



AGRICULTURAL INNOVATION AND TECHNOLOGY ADOPTION FOR
MELAKA'S SUSTAINABLE RUBBER INDUSTRY



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Bachelor of Technology Management with
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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**AGRICULTURAL INNOVATION AND TECHNOLOGY
ADOPTION FOR MELAKA'S SUSTAINABLE RUBBER
INDUSTRY**

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**This thesis is submitted in partial fulfillment of the requirements for
the award of Bachelor of Technology Management and
Technopreneuship
(Honours in Technology Innovation)**

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APPROVAL

“I hereby declare that I had read and go through for this thesis and it is adequate intern of scope and quality which fulfill the requirements for the awards Bachelor of Technology Management (Technology Innovation) with Honours”



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DECLARATION OF ORIGINAL WORK

I hereby declare that the work in this study is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in the candidature of any other degree



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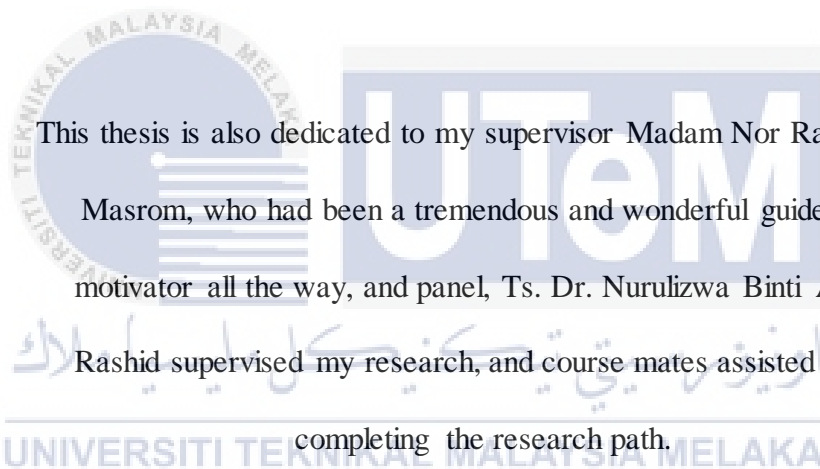
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DEDICATION

This thesis is dedicated to my family, for the immense support and motivation throughout the whole process.



This thesis is also dedicated to my supervisor Madam Nor Ratna Binti Masrom, who had been a tremendous and wonderful guide and motivator all the way, and panel, Ts. Dr. Nurulizwa Binti Abdul Rashid supervised my research, and course mates assisted me in completing the research path.

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ABSTRACT

The rubber tree (*Hevea brasiliensis*) is the main source of natural rubber, an important raw material for industrial and non-industrial products. Various innovations of agricultural and technology adoption to rubber industry but still the rubber industry in Malaysia is not developing well. Furthermore, smallholders are the main producers of rubber. They account for 85% of global rubber production and more than 90% in Malaysia. The increased volatility in global rubber prices has caused a decline in Malaysian rubber production and this has adversely affected the lives of local smallholders. Adoption of a technology depends on the characteristics of the recipient (rubber smallholders), extension agents and the technology itself. This study develops the conceptual framework from the Unified Theory of Acceptance and Use of Technology (UTAUT) and technology readiness. Via interview by face to face for survey, data were collected from five farmers of rubber industry. This research explores the agricultural innovation and technology adoption for Melaka's sustainable rubber industry, whether innovation and technology adoption is related to the lack of smallholders in improving the understanding of rubber stakeholders about the effect of interaction between factors on rubber production and facilitating the formulation of smallholder-oriented policies that effective. The researcher uses qualitative methods such as interviews, some rubber tappers and relevant parties to obtain the latest information related to agricultural innovation, technology use, poverty rate issues and so on. The results showed that current policies do not effectively address issues caused by the feedback between biophysical, socioeconomic and institutional factors in the global, national and farm levels within the rubber production system. This method provides a platform to better facilitate engagement with rubber stakeholders, especially smallholders, and inform the formulation of effective smallholder-oriented policies.

Keywords: Agricultural Innovation, Technology Adoption, Rubber Industry, Smallholders, Rubber Tappers, Natural Rubber.

ABSTRAK

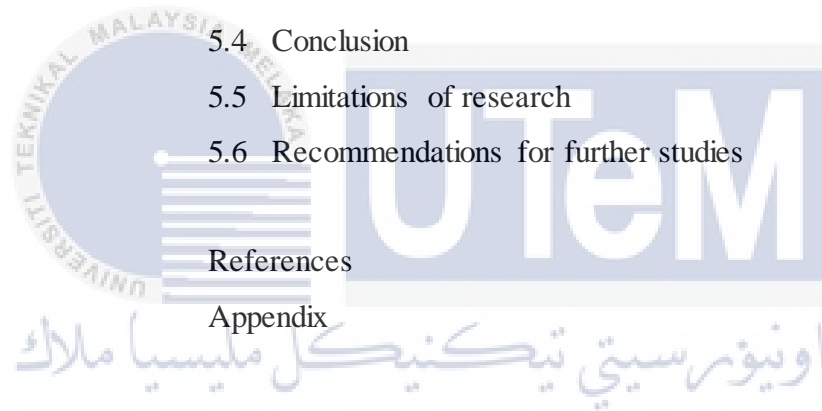
Pokok getah (*Hevea brasiliensis*) merupakan sumber utama getah asli, bahan mentah penting untuk produk industri dan bukan industri. Pelbagai inovasi penggunaan pertanian dan teknologi kepada industri getah namun industri getah di Malaysia masih tidak berkembang dengan baik. Tambahan pula, pekebun kecil merupakan pengeluar utama getah. Mereka menyumbang 85% daripada pengeluaran getah global dan lebih daripada 90% di Malaysia. Kajian ini membangunkan rangka kerja konsep daripada Teori Penerimaan dan Penggunaan Teknologi Bersepadu (UTAUT) dan kesediaan teknologi. Melalui temu bual secara bersemuka untuk tinjauan, data telah dikumpul daripada lima orang petani industri getah. Penyelidikan ini meneroka inovasi pertanian dan penggunaan teknologi bagi industri getah lestari Melaka, sama ada inovasi dan penggunaan teknologi berkaitan dengan kekurangan pekebun kecil dalam meningkatkan kefahaman pihak berkepentingan getah tentang kesan interaksi antara faktor terhadap pengeluaran getah dan memudahkan penggubalan pekebun kecil -dasar berorientasikan yang berkesan. Pengkaji menggunakan kaedah kualitatif seperti temu bual, beberapa penoreh getah dan pihak yang berkaitan untuk mendapatkan maklumat terkini berkaitan inovasi pertanian, penggunaan teknologi, isu kadar kemiskinan dan sebagainya. Keputusan menunjukkan bahawa dasar semasa tidak berkesan menangani isu yang disebabkan oleh maklum balas antara faktor biofizikal, sosioekonomi dan institusi di peringkat global, nasional dan ladang dalam sistem pengeluaran getah. Kaedah ini menyediakan platform untuk memudahkan penglibatan dengan pihak berkepentingan getah, terutamanya pekebun kecil, dan memaklumkan penggubalan dasar berorientasikan pekebun kecil yang berkesan.

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LIST OF ABBREVIATIONS

UTeM	University Teknikal Malaysia Melaka
RISDA	Rubber Industry Smallholders Development Authority
NR	Natural Rubber
MREPC	Malaysian Rubber Export Promotion Council
GDP	Gross Domestic Product
NR	Natural Rubber
IV	Independent Variable
DV	Dependent Variable
LTC	Log Latex Clones
TPB	Theory of Planned Behavior
IR	Industrial Revolution
MRC	Malaysian Rubber Council
IT	Information Technology
TOPG	Companies including Top Glove Corp.
KPPK	The Ministry of Plantation Industry and Commodity
SUCB	Supermax Corp.
UTAUT	The Unified Theory on Acceptance and use of Technology

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The purpose of this chapter is to explore the agricultural innovation and technology adoption for Melaka's sustainable rubber industry. This chapter will also cover the research background, problem statement, research questions, research objectives, research scope, significance of study, limitations of study, and operational definition.

The history of rubber cultivation in Malaya started in the late 1877 when nine seedlings from a batch of about 2700 germinated seeds at Kew Botanic Gardens near London were dispatched and planted in Kuala Kangsar, Perak. Since the first rubber plantation in Malaya was established in 1896, the rubber industry has grown tremendously into the present Malaysia. There were 218,900 hectares of rubber planted area in Malaya in 1910 as compared to 1.066 million hectares of rubber planted area in Malaysia in 2014 (Yusoff, S., Mohamed, Z., & Ahmad, A. Z. 2019). Malaysia is the largest producer of dyed rubber products in the world. In 2020, Malaysia's natural rubber consumption for the dipping rubber product industry will amount to approximately 382 million tons.

1.2 Background of study

The natural rubber used for the dipping rubber product industry is in liquid form, which is concentrated latex that is produced through a centrifugation process. Malaysia is the seventh largest producer of natural rubber in the world in 2020 and in year 2021, the rubber sector contributes 0.2% to the country's Gross Domestic Product (GDP). In fact, Malaysia managed to make a profit of up to RM63.2 billion by October 2021 through the export of rubber and rubber products - an increase of 70.7% compared to the previous year (RISDA, 2022). Most of the intensive efforts are carried out by RISDA, considering that the majority of rubber plantations in Malaysia are rubber plantations owned by smallholders. Efforts carried out by RISDA include disbursing funds, providing training, selling the latest products and technology for rubber plants as well as channeling aid to smallholders in need. All these initiatives are implemented so that the country's production of rubber products increases and safeguards the welfare of smallholders, especially in ensuring that their rubber plants are able to generate stable income.

The adoption of technologies important, until recently, the choice of technologies available to farmers was largely determined by the need to increase production, profits and productivity. The main constraints were the availability of capital, knowledge of how to use the technology and market risks — risks that in many countries policies were shielded by government policies. In the past, “good policy practices” was therefore rather straightforward, relating primarily to increasing output and the aim of agricultural policies was to increase productivity in agriculture. Agricultural research and extension services could concentrate, for example, on improving the productivity of small farms. The sharp rise in the national wage rates also increased the cost of rubber farming activities due to high labor input requirements. These are some of the key contributing factors that have led many smallholders to make the conversion from

rubber to oil palm (Ali, M. F., Akber, M. A., Smith, C., & Aziz, A. A. 2021). Now agriculture has to fulfil diverse objectives: it needs to be internationally competitive, produce agricultural products of high quality while meeting sustainability goals.

In order to remain competitive, agricultural producers need rapid access to emerging technologies. Farmers are faced with many more constraints — and also more opportunities. In addition to being profitable, they need to meet environmental standards and regulations, as well as deal with direct and indirect consumer and lobby group pressures. They may also be flooded with information from various government and industry sources, and also that make choosing appropriate technologies more difficult. Farmers also need to change their production and management practices in response to agricultural policies that include environmental conditions.

According to MRC 2021, throughout the past eighteen months of economic turmoil due to the COVID-19 pandemic, the Malaysian rubber industry has contributed immensely to economic resilience. Going forward, it is imperative that we focus on innovation, digitalisation and technology adoption in order to devise and market problem solving solutions and products that will sustain the sector's future performance. As a leading force in the global rubber sector, Malaysian researchers have already come up with notable innovations that could help mitigate the risks to our environment and planet. Going ahead, one of MRC's key focuses will be on championing these homegrown green rubber products that can make a tremendous difference for people's wellbeing and safety as well as net-zero carbon emission targets. Among these products are rubber seismic bearings or also known as High-Damping Natural Rubber Bearings (HDNRB) for protection against earthquakes; rubberising roads using Cuplump Modified Asphalt (CMA) to prolong the lifespan of bitumen road surfaces; and Ekoprena, one of the vital components in tyres that aim to be fuel-efficient, high performing and ecologically sustainable. However, the production declined over the same time period by 46%, from 1.3 million tons to 0.6 million tons (MRB, 2020). Malaysia, which used to be the leading rubber producing country during 1960s, is now the seventh-largest rubber producer. The rubber industry is a significant contributor to the Malaysian economy, top three contributors are rubber products (USD3.7 billion), raw

rubber (USD2.8 billion) and processed rubber (USD1.6 billion) (MRB, 2020).

This is an innovation using Cuplump Modified Asphalt (CMA) to prolong the lifespan of bitumen road surfaces. CMA is a combination of bituminous cuplump, a mixture of freshly coagulated natural rubber and bitumen and asphalt, which is a common composite material used for road surfaces. Cuplump can increase the viscosity of the asphalt mixture, making it more resistant to higher temperatures, preventing cracking of road surfaces, unlike conventional road building materials that can soften and become uneven in extremely hot weather. The initial cost of CMA may be higher, but it is long-lasting and maintenance-free which makes it more economical in the long run (MRC, 2021). The decline in production is a significant concern for the national economy. The primary factors thought to be responsible for this decline are increasing volatility of global rubber prices and a prolonged period of low prices. This is believed to have led to an increase in the abandonment of rubber plantations by farmers and increased conversion of rubber plantations to other more profitable crops such as oil palm. Oil palm plantation, offers higher wage rates and returns and are less labor-intensive compared to rubber. The sharp rise in the national wage rates also increased the cost of rubber farming activities due to high labor input requirements. These are some of the key contributing factors that have led many smallholders to make the conversion from rubber to oil palm (Ali, M. F., Akber, M. A., Smith, C., & Aziz, A. A. 2021).

Some rubber farmers leave farming altogether to pursue non-agricultural jobs (Ali, M. F., Akber, M. A., Smith, C., & Aziz, A. A. 2021). The impact of this can be seen in the decline of the total national rubber planting area by 44%, from 1.8 million hectares in 1990 to 1.0 million hectares in 2019 (MRB, 2020). The increased in farm productivity from around 1000 kg ha⁻¹ year⁻¹ in 1990 to 1500 kg ha⁻¹ year⁻¹ in 2019 (MRB, 2020) has not had a positive impact on the national rubber production, which is clear indication that the total number of active smallholders or/and harvested rubber farms have declined. This has been

the result of the shift in focus, from agriculture to manufacturing sector to diversify national revenue, back in 1950s to 1980s, by the Malaysian government. The rubber replanting program will be concentrated around the Alor Gajah and Jasin districts because the area is seen to still have many rubber plants that have the potential to be developed. Last year there was an increase of up to RM1000 for one ton. So, this rotation will also apply to rubber when the time comes.

The smallholder sector accounts for more than 80% of global rubber production Ali, M. F. B. (2021), in some countries such as Malaysia, Thailand and Indonesia, smallholders account for more than 90% of the production Ali, M. F. B. (2021). It creates employment opportunities and has a far-reaching impact on rural livelihood and poverty. The recent increase in rubber price volatility has placed many of these smallholders' livelihood at risk (MRB, 2020). Studies have also shown that prolonged low farm-gate prices have led to an increase in poor farm management by smallholders. For example, smallholders have been known to drastically reduce the number of tapping days, and more critically, some have even resorted to abandoning their nutrient management program, affecting the long-term growth and yield potential of the rubber trees. As a result of declining farm revenue, some smallholders have left rubber farming altogether and switch to crops with better returns such as oil palm or engaged in non-agricultural activities as an alternative source of income. The productivity and profitability of smallholders are heavily dependent on the support systems available through public institutions. Government of the rubber-producing countries commonly allocates specific funding to promote the growth of the rubber industry Ali, M. F. B. (2021). Various measures have been implemented by public institutions in the rubber-producing countries to assist rubber smallholders affected by low productivity and the decline in rubber prices. These measures include the provision of incentives and subsidies, development of high yielding rubber clones, introduction of enhanced intercropping techniques and the development of high value-added products (Ali, M. F. B. (2021). New initiatives include the construction of

road using rubberised bitumen and increasing downstream activities aimed at increasing internal rubber consumption and improving the rubber price.

1.3 Problem statement

Most of the rubber plantations in Malaysia are small plantations that do not generate enough income to support the life of entrepreneurs or rubber tappers. Because of this, rubber is not produced sustainably and rubber products from the country's downstream industry are exposed to the risk of social compliance in overseas markets. The cause of the decline in rubber production in Malaysia is the prolonged drop in rubber prices, in addition to the increase in the cost of living and better wages in other industries. The overall effect resulted in various disasters that affected the efforts of smallholders to continue tapping. As the existing skilled tappers age, they are no longer able to continue the heavy physical work required to cultivate their gardens and fields. Low of skilled tappers results in tree injury by less efficient tappers. Existing trees also become less productive because agronomic work is not done, such as fertilizing fields and gardens and weeding. In addition, tree diseases also plague gardeners and rubber farmers, such as pestalotiopsis leaf disease.

However, the price uncertainty in the rubber industry in the global market has caused a negative impact not only on the economy but also on smallholders. Based on the Report of the Malaysian Rubber Export Promotion Council (MREPC) in 2022 shows a rubber production fluctuation during in the first half of 2022 and (1H 2022) stood at RM15.63 billion, compared to RM39.83 billion recorded in the same period last year. In fact, the rubber industry is also facing a challenging situation when natural rubber is forced to compete with synthetic rubber. In addition, rubber production faces constraints from price fluctuation as well as uncertain weather conditions which impede procurement activities. In addition, low natural rubber prices are attributed to factors such as low crude oil prices, economic slowdown in major

importers, i.e. China, the European Union and the United States, as well as the perception of stock surplus as output exceeds demand, adds pressure to the rubber manufacturing industry (MohdFahmy-Abdullah, Lai Wei Siengb,c, etc. 2020).

In order to maintain its important role in the Malaysian agricultural sector, the domestic rubber industry must be able to maintain its competitiveness through the efficient and effective application of inputs in the cultivation process with the aim of obtaining the maximum output possible. Therefore, the efficient use of energy in rubber cultivation needs to be looked at seriously to meet its needs. One of the ways to achieve this goal is through the determination of cultivation methods that require less energy input with higher energy productivity. In other words, rubber needs to be grown in a way where the energy input is used efficiently and effectively. This is also consistent with the effective utilization of energy in agriculture being one of the conditions for sustainable agricultural production as it leads to financial savings, better conservation of fossil fuels and lower air pollution. Looking at previous research literature, many studies about the rubber industry in Malaysia have been reported by researchers such as H A Zulekipli and D E Pebrian (2019). This past study focused on the processing, economics and future prospects of this crop. Therefore, the findings are not relevant to know the understanding of energy use in rubber cultivation.

A special attempt has been made to study energy use in various crop production systems in Malaysian agriculture. Therefore, the study of energy use in rubber cultivation in Malaysia is necessary to enrich the understanding of when, where and how much energy input is spent in this crop cultivation in the field, and ultimately to recognize the opportunity to save energy input to save operations. According to Bashier, Y.M., Ahmed, E.M., Elfaki, K.E., Thambah, S., & Khin, A.A. (2022), Natural rubber is a critical and strategic industrial raw material and will remain so in the foreseeable future and is grown primarily in landholdings that small farmers own. The natural rubber industry is vulnerable to price

fluctuations from world economic forces' changes like fundamental factors of production and consumption. There are many challenges from internal and external factors that impact comparative and competitive advantage in rubber scrap production in Malaysia (MRB, 2022).

The country's rubber industry is currently facing various challenges such as unpredictable weather, price instability and the impact of travel controls due to the COVID-19 pandemic. The sharp drop in garden production to RM2 per kilogram at the same time has a big impact on the income of tappers. The ever-increasing cost of living coupled with the goods and services tax makes the Malay community, who are on average smallholders, very depressed because their daily income is not enough to meet their family's needs. Not only in Melaka, but all over Malaysia, Tappers are not only faced with falling rubber prices but also have to deal with the problem of low tapping yield, making their lives more difficult. Although the price of rubber reached RM4 per kilogram recently, the increase failed to satisfy plantation owners and rubber tappers. According to tapper, their net income fails to reach RM1000 per month, which is the minimum wage set by the government for all workers including foreign workers.

Also according to Ali, M. F. B. (2021), in order to address the issues faced in rubber production and improve rubber smallholders' livelihood, it is crucial for smallholders to increase their productivity through improved farm management. Government agencies need to develop and implement effective smallholder oriented policies and ensure that these policies are monitored and evaluated consistently to facilitate the improvement of smallholders' farm management. However, the development of such policies requires a compilation and interpretation of a diverse and extensive set of biophysical, socioeconomic and institutional factors. The dynamic relationship between these factors that affect smallholder rubber production may further complicate the process of developing, implementing, monitoring and evaluating smallholder-oriented policies. Therefore, a comprehensive understanding of the

relationship between the different factors that affect smallholder rubber production is critical to facilitate the improvement of smallholder production and livelihood.

However, lack of study regarding the agricultural innovation and technology adoption for Melaka's sustainable rubber industry. The studies found by the researchers, most of the studies are from 2016 and years before. Studies on the agricultural innovation and technology adoption for Melaka's sustainable rubber industry are little or no similar research on the topic of this study, which hinders the credibility and scope of this research.

In conclusion, is not impossible for the farmers to restore the stability of rubber production, indirectly increasing their income and reducing the poverty rate. Therefore, stakeholders can improve rubber production performance by developing the most efficient way to plan and schedule resources and optimize productivity. One example of how agricultural innovation and technology adoption does this is by using workflows that streamline business processes, carefully track employee performance, and analyse results. It is also important to increase awareness and knowledge on agricultural innovation and technology adoption for Melaka's sustainable rubber industry to increase their productivity. Therefore, this study will be conducted on the agricultural innovation and technology adoption for Melaka's sustainable rubber industry.