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Original Research Article

The Perspective of Vegetable Farmers in Readiness to Face the Post-COVID-19 Pandemic: A Cross-Tabulation Analysis

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Abstract: The ability of farmers to anticipate, avoid, and react to threats and shocks depends on their capacity to handle agricultural alarms. This study aims to determine whether farmers' demographic characteristics and readiness for the post-COVID-19 pandemic are related. This study reports the results of a survey in which 503 farmers in Peninsular Malaysia took part, using a structured questionnaire to examine farmers' perceptions of their readiness for post-COVID-19 problems. Chi-square testing and cross-tabulation analysis were used to assess the factors influencing farmers' perceptions of their readiness to meet the difficulties. According to the Chi-square test results, farmers' age was significantly ($p<0.05$) correlated with their technological skills. The findings also show a significant correlation between education level towards technology, implementation, and decision-making skills ($p<0.05$). The results confirmed that farmers' backgrounds and demography affected their preparedness to face upcoming issues and challenges. Therefore, the government must assist farmers and train them to improve their backgrounds to lessen their vulnerability and increase their capacity to meet challenges following COVID-19. This study suggests solid outputs that will help extension agents approach farmers based on their participation in a participatory approach to creating, introducing, and using technology related to readiness for any circumstances.

Keywords: Demography; chi-square; cross-tabulation; readiness; age; education level

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1. Introduction

Farmers' readiness to meet the problems existing by the disaster phenomenon has resulted in a delay in agricultural operations, logistics, and services, which has presented new challenges for the agricultural community. Buheji *et al*. (2020) conducted a study among communities to determine the readiness, capacity, and readiness of various groups and nations for self-sufficiency under lockdown scenarios and the need for social segregation. In order to address the challenges encountered in agriculture, farmers must equip themselves with knowledge, skills, and information, enabling them to effectively utilize technology tailored to their specific farm situations, thereby addressing the challenges in agricultural duties (Adnan *et al*., 2017; The Star, 2019). Hence, to boost agricultural output, highly educated farmers will use their information and knowledge to their advantage (Wang *et al*., 2018).

The agricultural community faces new obstacles due to a slowdown in agricultural operations, logistics, and services due to farmers' readiness to tackle challenges posed by the pandemic. COVID-19 presented several questions about the status, preparation, and capacity of various communities and countries' self-sufficiency during lockdown conditions and the need for social separation (Buheji *et al*., 2020). Through the pandemic, this research focuses on farmers' self-development, including knowledge of agriculture technology, implementation of technology on the farm, self-leadership, and decision-making based on current circumstances. These factors broadly impact farmers' readiness to continue farming after the pandemic.

Furthermore, farmers' assessments of the skills required to raise their readiness to tackle difficulties can be utilized to identify the many areas in which they need training (Hashemi *et al*., 2009). Moreover, prior knowledge of technology and the skills of farmers is critical for overcoming problems during a disaster. Bolarinwa and Oyeyinka (2011) claim that there has not been enough proven investment in agricultural research and modern technology, nor have there been enough extension services or strong connections between researchers, extension, and farmers. Furthermore, issues in the COVID-19 pandemic demand farmers to stay inside their constrained area, which presents another difficulty in using the existing input and resources. The implementation is also tied to technological expertise. Farmers cannot use such technology unless they practice it correctly. The findings of Baqutayan *et al*. (2017) offered excellent proof that using technology on their farms after obtaining knowledge and skills by participating in a program and boosting their agricultural productivity attests to this fact.

Likewise, farmers with leadership characteristics would adhere to farming management planning and arrangement needs. Large teams of people, intricate production and distribution markets, and constant pressure to innovate and adopt new technologies are all things that farmers must be able to manage (Ulvenblad & Björklund, 2018). Because of an interpersonal background, more excellent knowledge of decision-making mechanisms would aid in explaining poor performance and forecasting how agricultural management practices would alter as external conditions change. Farmers who are skilled decision-makers may utilize their expertise to validate the outcomes of their choices. Their decision will have an impact on the planning and execution strategies.

Farmers' educational backgrounds might influence their readiness level of technology, implementation, leadership, and decision-making skills. Through the pandemic, this research focuses on farmers' self-development, including technical knowledge, application on the farm, self-leadership, and decision-making skills, depending on the situation at hand. This study's objective is to understand better the relationship between farmers' demographic characteristics and their readiness in technology, implementation, leadership, and decision-making skills to face the challenges of the post-COVID-19 pandemic.

According to the most well-known innovation model, Rogers' Diffusion of Invention (DOI), adoption and invention do not happen simultaneously. As people approach and prepare for a new idea (innovation) differently, it gains traction over time and diffuses (or spreads) within specific populations or social systems. According to their readiness and willingness to adopt, people are divided into five groups by the DOI model, which also describes variations in the flow and rate of adoption based on a variety of factors, including communication channels, social systems, and innovation attributes (such as comparability and complexity) (Figure 1) Rogers (1962).

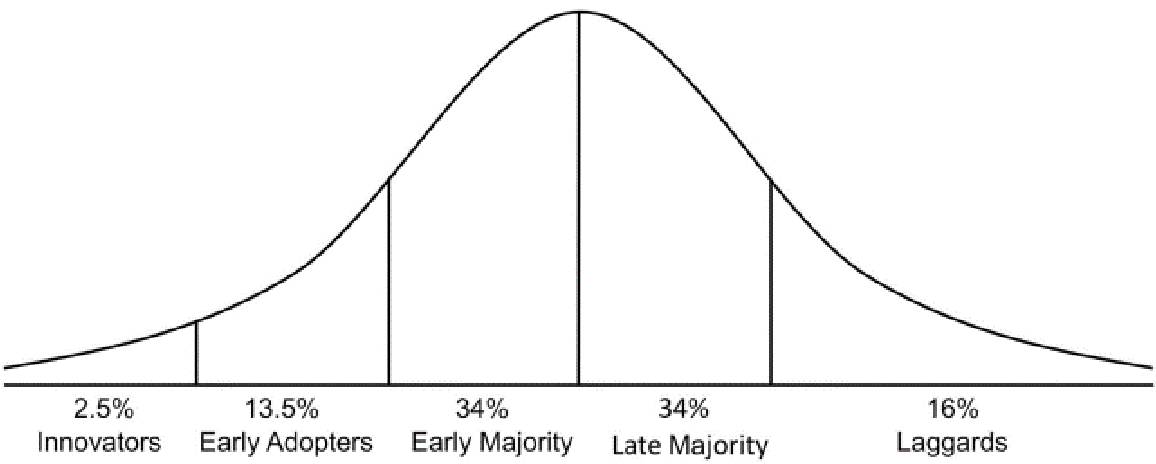

Figure 1. Diffusion of innovation model from Rogers (1962)
Source: Diffusion of Innovation, First Edition (Rogers, 1962)

An organization or farm faces financial risk when adopting an innovation, which makes it difficult to decide whether to invest in it. Some economic models have attempted to explain the decision to adopt. As a result, projections of future financial success will play a significant role in the grower's decision to adopt. This means farmers' finance can also influence their decision-making to adopt a new technology. Thus, to assess and predict an event and decide whether to allocate resources, decision-makers use a set of facts (belief, knowledge, and experience) before adopting an innovation (Edwards-Jones, 2006; Evans & Honkapohja, 2001; Muth, 1961). This study will assess the characteristics of farmers' backgrounds as a predictor of their level of adoption of any initiatives connected to knowledge and skills to improve their readiness to meet the COVID-19 pandemic crisis.

2. Materials and Methods

2.1 Research design

The questionnaires were delivered to vegetable farmers during the COVID-19 outbreak. This study implied the quantitative method to achieve the objective of the study. The surveys were completed by 503 people who participated in the study. This research focused on vegetable producers in Malaysia's peninsular.

2.2 Sample size

The sample size for this study was determined using simple random sampling, targeting vegetable growers cultivating mustard, spinach, okra, long beans, and eggplant due to their high per capita consumption in Malaysia. Initially, a comprehensive list of all farmers growing these specific vegetables was compiled. Subsequently, simple random sampling was employed to ensure that each farmer within this targeted population had an equal probability of selection. The sample size was calculated using Raosoft's online sample size calculator, utilizing standard statistical formulas to ensure that the results would be both reliable and valid. The following are the qualifications for qualifying targeted respondents for the inquiry being done in this study:

a) Farmers of vegetables (spinach/mustard/water spinach/okra/beans/eggplant)

b) Using the WhatsApp application

2.3 Data analysis

Chi-square analysis was employed in the study to analyze the phenomena that occur and factors that influence farmers' readiness for the COVID-19 epidemic. This test compares the two data sets to determine whether a discrepancy between actual and expected data results from chance or a relationship between technology, implementation, leadership skills and readiness to face post-COVID-19 challenges. In this study, cross-tabulation analysis was also used. Cross-tabulation, or contingency tables or cross-tabs, groups variables to reveal their connections and how correlations change as variables are grouped (Lynch, 2013). Crosstabulations show the frequency and proportion of responses to questions from various respondents' groups or categories (such as gender, profession, education level, etc.) (Joa *et al*., 2017; Lean *et al*., 1992; Olumakaiye *et al*., 2010). Therefore, this study looked at respondents' readiness for technology, implementation, leadership and decision-making skills based on their gender, age, and level of education.

3. Results

3.1 Respondents Profile

The gender composition of the respondents was 88.1% male and 11.9% female. Males dominate most vegetable farmers. Commonly, farmers in Malaysia are more male because of their energy and responsibility to work. Besides, the farmers' age distribution shows the highest percentage is between 41 and 50 (25.4%).

Table 1. Gender, age, race and educational level

Variables	**Frequency**	**Percentage (%)**
Gender		
Male	443	88.1
Female	60	11.9
Total	503	100
Age		
≤30	80	15.9
31–40	122	24.3
41–50	128	25.4
51–60	102	20.3
≥ 61	71	14.1
Educational Level		
Primary school	78	15.5
Secondary school	237	47.1
Institute certificate	42	8.3
Diploma	67	13.3
Bachelor	79	15.7

3.2. Gender

Farmers' background characteristics were discovered using cross-tabulation and chi-square analysis, which were likely related to their beliefs of readiness to face the COVID-19 epidemic. The percentage of gender (male and female) views on technology, implementation, leadership, decision-making skills, and level of readiness were all evaluated (Table 2).

Table 2. Chi-square test of gender towards farmers' skills

Variables/ Gender	Level of variables	Male (%)	Female (%)	Pearson Chi-Square (Asymptotic sig.)
Technology	1	4.6	1.2	0.101
	2	46.3	7.2	
	3	37.2	3.6	
Implementation	1	3.6	0.6	0.647
	2	46.7	13.0	
	3	37.8	10.4	
Leadership	1	3.2	0.0	0.314
	2	33.8	5.0	
	3	51.1	7.0	
Decision-making	1	3.0	0.2	0.359
	2	41.7	6.8	
	3	43.3	5.0	
Farmers' readiness	1	4.8	1.0	0.545
	2	40.2	5.8	
	3	43.1	5.2	

The mean scores for the level of agreement were calculated across three ranges on a 6-point scale (1-2.669 classified as low, 2.67-4.339 as moderate, and 4.34-6.00 as high), following the approach outlined by Olagunju *et al.* (2021). A brief calculation is performed to categorize the respondents' level using the data from the six-point scale. The formula is written as follows:

$$\text{Level} = (\text{Max-Min}) / \text{Number of groups} \quad (1)$$

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

$$= 1.67$$

The average male score was medium in terms of technology and implementation skills but high for leadership, decision-making, and readiness of farmers to face the post-COVID-19 challenges. On the other hand, females were assigned a medium level based on technology, implementation, decision-making skills, and readiness to face COVID-19 challenges. Only leadership skills demonstrated a high level. However, there were no significant differences in gender towards technology, implementation, leadership, decision-making skills, or readiness of farmers to face challenges. These findings revealed no difference between genders in explaining their level of technology, implementation, leadership, and decision-making skills.

3.2 Age

The age of a response is one of the influencing factors that will differentiate farmers' readiness for technology, implementation, leadership, and decision-making to face COVID-19 challenges and confront issues. The respondents' ages were classified into five groups based on their age.

Table 3. Chi-square test of age level towards farmers' skills

Variables/ Age level	Level of variables	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Pearson Chi-Square (Asymptotic sig.)
Technology	1	0.6	0.6	1.6	2.0	1.0	0.029
	2	7.0	12.5	13.7	10.9	9.3	
	3	8.3	11.1	10.1	7.4	3.8	
Implementation	1	0.2	0.6	1.8	0.8	0.8	0.318
	2	8.2	12.3	12.9	11.9	8.3	
	3	7.6	11.3	10.7	7.6	5.0	
Leadership	1	0.6	0.4	0.6	0.6	0.6	0.725
	2	5.8	9.3	10.5	8.0	8.0	
	3	9.5	14.5	14.3	11.7	11.7	
Decision-making	1	0.4	0.6	0.6	0.8	0.8	0.889
	2	7.2	12.5	12.9	9.7	6.2	
	3	8.3	11.1	11.9	9.7	7.2	
Farmers' readiness	1	0.8	1.0	1.8	0.6	1.6	0.158
	2	6.8	11.1	10.1	11.1	6.8	
	3	8.3	12.1	13.5	8.5	5.8	

*1: ≤30 years old, 2: 31–40 years old, 3: 41–50 years old, 4: 51–60 years old, 5: ≥ 61 years old

The responders, who ranged in age from under 30 to those with a medium level of execution, possessed high levels of technology, leadership, decision-making skills, and readiness. Findings show that (Table 3), compared to farmers under 30 years old (7%; 35 farmers), most respondents over 40 years old ranked (13.7%; 69 farmers) stated that the degree of technology as a medium. The Chi-square test also revealed that farmers' age is positively significant towards technology level ($p<0.05$). However, there was no significant difference in the other skills based on the age of the respondents. According to Hashemi (2011), no associations were found between farmers' ages and the overall significance of the safety measures, their perception of their overall competence in terms of the safety measures, their cultivated land area, their performance, or their past exposure to pesticide-related adverse health effects. Additionally, this study is consistent with previous studies that stated that farmers' age influenced farming management with modern technology (Kwanmuang *et al*., 2022).

Competence in handling new technology can vary among older individuals and is not solely determined by age. Instead, several factors can influence an older person's ability to adapt to and effectively use new technology, such as technology complexity, experiences, attitude, support, and training. This information can be valuable for policymakers, agricultural extension services, and technology providers. It suggests that strategies for introducing and promoting agricultural technology may need to be tailored to different age groups. Younger farmers might benefit from initiatives focused on technology adoption and training, while older farmers might require approaches considering their familiarity and comfort level with technology.

3.3 Level of Education

Education is the number of years a respondent completes in an educational institution. The education level is classified into five levels.

Table 4. Chi-square test of education level toward farmers' skills

Variables/ Education Level	Level of variables	A	B	C	D	E	Pearson Chi-Square (Asymptotic sig.)
Technology	1	2.0	3.0	0.2	0.6	0.0	0.000
	2	10.3	24.7	5.6	6.4	6.6	
	3	3.2	19.5	2.6	6.4	9.1	
Implementation	1	1.0	3.0	0.2	0.0	0.0	0.026
	2	9.5	23.1	5.6	7.2	8.3	
	3	5.0	21.1	2.6	6.2	7.4	
Leadership	1	0.8	2.0	0.0	0.2	0.2	0.135
	2	6.0	16.5	4.4	4.4	7.6	
	3	8.7	28.6	4.0	8.7	8.0	
Decision-making	1	0.6	2.4	0.0	0.2	0.0	0.019
	2	8.0	21.7	5.8	5.0	8.2	
	3	7.0	23.1	2.6	8.2	7.6	
Farmers' readiness	1	1.6	3.0	0.0	0.6	0.6	0.065
	2	8.2	22.5	4.4	5.0	6.0	
	3	5.8	21.7	4.0	7.8	9.1	

*A: Primary school, B: Secondary school, C: Institute, D: Diploma, E: Bachelor

Most farmers have completed secondary school, with fewer having completed higher education with educational level as follows: Primary school 15.5 % (78), Secondary school 47.1% (237), Institute certificate 8.3% (42), Diploma 13.3% (67), Bachelor 15.7% (79).

According to the data in Table 4, three variables were substantially associated with farmer education level: technology (p=0.000), implementation (p=0.026), and decision-making (p=0.019). These findings suggested that farmer education level affects technology adoption, implementation, and decision-making skills. Education provides the foundational knowledge and skills necessary to understand technology. Without a basic understanding of how technology works, its capabilities, and its limitations, making informed decisions or effectively implementing technology is challenging. Due to the movement's restriction, farmers had several challenges during the MCO, which led to financial losses and the dumping of agricultural goods, including fruits and vegetables. This may also be related to their expertise in market organization. Additionally, agricultural operations and farm management slow down, and farmers cannot function normally during the MCO due to limited access to maintain their farms and market their produce. Farmers struggled to sell their goods in the market due to the COVID-19 pandemic because the transportation infrastructure was shut down (Upendra *et al*., 2023).

4. Discussion

The adoption of technology by farmers to increase their readiness in this study was also influenced by education level, following Rogers' Diffusion of Innovation concept. The adoption process has five steps, according to Rogers (1962). The stages are innovators, early adopters, the early majority, the late majority, and laggards. Higher-educated people are regarded as having higher levels of adoption and can be classified as innovators and early adopters. Based on the Chi-square analysis, this study found that the level of education was influenced by technology, implementation and decision-making skills, as these three elements showed significant differences towards the level of education. This study, supported by Hossain (1991), pointed out that farmer behaviour influences the adoption of knowledge and technology. Physiological, economic, and social characteristics influence a farmer's actions. Adoption is the decision to use innovation as the best course of action currently available (Rogers, 2003).

Education lays the groundwork for informed decision-making and successful technology implementation. It equips individuals with the knowledge, skills, and adaptability to effectively understand, evaluate, and leverage technology. While implementation and decision-making are crucial components of technology utilization, education is the foundation upon which these activities rely. In addition, technology is constantly evolving, with new tools and systems emerging regularly. Education equips individuals with the adaptability and critical thinking skills needed to learn about and adapt to new technologies. This adaptability is crucial because the specific technologies can change over time.

Age, education, and gender of farmers have also been previously identified as factors influencing their decision-making about farm management (Burton, 2014). Younger farmers, those with higher levels of education, and female farmers were more inclined to change their methods, according to research looking at farmers' propensity to alter their environmental practices (Burton, 2014). Age, farming experience, education, socioeconomic level, cropping intensity, aspiration, economic motivation, inventiveness, information source, and agent trustworthiness have all been positively and significantly correlated with adoption (Rao & Rao, 1996). How frequently potential users use a technology impacts its adoption rate, ultimately defining its success level. Policymakers, extension personnel, and others can utilize this information to develop and implement programs to boost agricultural output.

5. Conclusions

In summary, our study reveals that gender alone does not demonstrate a significant association with farmers' readiness to confront challenges posed by crises such as COVID-19. Instead, variables such as education and age emerge as critical determinants. Farmers with higher levels of education are better equipped with information and technological resources essential for crisis understanding, risk management, and effective communication and market engagement. The intricate relationships among education, age demographics, and readiness underscore the necessity for targeted training programs tailored to diverse farmer profiles. Policy interventions aimed at crisis resilience should prioritize the development of adaptable educational initiatives capable of meeting the varying needs of agricultural communities across different regions and contexts.

Implementing these findings into policy frameworks holds significant potential to enhance agricultural resilience during crises like COVID-19. Targeted educational programs can empower farmers with the knowledge and skills needed to navigate crises effectively, while support for information access and technology adoption can ensure timely and informed decision-making. Age-sensitive interventions and community resilience-building initiatives can further strengthen readiness and response capabilities. By fostering flexible agricultural practices and promoting sustainable development, policies can not only mitigate the immediate impacts of crises but also lay a foundation for long-term resilience and food security. Integrating these insights into policy agendas empowers governments and stakeholders to proactively address agricultural challenges in times of uncertainty, fostering sustainable growth and resilience in agricultural sectors worldwide.

Several other potential factors could influence farmers' readiness but were not included in this study, such as years of farming experience, farm size, and financial assistance. Future research might include factors based on the limitations of this current study. For instance, the impact of farm size on readiness or explore how financial assistance programs affect farmers' preparedness for crises like COVID-19. In addition, future research could delve deeper into these relationships, examining how different combinations of education, age, and other variables affect farmers' readiness. This would provide a more nuanced understanding of the factors influencing readiness and enable the development of targeted interventions and support systems for farmers during crises. It also highlights the need for more comprehensive research to explore additional factors and calls for developing flexible training programs to meet farmers' diverse demands.

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study, contributing to its initial design and framework development. Nur Bahiah Mohamed Haris and Norida Mazlan both provided valuable reviews of the draft manuscript, offering critical feedback and suggestions that enhanced clarity, coherence, and academic rigor in the final presentation of the study

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