



Exploring Malaysian Grassroots Innovator Behaviour in Product Development Practices

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Abstract:

Recent reviews on research implementation underscore the significance of Research and Development (R&D) endeavours and lifelong learning initiatives for grassroots innovators to attain sustainable development effectively. The literature review and case study encompass several crucial factors, including disseminating the concept of grassroots innovation to the public focusing on its implications for income generation, social progress, and environmental advancement. Grassroots innovation encompasses utilising diverse resources and indigenous technologies to foster a more innovative and creative approach towards product development practices. In the realm of grassroots innovation practices, the development of products and processes is driven by many factors, including personal interests or hobbies, addressing needs, dealing with difficulties, and several other reasons. Multiple perspectives have been examined in discussions surrounding the behaviours of innovators and the underlying reasons behind their creation of products and innovations. The exploration and revelation of these grassroots activities are crucial, given their profound influence on income generation and social values. Local grassroots innovators often encounter challenges due to insufficient skills, knowledge, and access to technology. These limitations can impede their progress in product development and hinder their ability to innovate effectively. This study aims to identify the behaviour of grassroots innovators in product development practices and explore the potential avenues that improve the capacity building of grassroots innovators and further drive sustainable development.

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INTRODUCTION

In recent years, there has been a growing imperative to explore more effective strategies to address the multifaceted challenges associated with global poverty and promote inclusive and sustainable economic growth. Points eight and nine in “17 Goals to Change Our World” discuss decent work, economic growth, industry, innovation, and infrastructure (United Nations, 2015). The 17 goals to transform the world for individuals with disabilities parallel the United Nations' vision for 2030. This point is of utmost importance in facilitating and ensuring the continued progress of community development initiatives. Furthermore, aligning initiatives that promote inclusive participation enhances equitable access to social and economic opportunities.

Malaysia's grassroots innovation landscape is shaped by the practical concepts of "make-do and improve" and "do-it-yourself", through which communities, micro-entrepreneurs, and local innovators develop solutions that respond directly to lived challenges, limited formal research and development (R&D) infrastructure, and a strong reliance on tacit knowledge. Campbell (2017) argues that grassroots efforts are deeply embedded in personal context and even when such efforts fail, they provide a valuable learning opportunity for identifying more appropriate solutions. Furthermore, Campbell (2017) notes that this systematic pattern is particularly evident in a developing context, where communities are compelled to design and innovate in response to inequality, poverty and unmet needs. At the national level, this bottom-up innovation landscape aligns with Malaysia's development agenda, which emphasises inclusivity and sustainability. By leveraging local resources and tacit expertise, grassroots innovators foster adaptive resilience and environmentally responsive solutions that contribute to long-term sustainable development.

Grassroots innovation in Malaysia is increasingly institutionalised through dedicated intermediaries that identify, develop, and scale community-based solutions. Yayasan Inovasi Malaysia (YIM), under the Ministry of Science, Technology and Innovation (MOSTI), serves as a national platform supporting social and grassroots innovations with strong potential for community impact and commercialization. The number of grassroots innovators continues to grow, alongside an expanding range of products and solutions, with a more diverse group of stakeholders actively contributing as key drivers in this ecosystem. According to data from Yayasan Inovasi Malaysia under the Malaysia Social Innovation (MyIS) Akar Umbi (MaGRIs) programme, about 2,281 innovations have been developed; of which only 52 have been commercialised (Yayasan Inovasi Malaysia, 2025). The systematic exploration of these grassroots activities is essential to expand participation and enhance engagement across the public, agencies and government sectors.

Malaysian development policy continues to prioritise innovation and entrepreneurship as key drivers of inclusive and sustainable economic growth. Guided by the Ekonomi MADANI, the Thirteenth Malaysia Plan 2026–2030 (RMK13) emphasises accelerating structural transformation through digitalisation, technology adoption, and the development of high-value products and services, alongside the strengthening of future-ready, innovative talent to support entrepreneurial and technology-driven opportunities. In line with its inclusive growth agenda, RMK13 prioritises the empowerment of micro, small, and medium enterprises (MSMEs), community-based economic actors, and the third sector to enhance their contribution to socioeconomic development (Kementerian Ekonomi Malaysia, 2025). Within this policy context, grassroots innovation presents both challenges and opportunities for fostering sustainable economic growth through entrepreneurial capacity development, socioeconomic development, and environmental responsibility.

LITERATURE REVIEW

Grassroots Innovation

Innovation can be formally characterised as a systematic process of efficiently and profitably translating new ideas into solutions that meet the expectations of contented customers. In a broader sense, innovation can take place when new products or processes are spread through imitation or when gradual improvements resulting in higher productivity are made (Mohamad Hashim, 2010). Several distinct categories emerge during innovation: products, processes, new markets, new inputs, and innovative organisational structures. In fostering innovation enablers and establishing an innovation ecosystem, the ongoing innovation practice necessitates a strong connection between the public and the dissemination and transfer of knowledge.

Nasir and Subari (2021) discussed that the complexity of social and economic challenges calls for innovative approaches that are not only capable of catering for diminishing resources but also of effectively addressing various socio-economic issues such as poverty, income inequality and social exclusion consistent with today's rapidly changing world. Therefore, the usefulness of these innovations arises from the labour time they save, the hardship they obliterate, and the increased profits due to cost reductions (Sheikh & Bhaduri, 2020). Besides, innovations can be conceptualised as solutions that exhibit superior efficiency in addressing societal needs compared to established alternatives and foster enhanced capabilities by cultivating more robust relationships.

Grassroots innovation is an activity that uses multiple resources or indigenous technologies to create innovations that empower communities. Hilmi (2012) stated that grassroots innovation is a collection of innovations and products, with projects implemented at the bottom of the pyramid to promote sustainable development. In Malaysia, grassroots innovation is one of the high-impact programs intended to empower the bottom 40% of the income pyramid (Hashim, 2012). Grassroots innovators are responsible for creating various product categories, including recyclable furniture designs, affordable housing developments, agricultural commodities, multi-purpose products, vehicles, and handicrafts, often associated with community development initiatives or programs.

Ciftci and Walker (2017) discussed products and innovations practised by grassroots innovators, including craftwork, musical instruments, footwear, jewellery, brassware, carpets, etc. According to Martiskainen (2017), new technological and social innovations emerged to deal with society's problems, especially those related to the sustainability of electricity, transport, and other related systems. Grassroots innovation differs from conventional market-based innovations because grassroots innovations are driven by ideological commitment rather than profit-seeking motives (Martiskainen, 2017; Seyfang & Smith, 2007). These initiatives by civil society were created to adopt a sustainable approach to address everyday energy, food, and transport services, which have been conceptualised as grassroots innovations.

The term grassroots innovation is also defined as an innovative product or process created at the bottom of the pyramid, usually due to necessity, hardship, and challenges (Hilmi, 2012; Nasir & Subari, 2021). Sheikh and Bhaduri (2020) added that much of this activity occurs in the 'informal economy'. Grassroots innovation is supported by local values and culture that involves a wide range of non-firm factors such as civil society organisations like cooperatives, associations and informal community groups (Ng et al., 2022). Grassroots innovations are not primarily motivated by profit opportunities but rather by the commitment to address challenges encountered within local communities or among family members.

Ng et al. (2019) determined that grassroots innovation also relates to the concept of frugal innovation, a process of reducing the complexity and cost of a good and its production. It constitutes a cost-effective product of sufficient quality that fulfils the requirements of consumers facing resource constraints. Grassroots innovation can emerge through serendipity, systematic experimentation, trial and error, or the synthesis of solutions in novel configurations. The idea of "grassroots innovation" for sustainability was also discussed at the community level, which differs from top-down innovations and mainstream or business reforms (Shin et al., 2019). Contrary to mainstream business and corporate environmental initiatives, grassroots endeavours operate within civil society, engaging dedicated activists in exploring social innovations while adopting environmentally sustainable technologies.

Grassroots Innovator

Grassroots innovators employ creative concepts and dedicated efforts to develop and bring forth novel products and innovations. Grassroots innovators are unique because most work as farmers and have never received formal education or been exposed to engineering or related knowledge (Mohammad et al., 2011). This form of social innovation focuses on individuals as the agents of invention who undertake innovative efforts to solve problems that generally happen outside of formal organisations (Bhaduri & Kumar, 2010). This group includes children, youth, women, non-governmental organisations (NGOs), rural communities, and disabled individuals. Grassroots innovators are pivotal assets to the nation's sustainable development, and these innovators must be provided with early exposure and a platform for their personal growth and development.

Salleh and Daud (2021) stated that an innovator is an individual from a rural area who incorporates their creativity of tacit knowledge and traditional skills inherited for generations to produce, enhance, and add value to existing products or services within the limitation of resources to ensure sustainability. Aziz and Poh (2021) added that grassroots innovation emerges organically within the community. Such innovations are frequently propelled by necessity, as the innovators and the community are the primary end users of these inventive solutions. Moreover,

within the context of grassroots innovators, they contend with challenges from limited resources. The value in use, in this case, includes the satisfaction the innovator obtains by reducing the hassle of his family members (Sheikh & Bhaduri, 2020). Their efforts toward sustainability predominantly hinge on the adoption of beneficial technologies.

Grassroots innovators often rely on voluntary labour or mutual exchange. Some grassroots innovations are developed by individuals without formal professional degrees, particularly those who are self-employed and supported by formal sector institutions and organisations (Sharma & Kumar, 2018). These innovations are characterised as bottom-up social innovations developed by innovators. Grassroots innovators entail efficient solutions that intricately incorporate knowledge and behavioural adaptations to navigate challenging circumstances and conditions. The process brings together political activists, citizens' initiatives, unorganised lay people, hobbyists, craftsmen or local entrepreneurs (Ng et al., 2022). The central emphasis in this context is the social economy and not the market economy.

Grassroots innovators encounter challenges in effectively commercialising their innovations, primarily stemming from a dearth of knowledge regarding innovation processes and commercialisation strategies. According to Aziz and Poh (2021), there is a lack of studies on the inclusive innovation movement in Malaysia, specifically under the SME Masterplan 2012-2020, where several high-impact programs are defined to drive goals. Salleh and Daud's (2019) literature review indicated that the study of grassroots innovators' sustainability in Malaysia is still in its early stages and requires more research. The impactful Grassroots Innovators' Sustainability is still vague and has not been given a fair chance. However, these innovations are criticised for the lack of scalability to large-scale commercialisation (Sheikh & Bhaduri, 2020). These drawbacks have perhaps kept these innovations outside the gaze of policymaking. Nevertheless, it is crucial to thoroughly examine the value generated by this innovation as a strategy for nurturing sustainable growth.

RESEARCH METHODOLOGY

This study employed a mixed-methods research approach to collect and analyse relevant data. The integration of qualitative and quantitative research methods enables a deeper and broader understanding of multifaceted phenomena, thereby enhancing confidence in the research findings and conclusions (Adu et al., 2022). In the first stage, the states in Peninsular Malaysia were clustered into four regions, as illustrated in Figure 1. Accordingly, Peninsular Malaysia was categorised into the Northern Region (Perlis, Kedah, Penang, and Perak), the East Coast Region (Kelantan, Terengganu, and Pahang), the Central Region (Selangor, Kuala Lumpur, and Putrajaya), and the Southern Region (Negeri Sembilan, Melaka, and Johor). Peninsular Malaysia covers an area of approximately 132,265 km², representing about 40% of Malaysia's total land area, and comprises 11 states and two federal territories (Ministry of Land, Infrastructure, Transport, and Tourism Japan, 2022). Earlier estimates placed Malaysia's total population at approximately 32.73 million (Department of Statistics Malaysia, 2022), with the Central Region recording the highest population concentration, followed by the Southern and East Coast regions. More recent statistics indicate that the population increased to approximately 34.3 million in 2025, compared with 34.1 million in the third quarter of 2024, reflecting a slower population growth rate of 0.5% relative to 1.6% during the same period in 2024 (Department of Statistics Malaysia, 2025).



Figure 1: Peninsular Malaysia Map divided into regions.

A detailed study involving fifteen (15) innovators was conducted across the four main regions of Peninsular Malaysia following a thorough search across several districts (Table 1). All innovators were selected based on their availability and the provision of prior informed consent, and their identities were kept anonymous. The first phase of the study focused on identifying and documenting innovators across the four regions through field interviews, supplemented by secondary sources such as local newspapers, videos, and archival materials from local organisations. Participant observations related to the technical aspects of their innovations, including material selection, resource utilisation, and design processes, were also documented. Table 1 provides a summary of the innovators involved in the study.

Table 1: Description of Malaysian Peninsular Innovators Based on Five (5) Major Zones.

No.	Code Innovators	Regions	Product Innovation	Additional examples of innovative products
1	GI001	Central	Powerful portable battery	Household appliances, oven, ice bag, and innovative folding commercial table.
2	GI002	Central	Coconut opener tools	Coconut oil machines, a traditional <i>lidi</i> broom-making tool, durian opener tools, craft, etc.
3	GI003	Central	Recycled tyre furniture	Crafts, recycled products, and household appliances.
4	GI004	Northern	Fertiliser processing machine	Loading system machines, organic fertiliser products, etc.
5	GI005	Southern	Table and plant fertigation systems	Agricultural machines and multi-function lawnmowers.
6	GI006	East Coast	Extracted pipes and water taps	Tap, irrigation equipment, etc.
7	GI007	East Coast	Cleaning tools for the ablution area and pool	Bird repellent device, residential and workplace solution equipment, and biopest tuber pests for paddy plants.
8	GI008	Southern	Pineapple seedling planting machine	Grass-cutting machine for pineapple farming, multi-purpose stroller, truck, and other plant tools.
9	GI009	Southern	Multi-purpose truck for oil palm	Multi-purpose vehicles, handicrafts, etc.
10	GI010	Central	Disabled vehicles	Mobile beds for people with disabilities, coconut milk machines, corn kernel-making machines, Oil palm tree crushing machines, and others.
11	GI011	Central	Multi-function vehicle for the plantation	Oil palm plant tools, food manufacturing equipment, and other agricultural equipment.
12	GI012	Central	Adjustable and foldable commode chair	Shoe drying machine, line marking machine for grassed sports fields, soil excavation tools, and machines, and other agricultural equipment.
13	GI013	Central	Satay skewer production machines	Cleaning equipment for workers inside and outside the building, tools to burn wasp nests, tire locks, and other safety equipment.
14	GI014	Central	A foldable and portable wheelchair for persons with disabilities	Shoes, mobility support equipment for the disabled, and soybean processing machines.
15	GI015	Northern	Paper counting machine	Manual meat skewers machine, multi-function drying machines, product of wastewater treatment, hydraulic table truck, and multi-function steel lift table.

Subsequently, an in-depth data collection phase was undertaken, comprising extensive interviews and on-site visits with carefully selected innovators across the four regions of Peninsular Malaysia. To complement these data sources, interviews with scholars and industry experts were conducted to gain deeper insights into the tools and technologies utilized by the innovators, as well as their strategies for product commercialization. These expert engagements enabled the systematic identification of key components, operational elements, and institutional involvement at each stage of the innovation process. Furthermore, semi-structured interviews were employed to examine grassroots innovators' knowledge of innovation and commercialization, their behavioural attributes, and the challenges encountered throughout the innovation lifecycle.

DISCUSSION

Grassroots Sustainable Development

Sustainable development involves the management of resources and society so that the well-being of current generations does not hinder the ability to fulfil the needs of future generations. Fonseca et al. (2020) defined sustainable development as “the development that meets the needs of the present without compromising the ability of future generations to meet their own needs”. Sustainable development aims to address humanity's aspirations of a better life within the limitations imposed by nature. Sonogo, Echeveste and Debarba (2017) stated that sustainable development has been highlighted as a central idea for our age, including economic development, social inclusion, and environmental sustainability. Gibbons (2020) assessed that sustainability, as a science, practice, and movement, has made significant intellectual progress beyond unfettered environmental destruction for economic growth.

Sustainability is characterised by the capacity to consistently uphold specific values or interests over an extended duration. Creativity at the grassroots has assumed a central role in discussions on sustainable socio-economic development, particularly in developing nations (Geng et al., 2020). To promote sustainable consumption, designers must integrate users' preferences and consider users' behaviours during product design. Therefore, the sustainability of grassroots innovators becomes pivotal, representing a crucial element in translating and expediting societal well-being in line with the government's overarching master plan. Salleh and Daud (2021) stated that sustainability is the positive result sought from social, environmental, and economic initiatives. Consequently, the next generation will continue enjoying the benefits for the longest period. Outlined below are the goals and programmes associated with grassroots sustainable development:

Community and Environmental

Yayasan Inovasi Malaysia (2024) identified the number of innovators in Malaysia who are actively involved in innovation development activities, amounting to more than 6000 innovators. Based on the total, more than 100,000 individuals have benefited through the program and the development of innovative products carried out. The grassroots innovator program plays a significant role in family institutions and the community as it is perceived as a social unit that provides resources and influences lifestyle. Communities are incentivised to actively participate in developing innovative products and solutions to address local challenges. This proactive engagement facilitates the generation with new knowledge and directly contributes to sustainability endeavours.

In addition to engendering inventive products crafted from recyclable and discarded materials, grassroots innovators are incentivised to generate novel products underscored by sustainable design principles (Geng et al., 2020). Due to the increasing resource scarcity and environmental pressure, sustainable design has been promoted as an essential approach to alleviate or even eliminate the negative environmental impacts generated by production and consumption. Lara (2020) stated that eco-design was developed into the design for sustainability by including social, economic and environmental elements. Sustainable design is not an option but a necessity, whereby sustainable community repairs, reserves, and improves the environment and values for the advantages of present-day life (Bashir et al., 2016). This approach upholds sustainability by incorporating consumer preferences and considering environmental impacts.

Entrepreneurship

Entrepreneurship represents a significant national endeavour to address unemployment and increase income while bolstering the national economy. It carries substantial significance in the creation of employment opportunities and the enhancement of living standards. Entrepreneurship is an engine for poverty reduction, generating innovation for social, economic, and sustainable development (Ariffin, 2021; Rashid, 2019). As part of the government's initiatives to promote entrepreneurship among innovators and communities, entrepreneurship education and various entrepreneurship programs are implemented. Strategically, entrepreneurship has received significant attention on a global scale, particularly in the pursuit of Sustainable Development Goals (SDGs).

The government's commitment to promoting entrepreneurship through national plans, policies, and the establishment of various entrepreneurship-related agencies has persisted into the Ninth Malaysian Plan (Rancangan Malaysia Kesembilan (RMK-9)). The strategic objective for RMK-9 is to foster entrepreneurship, thereby enhancing innovation capabilities and augmenting the number of science- and technology-based companies. This initiative is integrated within the Science, Technology, and Innovation (STI) development framework. Besides that, a dedicated entity, SME Corporation Malaysia (formerly known as SMIDEC), has been established to coordinate and execute the responsibility of planning and implementing all the projects and programs related to small and medium industries (Ariffin, 2021).

Grassroots innovators must identify structural and commercially viable business opportunities to disseminate innovations within communities and extend their reach across different areas. Several action plans have been formulated to enhance the operation of enterprises (Ng et al., 2022). The Malaysian Social Enterprise Blueprint, a three-year roadmap to develop the Malaysian social enterprise sector, is also deemed relevant to Grassroots innovation (MaGIC, 2015). Launched in 2015 under the auspices of the Malaysian Global Innovation and Creativity Centre (MaGIC), a primary focal point of the blueprint is a community and outreach program designed to raise awareness and garner support from local stakeholders, grassroots, and rural communities regarding the potential and opportunities associated with social entrepreneurship. An updated version of the Malaysian Social Enterprise Blueprint is known as the Malaysia Social Entrepreneurship Blueprint 2030.

Support and Governance

The economic development agenda continues to emphasise on empowering the low-income groups, driving the micro, small and medium enterprises, apart from encouraging innovation from the society (Aziz & Poh, 2021). Meanwhile, the innovation intermediaries, such as government bodies, communities, industry, and support agencies, are pivotal in fostering and empowering grassroots innovation. The Malaysian government champions grassroots innovation to assist marginalised populations by integrating science and technology into their daily lives, which is achieved through various initiatives. Government ministries and agencies spearhead these initiatives, with the Ministry of Science, Technology, and Innovation (MOSTI) responsible for leading the nation's science, technology, and innovation (STI) pursuits. Additionally, the Malaysian Innovation Foundation (Yayasan Inovasi Malaysia, YIM) has been entrusted with the mandate to promote and cultivate creativity and innovation among the Malaysian populace.

Established in 2008, YIM serves as the primary entity responsible for directly coordinating and executing specialised programs to foster and instill grassroots-level innovation. This focus extends to specific demographic groups, notably targeted youths, rural communities, women, and non-governmental organisations (NGOs). YIM was established to promote and champion innovation in the country. Through the High Impact Project 6 (HIP6), the government aims to address the needs of the bottom 40% of the income group B40 (Aziz & Poh, 2021). The HIP6 initiatives have been formulated to stimulate innovation among the B40 segment, empowering them to develop solutions, goods, and services that fulfil their needs, which contribute to their empowerment.

In 2006, with the collaboration of the government, industry, and grassroots communities, YIM launched its Mainstreaming Grassroots Innovation (MaGRIs) project that focused on upscaling and accelerating the

development and diffusion of grassroots innovation in Malaysia (Ng et al., 2019). There are several other grassroots innovation initiatives and programs carried out by YIM, such as the Innovation Walk, Mainstreaming Grassroots Innovations (MaGRIS) and Inclusive Innovation under the High Impact Programme (HIP6) of the SME Masterplan 2012-2020 (Nasir & Subari, 2021; Aziz & Poh, 2021; Hashim, 2012). These initiatives highlight the governance, central importance, and intricate interrelationship of grassroots innovations within the larger context of Malaysia's inclusive agenda. Furthermore, some programs offer innovation development grants and opportunities for capacity building to support grassroots innovators.

Fund and Financial Inclusion

According to Seyfang and Smith (2007), grassroots innovators must be sufficiently nimble to take advantage of windows of opportunity, like new funding programmes attached to shifting policy agendas. Several other agencies in Malaysia have emerged as significant stakeholders actively translating innovation into wealth, thus expediting human capital development for the nation's advancement, leading to economic growth, societal well-being, and fostering innovation and creativity. One of the pioneering innovation initiatives marked by efforts focused on promoting financial inclusion among low-income households, primarily by creating employment opportunities and facilitating income generation. In this regard, microfinance emerges as a prominent exemplar. Microfinance aims to fill the gap in the existing financing service by providing the underprivileged access to finance, enabling them to start microenterprises (Nasir & Subari, 2021). Several institutions in Malaysia function as supportive agencies, offering financial assistance and loans. Among them is Amanah Ikhtiar Malaysia (AIM), a pioneering micro-finance institution established early in Malaysia's history and the Economic Fund for National Entrepreneurs (TEKUN). These institutions are pivotal in extending financial support to individuals facing economic hardship and financial constraints.

Education

The concept of lifelong learning underscores the perpetual process of knowledge and skill enhancement, achieved through integrating educational facets encompassing formal and non-formal education. Grassroots innovators are encouraged to improve their knowledge and diversify their skill sets through community skills and higher education institutions. Higher education establishments and community skill centres facilitate collaborative endeavours among innovators, fostering research and the subsequent development of innovative products. Salleh and Daud (2019) stated that various research and academic branches are dedicated to grassroots innovation, including institutions like Universiti Teknologi MARA (2019) and Innovation Management at UPM (2019), alongside several other educational establishments within the country.

Intellectual Properties and Protection

The existence of an innovative society within a country could be measured by the number of patents and the amount of innovation output owned and produced by its citizens (Mohamad Hashim, 2010). Grassroots innovators can register their inventions formally through the Malaysian Intellectual Property Corporation (MyIPO). The MyIPO is an entity tasked with the mandate of fostering the growth and administration of the intellectual property system in Malaysia. According to data from Intellectual Property Corporation of Malaysia (2021), a total of 59,948 Intellectual Property Rights (IPR) applications were filed in 2021. These applications encompassed trademarks, patents, and industrial designs, marking a notable increase of 17.8% from the 50,885 applications filed in the previous year. Concurrently, 7,709 patent applications were filed in 2021, reflecting a growth of 9.9% compared to the 7,015 applications submitted in 2020. Based on the growing number of IPR components owned by Malaysians, it is evident that Malaysia is advancing toward the realisation of an innovative society, aligning with the goals established in the national innovation action plan.

Grassroots Innovator Behaviour In Product Development Practices

Innovators exercise their choices and use their skills in designing, crafting, using and disseminating their innovations. Many of these innovators contend with constraints related to knowledge and financial resources; the

informal settings within which they operate afford them a certain freedom from the rigid structures imposed by organisational dictates and routines. Our cases cover fifteen (15) grassroots innovators based on their behaviour and priority to create innovative products. The obtained information is as follows:

1. Grassroots Innovator 1 (GI001)

GI001, the first innovator, has successfully developed an efficient portable battery. Besides that, he has also developed several products, including household appliances, stainless steel foldable tables, ice bag packs, etc. He demonstrates a propensity in electrical work and carpentry. GI001 is strongly inclined to conduct observations, actively engage in practical reading, and employ critical thinking as an effective approach to address the encountered problems. GI001 serves as a food vendor at night markets, operating more than one branch within the surrounding residential area. He innovated the portable battery to solve problems of his and the dealers engaged in night market activities. GI001 initiated the development process by generating an initial product mock-up and subsequently crafted an effective final prototype. The materials used to create this battery include recycled products such as automotive interior holders, electrical appliances, and various other components. This innovation is affordable, portable, operates silently, can be incorporated into an auto-cut charge system to conserve electricity, and is durable, with an estimated lifespan exceeding five (5) years. Additionally, the application of the battery extends beyond residential contexts, including recreational pursuits and agricultural activities.

2. Grassroots Innovator 2 (GI002)

The second innovator developed an innovative coconut-opening tool. This innovator has also developed other products, including a virgin coconut oil separator, a durian fruit opener, handicrafts, and similar creations. GI002 engages in innovation due to personal interest and the desire to utilise free time constructively. GI002 begins innovating by manually creating technical sketches on paper. GI002's common constraint is the limited access to essential equipment and facilities, which significantly challenges his innovative endeavours. Moreover, testing facilities for materials and innovative products are also limited. Typically, GI002 conducts individual tests on product innovations using manual methods. Most of the innovative products produced by this innovator aim to facilitate the daily tasks of the local community. The generation of ideas stems from personal experiences and observations. Due to inadequate facilities and machinery, external welders and manufacturers are approached to assist in these innovations. Consequently, GI002 has produced more than five distinct coconut peeling tools, each with unique designs and functional systems. The prevalent materials utilised in producing coconut peeling tools are scrap metal and stainless steel. The distinguishing feature of the coconut peeling tool manufactured is its ability to peel coconuts of varying sizes. Each innovative product created has the potential to generate income and serve as a supplementary source of revenue for the innovator. This innovative product is environmentally friendly, as it relies primarily on manual methods of operation.

3. Grassroots Innovator 3 (GI003)

GI003 specialises in producing furniture and handicrafts using recycled materials such as used tyres. Innovator (GI003) distributes his innovative products within his residential vicinity and the local community. GI003 exhibits a passion for innovating furniture during leisurely hours, which was then turned into an additional source of income. His ideas and product development processes are primarily derived from self-observation and social media content. His innovative products do not involve sketches or formal drawings but rely solely on his creative skills. Furthermore, this innovator also fulfils the requests from the local community to craft furniture designs and handicrafts based on customer ideas and inspirations. One of the notable benefits of furniture and craft production lies in the utilisation of scrap and recycled materials apart from the readily accessible local materials within the area. The innate desire to enable GI003 to create innovative products is accompanied by a growing recognition from the local community for his creative accomplishments.

4. Grassroots Innovator 4 (GI004)

Innovator GI004 formulated fertilisers based on his ingredients and ratios. The innovator has also developed multiple machines designed for the efficient execution of organic fertiliser production. The idea to produce fertiliser and develop innovative devices stemmed from the innovator's first-hand experience cultivating crops in residential areas. This experience prompted the innovator to address the issues associated with chemically processed fertilisers containing harmful substances. Consequently, the innovator decided to create organic fertilisers based on his ideas and unique blend of ingredients. Driven by a solid determination to establish organic alternatives, GI004 ingeniously utilised a range of discarded materials, such as household appliances like floor sweepers, baskets, and scrap irons, to craft distinctive machines to produce fertilisers. Initially, the device and fertiliser served the innovator's personal needs. He consistently made iterative improvements to overcome his challenges, aiming to enhance the machine's capacity to produce larger quantities of fertiliser. His interest in farming and gardening led him to innovate and create fertilisers to sell to a broader market. The machines developed by the innovator offer several advantages, including using waste materials, ensuring the quality and standards of organic fertilisers, and guaranteeing environmental preservation. Furthermore, GI004 has generated employment opportunities within the local community by involving individuals in fertiliser production and establishing sales agents for organic fertiliser products.

5. Grassroots Innovator 5 (GI005)

Innovator GI005 produced organic vegetable planting tables, plant fertigation systems, lawnmowers, and other agricultural machinery. His deep enthusiasm for agrarian activities was a strong impetus for him to create inventive solutions. GI005 focuses on designing innovative products to streamline his daily farming routines and enhance work efficiency. One of the driving factors behind his innovation is the constant disruption caused by wild animals and pests damaging his crops. Hence, he is resolute in developing a table and fertigation system to address these challenges. During the initial stages, he struggled to identify appropriate materials with suitable durability and environmental friendliness. GI005 employed wood as a cost-effective measure for the initial prototype of the table and fertigation system. However, subsequent observations revealed that the wooden materials only lasted 2 to 3 years. Consequently, he decided to allocate his financial resources towards replacing the rigid components with more durable alternatives, such as metal and plastic. This agricultural undertaking enabled him to operate a business while generating employment opportunities for the local community.

6. Grassroots Innovator 6 (GI006)

GI006 developed an innovative tool known as the broken water tap extractor. The innovator has been actively engaged in innovation for over seven years, focusing on producing products related to taps, irrigation equipment, etc. Initially, the innovator's motivation for creating innovative products was driven by interest and a desire to enhance the functionality of existing products instead of pursuing profit. The ideas for these innovative products were developed through discussions and brainstorming sessions with acquaintances and friends. The inspiration for the broken water taps extractor stemmed from the local community's problem of broken water pipes in residential areas, often left unaddressed. The innovator and friends decided to develop this product after searching for suitable methods to solve the issue. The development process involved discussions, rough sketches, and prototypes. The innovator utilised available resources to produce prototypes, which then underwent modifications to ensure material suitability and design. The innovator and the local community manually tested the innovated products' effectiveness. Through this innovation, GI006 not only assisted the local community in addressing their specific challenges but also played a crucial role in raising awareness about the significance of innovation.

7. Grassroots Innovator 7 (GI007)

Innovator GI007 developed the cleaning tools for ablution areas and pools. This innovator also developed bird repellents, agricultural tools, and water extraction tools designed explicitly for burial purposes. The ideas for innovation are often derived from the innovator's inclination towards reading, observation, and collaborative problem-solving. GI007 conducts extensive research on each product to drive continuous improvement. This innovative product's uniqueness was due to its utilisation of scrap materials, its capacity for water conservation in cleaning processes, and its demonstrated energy efficiency. The innovative products facilitate the community's daily tasks and enhance quality of life instead of being marketed commercially. GI007 employed observational methodology to identify prominent issues and devise appropriate solutions for generating innovations. The idea to produce cleaning tools for ablution areas and pools originated from the unsanitary and inadequately maintained ablution areas in mosques and residential complexes. The accumulation of dirt undermines the effectiveness of manual cleaning, resulting in the inefficient use of cleaning water. In general, GI007 promotes community engagement in technology and innovation, particularly among young individuals, to foster their participation in innovative product development.

8. Grassroots Innovator 8 (GI008)

Innovator GI008 developed several agricultural innovations designed explicitly for pineapple cultivation, including a pineapple seeder machine, a grass-cutting machine for pineapple farming, versatile wheelbarrows and trucks, and other solutions. Motivated by an enduring passion for innovation, GI008 initially developed inventive products for personal use within pineapple farming. GI008 experienced a lack of labour assistance, as the agricultural activities associated with his endeavour necessitated a substantial workforce. Hence, GI008 set out to help himself and began innovating using iterative experimentation and continual product modifications until the final prototype was achieved without relying on preliminary sketches. Despite the extensive market research on machines that could aid in pineapple planting work, GI008 found none that fulfilled the desired characteristics. Given this situation, GI008 developed custom machines tailored explicitly to the pineapple's unique requirements. Resourcefulness is a notable aspect of GI008's approach, as he ingeniously used repurposed materials from scrap metals and used machinery to modify them skillfully to suit the intended purpose. The resulting machine boasts noteworthy features, including ease of operation, enhanced soil looseness, precise hole creation without a measuring string, and consistent planting distance. This innovative threshing machine significantly improved productivity by replacing the traditional wooden threshing methods.

9. Grassroots Innovator 9 (GI009)

The innovator, GI009, developed a cost-effective, multi-purpose truck for oil palm cultivation to alleviate the labour burden among fellow villagers. GI009's exceptional grassroots innovation is exemplified through the construction of versatile vehicles employing discarded materials and items. GI009 also developed multi-purpose vehicles, agricultural machinery, and even handicrafts. A prime example of his ingenuity is the successful creation of a multi-purpose vehicle by ingeniously integrating a motorcycle engine. This innovative creation showcases its impressive capacity to accommodate up to 30 passengers. The selection of motorcycle engines was primarily motivated by their lightweight nature and manoeuvrability, which are essential considerations when operating within peat and swampy soil environments. The innate curiosity and strong inclination towards problem-solving served as the driving forces that propelled GI009 to generate innovative solutions. These inventions have greatly facilitated daily tasks and effectively tackled pertinent issues within the local community. The production process entails essential welding techniques, such as cutting and joining, while emphasising efficiency and user safety. However, GI009 encountered challenges during the manufacturing phase due to the scarcity of human resources and the growing demand for his inventions.

10. Grassroots Innovator 10 (GI010)

The tenth innovator garnered recognition for his contributions in developing specialised wheeled vehicles intended for individuals with disabilities. Among the other innovations by GI010 include wheelchairs, mobile beds for individuals with disabilities, customised motorcycles tailored to their needs, collapsible walking sticks, crushers for palm fronds, machines for extracting coconut milk, processors for corn kernels, and mixers for *dodol*. GI010 dedicated his professional career to innovation, creating a diverse array of wheelchairs customised to cater to the specific needs of disadvantaged individuals. These wheelchairs are meticulously designed to accommodate different sizes, shapes, and functionalities, addressing the physical and functional requirements of people with disabilities. The demand for these specialised wheelchairs, developed by GI010, has grown nationwide. However, the innovator encounters challenges in scaling up the commercialisation of each innovation primarily due to the need for customisation to suit the individual requirements of diverse users. GI010 aspires to commercialise its inventive products under Malaysian product brands and envisions establishing partnerships with industry stakeholders to facilitate large-scale production. His ultimate objective is to witness the widespread availability of his innovative products in the market and their consequential significant impact.

11. Grassroots Innovator 11 (GI011)

Innovator GI011 developed a multifunctional vehicle designed explicitly for plantation purposes. The innovator demonstrated a genuine interest in addressing the challenges faced by the local community through his innovative products. Having previously worked on a farm, the innovator encountered various obstacles in his work, such as the strenuous task of lifting palm bunches and heavy fronds and challenges related to the collection and cleaning processes within the farm area. His personal experiences catalysed his equipment and transportation innovations. Moreover, health concerns have also played a significant role in driving the innovator's pursuit of innovation. He resolved to develop innovative products that alleviate the physical strain and discomfort experienced by users. GI011 adeptly employed his creative thinking skills to generate innovative solutions while valuing the exchange of ideas and opinions with fellow grassroots innovators in his local community. He actively collaborates with other innovators, fostering a culture of shared knowledge, and further emphasising cooperation and mutual assistance. This collaborative environment promotes the exchange of ideas and opinions and the utilisation of shared equipment resources in developing innovative products. A salient feature of his innovative product is its predominant utilisation of discarded and recycled materials, encompassing scrap metal, plastic, and waste derived from household appliances. The multifunctional vehicle serves many objectives, providing substantial assistance to the surrounding community and labourers engaged in oil palm cultivation.

12. Grassroots Innovator 12 (GI012)

The innovative product of innovator GI0012 is an adjustable and foldable commode chair. GI012 has also designed a wide range of products and innovations, including a shoe drying machine, a line marking machine for grassed sports fields, soil excavation tools and devices, and various agricultural equipment. The innovator demonstrates a keen awareness of environmental issues by indirectly addressing challenges faced by the local community through his innovative products. Due to the lack of a dedicated workshop or production space, GI012 utilised the front yard of his residence as the primary location for product development. Creating the adjustable and foldable commode chair for individuals with disabilities, whereby discarded materials were ingeniously repurposed, was a significant accomplishment. This approach ensures environmental well-being while effectively reducing the costs associated with product development. GI012 consistently engages in iterative modifications and enhancements for each prototype. The advantage of this invention is that it allows the user to dispose of the plastic bags after they have been used. GI012 functioned autonomously, eliminating the need for paper-based drafts or sketches during pioneering product development. This adaptable and collapsible commode chair is lightweight and portable, exemplifying exceptional artistry.

13. Grassroots Innovator 13 (GI013)

GI0013 successfully introduced a novel advancement in the food manufacturing industry called the *Satay* skewer machine. Besides the skewer machine, GI013 has also created internal and external building cleaning equipment, tools for burning wasp nests, tyre locks, and other safety devices. GI013 demonstrated a proclivity for observing and analysing the surroundings, drawing inspiration from colleagues and the local community who report and share problems. As such, GI013 skillfully processes a combination of scrap materials to fabricate satay skewers. The product development process began with the inception of preliminary sketches on paper, subsequently advancing from the initial conceptualisation phase to the stage of conducting comprehensive product testing. The innovative products devised by GI013 possess attributes such as lightweight, portability, and the ability to operate with minimal workforce. Notably, GI013 does not commercialise these products, as his primary focus is innovation.

14. Grassroots Innovator 14 (GI014)

Similarly, another foldable wheelchair for disabled individuals was developed by innovator GI014. He also created several other innovative products, such as footwear, mobility support equipment for disabled individuals, and soybean processing machines. Being an individual with a disability himself, innovator GI014 exhibited a profound interest in addressing the challenges encountered by disabled individuals to enhance their daily lives while also assisting others facing similar difficulties. He utilised recycled materials to reduce manufacturing costs effectively. Moreover, he has applied his concept to optimise the ergonomic design of the wheelchair. However, financial constraints hindered GI014 from expanding and commercialising his creations. Individuals with disabilities, akin to innovator GI014, rely on financial support and multifaceted assistance to foster their innovative endeavours and generate sustainable income. Regarding promoting his innovations, GI014 actively uses social media platforms to showcase his creations.

15. Grassroots Innovator 15 (GI015)

The individual identified as innovator GI015 specialises in machine development, specifically focusing on paper sheet counting machines. GI015 has achieved significant accomplishments by conceptualising and creating a wide array of pioneering inventions. The remarkable contributions include *Satay* skewer manufacturing, multifunctional drying machines, sewage water treatment systems, and adjustable hydraulic systems tailored for unloading heavy materials. Innovator GI015 adopts observation and problem-solving skills in developing a new product. He actively collaborates with external vendors to ensure the superior quality of the final products, as specific machine components necessitate specialised production techniques. Consequently, he acquired various manufacturing and fabrication skills to foster effective communication with vendors and factories. This endeavour exemplifies his inquisitive nature and unwavering commitment to his craft. GI015's desires increased support and guidance from agencies toward grassroots innovators to facilitate the development of their inventions.

Key Factors Influencing Grassroots Innovators' Engagement in Innovation

Numerous factors catalyse innovators to engage in product development and innovation in Malaysia. Extensive research findings have identified a comprehensive list of eight primary factors linked to the inclination of grassroots innovators towards innovation. Meanwhile, the participants in this study are grassroots innovators actively engaged in innovation within Peninsular Malaysia. A total of 15 respondents, aged over 30 years, were selected, representing diverse educational and experiential backgrounds.

The interviewed respondents or innovators are from the four main regions of Peninsular Malaysia: the Northern Region, the East Coast Region, the Central Region and the Southern Region. Each grassroots innovator specialises in a distinct innovation product, each with unique characteristics. It is worth noting that innovators often develop

multiple innovative products. The data on the creativity of each respondent is presented in Table 1. All innovators have innovated more than one innovative product. A structured approach was employed to assess the factors influencing innovators' propensity to innovate, whereby all innovators indicated their inclination towards the eight (8) predetermined factors. Each element was evaluated on a five-point Likert Scale (1 = not considered, 2 = low, 3 = moderate, 4 = high, 5 = important).

The following subsection presents Figure 2, which illustrates the average values of the primary factors contributing to innovators' inclination to develop innovative products. The diagram revealed that the factor with the highest mean value was "Interests and Hobby" with a score of 4.93, whereas the lowest mean value was attributed to "Job Loss" at 1.00. Another significant factor is "to solve individual and localised problems," with a mean score of 4.67. "To Simplify the daily activities" ranks as the third-highest mean tendency factor in developing innovative products, with a score of 4.47. Additionally, the factors "To create new business opportunity" and "Environmental Preservation" both shared a mean tendency level of 3.60.

The results indicated that grassroots innovators in Malaysia exhibited a distinct inclination towards generating a wide range of innovative products, primarily driven by their profound interests and hobbies. The primary objectives of the grassroots innovators initiatives in Malaysia aim to enhance overall prosperity, focusing on fostering social development and increasing economic well-being, apart from alleviating poverty. In Malaysia, most innovators come from diverse backgrounds, contributing to their unique interests and hobbies. Fuelled by their creative ideas, grassroots innovators demonstrate a propensity for developing innovative products during their leisure time, motivated by the abundance of readily available natural resources. Moreover, local grassroots innovators actively produce innovative products to address challenges they and the local community encounter. Their problem-solving efforts have garnered a notable reputation within their respective communities.

The innovative ideas generated by each innovator possess the ability to streamline daily routines as the designs are based on their keen observations and personal experiences. Some innovators channel their efforts into creating innovative solutions to address health-related issues and cater to the needs of individuals with disabilities. Enhancing product functionality is a driving factor for innovators. They perceive products from a distinct perspective, allowing for modifications that align with the users' specific requirements and preferences. Grassroots innovators know that their innovative outcomes can yield new business opportunities. Their innovative products have the potential for commercialisation, contributing to local economic growth and community empowerment. By utilising environmentally friendly and recyclable materials, they actively promote sustainable development and contribute to safeguarding the environment.

Product development activities have also been part of additional income for some grassroots innovators. Nevertheless, the primary objective of grassroots innovators is not centred around generating supplementary income. Likewise, the job loss factor was only selected by one innovator, leading to his inclination towards producing innovations for monetary purposes. A comprehensive depiction of these dynamics is illustrated in Figure 2.

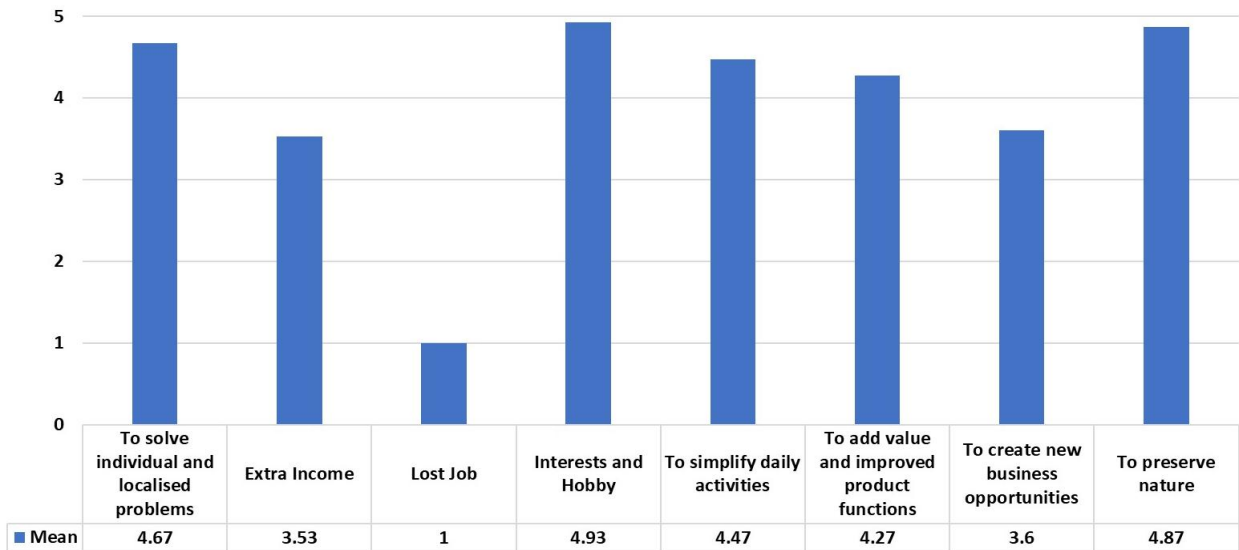


Figure 2: Key determinants influencing innovators' propensity to innovate.

An examination of grassroots innovators across Peninsular Malaysia revealed that they exhibit shared characteristics and perspectives. The cases conducted revealed several noteworthy factors.

- Firstly, these innovators display a creative aptitude, effectively leveraging the available resources to develop their products. Furthermore, various opportunities arise through incentives and programs provided by professional bodies and supporting agencies, although some innovators may remain unaware of such options.
- Secondly, the collective endeavours of grassroots innovators are propelled by their hobbies and intrinsic interest in innovation. Virtually all innovators possess an inherent passion for innovation. This fervour compels them to generate diverse innovations, driven by their desire to experiment and explore novel possibilities.
- Thirdly, almost all cases indicated a strong relationship between innovators and the local community. Most grassroots innovators go beyond addressing their challenges and actively seek to resolve the problems faced by fellow villagers and the community. Likewise, the mitigation of waste and the preservation of the environment can be underscored as significant outcomes when a community engages in innovation. These positive effects hold considerable importance in advancing the agenda of inclusive innovation.
- Fourthly, grassroots innovators tend to produce more than one innovative product or various innovations due to the need of environmental factors. Moreover, grassroots innovator intends to find more efficient processes by adding values and functionality to the existing products.
- In addition to their potential contribution to environmental preservation, the development of these products demonstrates strong commercialisation potential, which may generate increased income for innovators and local communities. The entrepreneurial drive of these innovators has also created new avenues, including knowledge sharing, income generation, and job opportunities for the local community.
- Lastly, it is worth noting that most of these innovators are interested in commercialising their innovative products. However, they also seek protection for their creations. Consequently, it becomes indispensable for all pertinent organisations and actors to engage in concerted efforts to highlight the significance and facilitate the registration of the intellectual property of grassroots innovators.

Strategic Pathways for Commercializing Grassroots Product Innovations

Several strategic approaches can facilitate the commercialization of grassroots products and innovations in support of sustainable development. These include:

1) Product Enhancement

Before market expansion, innovators must refine their product to ensure safety, functionality and user relevance. Products should address user and community needs while demonstrating durability, cost efficiency and improve design and packaging. Incremental enhancement strengthens competitiveness and consumer trust.

2) *Business Formalization*

Formal registration with the Companies Commission of Malaysia (SSM) legitimizes operation and enhances market credibility. Business registration enables innovators to establish formal banking accounts, access grants, participate in government programmes and distribute products through formal retail channels. Legal recognition is essential for sustainable growth.

3) *Intellectual Property*

Protecting intellectual assets preserves originality and minimizes the risk of unauthorized imitation. Innovators may register trademarks, industrial designs, patents or utility innovations (UI) with the Intellectual Property Corporation Malaysia (MyIPO). Early-stage protection does not require complex registration; cost-effective mechanisms, with guidance from agencies such as MyIPO, are often sufficient to support documentation and application processes.

4) *Incremental Financing*

Grassroots innovators should begin with small-scale funding rather than seeking large investors immediately. Micro-financing and grants from agencies such as Majlis Amanah Rakyat (MARA) and TEKUN Nasional can support early commercialization while minimizing financial risk.

5) *Accessible Market Channels*

Market entry should begin with low-barrier channels such as online platforms, local markets, or retail outlets. Strategic storytelling, which communicates the social value and origin of the product, can strengthen consumer engagement. Collaboration with local agents may further expand market reach

6) *Capacity Building*

Commercialization requires continuous skill development. Innovators should enhance competencies in new product development, costing, pricing, marketing and digital sales. Participation in training and mentoring programmes strengthens entrepreneurial capability and long-term viability.

Commercialization involves a gradual and strategic progression rather than rapid scaling. Through the integration of technical refinement, institutional support, and entrepreneurship programmes designed to assist innovators in commercializing their innovation, grassroots initiatives can successfully enter market while advancing inclusive and economic growth.

CONCLUSION

In conclusion, it can be asserted that Malaysia demonstrates a commendable culture of grassroots innovation. Driven by either necessity or personal interest, community members have taken proactive initiatives in innovation. Fostering this culture becomes imperative, as it holds the potential to establish the country as a prominent regional powerhouse in innovation. Innovators derive considerable advantages from interventions that advance their knowledge and support in marketing, promotion, entrepreneurship and securing financial resources. Notwithstanding, challenges hinder innovators' progress, particularly those concerning scaling capacity, deficiencies in knowledge and technology adoption, as well as the nature of their innovations. Several strategically positioned downstream initiatives aim to enhance and

amplify grassroots product development and innovation practices within the community. This highlight underscores the potential of supplementary downstream industries in propagating the culture of innovation nationwide, particularly among the younger generation, while equipping them with the requisite knowledge and skills to foster sustainable development.

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