TRANSFER OF TECHNOLOGY (ToT) SKILLS AMONG EXTENSION AGENT IN MALAYSIAN COCOA BOARD (PENINSULAR MALAYSIA)

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ABSTRACT – *The Malaysian cocoa industry has witnessed a sharp decline in production over the decades, primarily due to pest outbreaks, land use competition, and reduced farmer interest. In response, the Malaysian Cocoa Board (MCB) has prioritized the role of extension agents in transferring agricultural technologies to smallholder cocoa farmers. Therefore, extension agents need to possess strong Transfer of Technology (ToT) skills. ToT refers to the process by which technology is transferred from institutional research to the end users through extension services. Therefore, this study examines the ToT skills (technical, delivery, and evaluation) among the extension agents in the MCB in Peninsular Malaysia. A quantitative research approach was adopted, utilizing a structured questionnaire administered to 376 productive cocoa farmers in Peninsular Malaysia. The data were analyzed using SPSS Version 24 through descriptive statistics. The findings indicate that all three ToT skills are at a high level. Among them, technical skill recorded the highest mean score (M = 4.56), followed by delivery skill (M = 4.51) and evaluation skill (M = 4.49). This highlights the critical role of technical expertise in enhancing the effectiveness and efficiency of extension service delivery. Extension agents who are technically proficient are better equipped to address farmers' needs, provide practical solutions, and build trust within the farming community, thereby contributing to improved performance outcomes. In conclusion, the study underscores the significance of ToT skills among extension agents, highlighting the importance of strengthening ToT competencies as key drivers in enhancing cocoa production through effective extension services by MCB.*

Keywords: Transfer of technology (ToT), extension agents, cocoa farmers, technical skills, delivery skills, evaluation skills

INTRODUCTION

Cocoa, scientifically known as *Theobroma cacao L.*, is a perennial crop that can live for more than 25 years under optimal conditions. It was introduced in Malaysia in the 1950s and eventually became the country's third major commodity crop, playing a significant role in agricultural exports (Arshad *et al*., 2015). Malaysia's cocoa production peaked in the early 1990s. However, the post-1990s period saw a significant decline due to several factors, including falling global cocoa prices, competition from oil palm cultivation, and widespread infestation of Cocoa Pod Borer (CPB) disease (Arshad *et al*., 2015).

The cocoa planted area dropped from 393,465 hectares in 1990 to 167,646 hectares in 1996, a reduction of more than half. This downward trend continued, reaching just 17,554 hectares by 2017 (Tee *et al*., 2022). Despite efforts to revive the sector, Malaysia's cocoa industry has been unable to meet its production target of 40,000 tonnes per year. In 2014, the country produced only 2665 tonnes of dry cocoa beans (Fadzim *et al.,* 2017). Currently, local cocoa production is insufficient to support the grinding sector, leading to an imbalance between the upstream and downstream segments of the industry (Tee *et al*., 2022).

To address these challenges, the Malaysian government has made substantial efforts to support cocoa cultivation, recognizing the importance of cocoa as a smallholder crop and its potential to enhance rural livelihoods and reduce poverty. One of the key mechanisms supporting these efforts is the Transfer of Technology (ToT), which plays a key role in improving farming practices. ToT is a learning process involving the delivery of expertise, resources, and services from extension agents to farmers. It encompasses both formal and informal education and emphasizes the relationship between the providers and the recipients. ToT skills consist of technical skills, technology delivery skills and technology evaluation skills.

Grosse (1996) defined ToT as the process of transferring technology from its place or research group of origin to wider distribution among more people and locations. In line with this, the Malaysian Cocoa Board (MCB) introduced the Cocoa Smallholder Development Programme (CSDP) to help increase smallholder cocoa production from 0.5 tonnes to 1.5 tonnes per hectare (Ramle, 2012). This program promotes group-based learning and has proven to be an

effective and time-efficient method of technology transfer. CSDP remains active today, continuing to play a vital role in educating farmers on cocoa technologies and best practices.

However, despite strong efforts in agricultural research and extension services, past initiatives have often overlooked the marketing and agricultural extension aspects. Mad Nasir (1998) highlighted that marketing, especially by extension agents, has historically been the weakest link in the agricultural production chain. Moreover, technology adoption depends not only on the availability of innovations but also on the farmers' willingness and ability to implement them correctly. A strong relationship between extension agents and farmers is essential; without it, technology transfer efforts are unlikely to succeed (Hassan *et al*., 2017).

Cocoa farmers often suffer from low productivity due to inefficiencies in production. Smallholders rely heavily on extension agents for support, knowledge transfer, and access to appropriate technologies. The Malaysian government recognizes that many cocoa farmers face obstacles such as limited formal training, poor understanding of crop conditions, and lack of knowledge about improved production techniques. To overcome these challenges, it is crucial to ensure that extension agents possess strong competencies that allow them to deliver, communicate, and evaluate technology transfer effectively.

To understand how competencies affect extension performance, this study draws on the Iceberg Model introduced by Spencer and Spencer (1993), which explains the concept of competency. Competency is defined as the expertise gained through work experience, knowledge, and practice, enabling individuals to perform specific tasks effectively. According to Spencer and Spencer (1993), extension agents must possess five core competencies: knowledge, skills, self-concept, motives, and traits.

The Iceberg Model is significant because it distinguishes between visible competencies, such as knowledge and skills, and hidden competencies, such as motives, traits, and self-concept. This study focuses specifically on the visible components, emphasizing the knowledge and skills of extension agents in transferring technology (ToT) to farmers. Applying the Iceberg Model, the study links the competencies of extension agents to their effectiveness in technology transfer, highlighting that well-qualified agents possess strong technical knowledge, are familiar with adult education principles, excel in community engagement, and can employ strategies to enhance farmer participation. Moreover, skilled extension agents can plan and coordinate activities, assess and respond to emerging challenges, analyse situations effectively, and propose suitable courses of action.

Despite the importance of these competencies, limited research has specifically examined the level of ToT skills among Malaysian Cocoa Board extension agents, particularly from the perspective of the farmers they serve. Addressing this gap, this study seeks to evaluate how farmers perceive the technical, delivery, and evaluation skills of extension agents and to identify areas where capacity-building efforts can be strengthened to improve technology transfer outcomes.

MATERIALS AND METHODS

The study was carried out in Peninsular Malaysia, targeting all productive cocoa farmers who had participated in extension activities facilitated by the MCB extension agents for at least five years and attended a minimum of two training sessions. A stratified random sampling method was employed, covering all three major regions where MCB smallholder farmers operate in Peninsular Malaysia. The list of productive cocoa farmers was obtained from the MCB, bringing the total to 561 farmers across these areas (Kelantan, Perak, Pahang and Johor). Based on Krejcie and Morgan's (1970) sample size determination table, a total of 376 productive cocoa farmers were selected to represent the sample for this study. This research adopted a descriptive correlational design, integrating both descriptive and correlational approaches. The study focused on Transfer of Technology (ToT) skills, which consist of three main components, technology skills, technology delivery skills, and technology evaluation skills, as independent variables, while work performance was examined as the dependent variable.

Instrumental Design

The questionnaire was developed by adapting items from Sail (2010) and Motolani et al. (2017). It consisted of four sections: A, B, C, and D. Section A was designed to collect personal demographic information and farm profiles of the respondents. The demographic part included six items: age, gender, race, monthly income, and level of education. The farm profile section contained four items related to crop information, including the year the respondent started planting cocoa, the size of cultivated land, and the main sources of information on cocoa technology.

Section B, Technical Skill, comprised nine statement items that measured the level of ToT technical skills, focusing on technologies related to cocoa plant pruning, fertilizer application, pest and disease control, and cocoa bean processing. Section C,

Technology Delivery Skill, included nine statement items assessing the delivery skills of extension agents in teaching the theory, methods, and practical application of cocoa technologies such as pruning, grafting, fertilizing, pest and disease control, and bean processing. Section D, Technology Evaluation Skill, contained nine statement items measuring the evaluation skills of extension agents in assessing farmers' understanding of cocoa technologies in areas including pruning, fertilization, pest and disease control, and cocoa bean processing.

The questionnaire used Six Scale to examine how strongly respondents agree or disagree with the statements on a 6-point scale with the following score: 6=Strongly Agree, 5=Agree, 4=Slightly Agree, 3=Slightly Disagree, 2=Disagree, 1=Strongly Disagree.

Data Collection Procedure

The researcher employed the drop-off and pick-up method to collect data from respondents in Peninsular Malaysia. This method offers the advantage of reaching all respondents effectively while allowing them sufficient time to complete the questionnaire (Trentelman et al., 2016). Before distribution, the person in charge of each area was briefed thoroughly to ensure a clear understanding of the questionnaire and the research objectives. The respondents then self-administered the survey, which took approximately 5 to 10 minutes to complete.

Data Analysis

SPSS Version 24 was used to analyze the data of this study. Descriptive analysis was used to determine the level of each ToT skills. Given the 6-point Likert scale used in the study, these levels were determined by dividing the possible range (1 to 6) into three equal intervals using the formula below:

$$Level = \frac{Max - Min}{No.of\ groups}$$

$$= \frac{(6-1)}{3}$$

$$= 1.667$$

Table 1: Indicator value for each level

Mean Score	Level
1.00 – 2.66	Low
2.67 – 4.33	Moderate
4.34 – 6.00	High

RESULTS AND DISCUSSIONS

Demographic Information

The results of the farmers' demographic information are presented in Table 2. The majority of cocoa farmers were aged 50 years and above (66.3%), followed by those between 40 and 49 years old (22.1%). Only a small proportion of farmers were aged 39 and below. In terms of gender, the sector was male-dominated, with 88.4% male farmers and only 11.6% female farmers. Regarding ethnicity, most cocoa farmers were Malay (47.9%), followed by Orang Asli (36.3%), Chinese (15.6%), and a very small proportion of Indian farmers (0.3%). In terms of education level, 81% of farmers had completed primary school, 17.6% had completed secondary school, 0.8% held a certificate, 0.3% held a diploma, and 0.3% held a bachelor's degree.

Table 2: Respondent demographic profile (n=353)

Items	Frequency	Percentage (%)
Respondents age		
≤19	1	0.3
20-29	6	1.7
30-39	34	9.6
40-49	78	22.1
≥ 50	234	66.3
Gender		
Male	312	88.4
Female	41	11.6
Race		
Malay	169	47.9
Chinese	55	15.6
Indian	1	0.3
Orang Asli	128	36.3
Level of education		
Complete primary school	286	81.0
Complete secondary school	62	17.6
Certificate	3	0.8
Diploma	1	0.3
Bachelor	1	0.3

The summary of the farm profiles is presented in Table 3. A total of 34.8% of the farmers are from Perak, while 28.3% are from Kelantan, followed by 25.5% from Pahang and 11.3% from Johor. In terms of planting history, 69.4% of the farmers began cultivating cocoa between 2010 and 2006, 19.8% started between 2005 and 2001, and only 10.8% had started in 2000 or earlier. Regarding farm size, 81.3% of farmers cultivated less than 1 hectare, 17.8% cultivated between 1 and 3 hectares, and only 0.8% cultivated between 3 and 5 hectares.

Table 3: Summary of farms profile (n=353)

Variables	Frequency	Percentage (%)
Location of state		
Perak	123	34.8
Kelantan	100	28.3
Pahang	90	25.5
Johor	40	11.3
Starting year of cultivation		
2010-2006	245	69.4
2005-2001	70	19.8
At/Before 2000	38	10.8
Hectare Cultivated		
<1	287	81.3
1-3	63	17.8
3.1-5	3	0.8

Level of Transfer of Technology (ToT) Skills

The results in Table 4 show that most cocoa farmers perceive extension agents as having a high level of technical skill, with 75.6% rating them in this category. Additionally, 21.8% of farmers perceive the agents as having a moderate level of technical skill, while only a small proportion (2.5%) view them as having a low level of technical skill. The overall mean score was M = S4.56, with a standard deviation of SD = 0.63, indicating that, overall, extension agents are perceived to possess a strong level of technical expertise related to the technologies they transfer to cocoa farmers.

Table 4: Level of technical skill (n=353)

Variables	Level	Frequency	Percentage (%)	M	SD
Technical skill	Low	9	2.5		
	Moderate	77	21.8	4.56	0.63
	High	267	75.6		

According to Table 5, the majority of cocoa farmers (72.8%) perceived extension agents as having a high level of technology delivery skill, while 24.9% perceived them as having a moderate level, and only 2.3% perceived them as having a low level. The mean score was M = 4.51 with a standard deviation of SD = 0.63, indicating that, overall, the extension agents' technology delivery skills are perceived to be at a high level by the farmers.

Table 5: Level of technology delivery skills (n=353)

Variables	Level	Frequency	Percentage (%)	M	SD
Technology delivery skill	Low	8	2.3		
	Moderate	88	24.9	4.51	0.63
	High	257	72.8		

Table 6 presents the farmers' perceptions of the agents' technology evaluation skills, with 73.1% high ratings, 24.6% moderate, and just 2.3% low. The mean score for this skill was M = 4.49, with SD = 0.65. This indicates that farmers largely perceive extension agents as effective in evaluating and assessing technology use and outcomes.

Table 6: Level of technology evaluation skill (n=353)

Variables	Level	Frequency	Percentage (%)	M	SD
Technology evaluation skill	Low	8	2.3		
	Moderate	87	24.6	4.49	0.65
	High	258	73.1		

All three ToT skills of extension agents were perceived by cocoa farmers to be at a high level. Among the three, technical skills ranked the highest, with 75.6% followed by technology evaluation skills at 73.1% and technology delivery skills at 72.8%. Although the differences are small, this suggests farmers perceive extension agents as particularly strong in technical competence. These results align with the findings of Motolani *et al*. (2017), who emphasized that extension agents should be expertise in ToT skills to achieve outstanding performance in transferring new technologies to the farmers. Similarly, Abd Halim *et al*. (2022) found that extension agents in Sarawak cocoa industry demonstrated high ToT skill levels, with technical skills rated the highest, followed by technology delivery and evaluation skills. The consistencies of this findings indicated that there is need to pay attention to improve how knowledge is communicated and how feedback is incorporated to improve future practices. Strengthening these areas can enhance the overall effectiveness of extension services, ensuring that innovations are not merely disseminated but are also well understood, effectively applied, and continuously improved based on farmer experiences.

Table 7 illustrates cocoa farmers' perceptions of extension agents' Transfer of Technology (ToT) skills based on their educational levels. The findings reveal that a significant majority of farmers (349 out of 354) perceived extension agents to have high technical skills, with 282 of these positive perceptions coming from farmers with only primary education. This suggests that extension agents exhibit strong technical competencies that inspire confidence among farmers, regardless of the farmers' own educational backgrounds. It also implies that technical knowledge is being communicated effectively and in ways that are accessible even to farmers with lower formal education.

In terms of technology delivery skills, 289 cocoa farmers, mostly those with primary education, perceived the extension agents to be highly capable. However, there are still farmers with primary and secondary education levels who perceive extension

agents' delivery of technology skills as low. This highlights the need to strengthen communication strategies to ensure they are aligned with the educational backgrounds and comprehension levels of the farmers.

Regarding evaluation skills, 234 farmers with primary education rated the extension agents as having high competence in assessing and responding to technology-related challenges. This is significant because it indicates that even farmers with minimal formal education are able to understand and benefit from the evaluative processes used by the extension agents. In other words, the agents are not only transferring technology but are also doing so in a way that farmers can follow, assess, and respond to, which is critical for effective and sustainable technology adoption.

Table 7: ToT skills by education level

	Technical Technology Skill			
	Low	Medium	High	Total
Primary	0	4	**282**	286
Secondary	0	1	64	65
Certificate	0	0	3	3
	Delivering Technology Skill			
	Low	Medium	High	Total
Primary	6	52	**232**	290
Secondary	1	13	52	66
Certificate	0	0	5	5
	Evaluation Technology Skill			
	Low	Medium	High	Total
Primary	6	47	**234**	287
Secondary	1	8	55	64
Certificate	0	2	3	5

Table 8 This table presents how cocoa farmers of different age groups (≤19, 20–29, 30–39, 40–49, and ≥50 years old) perceive extension agents' ToT skills, specifically in Technical, Delivering, and Evaluation skills. The majority of all age groups, especially farmers aged 50 and above (191 individuals), rated extension agents as having high technical skills. Overall, technical skills are strongly recognized and appreciated across all ages, especially among older farmers, who make up the largest group.

Most farmers across all age groups still perceive delivery skills as high, especially older farmers (≥50). However, there is a noticeable increase in medium and low ratings, particularly in the ≥50 age group (6 low, 48 medium). This suggests that while extension agents perform well, some older farmers may struggle with how information is delivered, possibly due to differences in communication styles or literacy levels.

A large majority still rated evaluation skills as high, especially among the 40–49 (66) and ≥50 (186) groups. However, similar to delivery skills, the ≥50 group again shows more medium and low ratings, indicating a need to simplify evaluation processes or improve clarity in follow-ups and assessments.

The findings from Table 8 indicate that cocoa farmers across all age groups generally perceive extension agents' ToT skills, particularly technical skills, as strong and effective. However, slight declines in the perception of delivery and evaluation skills among older farmers (≥50) suggest that communication and assessment methods may need to be adjusted to better suit their needs. Tailoring extension approaches to match farmers' age-related preferences and comprehension levels can enhance technology transfer effectiveness and ensure more inclusive engagement across all age groups.

Table 8: ToT skills by age

	Technical Technology Skill			
	Low	Medium	High	Total
≤19	0	0	1	1
20-29	0	1	5	6
30-39	1	1	32	34
40-49	0	12	66	78
≥ 50	4	39	**191**	234
	Delivering Technology Skill			
	Low	Medium	High	Total
≤19	0	0	1	1
20-29	0	1	5	6
30-39	0	3	31	34
40-49	1	13	64	78
≥ 50	6	48	**180**	234
	Evaluation Technology Skill			
	Low	Medium	High	Total
≤19	0	0	1	1
20-29	0	1	5	6
30-39	0	3	31	34
40-49	1	11	66	78
≥ 50	6	42	**186**	234

CONCLUSIONS

In conclusion, this study aimed to determine the level of ToT skills possessed by MCB extension agents in transferring technology to cocoa farmers in Peninsular Malaysia. The findings revealed that farmers perceive the extension agents' ToT skills to be at a high level, with technical skills ranked the highest, followed by technology delivery skills and technology evaluation skills. These results highlight the crucial role that extension agents play in supporting cocoa farmers, not only by providing technical expertise but also by effectively delivering and evaluating new agricultural technologies.

Several key recommendations emerge from this study to strengthen the capacity and impact of extension services such as targeted training programs to improve extension agents' communication, delivery, and evaluation techniques, ensuring that transferred technologies are fully understood and applied by farmers. Besides that, continuous professional development opportunities, such as workshops, seminars, and cross-learning sessions, should be institutionalized to keep extension agents updated on both technical innovations and effective transfer strategies.

MCB can further enhance the effectiveness of its extension services by implementing these recommendations, ensuring that technology transfer efforts lead to meaningful and sustained improvements in cocoa production and farmer livelihoods. This will not only strengthen the resilience and productivity of the cocoa sector but also contribute to broader agricultural development goals in the region.

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