

## Malaysia Modern Rural Ranking Index: Validated Dimensions, Criteria Groups, and Performance Criteria

Mohd Fadzil Abdul Rashid<sup>1\*</sup>, Kushairi Rashid<sup>1</sup>, Muhamad Azrul Azwan Azman<sup>1</sup>, Aizazi Lutfi Ahmad<sup>1</sup> and Hafriz Suhairi Mohd Rejab<sup>2</sup>

<sup>1</sup>Department of Built Environment Studies and Technology, College of Built Environment, Universiti Teknologi MARA, Perak Branch, 32610 Seri Iskandar, Perak, Malaysia

<sup>2</sup>IZM Consultant, Taman TTDI Jaya, 40150 Shah Alam, Selangor, Malaysia

### ABSTRACT

In Malaysia, rural areas are essential economic focal points for improving rural livelihoods and reducing the life quality gaps between urban and rural areas. To that extent, rural assets and resources, such as agricultural, entrepreneurial, business, and tourism, along with rural infrastructure and service centres, become important elements to further explore and assess for synergising rural change towards a modern approach. To our knowledge, no attempt has been made to assess rural development progress based on the transition towards a modern rural approach. Inspired by this, the study aims to offer a Malaysia modern rural ranking index, the Malaysia Assessment Measure for Modern Rural Development (MAMRD)—a missing link approach for assessing rural development progress towards a modern rural system. The MAMRD was validated based on focus group discussions (FGDs) on three case studies and finally constructed on the three dimension-objectives measure, comprising 13 criteria groups and 141 criteria, to rank a village in a MAMRD star rating index. Using the MAMRD for the rural assessment is reliable for assessing the rural performance towards the future niches of rural development in Malaysia—rural resilient-liveability-and-smart.

*Keywords:* MAMRD, modern rural, resilient-liveability-and-smart, rural infrastructure, technology practices

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*E-mail addresses:*

mohdf032@uitm.edu.my (Mohd Fadzil Abdul Rashid)

kusha575@uitm.edu.my (Kushairi Rashid)

azrull14@uitm.edu.my (Muhamad Azrul Azwan Azman)

aizaz232@uitm.edu.my (Aizazi Lutfi Ahmad)

Hafrizsuhairi@izmeconsult.com (Hafriz Suhairi Mohd Rejab)

\* Corresponding author

### INTRODUCTION

In Malaysia, rural areas serve as vital guardians of food security, economic resources, and assets while also being wonderful places to work, live, invest,

and visit—a legacy for future generations. Unfortunately, rural assets and resources, such as agriculture, entrepreneurship, business, and tourism, still require diversification (Rural Development Policy 2030 or *Dasar Pembangunan Luar Bandar 2030 [DPLB]*, 2018; Rashid et al., 2021). Without this diversification, there will be a shortfall in bridging the gap between rural and urban living standards. This alarming issue has resulted in youth out-migration from rural to urban areas as they seek more significant opportunities and desire to overcome the limitations of financial resources (Kusumo et al., 2023). Consequently, this trend has led to a dearth of rural human resources and low productivity (*DPLB*, 2018; Rashid et al., 2021), demanding immediate attention and action. In addition, it is crucial to establish a link between the national development policies and strategies while fostering understanding among rural stakeholders to effectively translate rural development agendas into actionable initiatives.

In line with the government’s directive aspirations, the Sustainable Development Goals (SDGs), particularly Goal 9: Industry,

Innovation, and Infrastructure and Goal 10: Reduced Inequalities (United Nations, 2015), along with the advent of new technologies in rural practices both nationally and globally, highlight four crucial factors that underscore the urgency of assessing rural development progress, as summarised in Figure 1.

These outlined factors call for a notable contribution to existing government policies, such as the National Rural Physical Planning Policy 2030 or *Dasar Perancangan Fizikal (DPF) Desa Negara 2030* (2017), particularly during the implementation stage. Therefore, adopting a place- or strength-based strategy is crucial, enabling all rural settlements to achieve remarkable progress and increase sustainability and prosperity. Inspired by this, the current paper aims to offer a Malaysia modern rural ranking index, the Malaysia Assessment Measure for Modern Rural Development (MAMRD)—a missing link approach for assessing rural development progress towards a modern rural ecosystem.

## LITERATURE REVIEW

A MAMRD is an extension of a Framework of Modern Rural Development (FMRD),

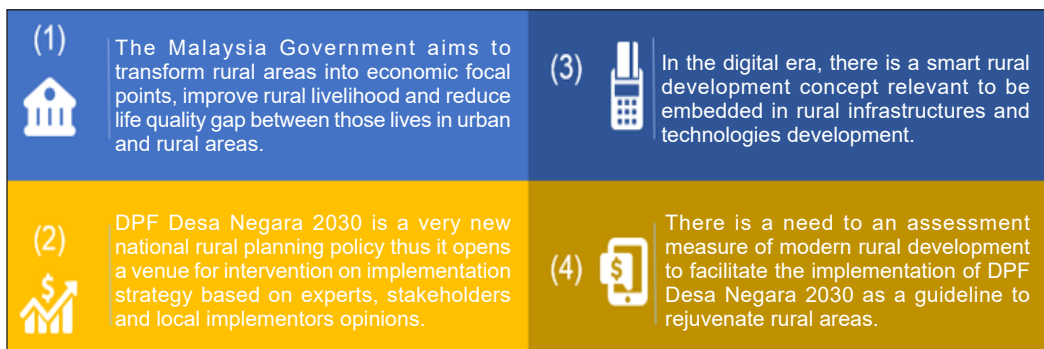


Figure 1. Factors alarming to the need for rural development measure (Source: Authors’ work, 2023)

effectively translating the government's directive aspirations into a quantifiable measure of rural progress. Rashid et al. (2021) have developed the FMRD as a new approach to synergise rural transformation and solutions. The FMRD is structured as an objective mechanism for assessing rural transition towards a modern approach, functioning as a translation of the essential criteria required for modern rural development. It is grounded on three dimensions of objective measures: (1) rural economic boosters and catalyst infrastructures, representing the concept of resilience; (2) rural characteristics and social well-being infrastructures, representing the concept of liveability; and (3) smart and green technology practices, representing the concept of smartness. It relies on the adequacy of rural infrastructures, social facilities, services, and technology practices, particularly in agricultural, entrepreneurship, business, and tourism developments. Then, it is strengthened by incorporating the best practices or ideas from a smart village approach into the existing Malaysia rural development approach, which emphasises resilience and liveability, as outlined in *DPF Desa Negara 2030* (2017) and *DPLB 2030* (2018).

In Malaysia, the concept of 'modern' or 'rural modernisation' has long been incorporated into rural development agendas, starting as early as 1971 with the National Economic Policy (NEP, 1971–1990). This policy aims to modernise rural areas by introducing advanced techniques in agriculture, improving irrigation and

drainage systems, establishing credit and marketing institutions, developing rural infrastructure, enhancing transportation and communication networks, and introducing new secondary schools in rural regions (Bruton, 2007). Building upon this, the *Falsafah dan Strategi Baharu Pembangunan Luar Bandar* (A New Philosophy of Rural Development) in 1994 focused on empowering people (human development) and initiating the *Gerakan Desa Wawasan* (Visionary Capability Movement) programme. This programme aimed to uplift villages, making them more advanced, attractive, and beneficial. The key approach was to raise awareness and change the attitudes of rural residents towards rural transformation. In 2010, the Rural Development Master Plan was introduced as a strategic action plan blueprint to promote rural development. The plan centred around three main pillars: (1) fostering a sustainable and advanced economy, (2) creating a prosperous society, and (3) ensuring environmental sustainability (*Ministry of Rural and Regional Development*, 2010). These efforts are further emphasised in the current policies of *DPF Desa Negara 2030* (2017) and *DPLB 2030* (2018), which highlight specific niches and discoveries for rural advancement.

In Malaysia's context of rural development, one significant strategy initiated by the government, namely a village action plan strategy launched in 2009, marks a new movement of rural planning in Malaysia (Ngah et al., 2010). It is a rural development strategy also

under the Visionary Capability Movement Programme to strengthen the capacity building of rural leaderships, such as the Village Community Management Council or *Majlis Pengurusan Komuniti Kampung (MPKK)* and rural people in planning and executing the village activities and projects. Ngah et al. (2010) demonstrate their research findings on the strategy implemented in the initial 17 villages throughout Malaysia. They found that village people have the capability to participate in planning and implementing development projects in their villages according to their needs and aspirations. In this manner, the knowledge and experience available from the various backgrounds of village people could be easily transferred into the plan-making and implementation processes if adequately organised and encouraged. They also found that the village people were ready and able to identify a range of development priorities, covering physical, economic, social and institutional dimensions. This participatory empowerment that has already been nurtured in rural people can potentially be embedded in the new environment of the rural digital era to well-integrated the government's directive aspirations and rural people's needs and capabilities to synergise rural transformation and solutions in a quantifiable way.

Therefore, the formulation of the FMRD by Rashid et al. (2021) is timely for incorporating technology disruption and practices (transpired from a smart village approach) into rural activities at the community level, including the Internet

of Things (IoT), robotics, and big data analytics. It offers solutions to everyday problems in farming, SMEs, energy usage and healthcare in rural areas (Alabdali et al., 2023).

All processes underwent three major stages. Stage 1 involved reviewing contemporary rural development concepts. Stage 2 involved analysing the content of *DPF Desa Negara 2030* (2017) (Thrust 2 to Thrust 5) and *DPLB 2030* (2018), extracting the key performance criteria. Lastly, Stage 3 involved a single-round expert view survey using a structured assessment form, which included a rating priority exercise to validate and assess the importance and relevance of dimensions, group criteria, and performance criteria that reflect modern rural development outcomes. As a result, the FMRD, tailored to the national development agendas and smart technology practices, would enhance rural opportunities for change and align with future government aspirations (Figure 2). Rashid et al. (2021) provide detailed information about the formulation process, criteria groups, and performance criteria of the FMRD.

In continuation (extension) of the FMRD, the current paper attempts to provide an overview of the completed work on this rural performance measure, the so-called Malaysia Assessment Measure for Modern Rural Development (MAMRD). The MAMRD is a new measurement tool that assigns a rating (ranging from zero to six stars) to assess a village's progress according to the MAMRD criteria. This measurement tool takes

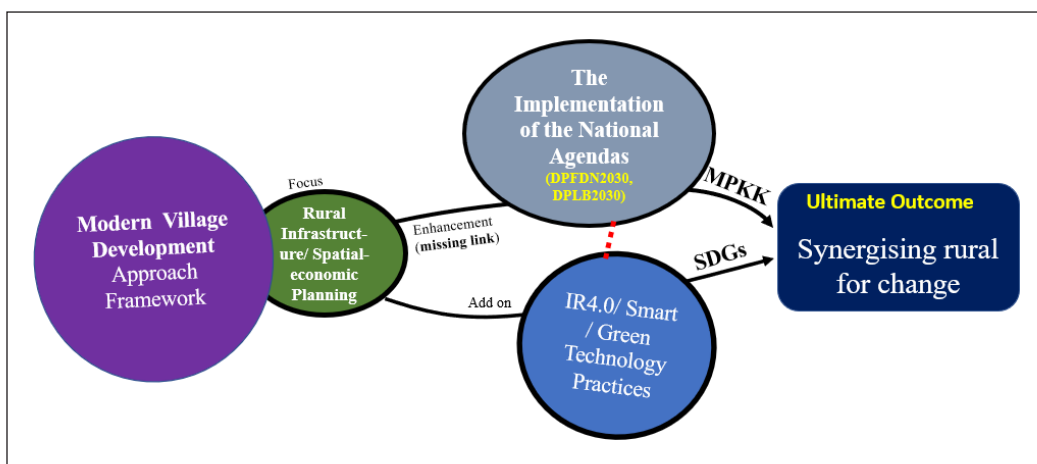


Figure 2. The FMRD serves as a missing link and catalyst for rural change in Malaysia (Source: Authors’ work, 2023)

into account the aspirations of the rural communities, particularly the youth, amidst the challenges posed by globalisation. To the best of our knowledge, this study represents a pioneering rural measurement index in Malaysia, highlighting its novelty. Others, such as Rashid et al. (2019), work in different dimensions, concentrating more on the rural revitalisation framework based on five economic performance factors: economic, human, social, cultural and environmental. By formulating a rating tool index for rural development progress incorporating technology practices for rural livelihoods and solutions, this study emphasises the importance of adopting a modern approach to rural development. Technology applications have become vital to narrowing the gap between rural and urban living standards and driving rural development to be smarter, more advanced and more efficient. It is worth noting that it aligns with the government effort, where the Malaysian government

initiated the National Fourth Industrial Revolution (4IR) in 2021 (Economic Planning Unit, 2021a) as the guiding principle, positioning Malaysia to stay ahead of the 4IR technologies curve and optimise its associated benefits.

## METHODOLOGY

Overall, this research uses a qualitative approach involving literature review and contents analysis, experts’ views, and FGD sessions. However, a quantitative method has also been used in the data analysis, particularly in a decision-making problem regarding MAMRD’s dimensions and criteria groups. Figure 3 depicts the five stages of the research process involved in developing MAMRD.

There are two main processes (Stages 4 and 5) in formulating a MAMRD measure: (a) weighting the dimensions and criteria groups and (b) the implementation of MAMRD through FGDs.

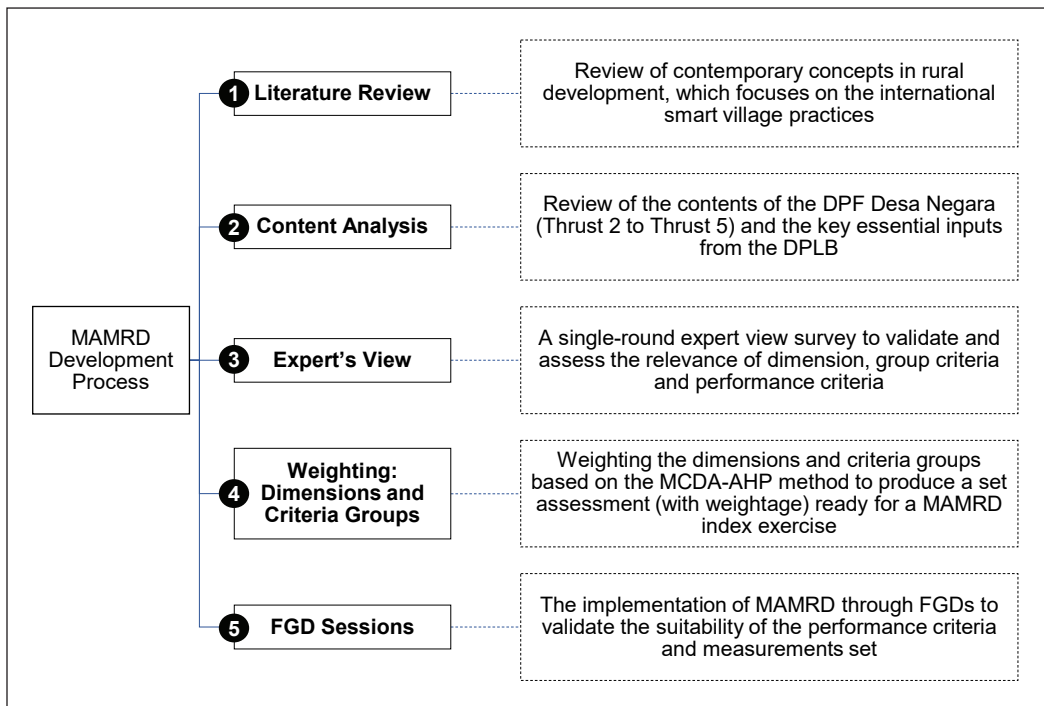


Figure 3. Overall research process: The five stages involved in MAMRD development (Source: Authors' work, 2023)

Note. Stages 1–3 can be further referred to Rashid et al. (2021)

### Weighting the Dimensions and Criteria Groups

According to the experts' views (Rashid et al., 2021), the MAMRD should emphasise rural economic boosters and catalyst infrastructures (D1) more than rural characters and social well-being infrastructures (D2) and smart and green technology practices (D3). Thus, the three dimensions hold varying degrees of importance in the overall assessment, similar to the criteria groups that possess different extents of influence. This situation poses a decision-making challenge for the MAMRD measure, necessitating further refinement to enhance precision. Consequently, the study employed Multi-Criteria Decision Analysis

(MCDA), which was based on Saaty's (1980) Pairwise Comparison Matrix (PCM) in the context of the Analytic Hierarchy Process (AHP). This procedure aims to enhance the ranking method (Saaty, 1980; Saaty & Kearns, 1985) to ensure that each dimension and criterion group contributes appropriately to the measurement results. This technique is a relatively popular and practical approach in decision-making processes related to urban development strategies (Malczewski, 1999; Rashid et al., 2023). As such, Table 1 shows the dimension and criteria group weighting results. D1 was weighted at 54%, D2 was weighted at 30%, and finally, D3 was set at 16%. This weighting process was carried out

Table 1  
 Weightage of each MAMRD's dimension and criteria group based on PCM

Dimensions	Criteria Groups
<b>D1: Rural Economic Boosters and Catalyst Infrastructures</b> Weight = 0.54	CG1-D1: Economic and Rural Services Centre (Town) Weight = 0.50
	CG2-D1: Rural Growth Centre (RGC) Weight = 0.25
	CG3-D1: Rural economic cluster (agricultural, entrepreneurial, and tourism) Weight = 0.25
	<b>Consistency Ratio (RC) = 0.000</b>
<b>D2: Rural Characters and Social Well-Being Infrastructures</b> Weight = 0.30	CG1-D2: Rural spatial characters and heritage Weight = 0.064
	CG2-D2: Transportation networks of rural-town-city, and rural accessibility Weight = 0.275
	CG3-D2: Efficient infrastructure Weight = 0.402
	CG4-D2: Internal village amenities Weight = 0.098
	CG5-D2: Rural governance (MPKK) and database Weight = 0.161
<b>Consistency Ratio (RC) = 0.024</b>	
<b>D3: Smart and Green Technology Practices</b> Weight = 0.16	CG1-D3: Rural agricultural, infrastructures, technologies, and innovations Weight = 0.40
	CG2-D3: Rural entrepreneurial technologies and innovations Weight = 0.29
	CG3-D3: Rural marketing and e-commerce Weight = 0.13
	CG4-D3: Village smart and green technology practices Weight = 0.12
	CG5-D3: Community-IoT-based smart technology practices Weight = 0.06
<b>Consistency Ratio (RC) = 0.008</b>	<b>Consistency Ratio (RC) = 0.023</b>

Source: Authors' work (2023)

in accordance with the Consistency Ratios (CR) being below the threshold of 0.10, ensuring the validity of the results.

Within the dimensions, the criteria groups were compared. In D1, for example, the criteria group with the highest weight is the economic and rural services centre (CG1-D1), with a weight of 0.50, followed by CG2-D1 and CG3-D1, both carrying a

weight of 0.25. Further details can be seen in Table 1. The individual performance criteria, however, were not assigned weights because they were given scores of 1 (available) or 0 (not available) within their respective criteria groups. This approach allows each village or case study to be evaluated according to its performance within the criteria. It is important to point out that the



overall scores and rankings are contingent upon data availability, thus accommodating flexibility in the face of data limitations.

**The Implementation of MAMRD Through FGDs**

The application of MAMRD in various village categories serves three main purposes. Firstly, it aims to validate the suitability of the performance criteria and measurements set. Secondly, it seeks to determine the score (index) for each participating village. Finally, it aims to identify issues and challenges while finding solutions, enabling lessons to be learned for further improvements in rural development strategies. However, this paper focuses on the first result, clarifying and validating the 139 performance criteria outlined in the FMRD (Rashid et al., 2021). The MAMRD intends to inform rural development actors, including the funding agencies, on the strengths and weaknesses of each participating village to become a resilient, liveable, and smart village. Therefore, the MAMRD is based on the active participation of rural actors in fostering smart and sustainable rural livelihoods. It acknowledges their ability to form an aspiration (specific goal or desired state) and adapt to new solutions, providing creative solutions, innovation, and diversity to their communities. This participatory approach is critical for a village to be considered modern, embodying the principles of being resilient, liveable, and smart.

As mentioned earlier, the availability of each criterion in the case study will be given one mark each. The total mark

obtained was then weighted based on the dimensions and criteria groups (Table 1). Dimension 1 carries a weight of 54% of the total marks, Dimension 2 is weighted at 30%, and Dimension 3 is at 16% of the marks. All marks are summed up to calculate each village’s final score or overall index under study. Based on the obtained final score, the village is assigned a star rating reflecting its MAMRD index performance. The star ratings range from 0 to six stars, corresponding to a score of 0 to 100 (Table 2).

As presented in Table 2, the minimum score required for each village to be eligible for a star is 15 points. The higher the star rating, the higher the score required, with a maximum score of 90 or more needed to attain the six stars. As previously stated, the results of the MAMRD star rating will be presented in other publications.

This study was conducted in two main sessions of FGD with three different village categories: (1) aqua-tourism and smart community-based village (Kampung Padang Rumbia, Pekan, Pahang), (2) fishing-based

Table 2  
*Star rating to pursue in the MAMRD index*

Star Rating	*MAMRD Rating Range (%)
☆☆☆☆☆☆	>90 - 100
☆☆☆☆☆	>75 - <90
☆☆☆☆	>60 - <75
☆☆☆	>45 - <60
☆☆	>30 - <45
☆	>15 - <30
	>0 - <15

*Note.* \*This star rating is adopted from the Malaysia Research Assessment Instrument (MyRA), an established rating index in Malaysia  
*Source:* Shamsir (2021)



village (Kampung Tepi Sungai, Sungai Muda, Kedah), and (3) agriculture-based village (Kampung Alur Gandak, Alor Setar, Kedah). The selection of these three villages was based on their profiles and specialised economic activity, which have the potential to embrace smart technologies. It helps validate the MAMRD's performance criteria and adds other essential criteria to suit their rural activities or solutions to problems. For the three case studies, the representatives of the *MPKK*, rural development agencies, and local institutions (ranging from 7 to 15 participants) were initially identified and invited through official letters, e-mails or WhatsApp prior to the FGD sessions.

In the FGD sessions, they were led by two researchers, one chairing the discussion and another taking notes. In the initial session, the MAMRD and the objectives of the FGD were explained. The researchers also provided details on the actions required from the participants. For the second session, the researchers assisted the participants in completing the MAMRD criteria checklist, a structured assessment form through FGD. The participants' inputs were crucial in validating and informing the availability of each criterion within their respective villages. Rashid (2020) goes into detail on this.

## RESULTS AND DISCUSSION

### Formulation of a Modern Rural Model

A Modern Rural Model—a translation from the FMRD—is the foundation for the MAMRD. Its goal is to synergise for rural change by improving local asset-based economies, infrastructures, social

facilities, and smart technology practices. As a directive vision, the model of modern rural development is constructed based on a three dimension-objectives measure that translates the smart village and the resilient and liveable rural concepts into a new approach to modern rural development (see Figure 4).

Resilient criteria (D1) highlight the readiness and preparedness of rural areas and their communities in various aspects, such as physical, social, and economic, to effectively handle and recover from unforeseen scenarios like disasters. Liveable criteria (D2) focus on preserving rural characters, attractiveness, comfort, adequate infrastructure and support, and economic opportunities as desired by all people, including entrepreneurs, investors, and urban residents. On the other hand, smart criteria (D3) emphasise rural creative and innovative technology practices (intelligent rural supports), enabling solutions that enhance livelihoods. These three dimensions are crucial pillars in promoting and materialising the modern rural development approach, as depicted by their functions in Figure 5. The model is also built to cater to the four characteristics of rural areas as proposed in the *DPF Desa Negara 2030* (2017): Urban-rural (UR), rural-urban (RU), rural (R5), and mainly rural (R6).

The modern rural model plays a crucial role in synergising and boosting rural areas, and it is based on eight core principles that serve as the cornerstone for constructing the key assessment criteria and the factors contributing to the MAMRD's success as a

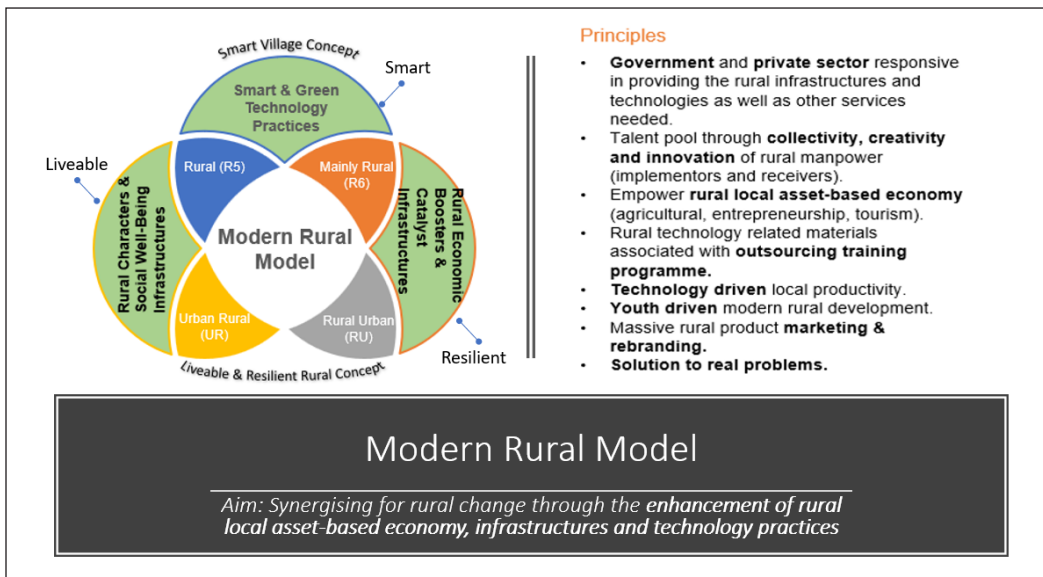


Figure 4. Modern Rural Model (Source: Authors' work, 2023)

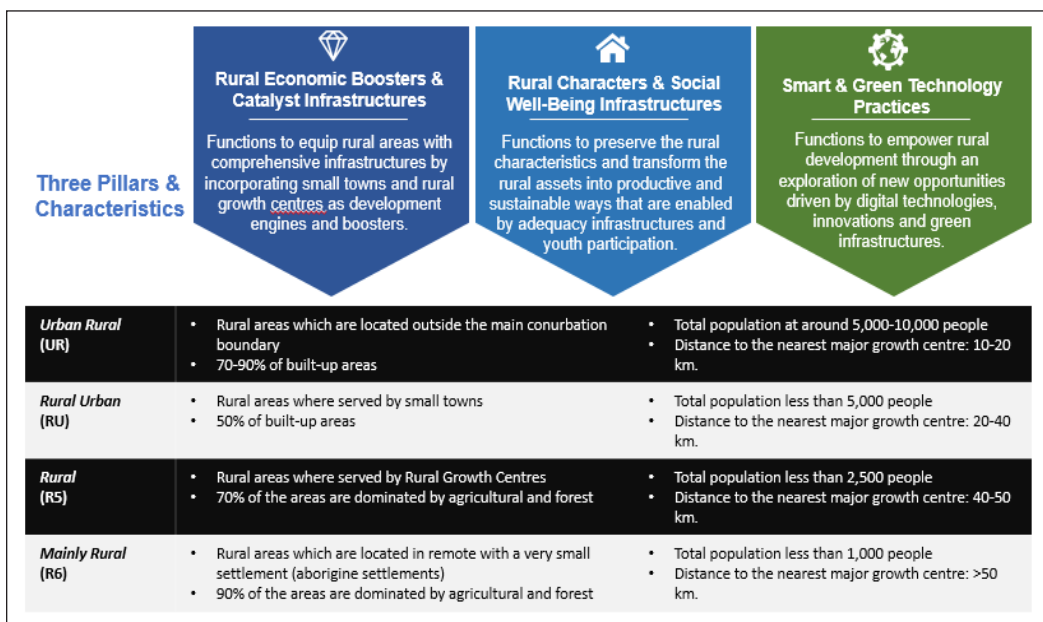


Figure 5. Functions of the three dimension-objectives measure and characteristics of rural areas for modern rural development approach (Source: Authors' work, 2023)

whole. It emphasises the government and the private sector to function proactively and responsively, especially with regard to providing social facilities, infrastructures, and the latest needed technologies required by rural actors, such as farmers and entrepreneurs), consequently providing higher standards of services. Moreover,

the model aims to provide a better quality of life for rural communities and fulfilling their needs. The efforts from the government and private sectors are not enough to boost the synergy and transformation in rural areas. It demands concerted energy from the community as the driven actors in exploring and utilising rural assets that can enhance their value and economic chain. In other words, they are the key players in the rural progress towards modern rural development. It includes the community leaders and local champions who are regarded as catalysts for planning, monitoring, and empowering the rural community's living conditions (Rami et al., 2021). Technology and courses related to technology, as well as their practices, must be parallel or suited to the local context requirements (Zavratnik et al., 2018). It ensures that technology is effectively used to build a knowledge-based society, consequently driving local productivity and transformation. Training courses on drone handling skills for agricultural purposes is one of the many examples of how technology can be used and benefited. Using drones in agriculture is essential today because the technology is more cost-effective in terms of time, human resources, and finances. It would reduce the need for human resources in tasks such as fertiliser and pesticide operations, where human resources become an obstacle in rural areas (Rashid et al., 2019). Using drones is also more effective because they can cover a vast agricultural area and be introduced concisely. This situation can attract financiers, investors, or private

sectors to contribute to the sustainability of rural areas through a concerted idea, energy, and capital to develop the rural area (DPLB, 2018) as these financiers, investors, or private sectors are profit-oriented.

The younger generation is an asset for rural areas, and harnessing their potential optimally and wisely is essential. Some are educated, motivated, and have a strong interest and energy to contribute to the rural transformation process. Furthermore, the youth are more adept at using technology, particularly for gaining advantages in various job sectors, like agriculture, than the older generation (Marescotti et al., 2021). Given their familiarity with technology, it is vital to introduce them to skills focused on using technology in agriculture, fisheries, and businesses, ultimately leading to increased local productivity. Higher productivity, in turn, increases the marketing potential of rural products and widens the opportunities for rebranding, ultimately translating into higher incomes.

### **MAMRD's Performance Criteria: Validated and Finalised Version**

After analysing and interpreting the MAMRD survey form for the three case studies, it was determined that only 13 criteria are needed for further refinement, with one criterion being removed and two new criteria added to comply with the local context or practices in the case studies. Finally, the MAMRD will be assessed based on a three-dimensional objective measure comprising 13 criteria groups and 141 performance criteria (Table 3). It differs

Table 3

*The finalised MAMRD's performance criteria for assessing modern rural index*

Dimensions (With Weightage)	Criteria Groups (With Weightage)	Criteria
<b>D1: Rural Economic Boosters and Catalyst Infrastructures (W = 0.54)</b>	CG1-D1: Economic and Rural Services Centre (Town) (W = 0.50)	<b>Economic Development</b>
		1 Mini market 2 Retail: Food and beverage 3 Retail: Home appliances 4 Retail: Vehicle equipment 5 Retail: Agricultural equipment 6 Souvenir shop 7 Market/stall/bazaar 8 Farmers market/night market/day market 9 Restaurants/other food outlets* 10 Food court 11 Small-medium business 12 Agricultural product collection centre 13 Petrol station 14 Insurance agent/company* 15 Hotel/budget hotel/guest house
		<b>Infrastructure Facilities</b>
		16 Road network 17 Power and water supply 18 Telecommunication and ICT/Internet Service Provider (ISP)* 19 Bus station/terminal 20 Bus stop 21 Railway station 22 Ferry/boat terminal
		<b>Service Centre</b>
		23 Secondary school 24 Primary school 25 Kindergarten 26 Mosque 27 <i>Surau</i> 28 Church 29 Hindu temple 30 Buddhist temple 31 Cemetery 32 Health clinic 33 Rural clinic 34 Police station 35 Fire station

Table 3 (continue)

Dimensions (With Weightage)	Criteria Groups (With Weightage)	Criteria
		36 Multipurpose hall
		37 Public hall
		38 Community working hall ( <i>Balai raya</i> )
		39 Rural library
		40 Local park
		41 Neighbourhood park
		42 Playground
		43 Bank
		44 Registered bank agent
		45 Mini Rural Trade Centre (RTC)
		<b>Human Development</b>
		46 Local centre for business and consultation services
		47 Entrepreneurship skills training centre
		48 Community Rehabilitation Programme (CRP)
		<b>Economic Development</b>
		1 Agricultural (including fishery) product collection centre*
		2 Small-scale retail
		3 Shop that supplies modern agriculture (including fishing and livestock) equipment and technology (including technical services)*
		4 A workshop that provides maintenance and repair services for agricultural equipment
		5 Hardware shop
		<b>Infrastructure Facilities</b>
		6 Road network
		7 Power and water supply
		8 Telecommunication, high-speed broadband, and other ICT services
		9 Public transport terminal
		<b>Service Centre</b>
		10 Community and recreational facilities
		11 Mobile Community Transformation Centre (CTC)
		12 Registered bank agent
		<b>Human Development</b>
		13 Community Rehabilitation Programme (CRP)
		14 Elderly activity centre
		15 Youth and innovation centre (multipurpose skills training centre, including for disadvantaged individuals and single mothers)*
	CG2-D1: Rural Growth Centre (RGC) (W = 0.25)	

Table 3 (continue)

Dimensions (With Weightage)	Criteria Groups (With Weightage)	Criteria
	CG3-D1: Rural economic cluster (agricultural, entrepreneurship, and tourism) (W = 0.25)	1 Tourist information unit* 2 Homestays operated by the community through MPKK 3 Cheap accommodation/ budget motel 4 Traditional and casual food premise concept 5 Permanent Food Production Farm (TKPM) 6 Rural trade and retail 7 Eco-friendly farm-based rural tourism attraction** 8 High-speed broadband facilities (dedicated space) for retailers and purchasers*
<b>D2: Rural Characters and Social Well-Being Infrastructures (W = 0.30)</b>	CG1-D2: Rural spatial characters and heritage (W = 0.064)	1 Rural boundary (delineation of village assets)* 2 Rural landmark (gateway, statue, and welcoming signage) 3 Excellent rural asset development award 4 Agricultural areas maintained as a rural buffer zone* 5 New development of low-density housing (detached) suits with rural characters and B40 6 Adaptive reuse or restoration of old house 7 Preservation of traditional Malay houses (or maintain the traditional archi-style) 8 Individual registration as National Heritage Living Person (WAKOH)
	CG2-D2: Transportation networks of rural-town-city, and rural accessibility (W = 0.275)	1 The bus stop for stage buses (located within 500 meters of the village) 2 Shuttle train station 3 Water transport jetty 4 Rural paratransit stops (minibus/van) 5 MyCar, Grab, and other e-hailing service providers 6 Paved main entrance/access 7 Paved rural internal road
	CG3-D2: Efficient infrastructure (W = 0.402)	1 Continuous, adequate, and clean water supply* 2 Extensive power supply 3 1Malaysia Internet Centre (PIIM) 4 High-speed broadband 5 Fibre optic (fixed bandwidth) coverage 6 Sanitary landfill 7 Recycling centres are operated either by the government or in partnership with the local community 8 Septic tank system

Table 3 (continue)

Dimensions (With Weightage)	Criteria Groups (With Weightage)	Criteria
	CG4-D2: Internal village amenities (W = 0.098)	1 Mobile facilities (clinic and library)
		2 Community hall/rural community centre
		3 <i>Surau</i>
		5 Football field/public field/recreational park/sports facility separate from school*
		6 Healthcare centres (for the elderly, disabled people, and neglected mothers)
		7 Temporary shelter/transit service for disasters with a dedicated command centre separate from schools
2 Rural community co-operative centre		
3 Rural village database managed by a dedicated or a paid staff		
<b>D3: Smart and Green Technology Practices</b> (W = 0.16)	CG1-D3: Rural agricultural, infrastructures, technologies, and innovations (W = 0.40)	1 Tractor
		2 Plough
		3 Harvesting machine
		4 Micro-watershed management
		5 Farmers Information System (FIS)/Fisheries Information System/drone technology*
		6 Drone or UAV technology (crop monitoring and pest control)
		7 Smart database for agriculture through sensors and satellite data
		8 Smart weather and irrigation system
		9 Vertical farming
		10 Vinyl greenhouse agriculture
		11 Smart dairy through smart devices (livestock)
		12 Production of high-demand agricultural products (kenaf, vanilla, basmati rice, <i>musang king</i> , stingless bee/ <i>lebah kelulut</i> , and <i>burung walit</i> )
	CG2-D3: Rural entrepreneurship, technologies, and innovations (W = 0.29)	1 Agro-industry basic facilities (such as incubator centres for up to district scale)
		2 Community biogas plant for entrepreneurship activities
		3 Market analysis tools/software
		4 Village community radio
		5 Telecommunication and video conferencing
		6 ICT-related materials and outsourcing training
		7 Mentor-mentee training programme or rural icon in business



Table 3 (continue)

Dimensions (With Weightage)	Criteria Groups (With Weightage)	Criteria
	CG3-D3: Rural marketing and e-commerce (W = 0.13)	<ol style="list-style-type: none"> <li>1 Fresh fruit stall (GBBS)</li> <li>2 Agrobazaar</li> <li>3 KShoppe</li> <li>4 Training centre and e-commerce services (equipped with high-speed broadband)</li> </ol>
	CG4-D3: Village smart and green technology practices (W = 0.12)	<ol style="list-style-type: none"> <li>1 Rainwater harvesting</li> <li>2 Renewable energy (through solar rooftop PV, solar micro grid, micro-hydroelectric, and solar farming)</li> <li>3 Generate energy through biogas digestion</li> <li>4 Micro-hydroelectric power for multipurpose uses**</li> <li>5 Solar cookers</li> <li>6 LEDs</li> <li>7 Low-energy motors</li> <li>8 Flood risk alarming through a smartphone</li> <li>9 Biochar for transforming garden waste into organic fertilisers—waste-to-wealth</li> </ol>
	CG5-D3: Community-IoT-based smart technology practices (W = 0.06)	<ol style="list-style-type: none"> <li>1 Smart healthcare facilities/healthcare mobile apps</li> <li>2 Waste monitoring and management system through wireless sensors monitor</li> <li>3 Smart education (through videos, smart classroom, and fun-toy library)</li> <li>4 CCTV cameras/smart surveillance system</li> <li>5 Goods and services delivery system via mobile apps</li> </ol>

Note. \*The criteria which have gone through the refinement; and \*\*the additional new criteria of the MAMRD (Source: Authors' work, 2023)

from the FMRD by adding only two criteria to the original 139 criteria.

The MAMRD's performance criteria have compounded all the essential criteria of *DPF Desa Negara 2030* (2017) and *DPLB 2030* (2018) while integrating them with smart technologies and ICT applications to modernise infrastructures and village/community practices within rural areas. This kind of approach reflects

a holistic approach to addressing rural problems, harnessing the potential of new technology practices (Morris et al., 2022; Zavratinik et al., 2018), and catching up to rural economies and overall productivity (United Nations, 2021). However, the successful application largely depends on technological diffusion, socio-cultural aspects, and the readiness of rural actors, particularly their educational

levels and skills (Curry et al., 2021; Morris et al., 2022; Salemink et al., 2017). Developing telecommunications and information infrastructures (ICT and digital infrastructures), especially high-speed broadband, also plays a crucial role in expanding coverage and capacity within and around rural areas. Improving the quality of these infrastructures and adopting new technologies in agriculture, business, and other rural sectors contribute to creating an attractive and smart environment. Moreover, it empowers individuals, especially the younger generation, to actively participate in modern-smart rural life and adapt to new solutions, fostering creative solutions, innovation, and diversity within their villages and communities.

The 141 MAMRD criteria have been considered in shaping the future niches and the pathways of rural development in Malaysia, as well as globally. They can be summarised but not limited to:

- Future rural development patterns are becoming more complex, necessitating a more strategic vertical and horizontal development approach.
- The involvement and participation of all parties, including rural actors, private sectors, and government interventions, are crucial for promoting proactive and well-balanced dimensions of rural development.
- The integration of bottom-up and community engagement (involving youths, entrepreneurs, pensioners,

and private sectors) alongside top-down approaches is essential to effectively implement current policies and fulfil the aspirations and capabilities of the rural community.

- To account for the characteristics and uniqueness of the rural community, “there is no one-size-fit-all solution.”
- The rural community needs to undergo a paradigm shift, moving away from overdependence on the government and instead fostering their creativity, innovation, and proactive approach to developing their villages.
- Rural growth centres (RGC)/ rural community centres (RCC) become the foundation for the development and liveability of rural areas by providing goods and services needed by the community, especially daily and weekly goods.
- The adoption and application of technology and ICT (IoT) in rural activities can potentially elevate rural areas in terms of information, knowledge, business, marketing, and accessibility. Moreover, it enhances resilience in the face of risks, such as the ongoing COVID-19 endemic, which continues to impact Malaysia and the global community. It is one of the strategic principles resetting rural development for the 21st century outlined by the United Nations (2021).

Therefore, the MAMRD plays a timely role in empowering rural areas for transformation, focusing on infrastructure, services, and the rural community. It is worth noting that existing literature highlights the need for higher adoption levels of advanced technologies, which progress slowly among small-scale farmers in developing countries (Curry et al., 2021). Hence, this paper contributes significantly to promoting the widespread application of digital and ICT technologies to realise the modern rural approach in Malaysia.

### **Dissemination of the MAMRD Exercise**

As mentioned earlier, the model of modern rural is derived from four of the six typologies (characteristics) outlined in the *DPF Desa Negara 2030* (2017), namely UR, RU, R5, and R6. The remaining two typologies, U1 and U2, are exempted as their primary land use is no longer agriculture, and their communities primarily consist of service sector workers. Therefore, implementing the MAMRD is suggested for the four mentioned typologies (see Figure 4), which are based on agriculture, rural assets, or rural resources comprising entrepreneurship, SMEs, tourism, and other sectors.

The third case study, Kampung Alor Gandak, is categorised as U1 as the community is situated within the perimeter of Alor Setar city. Nevertheless, it is still selected as a case study because its land use is still dominated by agriculture, and most residents are farmers. This situation indicates that the MAMRD is suitable for all categories of villages. However, the main

focus remains on the villages in the four categories stated earlier. The Indigenous people villages located on the outskirts are also deemed suitable for implementing the MAMRD because they are categorised as sustainable, given equipped facilities and the community's adherence to conservative or environmental-friendly practices. However, it should be noted that Indigenous villages in remote areas face challenges in meeting all 141 criteria listed by the MAMRD. In such cases, certain criteria, particularly those related to D2 and D3, can be considered for measurement to attain the MAMRD index while exempting D1.

Based on these considerations, the implementation of the MAMRD is summarised as the following village characteristics:

- All villages from the four typologies in the model (Figure 4) are eligible for assessment using the MAMRD.
- Villages from typologies U1 and U2 are also suitable for evaluation if agriculture remains the dominant land use.
- Although Indigenous villages are included in the MAMRD assessment, the focus is not on their index or star rating. Instead, the evaluation focuses on measuring the level of technology practices and the adequacy of provided facilities that align with the aspirations of modern rural characteristics. In this regard, it is crucial to establish and enforce

the RGC/RCC for the sake of the community's welfare, services, amenities, and prosperity.

## CONCLUSION

This research mainly focuses on formulating the MAMRD as an innovative approach to undertaking existing government policies such as the *DPF Desa Negara 2030* (2017) and *DPLB 2030* (2018). The MAMRD offers a measurement tool for rural stakeholders to monitor and realise the aspirations of rural development agendas. It would provide additional impacts and efforts in transforming rural change towards a modern approach. It is important to highlight that this research has discovered a new approach to rural development by synthesising and adopting the concepts of resilience, liveability, and smartness, reflecting Malaysia's modern rural development context. The MAMRD deserves endorsement as it pioneers the integration of innovative modern technology practices in rural areas. Furthermore, applying weights to the dimensions and criteria groups ensures transparency and facilitates meaningful comparisons across regions, states, districts, and other levels.

The modern-smart approach in agriculture has been one of the main elements of the Twelfth Malaysia Plan (Economic Planning Unit, 2021b). This approach includes using innovative technologies and information and knowledge-based technology in rural development. Technologies such as sensor networks, mobile applications, and other

advancements contribute tremendously to the transition towards a knowledge-driven society where constraints of time and place are no longer significant. As a result, new models for rural businesses, agriculture, and industries will emerge to replace the existing processes with new roles, mechanisms, and technologies. Indeed, the utilisation of these technologies will not only increase productivity and decrease the dependency of the workforce but also attract younger generations and investors to participate in rural activities and actively contribute to their enhancement.

The MAMRD, while primarily focused on providing infrastructures, facilities, services, and rural technology practices, also enforces investment in rural communities. It emphasises the opportunities available in the social, economic, and environmental dimensions, as well as the development of smart individuals to synergise and boost the rural change that will lead to modern rural outcomes. Therefore, using the MAMRD for rural assessments is a reliable approach to optimise rural performance towards future niches and pave the way for future advancements in rural development in Malaysia. As mentioned earlier, the best practice to obtain data for the MAMRD assessment is through an FGD, and the MPKK, in particular, are the key informants to provide the needed information. More importantly, they will receive first-hand output (direct feedback) regarding the advancement of their village towards a modern approach, as indicated by a rating star.

## Implications for Practices

This study has achieved the aim pertaining to the validated dimensions, criteria groups, and 141 MAMRD's performance criteria for the rural development measurement index towards a modern approach. The MAMRD measure offers a significant star rating index that enables the rural stakeholders to monitor rural development transformation by relying on technology practices and enhanced solutions. More importantly, it has been tailored to the national rural development policies, such as the *DPF Desa Negara 2030* (2017) and *DPLB 2030* (2018), so it has its impacts on rural development in Malaysia. It is important to emphasise that the policies above have progressed to the revision stage after a duration exceeding five years in the implementation phases. Consequently, the MAMRD's dimension, specifically D3 (Smart and Green Technology Practices), is poised to provide pertinent guidelines. This dimension focuses on enhancing smart village practices in Malaysia, and it is evident that neither or less of the policies were designed considering this aspect. Malaysia is igniting its path towards increased digitalisation and embracing the Fourth Industrial Revolution (4IR) in 2021, two to three years after the policies were implemented.

So, the MAMRD comes timely and impacts future rural transformation in Malaysia, either at top-down (policymakers) or bottom-up (rural actors) levels. Anticipated outcomes include enhanced benefits for rural communities, such as connectedness, increased economic chances, increased

readiness for a disaster, and improved healthcare facilities by implementing the MAMRD index measurement.

## Limitations and Recommendations

The above summary findings and implications are subjected to the methods and assumptions applied by the study. Therefore, the generalisation of the study findings in different contexts or cases should be cautiously considered, considering the three limitations. First, the MAMRD was developed using content analyses and expert opinion surveys. For the expert opinion, five local/international experts on rural development were invited to validate the criteria used in the MAMRD in only a single-round survey. During the survey, criteria validation was made using Likert scale measurement. Despite that, experts were encouraged to suggest new criteria and confirm the dimensions and the criteria groups. Although the number of experts and the round involved in the validation process is relatively limited, the study further validated the criteria via the case studies approach – the participants' (rural actors) opinion in the FGD sessions for further validation. Therefore, a further round of opinion surveys is not necessary. Future research may benefit from an enlarged number of experts in the expert opinion survey and an additional round of the expert survey.

Second, the important findings are based on the three village categories: aqua-tourism and smart community-based village, fishing-based village, and agriculture-based village.

The selection of the village categories was made considering agricultural activities that are mainly practised in Malaysia's rural areas. Considering all types of villages in all grids as stipulated in the *DPPF Desa Negara 2030* (2017) may yield a multi-dimensional insight into the rural activities and various ground conditions and benefit future researchers.

The third limitation is that the study only focused on rural infrastructures, facilities, services and technology practices as the key assessment criteria for facilitating modern rural development. Instead, the *DPPF Desa Negara 2030* (2017), the *DPLB 2030* (2018), and other policies have comprised the strategies for rural development, including infrastructure, social, economy, environment, land use, and many more. Including these elements in future research may yield a better comprehension of the issues and challenges faced by agricultural-entrepreneurial-tourism-based rural residents.

It is necessary to note that all the above limitations do not compromise the quality of the study outcomes since it was conducted with vigorous methodology or processes and valid and reliable data. Moreover, potential areas for future research could be explored as a limitation of this research. As suggested in the following:

- Participatory-based research will implement the technology practices proposed in the MAMRD to achieve a society 5.0 @ rural in Malaysia. It involves rural actors in decision-making, adapts technologies to rural contexts, and

aims for societal advancement through technological innovation and community participation.

- Profiling the knowledge-based society and technology practices among rural communities in Malaysia. This research involves an inventory of rural champions and technology practices. It will explore how they engage with technology to promote socio-economic development and enhance their way of life and prosperity.
- Rural actors' behaviours framework for synergising rural transformation towards a modern approach. This research involves developing a framework of rural actors' behaviours to enhance rural transformation, aligning with the MAMRD's dimensions and index measurement.

In addition to that, it recommended a more frequent site visit to explore multiple ways of looking at the issues, challenges, and ideas in rural areas extensively, including understanding the forces and changes of the past, recording narratives from vastly experienced local residents and entrepreneurs to calibrate the reality of their lives, and gaining real insights into how things progress in rural areas.

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