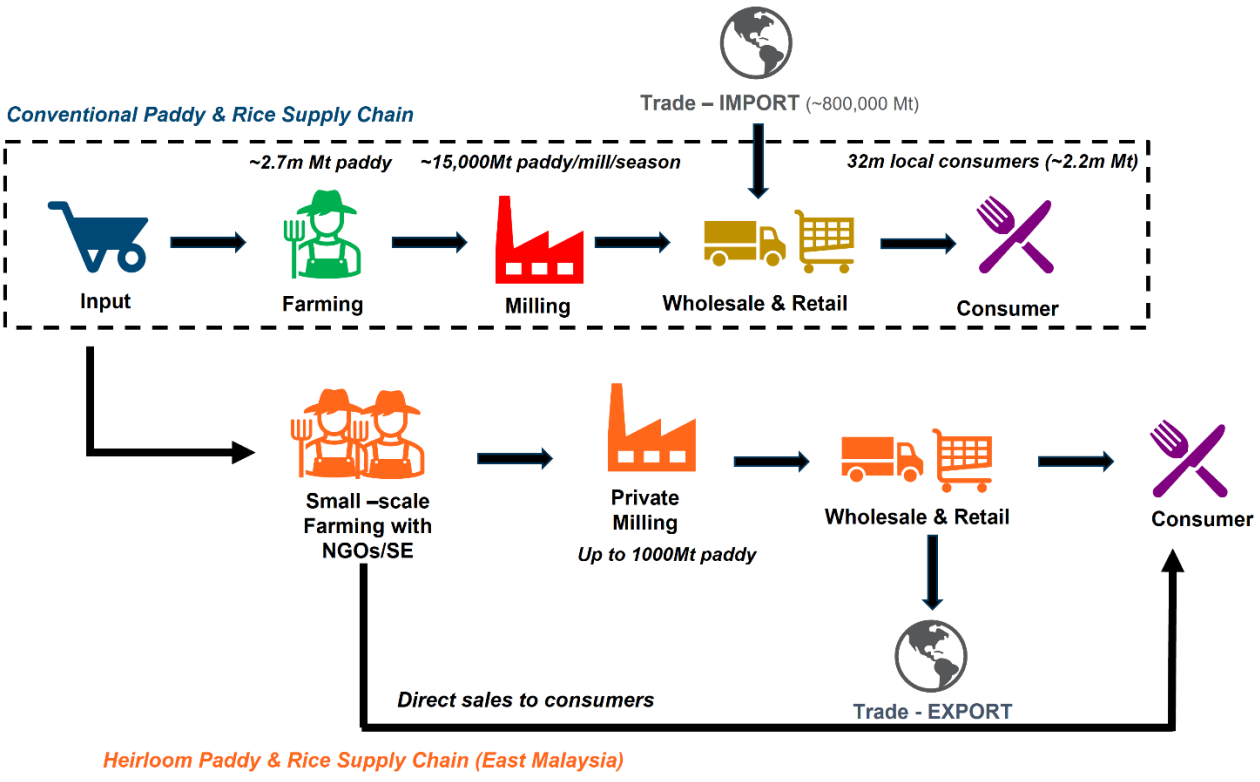
The other type of rice produced in Malaysia is categorised as premium (often fetching more than RM10/kg), artisanal rice. These are made in small quantities in local, rural communities throughout Sabah and Sarawak. This rice category has unique qualities and flavour and meets a niche market. Examples include Adan (Bario), Bajong, Biris, and Pandasan (This is described more in Chapter 5)[357]. Because varieties in Sabah and Sarawak are unique to Borneo, there is a large potential to commercialise these varieties as premium local products carrying Geographical Indicators (GI) that can be exported world-wide, helping to improve the economy of rural communities. In Malaysia, Sarawak Pepper, Sabah Tea and Musang King are among the local GIs known globally.

[357] KRI Field Study in 2022

As stated earlier, the heirloom/specialty paddy is mostly uncharacterised, uses informal nomenclature or not officially recognised at the national level. Under Act 522, there is no distinction between the cheaper, high-yielding medium-grained plain rice for the domestic population and premium rice for commercialisation. This could prove problematic because rice meant for commercialisation must have an enabling business environment such as ease of movement across states and export overseas. It is logical and rational that Act 522 allows prohibitions of movement for security purposes for medium-grained rice, but it is problematic to be imposed on the premium segment.

Furthermore, it is different if we compare the supply chain between the cheaper medium-grained rice and premium artisanal rice (Figure 6.8). As seen in the illustration, cheap medium-grained rice is produced by many farmers in huge quantities (about 2.7m Mt per season[358]) and sold to 157 licensed millers and 1,660 wholesalers[359]. These players process large quantities of paddy into about 1.8m Mt rice.

Figure 6.8: Comparison between Conventional and Heirloom/Specialty Paddy and Rice Supply Chain



Source: KRI illustration & stakeholder engagements
Note: For heirloom paddy and rice supply chain, orange represents a single MSME having to function across the supply chain. For conventional paddy and rice supply chain, it comprises multiple colours representing different entities at each segment of the supply chain

[358] KRI (2019)
[359] Ibid.

However, the artisanal segment typically comprises MSMEs processing smaller quantities of rice (up to 1,000Mt per year per entity)[360]. They are also different because their activities cover the whole supply chain, from working with the farmers on adopting sustainable farming initiatives to milling, packaging, branding, and marketing.

6.4 Existing Regulatory Challenges for the Specialty Rice Sector

While Act 522 and its subsidiary legislations are crucial in protecting the rice and paddy industry in Malaysia, it poses several regulatory challenges that limit the development of the artisanal specialty segment of paddy cultivation. The following subsections elaborate on the regulatory areas that warrant an update and is applicable to the commercialisation of specialty rice in East Malaysia.

6.4.1. High Working Capital Required for License Application

As shown in Figure 6.9, milling and wholesale licenses have a working capital requirement, which is as steep as RM100,000 for Bumiputera and RM150,000 to RM200,000 for non-Bumiputera. The working capital requirement also applies to those who intend to apply for an import or export license as one needs to have a wholesale license to be eligible for import and export license applications. The primary purpose of this criteria is to ensure the owner of a rice miller or wholesale business possesses the financial capacity necessary for business viability.

Hence, it is justifiable to impose such requirements on the large players, given the scale of their businesses. As elaborated in the previous section, the key players in the East Malaysia specialty rice industry, however, are normally MSMEs that typically have a smaller rice processing capacity than the large wholesalers and millers in the Peninsula. For these small players, the RM150,000 to RM200,000 working capital per license requirement may be monumental and discourage more micro to small enterprises from exploring this segment.

[360] KRI stakeholder engagement and focus group discussions in 2022

Figure 6.9: Issuance Fee and Working Capital Requirement for Each Rice and Paddy License

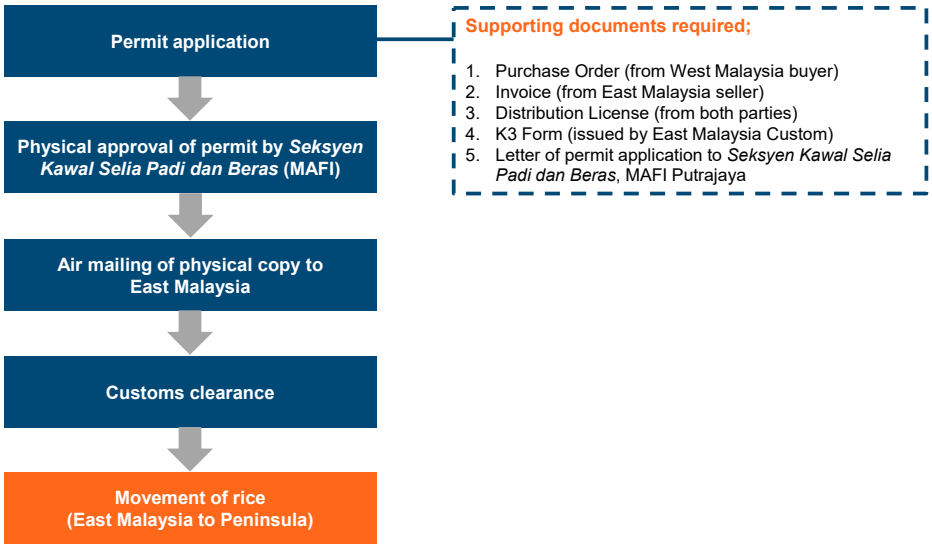
License type	Paddy purchase license	Milling license[b]	Wholesale license	Retail license	Movement of Goods Permit	Import license	Export license
Issuance fee	**West Malaysia:** RM50/annum **East Malaysia:** RM10/annum	**West Malaysia:** RM200/annum for the first 1,000MT, RM10/annum for the subsequent 1,000MT **East Malaysia:** RM100/annum for the first 1,000MT, RM10/annum for the subsequent 1,000MT	RM200/annum for the first 100MT, RM10/annum for the subsequent 100MT	RM20/annum for the first 10,000kg, RM10/annum for the subsequent 10,000kg	N/A	RM 200/annum	RM 200/annum
Working capital requirement[a]	N/A	**Bumiputera:** RM100,000 **Non-Bumiputera:** RM200,000	**Bumiputera:** RM100,000 **Non-Bumiputera:** RM150,000	N/A	N/A	N/A	N/A

Source: Subsidiary legislations of Act 522 and ELPBB (www.elesen.mafi.gov.my)
Note: [a]Applicants are required to submit a 3-month bank statement showing sufficient working capital. [b]The issuance fee listed is for the application of licence to operate rice mill on a commercial basis (Form A). Different fee applies for the application of milling licence for drying and milling paddy owned by farmers for their own consumption (Form B).

6.4.2. Restrictions on Interstate Movement of Rice

Another process for the premium segment which was inherited from the cheap medium-grained rice regulation, is the restriction on the interstate movement of rice. As seen in Figure 6.10, companies that intend to transport rice from East Malaysia to the Peninsula must apply for a permit from *Seksyen Kawal Selia Padi dan Beras* under MAFI, located in Putrajaya. **The requirement of physical approval (official stamp) from MAFI will result in processing time being lengthened as physical copy of the permit will need to be mailed back and forth between East Malaysia and Peninsular Malaysia, before customs can clear it for movement.** Recently there have been indications that the government is in the process of making this process entirely online.

Figure 6.10: Interstate Movement of Rice Process from East Malaysia to the Peninsula



Source: MAFI (2022b); KRI illustration

In contrast, the rice movement application process between states within the Peninsula is relatively more straightforward. This is because the permit application process for states within the Peninsula has been digitalised, particularly through skpb.gov.my. Companies that intend to apply for a permit for the movement of rice between states in the Peninsula may utilise the website and upload all supporting documents required. The digitalisation process has significantly shortened the permit approval time, whereby permit approval can be obtained in less than one working day, given all requirements and supporting documents are met and completed. However, it may still be subject to technical ICT issues.

The permit application for the movement of rice is an important process to protect the paddy and rice industry for several reasons[361]. Firstly, it is to safeguard millers from shutting down their premises due to a lack of paddy available for processing. For example, the paddy milling capacity in Kedah is higher than its capacity to produce paddy. To optimise its milling capacity, these millers in Kedah resorted to acquiring paddy from other states (e.g., Perak or Selangor). This has an impact on millers located in the states where paddy is acquired (e.g., Perak, Selangor), as farmers in these states might choose to transport their paddy to Kedah if they receive more competitive prices from the millers there. In the past, there have been events whereby paddy millers in Selangor and Perak have had to shut down their businesses due to insufficient paddy available for processing**. Therefore, in this scenario, the function of the permit is to protect local millers, as interstate movement permit approval can only be obtained in events where there is excess rice in each state in Malaysia**. **In other words, paddy can only be transported to other states after millers in the respective states have reached their capacity for paddy processing.**

The second reason why interstate movement permit is important for the industry is to protect farmers and consumers from the effects of rice smuggling activities. **As smuggling activities are more rampant in states with cross-country borders (e.g., Kelantan-Thailand border), the importance of the interstate movement permit is to control the movement of rice from Kelantan to other states in Malaysia.** The benefit of controlling the movement of smuggled rice is to protect our local farmers' income. The second benefit is to protect the health and safety of Malaysians as smuggled rice do not go through health and safety inspections before sale.

The above reasons are justifiable, especially for the cheap rice category to safeguard adequate supply at affordable prices. However, it is not relevant for the premium segment and adds on additional processes. Control/restrictions on the movement of premium rice will discourage the active trade of goods which is needed in the private sector. After all, there is no need to 'safeguard' this premium rice category as it meets a different consumer segment and is not a food security issue. If we can differentiate between cheap rice and premium rice categories, it is then possible to exclude premium rice from these restrictive, protective measures and in the process, allow this segment to be competitive. A similar observation is seen in the next section.

[361] MAFI (2022b)

6.4.3. Rice Import and Export

According to Act 522, the application and approval for both import and export licenses are within the power of the Director General. As rice import is solely managed by Padiberas Nasional Berhad (BERNAS), this section will therefore focus on export of rice, highlighting some of the challenges to export specialty rice from East Malaysia. Malaysia is not allowed to export paddy and rice as per Customs Act 1967 Customs (Prohibition of Export) Order 2012 except under the manner provided in the order. This is logical from the food security angle, as Malaysia is a net importer of rice, as such, there is a need to protect domestic rice from being moved out of the country. However, as mentioned earlier, this is only relevant for the cheaper medium-grained rice category but is not relevant for the premium segment of rice which does not need to be protected. The authorities have recognised this difference, and as such, with special permission from the Director General, upon fulfilling several requirements and processes, export is permitted.

The following are the current requirements and processes. Three types of rice are allowed to be exported[362];

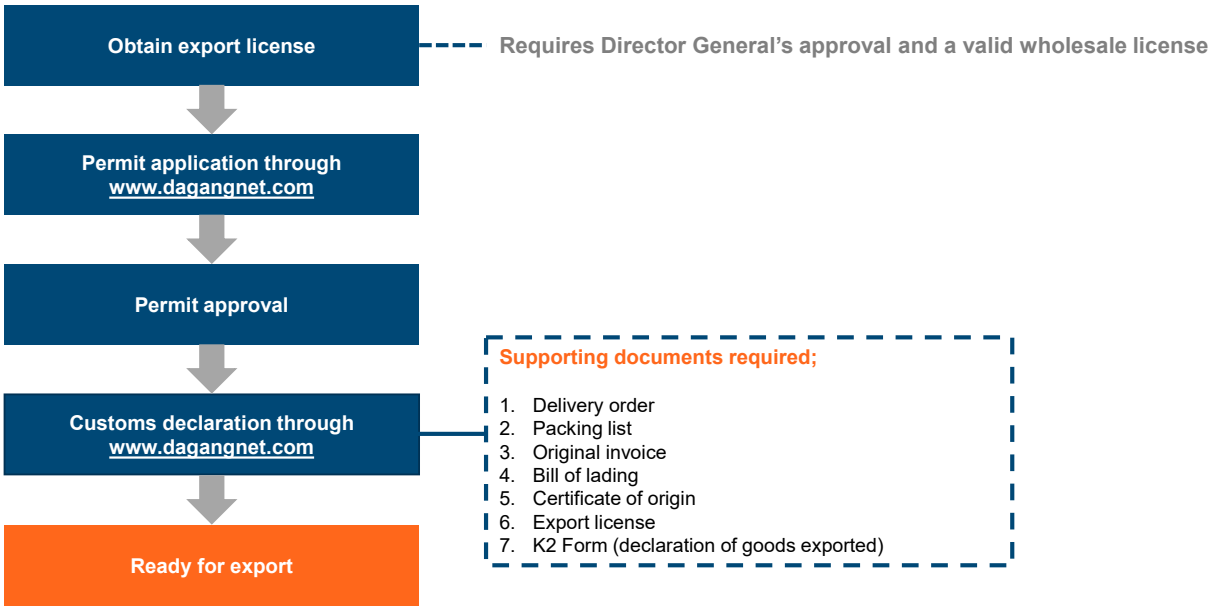
- Brown Rice: Rice that is unpolished with the husk of the grain removed, leaving the bran and germ layer of rice still intact;
- Parboiled Rice: Rice that has been pre-cooked in the husk before being dried; and
- **Heirloom/specialty rice from Sabah and Sarawak, such as *beras* Bario, Bajong, Biris, Sia, etc.**

Generally, the approval process for the export of these rice types is through the consideration of the *Technical Committee for Import and Export,* chaired by the Secretary General of MAFI (Figure 6.11). Some of the key elements necessary for the approval process include:

- Supporting documents to prove market demand for the rice to be exported (e.g., purchase order);
- Details on rice to be exported (e.g., weight, type, price);
- Details on rice source (e.g., rice origin, total production, number of farmers involved in production);
- Details on subsidy received for production; and
- Report from a certified laboratory (to ensure no harmful chemicals are used during production or to prove that paddy is planted organically in events where there are such claims).

[362] MAFI (2022b)

Figure 6.11: Rice Export Process



Source: KRI illustration

Upon approval by the technical committee, rice exporters will be required to obtain a valid export license. To acquire this export license, the applicant must have a valid wholesale license, as outlined in subsidiary legislation Control of Padi and Rice (Licensing of Importers and Exporters) Regulations 1994. Subsequently, Sabah and Sarawak exporters will apply for export permits by or on behalf of the Director of Agriculture Sabah, or Sarawak under the Plant Quarantine Regulations 1981 (for paddy only). Export permission is granted subject to inspection and approval from the Department of Agriculture Sabah, or Sarawak [363] before going through customs declaration, whereby the process can be completed through dagangnet.com.my before goods are ready to be exported (Figure 6.11)[364].

It is appreciated that this is a lengthy exception introduced to circumvent the issue whereby Act 522 does not provide for a distinction between cheap rice and premium rice, with the default being no export of rice. However, it can be a daunting and lengthy process, creating a lethargic business environment and discouraging export. It is worth noting that applicants must also prove market demand in the destination country as part of this export application. However, it is a chicken-and-egg scenario as industries need to export to test their market acceptance before they can venture fully into this segment. These requirements may restrict the development of the premium market.

[363] Based on Customs Act 1967 Customs (Prohibition of Export) Order 2012
[364] MAFI (2022b)

6.5 Chapter Conclusion & Key Takeaways

Act 522 is relevant to safeguard the supply and access to rice for all Malaysians. This should not be contested. This objective was and still is, achieved but came at a price: lack of industry growth and competitiveness. There is a possible solution: we recommend carving out a segment recognised as specialty rice to differentiate it from cheaper, high-yielding medium-grained rice. Once it is recognised that the paddy industry is dual and both types are identified, then different policies and regulations can be imposed separately and appropriately. This is to ensure that a large population of Malaysians continue to have access to cheap rice, but it also enables the industry to be competitive and lucrative by allowing the premium segment to grow.

For the premium specialty rice, once it is recognised as a separate segment, we propose to:

I. **Remove input subsidies for premium rice growers**

As the specialty rice is sold at a premium price and exported, its production does not need to be subsidised by the government. This is also to comply with the World Trade Organisation (WTO) Agreement on Agriculture that initiated reductions in domestic support in agriculture production, including trade-distorting subsidies that stimulate production directly[365]. The agreement ensures a fairer and more competitive world market by preventing overproduction and low-priced dumping of agricultural products. It also provides that Malaysian taxpayers do not subsidise global consumers.

II. **Allow the transportation of premium rice across states** without special permission, especially between East Malaysia and the Peninsula

The Act 522 subsidiary legislation, specifically Control of Padi and Rice (Restriction of Interstate Movement) Regulations 1997 (P.U.(A) 31/1997) was put in place to ensure that there is minimal smuggling and that the supply of rice across states is controlled and monitored for food security reasons. However, this may not be relevant for specialty rice whereby its value is not in local communities where it is cultivated, but to consumers in larger cities opting for the higher priced rice.

III. **Allow the default export of specialty rice**

For cheap medium-grained rice, it is about securing the supply of rice for local consumption. As such, it made sense to ban any export of local rice overseas. However, this is not relevant for specialty rice whereby it is meant for the premium and export market. Allowing the export of specialty rice without requiring the tedious processes outlined in Section 6.4.3 enables the industry to be more competitive and responsive to global markets. However, the default export of specialty rice can only happen if there is some form of formal differentiation and recognition of the different rice types (cheap vs specialty).

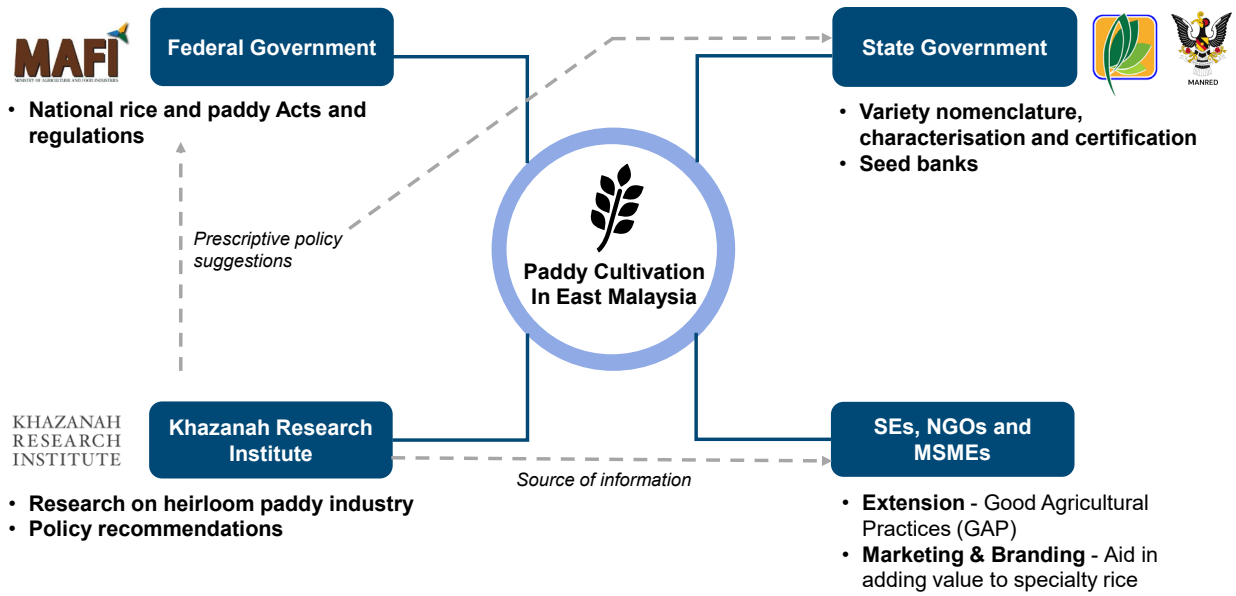
[365] WTO Uruguay Round Agreement, 1995

IV. Lower the required working capital for MSMEs

The commercialisation process of specialty rice involves both a milling license and wholesale license, which have a working capital requirement of RM100,000 for Bumiputera or RM200,000 and RM150,000 for non-Bumiputera, respectively. This can be a major impediment to MSMEs as they typically have a smaller financial capacity. Lowering the required working capital for MSMEs will allow the commercialisation of specialty rice to be more business-friendly.

In summary, various stakeholders can play different yet complementary roles in helping the farmers to spur the specialty rice segment for Malaysia's paddy and rice industry. For example, research institutions such as KRI can conduct policy research and provide prescriptive policy recommendations to policymakers. The federal government can update the relevant Acts and recognise specialty varieties at the national level. State governments can expand their policy targets beyond rice SSL and include growth of the premium segment measured in the export quantity of specialty rice. With the federal government's help, state governments can also increase resources to better organize the variety nomenclature, characterisation, certification, and parent seed storage. SEs, NGOs, and MSMEs can play their role by encouraging good agricultural practices, improving farm yield, giving good returns to the farmers, and providing marketing and branding assistance.

Figure 6.12: Roles of the Various Entities and the Inter-Relationships



Source: KRI's illustration

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ABBREVIATIONS

AD	:	Anno Domini
ASEAN	:	Association of Southeast Asian Nations
b	:	Billion
BERNAS	:	Padiberas Nasional Bhd
BMI	:	Body mass index
BRCS	:	Bario Rice Certification Scheme
Covid-19	:	Coronavirus disease
CPI	:	Consumer Price Index
DNA	:	Deoxyribonucleic acid
DOA	:	Department of Agriculture
DOS	:	Department of Statistics Malaysia
DVS	:	Department of Veterinary Sciences Malaysia
EIU	:	Economic Intelligent Unit
ELPPB	:	*Portal Rasmi Sistem Lesen Permit Padi Beras*
EPU	:	Economic Planning Unit
FAO	:	Food and Agricultural Organisation
FIES-SM	:	Food Insecurity Experience Scale
GHG	:	Greenhouse gas
GDP	:	Gross Domestic Product
GFSI	:	Global Food Security Index
GI	:	Geographical indication
GI	:	Glycemic index
GMP	:	Guaranteed Minimum Price
Ha	:	Hectare
HFSSM	:	Household Food Security Survey Module
HIES	:	Household Income & Expenditure Survey
IADA	:	Integrated Agriculture Development Areas
ICN	:	International Code of Nomenclature for algae, fungi, and plants
ICNCP	:	International Code of Nomenclature for Cultivated Plants
IPH	:	Institute for Public Health
IRRI	:	International Rice Research Institute
JPKM	:	Jawatankuasa Pengurusan Korporat MARDI

ABBREVIATIONS

JPPI	:	Jaw atankuasa Penyelidikan dan Inovasi MARDI
KADA	:	Kemubu Agricultural Development Authority
LPP	:	Farmers' Organisation Authority
m	:	Million
MADA	:	Muda Agricultural Development Authority
MAFI	:	Ministry of Agriculture and Food Industries Malaysia
MANRED	:	Ministry of Food Industry, Commodity and Regional Development Sarawak
MAQIS	:	Malaysian Quarantine and Inspection Services
MARDI	:	Malaysian Agricultural Research and Development Institute
MOH	:	Ministry of Health Malaysia
MSMEs	:	Micro-, small- and medium-sized enterprises
Mt	:	Metric tonnes
MyGAP	:	Malaysia Good Agricultural Practice
MyIPO	:	Malaysian Intellectual Property Corporation
NAP	:	National Agricultural Policy
NCDs	:	Non-communicable diseases
NEP	:	New Economic Policy
NGOs	:	Non-governmental organisations
NHMS	:	National Health and Morbidity Survey
OECD	:	Organisation for Economic Co-operation and Development
PLI	:	Poverty Line Income
R&D	:	Research and Development
RM	:	Ringgit Malaysia
RTK-Ag	:	Antigen rapid test kit
SALCRA	:	Sarawak Land Consolidation and Rehabilitation Authority
SBPKP	:	Federal Government Paddy Fertiliser Scheme
SBPKP	:	Federal Government Paddy Fertiliser Scheme
SEs	:	Social Enterprises
SLDB	:	Sabah Land Development Board
SMEs	:	Small- and medium-size enterprises
SOP	:	Standard operating procedure
SPB	:	Sabah Padi Board

ABBREVIATIONS

SRI	:	Systems of Rice Intensification
SSL	:	Self-sufficiency level
SST	:	*Super Special Tempatan*
ST	:	*Super Tempatan*
STEM	:	Science, Technology, Engineering, and Mathematics
UNICEF	:	United Nations Children's Fund
USDA	:	United States Department of Agriculture
VND	:	Vietnamese dong
WHZ	:	Weight-for-height z-score
WWF	:	World Wildlife Fund

GLOSSARY

Food Consumer Price Index (CPI)	:	A measure of the average changes in the retail prices of food items. It is an indicator of food price inflation. *Source: U.S. Bureau of Labor Statistics (n.d.)*
Greenhouse gas	:	The atmospheric gases responsible for causing global warming and climate change. The major GHGs are carbon dioxide (CO2), methane (CH4) and nitrous oxide (N20). Less prevalent but very powerful greenhouse gases are hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF6). *Source: UNFCCC (n.d.)*
Guaranteed Minimum Price (GMP)	:	A policy implemented by the government to ensure paddy farmers receive a reasonable minimum farm income while reducing poverty incidences. *Source: FFTC-AP (2015)*
Incidence of absolute poverty	:	The percentage of households with gross monthly household income below Poverty Line Income (PLI), which is predetermined at RM2,208. *Source: DOS (2020)*
Poverty Line Income (PLI)	:	The minimum gross monthly income required by a household to meet the basic food and non-food needs for each of its members. The Food PLI refers to the amount of income necessary to meet a household's daily nutritional requirements as determined by the Ministry of Health. The non-food PLI is the amount of income necessary to meet the minimum requirements for items such as clothing, housing, transport, and other non-food needs by sex and age of a person and is based on the expenditure patterns of low-income households. *Source: DOS (2020)*
Self-sufficiency level (SSL)	:	The extent to which a country can satisfy its food needs from its own domestic production. The calculation is as follows: $SSL = \frac{Production}{Production + Imports + Stocks - Exports}$ *Source: FAO (1999)*
Specialty/Heirloom/Artisanal rice	:	In this report, specialty rice, traditional rice, heirloom rice and artisanal rice are used interchangeably to refer to native rice grown in and unique to Sabah and Sarawak. This type of rice comprises paddy varieties that have been passed down through generations in East Malaysia and have a distinct colour, flavour, and/or fragrance.

GLOSSARY

Super Special Tempatan (SST)	:	The *Super Special Tempatan* 5% or SST5 refers to locally produced white rice which contains 95% of head rice and 5% of broken rice. It is regarded as the most superior grade of domestic white rice. *Super Special Tempatan* 10% or SST10 contains 90% of head rice and 10% of broken rice. *Source: Chung et al. (2016)*
Super Tempatan (ST)	:	The *Super Tempatan* 15% or ST15 refers to locally produced white rice that contains 85% of head rice and 15% of broken rice. It is considered an inferior grade of rice that is sold at a cheaper price due to its higher content of broken rice. *Source: Chung et al. (2016)*

KHAZANAH
RESEARCH
INSTITUTE

Level 17 Mercu UEM
Jalan Stesen Sentral 5
Kuala Lumpur Sentral
50470 Kuala Lumpur
MALAYSIA

Tel: +603 2705 6100

www.KRInstitute.org