READINESS OF RURAL COMMUNITY IN SARAWAK TOWARDS SMART RURAL DEVELOPMENT

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ABSTRACT

Socioeconomic disparities can hinder a country's development progress. Evidently, in Malaysia, there is a gap in the socioeconomic development between West and East Malaysia. Consequently, the government had initiated efforts to enhance development strategies by incorporating rural East Malaysian areas into the 12th Malaysian Plan (12MP). While the government has introduced strategies to address development gaps, smart rural development remains absent from policies. Additionally, there is a lack of research on the readiness of rural communities in Sarawak for smart rural initiatives. This paper aims to assess Sarawak's rural communities' readiness across social, economic, environmental, resource, and technological domains. The case study involves two villages in Marudi, Sarawak, and was studied using questionnaires and interviews, involving 266 respondents. The analysis indicates that both villages are not ready in terms of its economic aspect. However, they show promising readiness in the environmental, technology, and resources aspects, suggesting favourable conditions for the adoption of smart rural initiatives. Moreover, the communities in both villages demonstrate strong social readiness, indicating a high level of support for smart rural. Overall, neither village is fully prepared for smart rural development. It is hoped that this study can be useful for the local government to note which areas to improve or focus on for the rural community to become a smart rural community.

Keywords: Smart rural, Readiness, Socioeconomic, Sarawak.

1.   INTRODUCTION

In today's rapidly evolving digital age, the concept of smart cities has gained significant attention. Smart cities aim to leverage technology and data to improve the quality of life for residents, enhance sustainability, and drive economic development (Albino et al., 2015). While the concept of smart cities has primarily focused on urban areas, there is a growing recognition of the need to extend these advancements to rural communities as well, and this leads to the smart rural concept (Chourabi et al., 2012). Smart rural initiatives include integrating smart technologies that foster innovation within the rural communities to achieve sustainability (Neal et al., 2019; Naldi et al., 2015; Maja et al., 2020). To ensure the successful implementation of smart rural initiatives, it is crucial to consider the socioeconomic readiness of these communities (Mukti et al., 2022b). Socioeconomic readiness refers to the preparedness of rural communities to adopt and benefit from smart technology (Zavratnik et al., 2018).

Notably, smart rural initiatives are aligned with the United Nations' Sustainable Development Goals (SDGs), particularly SDG 10 (Reduced Inequalities) and SDG 11 (Sustainable Cities and Communities). By addressing the unique socioeconomic challenges in rural areas, smart rural development may help reduce inequalities between urban and rural regions, contributing to more equitable access to technology, education, and resources (Zavratnik et al., 2018). Specifically, these initiatives align with Target 10.2 of SDG 10, which aims to empower and promote the social, economic, and political inclusion of all, irrespective of location (United Nations, n.d). Furthermore, smart rural initiatives promote sustainable community development by improving infrastructure, connectivity, and overall quality of life in rural areas, in line with Target 11.a of SDG 11. This target promotes positive economic, social, and environmental links between urban, peri-urban, and rural areas by strengthening national and regional development planning (United Nations, n.d).

Despite the absence of specific smart rural policies in Malaysia, there are various national policies and initiatives aligned with smart rural goals. The Twelfth Malaysia Plan (12MP) emphasise reducing inequalities and improving rural infrastructure, particularly in East Malaysia, which includes Sarawak (Rashid, 2021). Additionally, the National Digital Network (JENDELA) initiative seeks to enhance digital infrastructure, particularly internet connectivity in rural areas (Malaysian Communications and Multimedia Commission, 2020), laying the groundwork for the adoption of smart technologies. Moreover, the National Rural Physical Planning Policy (NRPPP) and the Shared Prosperity Vision 2030 highlight the importance of reducing disparities between urban and rural areas, aligning with the objectives of SDG 10 (Economic Planning Unit, 2019; Department of Town and Country Planning, 2017). These policies, alongside the MyDIGITAL initiative, demonstrate the government's commitment to fostering digital adoption and rural development (Economic Planning Unit, 2021), despite the lack of a formal smart rural policy frameworks.

Several factors contribute to socioeconomic readiness for smart rural. Firstly, access to technology and connectivity (Mukti et al., 2022b). For smart rural initiatives to be successful, rural communities need access to reliable and high-speed internet connectivity (Mukti et al., 2022b). Secondly, the availability of education and digital literacy (Li et al., 2020). Digital literacy is the ability to effectively and critically use digital technologies, such as smartphones and the internet, to find, evaluate, create, and communicate information (Law et al., 2018). It is essential for rural residents to have access to education and digital literacy programs that equip them with the necessary skills to effectively use and leverage smart technologies. Finally, having adequate financial resources (Zhuang, 2019). Adequate financial resources are vital for the implementation and maintenance of smart rural initiatives.

Sarawak, one of the regions in East Malaysia, faces unique economic challenges that influence its readiness for smart rural development. The state has traditionally relied on agriculture, logging, and energy production through dams, but many of its rural communities still grapple with economic constraints, limited infrastructure, and unequal access to resources (Rashid et al., 2019). While Sarawak has experienced economic growth over the years, this progress has not been evenly distributed, particularly in remote villages, making its economic condition a crucial factor for the success of smart rural initiatives. Inadequate access to economic resources, combined with the high cost of upgrading rural infrastructure, poses a significant hurdle for the implementation of smart rural initiatives in the region.

When assessing the socioeconomic readiness for smart rural development in Asia, it is important to consider the unique challenges and opportunities present in the region (Zhang & Zhang, 2020). Asia is diverse, with varying levels of economic development, infrastructure, and access to technology across different countries and rural areas (Asian Development Bank, 2017). In many parts of rural Asia, there is a significant digital divide, with limited

access to reliable internet connectivity and technology infrastructure (Soni, 2020). Addressing this gap is crucial for the successful implementation of smart rural initiatives.

Furthermore, the socioeconomic disparity in Malaysia has resulted in the same challenges as previously mentioned (Salemink et al., 2017; Rashid et al., 2019). The socioeconomic disparity between West and East Malaysia might prove to be a hurdle that needs to be overcome by the local government before integrating smart rural into the development plan. Although this disparity has urged the Malaysian government to focus more on the socioeconomic development in East Malaysia in The Twelfth Malaysian Plan (12MP) (Rashid, 2021), smart rural has yet to be included in policies and development planning.

Therefore, ensuring the readiness of socioeconomic factors for smart rural development in Sarawak involves addressing various challenges to facilitate successful implementation. One of the major challenges in ensuring socioeconomic readiness for smart rural development in Sarawak is the limited access to infrastructure (Rashid et al., 2019). Rural areas in Sarawak may lack basic infrastructure such as reliable electricity supply, road connectivity, and telecommunication networks. Without proper infrastructure, it becomes difficult to establish a strong digital foundation that is necessary for smart rural initiatives (Salemink et al., 2017). Another challenge is the insufficient education and digital literacy among rural residents in Sarawak (Rashid et al., 2019). Limited access to quality education and a lack of digital literacy skills hinders the ability of rural residents to fully utilize and benefit from smart technologies (Rashid et al., 2019). Without proper education and digital literacy programs, there is a risk of exclusion and a widening digital divide in rural areas (Rashid et al., 2019).

Addressing the readiness of socioeconomic factors for smart rural development in Sarawak involves overcoming specific challenges such as limited access to infrastructure, insufficient education and digital literacy among rural residents, and limited financial resources. These challenges need to be addressed to facilitate the successful implementation of smart rural initiatives in Sarawak.

2.   LITERATURE REVIEW

The concept of smart rural development and the implementation of advanced technologies in rural communities have gained increasing attention in recent years (Zavratnik et al., 2018). Despite the efforts of successfully implementing smart villages in various countries such as Ireland, China, and Indonesia, there are still no developed standard measurements to measure the readiness of rural communities to accept smart rural initiatives, especially in Malaysia.

A study by Lynn et al. (2020) proposed a framework to measure digital readiness for smart rural development in the European Union (EU). There are eight dimensions to this framework that include education, civil society, digital business, digital public services, digital tourism, horizontal integration, connectivity, and digital citizen (Lynn et al., 2020). The framework was created to meet the demand for community-driven planning and to offer a resource for assessing the level of digital readiness in rural areas (Lynn et al., 2020).

It is essential to ensure that rural communities are equipped with the necessary resources and infrastructure to embrace smart rural development (Zhang & Zhang, 2020). Additionally, a key aspect of readiness is the presence of an inquisitive rural culture, which fosters an openness to innovation and technological advancement (Zhang & Zhang, 2020). This study by Zhang and Zhang in China (2020) emphasises the importance of developing indicators for smart rural villages and highlights the need for rural communities to be ready and willing to embrace smart rural development to fully benefit from the potential advancements and opportunities it can bring. It is crucial to consider the unique needs and characteristics of rural communities when implementing smart rural development initiatives.

In a study by Mukti et al. (2022b), indicators for smart rural villages were developed using a systematic literature review, the 2030 agenda for sustainable development, as well as the ISO37122 smart cities indicator standard. These indicators were proposed to aid in determining the rural readiness to accept smart rural (Mukti et al., 2022b). The indicators prioritise sustainability, smartness, and connectivity and include various aspects such as access to affordable energy, adequate housing, safe drinking water, an inquisitive rural culture, and early warning systems against adverse weather conditions and severity of water pollution (Mukti et al., 2022b). Furthermore, this study highlights the need for rural communities to be prepared to embrace smart rural development (Mukti et al., 2022b).

Recently, Rokhman et al. (2023) studied the smart village readiness in Indonesia by using the decision tree analysis. The variables that the authors considered were smart government, smart environment, smart economy, smart mobility, smart community, and smart living. The results of the study showed that rural community heavily influences the readiness to accept smart village development and majority of the respondents disagree with including smart mobility in smart rural planning (Rokhman et al., 2023).

Based on the literature review, the regions that had studied the rural readiness were Ireland and countries in Asia such as China and Indonesia. However, this shows that the readiness of rural communities in Malaysia, specifically in Sarawak, has yet to be studied. Furthermore, the readiness measurements or indicators from the literature mentioned can be used as examples or references for rural readiness studies.

2.1 Smart Rural Indicator

The smart rural indicators in this research were extracted from past studies. Table 1 shows the sources for these indicators and the five domains, namely social, economic, environmental, technology, and resources. There are 8 indicators for the social domains, 11 indicators for both economic and environmental domains, 4 indicators for the technology domain, and 5 indicators for the resources domain. Altogether, there are 39 indicators. The full terms for the abbreviations of the indicators and references are shown in Table 2 and Table 3 respectively.

Table 1: Smart Rural Indicators

Domains	Indicators	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15	R16
Social	S1	/					/			/		/					
	S2	/		/			/							/			
	S3	/				/								/			
	S4	/							/								
	S5		/				/	/			/						
	S6		/				/	/			/						
	S7					/			/						/		
	S8					/	/		/	/							/
Economic	EC1				/		/		/								
	EC2				/		/	/	/	/							
	EC3	/		/					/		/						
	EC4								/					/			
	EC5	/				/					/						
	EC6				/	/		/	/								
	EC7			/					/	/				/			
	EC8	/		/													
	EC9					/									/		
	EC10	/		/									/		/		
	EC11	/		/									/		/		
Environmental	EN1		/	/							/						
	EN2	/	/	/							/						
	EN3			/					/			/					
	EN4			/					/			/					
	EN5			/					/			/					
	EN6			/								/	/				
	EN7	/		/									/				
	EN8			/					/			/	/				
	EN9			/		/				/			/		/		
	EN10														/		
	EN11					/			/						/		
Technology	TC1	/		/						/							
	TC2	/		/						/							
	TC3	/		/						/							
	TC4			/						/		/					

Table 1: Smart Rural Indicators (continued)

Domains	Indicators	References															
		R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15	R16
Resources	RE1	/															/
	RE2	/		/			/							/			
	RE3	/			/	/							/				/
	RE4	/			/								/				/
	RE5	/	/	/							/						

Note: [R1] Maja et al. (2020), [R2] Abu-Rayyash & Dincer (2023), [R3] Aziiza & Susanto (2020), [R4] Mukti et al. (2022a), [R5] Kim et al. (2020), [R6] Kaye-Blake et al. (2019), [R7] Ye et al. (2023), [R8] Yang et al. (2022), [R9] Li et al. (2021), [R10] Hussain et al. (2023), [R11] Lin & Hou (2023), [R12] Li et al. (2022), [R13] Lopez-Penabad et al. (2022), [R14] Lacirignola et al. (2012), [R15] Copus & Crabtree (1996), [R16] Illskog & Kjellstrom (2008)

Table 2: Abbreviations for Indicators

Domains	Indicators	Abbreviations
Social	Owning smartphones	S1
	Using internet	S2
	Network coverage satisfaction	S3
	Having cable TV	S4
	Election voting	S5
	Participation in meetings	S6
	Having food stocks	S7
	Migrated household residents	S8
Economic	Employment rate	EC1
	Monthly income	EC2
	Current road condition	EC3
	Distance to nearest city	EC4
	Personal vehicles	EC5
	Secondary income	EC6
	Area of arable land	EC7
	Online banking usage	EC8
	Food expenses per month	EC9
	Food waste per month	EC10
	Food waste utilisation	EC11
Environmental	Daily fossil fuel usage	EN1
	Daily non-fossil fuel usage	EN2
	Yearly agricultural yield	EN3
	Yearly fertiliser usage	EN4
	Yearly pesticides usage	EN5
	Agricultural technicians in household	EN6
	Farmer cooperative in household	EN7
	Sanitary toilets	EN8
	Monthly water usage	EN9
	Diet sourced from agricultural yield	EN10
	Food scarcity from low yield	EN11
Technology	Experience extreme weather conditions	TC1
	Household affected by those conditions	TC2
	Area of crops affected	TC3
	Area of crops properly irrigated	TC4
Resources	Access to high cellular connection	RE1
	Access to internet	RE2
	National grid connection	RE3
	Meter used in household	RE4
	Using solar panels	RE5

3.   METHODOLOGY

3.1   Case Study

This research uses the case study approach with 2 rural areas in Marudi, Sarawak. The case study method is often used to study or analyse an entire community (Singh, 2006). Additionally, past studies in rural areas are often conducted through case studies. For example, Rashid (2019), Abdullah (2017), and Tedong et al. (2022), just to name a few. Therefore, a case study method is adapted in this research as data are collected from the rural communities in Sarawak. Furthermore, case study approach allows an in-depth investigation of the rural area in the present setting, and may result in impactful insights (Crowe et al., 2011).

3.2   Population and Sample Size

Among the 29 districts in Sarawak, Marudi District is the largest (22,070 km2), with a total population of 62,883 people (Wong, 2012). Long Banyok and Uma Akeh has a total population of 213 and 305 people respectively, therefore the sample size for a valid finding is 120 respondents for Long Banyok, and 145 respondents for Uma Akeh. This study has obtained 121 responses in Long Banyok, and 145 responses in Uma Akeh.

It is also important to note that these two villages are in the P2 (Pedalaman 2) category of rural area in Sarawak. The village criteria affect the category, where P2 stands for slightly underdeveloped village. The criteria include using power generators for electric supply, using river water as water supply, having travel risks such as flood, and having only one public facility (Zeki et al., 2020).

3.3   Data Analysis Method

3.3.1   Descriptive Analysis

Descriptive analysis is an analysis that involves the systematic description, summarisation, and interpretation of data. Descriptive analysis focuses on providing a detailed and comprehensive understanding of a particular phenomenon or problem (Lau & Kuziemsky, 2017). In this study, the analysis of demographic data is performed through descriptive analysis. One of the main advantages of descriptive analysis is providing detailed description of the research data through frequency, percentages and range of scores (Lau & Kuziemsky, 2017; Cresswell, 2014).

3.3.2   Readiness Scale and Analysis

There is no established scale to assess the readiness for rural community to accept smart rural. Therefore, this research has adapted a method from Muazir et al. (2021) in Indonesia, where they assess the smart rural readiness through scores. This readiness scale was adapted in this research to compare the readiness within the two villages. Then, the readiness of the villages were combined to assess the overall readiness.

The readiness scale in Table 3 is based on the readiness scores of 'Not Ready' (score = 1), 'Quite Ready' (score = 2), and 'Very Ready' (score = 3). The readiness scale was developed by dividing the difference between the highest and the lowest score by 3, resulting in a scaling factor of 0.67. This method ensures that the readiness categories were evenly distributed, allowing for consistent and non-biased interpretation of the readiness levels across all domains.

Table 3: Readiness Scale

Not Ready	Quite Ready	Very Ready
Score: 1 – 1.67	Score: 1.68 – 2.34	Score: 2.35 – 3

4.   RESULTS AND DISCUSSION

4.1   Demographic Information

Table 4 shows the demographic information on villages 1 and 2. The total population for Village 1 was 213 people and for Village 2 was 205 people.

Table 4: Demographic Information

Demographic Information	Village 1 (n₁= 121)		Village 2 (n₂= 145)	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Gender				
Male	48	39.7%	61	42.1%
Female	73	60.3%	84	57.9%
Nationality				
Malaysian	121	100.0%	145	100.0%
Ethnicity				
Kenyah	121	100.0%	145	100.0%
Marital Status				
Single	0	-	0	-
Married	95	78.5%	83	57.2%
Divorced	0	-	2	1.4%
Widowed	26	21.5%	60	41.45
Highest Level of Education				
Primary School	53	43.8%	71	49.0%
Secondary School	34	28.1%	27	18.6%
Technical/Vocational School	0	-	0	-
Diploma	0	-	0	-
Undergraduate	0	-	0	-
Postgraduate or higher	0	-	0	-
Others (none)	34	28.1%	47	32.4%

4.2   Social Domain

Table 5 shows the readiness in the social domain for Villages 1 and 2. Majority of the respondents from Village 1 and Village 2 own a smartphone and have access to internet, but their satisfaction with the network coverage slightly defers from each other. Village 1 is more unsatisfied with their network coverage compared to Village 2. The main complaint from the rural community regarding the network coverage is that there are times where there will be no phone reception for some time, especially when the weather is bad. This is contrary as to what Aziiza and Susanto (2020) had mentioned in their study regarding the implemented smart rural in Banyuwangi, Indonesia. The smart rural development efforts there has provide ICT services that can aid the rural community with problems regarding their ICT infrastructure (Aziiza & Susanto, 2020).

With an average of up to 8 to 10 people migrating from each household in Village 1 and Village 2 respectively, those migrating are mainly the children to the rural residents. The major reason for them to migrate to the urban area is for higher chance of working opportunities, and to settle down in the city. With both villages facing aging population, their working children are the ones that support their daily needs to prevent any shortages in their essentials. With over 50% of the population from Villages 1 and 2 migrating to the city, the older folks mentioned the lack of working energy from youngsters when doing community and cultural activities. This is the same case as what Rashid et al. (2023) has discovered in their case study. Lack of involvement from younger generations have affected the rural economic, livelihood, and the programmes held by the rural governance (Rashid et al., 2023). Moreover, the lack of presence of the younger generation in these programmes causes them to not have the skills and training required to take over the cultural and traditional customs of that village (Rashid et al., 2023).

Table 5: Readiness for Social Domain

Indicators	Village 1			Village 2		
	Readiness Score			Readiness Score		
	Not ready (1)	Quite Ready (2)	Very Ready (3)	Not ready (1)	Quite Ready (2)	Very Ready (3)
Owning smartphones			/			/
Using internet			/			/
Network coverage satisfaction	/				/	
Having cable TV	/				/	
Election voting			/			/
Participation in meetings			/			/
Having food stocks			/			/
Migrated household residents		/		/		
Total Score		19			19	
Mean		2.38			2.38	

4.3 Economic Domain

Table 6 shows the readiness in the economic domain for Villages 1 and 2. After spending some time with the rural community Villages 1 and 2, it is determined that the community have some issues in saving money. This is due to the majority of them being self-employed as farmers. Their unstable income has resulted in low monthly savings ranging from RM 50 to RM150, while some even stated that they do not save their money at all due to the prices of essentials especially food expenses at an all-time high. Therefore, they cannot afford to waste their food and has done a stellar job in keeping food waste to a minimum by using the food waste to feed pets or be used as compost or both. Additionally, majority of them stated that it is hard to do so as their monthly income is not that much to begin with, therefore some of them even have the initiative to have a secondary income to support their livelihood. Similarly, Modin et al. (2023) has found that a significant amount of the rural dwellers in Belaga, Sarawak has an income of below than RM500 per month. Moreover, rural households in Sarawak are often grouped as the Bottom 40% (B40), the lowest income classification in Malaysia (Voon et al., 2023).

With an average distance to the closest town is 151km for Village 1 and 153km for Village 2, there are some mixed opinions regarding the newly repaired village road. Although the current road has been cemented, some rural residents are still not satisfied as the cemented road is done in segments. This is also the reason why the majority of rural dwellers opt not to own any vehicles aside from their income. Road development in Sarawak has improved greatly over the years, especially with the Pan Borneo highway construction undergoing (Maiman and Laitiffi, 2023). However, the village roads in Sarawak still need to be improved as Modin et al. (2023) have discovered that logging roads are still the main travelling road for rural dwellers, especially when they need to go to school.

Table 6: Readiness for Economic Domain

Indicators	Village 1			Village 2		
	Readiness Score			Readiness Score		
	Not ready (1)	Quite Ready (2)	Very Ready (3)	Not ready (1)	Quite Ready (2)	Very Ready (3)
Employment rate		/			/	
Monthly income	/			/		
Current road condition			/			/
Distance to nearest city	/			/		
Personal vehicles	/			/		
Secondary income	/			/		
Area of arable land	/			/		
Online banking usage	/				/	
Food expenses per month		/			/	
Food waste per month	/			/		
Food waste utilisation			/			/
Total Score		14			14	
Mean		1.27			1.27	

4.4   Environmental Domain

Table 7 shows the readiness in the environmental domain for Villages 1 and 2. The usage of fossil fuels outweighs the non-fossil fuel usage in both villages. Although both villages are using solar panels, it is only supplementary to the diesel-powered generators as they still have no direct access to electricity. Additionally, renewable energy such as solar power is preferred in smart rural initiatives to encourage a smart environment (Scherbina & Gorbenkova, 2018).

The average agricultural yield for Village 1 adds up to 21.2 kg/year, while Village 2 has an average of 25.5 kg/year. Additionally, the amount of fertiliser used by Village 1 is 148.1 kg/year and Village 2 is 155.7 kg/year, while the pesticides used is 3.1kg/year and 4.2 kg/year respectively. When compared to Li et al. (2022), study in Sichuan, China, their standard amount of fertiliser usage is 400kg/year, and the standard amount of pesticides usage is 6kg/year. This shows that both Villages 1 and 2 uses less fertilisers and pesticides which in turn is better for the environment. Although there is quite a low yield of agriculture for both villages, Villages 1 and 2 have yet to adapt agricultural technicians and farmer cooperatives in their households as they are only receiving agricultural knowledge from the older generations. Again, comparing to Li et al. (2022), the standard number of agricultural technicians and farmer cooperatives is 5 people for each household. There is quite a difference as Villages 1and 2 have neither. Not to mention, these agricultural yields are the rural community's main source of food and ultimately, they have experienced food scarcity especially when there is low yield from their agricultural activities.

The toilet system for Villages 1 and 2 are non-existent as they do not have access to sewers or septic tanks to manage their wastewater. In comparison to Li et al. (2022) in Sichuan, China where the proportion of villages with centralized treatment of domestic sewage is 80%. Additionally, the average water consumption per household in Village 1 is on par with the average consumption per household as suggested by United Nations (Economic Planning Unit, 2021), whereas Village 2 has a higher water consumption as they have access to clean water.

Table 7: Readiness for Environmental Domain

Indicators	Village 1 Readiness Score			Village 2 Readiness Score		
	Not ready (1)	Quite Ready (2)	Very Ready (3)	Not ready (1)	Quite Ready (2)	Very Ready (3)
Daily fossil fuel usage	/			/		
Daily non-fossil fuel usage			/			/
Yearly agricultural yield		/			/	
Yearly fertiliser usage			/			/
Yearly pesticides usage			/			/
Agricultural technicians in household	/			/		
Farmer cooperative in household	/			/		
Sanitary toilets	/			/		
Monthly water usage		/			/	
Diet sourced from agricultural yield		/				/
Food scarcity from low yield	/			/		
Total Score		21			22	
Mean		1.91			2.00	

4.5   Technology Domain

Table 8 shows the readiness in the technology domain for Villages 1 and 2. Villages 1 and 2 experience extreme weather conditions that ultimately also affects their household and crops. Although the latter is not as heavily affected as the former, this shows the level of technological advances that have taken place in both villages and lack thereof. The reason for their household not being affected by these harsh weather conditions is due to the usage of concrete houses in both villages. To date, there is no technological advances that can completely combat the effects of these extreme weather conditions in Villages 1 and 2. In contrast, Aziiza and Susanto (2020) mentioned the smart rural implementation in Banyuwangi, Indonesia to have sensor technology and cloud computing to aid them during these extreme weather scenarios. Additionally, due to decreasing manpower to work on the paddy fields in Village 1, their irrigation system is not effective thus giving decreasing yield each year. Proper irrigation of arable land is vital to the rural community, especially when a rural area is heavily reliant on

their agricultural yield such as Villages 1 and 2. When compared to the technological advances in Sichuan, China as mentioned by Li et al. (2022), their irrigation system is more effective with high utilisation of systematic irrigation in their farmlands.

Table 8: Readiness for Technology Domain

Indicators	Village 1			Village 2		
	Readiness Score			Readiness Score		
	Not ready (1)	Quite Ready (2)	Very Ready (3)	Not ready (1)	Quite Ready (2)	Very Ready (3)
Experience extreme weather conditions	/			/		
Household affected by those conditions	/			/		
Area of crops affected			/			/
Area of crops properly irrigated	/			/		
Total Score		6			6	
Mean		1.5			1.5	

4.6   Resources Domain

Table 9 shows the readiness in the resources domain for Villages 1 and 2. In terms of technological advances, there is only one telecom tower throughout Village 1, and it only supports one telecom service. Although it supports 3G and higher connectivity, the rural residents would complain about the inconsistency of their phone line service. Whereas for Village 2, they are more advanced in terms of connectivity as they have free public Wi-Fi as a result from the government's initiative. In contrast, Indonesia has already implemented this smart rural concept in their rural areas and their technological advances are more modern than Malaysia. This study is mentioned by Aziiza and Susanto (2020) where the smart rural development in Banyuwangi, Indonesia has achieved stellar technological advances to prepare their community to be Information Technology (IT) literate. For example, there are IT staff ready in the village of that region to aid the rural community navigate online services (Aziiza & Susanto, 2020).

Not only that, but Villages 1 and 2 has no direct electricity source as they are not connected to the national grid. Due to this issue, they are still dependant on diesel-powered generators as their main electricity source and only using solar panels as their light source on some occasions. Although all the respondents in both villages uses solar panels as a supplementary electricity source, this does not change the fact that they are still heavily reliant on their generators. The high diesel consumption is not aligned with the UN SDG 12 – Responsible Consumption and Production (Hussain et al., 2023). Although it is understandable that the rural dwellers have no other choice than to resort to using diesel-powered generators for electricity.

Table 9: Readiness for Resources Domain

Indicators	Village 1			Village 2		
	Readiness Score			Readiness Score		
	Not ready (1)	Quite Ready (2)	Very Ready (3)	Not ready (1)	Quite Ready (2)	Very Ready (3)
Access to high cellular connection			/			/
Access to internet			/			/
National grid connection	/			/		
Meter used in household	/			/		
Using solar panels	/			/		
Total Score		9			9	
Mean		1.80			1.80	

4.7   Overall Readiness

Table 10 shows the overall readiness based on the mean total scores for all five domains. The overall readiness is based on Table 2, whereby the overall readiness for both villages is in the 'Quite Ready' category.

The social domain appears to be 'Very Ready', whereas the environmental, technology, and resources domains are in the 'Quite Ready' category, and finally, the economic domain is in the 'Not Ready' category.

Although the overall readiness falls within the 'Quite Ready' category, higher readiness needs to be achieved before fully embracing the smart rural initiatives into Sarawak's rural development. Furthermore, local government need to focus on the environmental, technology, and resources aspects to rural development, and this is especially for the economic aspects.

Table 10: Readiness Analysis

Village (V)	Mean Readiness Score for Each Domain					Mean Total Score	Overall Readiness
	Social	Economic	Environmental	Technology	Resources		
V1	2.38	1.27	1.91	1.50	1.80	1.77	Quite Ready
V2	2.38	1.27	2.00	1.50	1.80	1.79	

5.   CONCLUSION

With the rise in focus towards urban development, rural development needs to equally be focused on. Especially with Sarawak having a large population and the rural population being a significant part of it (Abdullah, 2017). Therefore, rural areas in Sarawak can benefit from the smart rural initiatives to help alleviate some of its major concerns, namely, rural poverty (Tedong et al., 2022) and efficiency in rural governance (Latiff, 2022; Rami, 2021).

The analysis indicates that both villages are not ready in the economic domain, and showed mild readiness in the environmental, technological, and resource aspects, primarily due to the lack of necessary infrastructure such as reliable electricity, internet connectivity, and road access. These limitations pose significant barriers to implementing smart rural initiatives, particularly in fostering economic growth and technological adoption. However, the communities in both villages demonstrate strong social readiness, indicating a high level of support for smart rural initiatives. After analysing the readiness of Villages 1 and 2, it can be deduced that there are still many improvements needed to prepare the rural community to accept smart rural development in Sarawak.

To overcome the infrastructure challenges in Sarawak's rural areas, several strategies can be considered. Public-Private Partnerships (PPPs) can help co-fund key rural infrastructure projects such as road development and internet expansion in the rural areas, thus reducing government costs while enhancing technical expertise. Furthermore, the government might want to consider in prioritising rural infrastructure upgrade, especially under the 12th Malaysian Plan by having targeted investments towards the rural economic sector. These approaches may help to enhance readiness for smart rural initiatives in Sarawak.

In conclusion, aspects that showed low to mild readiness were in the economic, environmental, technological, and resources domains. Thus, rural Sarawak needs significant improvements within these aspects to adopt smart rural initiatives.

6.   RESEARCH IMPLICATIONS AND FUTURE RESEARCH

Overall, the implications of this study provide valuable insights for the Sarawak government, particularly in addressing areas of low readiness, which was the economic domain. While moderate readiness has been observed in environmental, technological, and resource domains, significant challenges remain, such as inconsistent infrastructure and financial constraints. These factors may hinder the adoption of smart rural initiatives. Therefore, it is crucial to delve deeper into these challenges in future research to gain a more comprehensive understanding. Addressing these issues may significantly enhance the implementation of smart rural initiatives in rural Sarawak.

Although this study evaluates readiness at the village community and individual levels, broader challenges must be considered, as they could impact the success of smart rural initiatives. Future studies should consider focusing on the infrastructure limitations, economic barriers, and potential social barriers to find out how these factors may impede progress in rural areas.

Furthermore, since the indicators in this study was only focusing on the village and individual level, future research may also consider the government policies, economic conditions, and environmental challenges on a macro level to provide a more comprehensive view of how these factors might affect the implementation of the smart rural initiatives.

Additionally, future studies can explore more rural areas in Sarawak since this research only focuses on the rural area in Marudi, Sarawak. Furthermore, the study only considered the P2 category of rural area. Therefore, future research needs to be done for other categories of rural areas such as P1 and P3 for the rural readiness study to be all inclusive.

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7.   REFERENCES

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