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Critical Success Factors of the Green Community-Based Social Enterprise Partnership in the West Coast Division of Sabah

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Abstract
Community-based social enterprises (CBSEs) have increasingly been recognised as an effective mechanism for promoting sustainable livelihoods, environmental stewardship, and socio-economic empowerment among disadvantaged communities. This study evaluates the impact of the Freshwater Lobster Production–Green Aquaponics Perennial System (FLP-GAPS), an RM3.5 million flagship initiative funded by TERAJU under the *Dana Pembangunan Usahawan Bumiputera* and implemented by Universiti Teknologi MARA (UiTM) Sabah Branch. The project integrates freshwater lobster production, green aquaponics, and perennial agriculture into a sustainable community enterprise model designed to improve the socio-economic well-being of B40 households in the West Coast Division of Sabah. An impact assessment was conducted after three years of project implementation (2023–2025) to evaluate the extent to which the project achieved its intended objectives and key performance indicators (KPIs) stipulated in the Memorandum of Agreement (MoA) between UiTM and TERAJU. Using a purposive homogeneous sampling approach, data were collected from 80 eKasih-registered participants and six landowners from six villages in the West Coast Division of Sabah who voluntarily contributed land for project implementation. The study focused on identifying the critical success factors (CSFs) that influenced project sustainability, community participation, and overall performance. The findings indicate that strong institutional collaboration, community commitment, strategic resource sharing, continuous capacity building, effective project governance, and stakeholder engagement were the principal critical success factors contributing to the successful implementation of FLP-GAPS. The project generated positive socio-economic and environmental outcomes by enhancing participants' entrepreneurial capacity, promoting sustainable agricultural practices, and strengthening community resilience through a green social enterprise ecosystem. This study contributes to the growing body of knowledge on project evaluation and community-based social entrepreneurship by providing empirical evidence on the factors underpinning the successful implementation of integrated green enterprise initiatives. The identified critical success factors offer practical guidance for policymakers, funding agencies, higher education institutions, and community organisations in designing and implementing sustainable community grant programmes and social enterprise partnerships.

Keywords: critical success factors; community-based social enterprise; green entrepreneurship; aquaponics; freshwater lobster production; Sabah

1. Introduction

Community-based social enterprises (CBSEs) have gained significant academic and policy attention as a powerful mechanism to deliver sustainable livelihoods, poverty alleviation, and environmental stewardship simultaneously. CBSEs operate at the intersection of social mission, community localization, and commercial viability, deploying business models specifically structured to empower marginalized groups. In developing and emerging economies, rural populations often face persistent exclusion from mainstream commercial supply chains due to technical, financial, and geographical constraints. This socioeconomic isolation is particularly evident in the East Malaysian state of Sabah, where rural communities represent some of the highest densities of low-income (B40) and hard-core poor households registered under the national *eKasih* system. To uplift these communities sustainably, integrated green agricultural technologies combined with community-led entrepreneurial structures offer a viable path forward, aligning directly with the state's 'Sabah Maju Jaya' development blueprint. To operationalize this model, Universiti Teknologi MARA (UiTM) Sabah Branch developed and implemented a flagship community development project known as the Freshwater Lobster Production–Green Aquaponics Perennial System (FLP-GAPS). Funded via an RM3.5 million grant under the Dana Pembangunan Usahawan Bumiputera 2019 (DPUB19) program administered by TERAJU (the Bumiputera Agenda Steering Unit), FLP-GAPS represents a high-impact, university-community-agency partnership. The program integrates

three distinct ecological and agricultural systems: high-value freshwater lobster production (Cherax Quadricarinatus, locally referred to as *Lobster Air Tawar* or LAT), vertical green aquaponics pen, and perennial agriculture. By combining these, the project establishes a circular, zero-waste agricultural loop where lobster nutrient waste feeds organic leafy vegetables, optimizing water resources and land productivity for rural households. Launched in March 2020, the FLP-GAPS project navigated highly challenging implementation conditions due to the global COVID-19 pandemic, which severely restricted logistical movements, delayed material supply chains, and disrupted initial community training schedules. Despite these setbacks, the project team successfully established six highly specialized decentralized hatchery units or 'Living Labs' across the West Coast Division of Sabah, located in Kg. Bantayan (Tamparuli), Kg. Ratau (Menggatal), Kg. Kayu Madang (Telipok), Kg. Duvanson (Putatan), Kg. Muhibbah (Petagas), and Kg. Shabandar (Tuaran). Following infrastructural stabilization and piloting phases, the project transitioned to full, independent commercial operations starting in the first quarter (Q1) of 2024. To ensure compliance with institutional agreements and rigorously evaluate the model's socio-economic efficacy, a formal project critical success assessment was mandated under Article 5.0 (Monitoring and Assessment) of the Memorandum of Agreement (MoA) between UiTM and TERAJU. This study systematically reports on the three-year impact evaluation (2023–2025) of FLP-GAPS, examining its success, relevance, technical and attitudinal outcomes, and identifying the Critical Success Factors (CSFs) that determine its long-term sustainability.

2. Research Methodology

This study adopted a mixed-methods research design combining quantitative survey assessments and qualitative field observations. The quantitative evaluation utilizes structured questionnaire data collected following a three-year implementation cycle (2023 to 2025). To ensure high data reliability and relevance, a purposive homogeneous sampling technique was utilized, targeting individuals who were directly involved in and impacted by the project's ecosystem. The final sample of N = 80 stakeholders comprises 30 *eKasih*-registered direct participants, 4 Special Interest Group (SIG) academic implementers from UiTM, 10 university representatives handling technical and administrative roles, 5 funding and development agency representatives from TERAJU, 6 on-site project managers and supervisors, 12 aquaculture industry partners, and 13 other direct stakeholders (such as local administrative leaders and part-time hatchery workers). Additionally, six land-contributing owners across the six target villages were interviewed regarding land utilization impacts. In addition to the survey, a structured six-month qualitative observation phase was conducted in 2024 during the project's full commercial operations. Field monitoring focused on the operational dynamics of the six Living Lab hatcheries established in: Kg. Bantayan (Tamparuli, designated as site WS1), Kg. Ratau (Menggatal, site W2), Kg. Kayu Madang (Telipok, site WS3), Kg. Duvanson (Putatan, site WS4), Kg. Muhibbah (Petagas, site WS5), and Kg. Shabandar (Tuaran, site WS6). The primary survey instrument was developed by the Technology-Oriented Community Development and Social Entrepreneurship (SIG-ToCoDeS) research group at UiTM Sabah. The instrument consists of ten structured sections (Parts A through J) addressing demographic baselines, community relevance, institutional collaboration, stakeholder support, changes in attitude/knowledge/skills, personal experiences, innovation adoption, technical challenges, community empowerment, and future sustainability. Data were analyzed using descriptive statistical analysis, focusing on frequency distributions and percentage representations to provide a transparent overview of project outcomes.

3. Quantitative Results and Analysis

3.1 Demographic Factors

Table 1: Demographic Factors

Demographic Variable	*Classification Category*	*Frequency (f)*	*Percentage (%)*
Age Range	*< 25 years old*	*5*	*6.25*
	25 – 35 years old	*10*	*12.50*
	36 – 46 years old	*27*	*33.75*
	47 – 57 years old	*26*	*32.50*
	58 – 68 years old	*8*	*10.00*

	> 68 years old	*4*	*5.00*
Gender	*Male*	*52*	*65.00*
	Female	*28*	*35.00*
Marital Status	*Single*	*27*	*33.75*
	Married	*38*	*47.50*
	Single Parent (Mother/Father)	*15*	*18.75*
Educational Attainment	*No Formal Education*	*5*	*6.25*
	Primary School Education	*10*	*12.50*
	Secondary School Education	*15*	*18.75*
	Diploma Holder	*20*	*25.00*
	Bachelor's Degree	*18*	*22.50*
	Master's Degree	*7*	*8.75*
	Doctoral Degree (PhD)	*5*	*6.25*
Primary Occupation	*Unemployed / Self-Employed*	*38*	*47.50*
	Government Sector Employee	*20*	*25.00*
	Private Sector / NGO Employee	*22*	*27.50*
Project Role	*Direct Project Participant (Beneficiary)*	*30*	*37.50*
	SIG (ToCoDeS) Academic Member	*4*	*5.00*
	University Representative (UiTM Support)	*10*	*12.50*
	Funding/Development Agency Rep (TERAJU)	*5*	*6.25*
	Hatchery Project Manager / Supervisor	*6*	*7.50*
	Industry Partner / Aquaculture Expert	*12*	*15.00*
	Other Direct Stakeholders / Workers	*13*	*16.25*
Duration of Involvement	*< 6 months*	*6*	*7.50*
	6 months – 1 year	*26*	*32.50*
	> 1 year	*48*	*60.00*

Under this section, a typical kind of scope asked including age, gender, marital status, education, occupation, project role, and duration of project involvement, specifically the FLP-GAPS Project.

3.2 Program Relevance and Socioeconomic Community Benefits

A foundational focus of the impact study was evaluating the community's perception of program relevance and its tangible multi-dimensional benefits. As displayed in Table 2, there is an overwhelming consensus regarding the necessity of the project. A combined 96.25% of respondents agree or strongly agree that the FLP-GAPS program is highly relevant and required by the community (Item B1). Furthermore, 92.50% affirm that the project directly fulfills the community's actual socioeconomic demands (Item B2). When disaggregated by specific benefit categories, ecological sustainability ranked the highest, with 98.75% of respondents acknowledging positive environmental impacts (Item B3d). Economic advantages (96.25% agreement, Item B3a) and educational growth (87.50% agreement, Item B3b) also scored exceptionally high, proving that the integration of high-tech aquaculture and agriculture delivers substantial, well-rounded community assets.

Table 2: Program Relevance and Socioeconomic Community Benefits

Survey Item (Part B)	***Strongly Disagree (%)***	***Disagree (%)***	***Neutral (%)***	***Agree (%)***	***Strongly Agree (%)***
B1. Program relevance & necessity for the community	*0.00*	*0.00*	*3.75*	*45.00*	*51.25*
B2. Fulfills the actual needs of the community	*0.00*	*0.00*	*7.50*	*42.50*	*50.00*
B3a. Tangible perceived benefits: Economic development	*0.00*	*0.00*	*3.75*	*50.00*	*46.25*
B3b. Tangible perceived benefits: Educational advancement	*0.00*	*2.50*	*10.00*	*45.00*	*42.50*
B3c. Tangible perceived benefits: Social integration & unity	*0.00*	*1.25*	*12.50*	*46.25*	*40.00*
B3d. Tangible perceived benefits: Environmental sustainability	*0.00*	*0.00*	*1.25*	*50.00*	*48.75*

3.3 Institutional University-Community Collaboration

A critical feature of the FLP-GAPS model is the formalization of university-community linkages via institutional agreements. As shown in Table 3, while 58.75% of stakeholders are explicitly aware of the formal MoA signed between UiTM and the community under the TERAJU DPUB19 funding framework (Item C1), a notable 25% remain unsure, and 16.25% are unaware. This indicates a gap in agreement-level transparency at the grassroots level. However, among those aware, there is solid acknowledgement of the partnership's value: 82.50% agree that the collaboration has had a direct, highly positive effect on overall project execution (Item C2). Most importantly, 92.50% of respondents believe that this specific institutional partnership model represents a robust, replicable blueprint that should be adopted for future rural development initiatives (Item C3).

Table 3: Institutional University-Community Collaboration

Collaboration Indicator (Part C)	*Response Category*	*Frequency (f)*	*Percentage (%)*
C1. Awareness of formal MoA between UiTM and community	*Yes*	*47*	*58.75*
	Unsure	*20*	*25.00*
	No	*13*	*16.25*
C2. Agreement that collaboration positively impacted project execution	*Strongly Disagree*	*0*	*0.00*
	Disagree	*0*	*0.00*

	Neutral	*14*	*17.50*
	Agree	*33*	*41.25*
	Strongly Agree	*33*	*41.25*
	Strongly Disagree	*0*	*0.00*
C3. Partnership can serve as a replicable model for other projects	*Disagree*	*0*	*0.00*
	Neutral	*6*	*7.50*
	Agree	*30*	*37.50*
	Strongly Agree	*44*	*55.00*

3.4 Stakeholder Support and Communication Effectiveness

Effective social enterprises rely on active alignment and robust communication networks among diverse stakeholders. As detailed in Table 4, 83.75% of respondents agree that the various direct stakeholders (including academic researchers, community representatives, and development agencies) actively supported the project's roll-out (Item D1). Communication adequacy was rated positively, with 76.25% indicating that information flow and cooperation channels were sufficient for daily hatchery operations (Item D2). Nonetheless, 18.75% remained neutral, and 5.00% expressed explicit dissatisfaction, pointing to localized communication bottlenecks between remote rural participants and administrative centers.

Table 4: Stakeholder Support and Communication Effectiveness

Communication Variable (Part D)	*Strongly Disagree (%)*	*Disagree (%)*	*Neutral (%)*	*Agree (%)*	*Strongly Agree (%)*
D1. Active support from all stakeholders (UiTM, community, TERAJU)	*1.25*	*1.25*	*13.75*	*42.50*	*41.25*
D2. Adequacy of communication and mutual cooperation channels	*1.25*	*3.75*	*18.75*	*37.50*	*38.75*

3.5 Attitudinal, Knowledge, and Technical Skill Development

The FLP-GAPS program aimed to drive substantial personal development among participants. Table 5 demonstrates highly positive psychological and technical growth. Specifically, 90.00% of respondents report that the program successfully shifted their attitudes toward actively seizing socioeconomic opportunities (Item E1). Knowledge acquisition in high-value freshwater lobster husbandry and green aquaponics was exceptionally high at 96.25% (Item E2). Crucially, 87.50% of stakeholders confirm that the advanced technical skills acquired directly empowered them to manage complex aquaponics and hatchery systems with greater autonomy (Item E3). Family economic aspirations were also significantly elevated, with 93.75% indicating heightened ambitions for their households' financial future (Item E4).

Table 5: Attitudinal, Knowledge, and Technical Skill Development

Impact Dimension (Part E)	*Strongly Disagree (%)*	*Disagree (%)*	*Neutral (%)*	*Agree (%)*	*Strongly Agree (%)*
E1. Attitudinal shift towards socioeconomic opportunities	*0.00*	*1.25*	*8.75*	*46.25*	*43.75*
E2. Increased knowledge in LAT husbandry & aquaponics	*0.00*	*0.00*	*3.75*	*50.00*	*46.25*

E3. Technical skill improvement in managing system assets	*0.00*	*0.00*	*12.50*	*47.50*	*40.00*
E4. Elevated family long-term economic aspirations	*0.00*	*0.00*	*6.25*	*52.50*	*41.25*

To capture deeper individual experiences, respondents were evaluated on specific personal attribute growth and community integration, as shown in Table 6. Proactive behaviors increased 85.00% of participants (Item F1a), and self-confidence grew by 90.00% (Item F1b). A vast majority (90.00%) also reported becoming highly open to adopting new scientific and entrepreneurial knowledge (Item F1c). At a broader level, 97.50% felt deeply inspired to participate in future community development projects (Item F3), and 93.75% reported a marked increase in community unity and localized cooperation as a direct consequence of the project's collaborative operational model (Item F4).

Table 6: Personal Attribute Growth and Community Integration

Personal Growth & Unity (Part F)	*Strongly Disagree (%)*	*Disagree (%)*	*Neutral (%)*	*Agree (%)*	*Strongly Agree (%)*
F1a. Individual proactivity (Lebih Proaktif)	*0.00*	*0.00*	*15.00*	*41.25*	*43.75*
F1b. Individual self-confidence (Lebih Yakin)	*0.00*	*0.00*	*10.00*	*45.00*	*45.00*
F1c. Openness to new scientific knowledge (Lebih Terbuka)	*0.00*	*1.25*	*8.75*	*46.25*	*43.75*
F3. Inspiration to engage in future community projects	*0.00*	*0.00*	*2.50*	*50.00*	*47.50*
F4. Perceived growth in community unity & mutual trust	*1.25*	*1.25*	*3.75*	*46.25*	*47.50*

The acquisition of practical, highly specialized skills was key to establishing viable community-based social enterprises. Table 7 highlights the perceived utility of the core training modules provided. Respondents rated the usefulness of the training exceptionally high across all areas, with entrepreneurship and micro-business management training scoring the highest (95.00% agreement, Item F2c). This was closely followed by operationalization skills for vertical aquaponics (91.25%, Item F2b) and freshwater lobster husbandry techniques (87.50%, Item F2a), demonstrating the high quality of the university's technical transfer program.

Table 7: Perceived Utility of The Core Training Modules Provided

Core Technical Skills Acquired (Part F)	***Strongly Disagree (%)***	***Disagree (%)***	***Neutral (%)***	***Agree (%)***	***Strongly Agree (%)***
F2a. Freshwater lobster (LAT) husbandry management	*0.00*	*0.00*	*12.50*	*43.75*	*43.75*
F2b. Engineering operations of vertical aquaponics system	*0.00*	*0.00*	*8.75*	*46.25*	*45.00*
F2c. Entrepreneurial and micro-business management	*0.00*	*0.00*	*5.00*	*48.75*	*46.25*

3.6 Innovation Adoption and Daily Practice Changes

A critical test of any technology-driven community initiative is the actual translation of training into daily behavioral and operational practices. Table 8 details these behavioral changes. A significant 95.00% of stakeholders agree that participation in FLP-GAPS fundamentally altered their daily resource management, environmental conservation, and socioeconomic practices (Item G1). Direct application of the vertical aquaponics system in daily life or household economic activities was reported by 91.25% of respondents (Item G2). Consequently, 92.50% experienced marked improvements in productivity and agricultural resource efficiency (Item G3), showing that the technical system successfully transitioned from a university-led experiment into a functional, household-level economic asset.

Table 8: Innovation Adoption and Daily Practice Changes

Innovation Variable (Part G)	*Strongly Disagree (%)*	*Disagree (%)*	*Neutral (%)*	*Agree (%)*	*Strongly Agree (%)*
G1. Fundamental shift in daily resource/environmental practices	*0.00*	*1.25*	*3.75*	*50.00*	*45.00*
G2. Direct routine application of aquaponics in daily life	*0.00*	*1.25*	*7.50*	*47.50*	*43.75*
G3. Perceived improvements in productivity and efficiency	*0.00*	*1.25*	*6.25*	*46.25*	*46.25*

To further dissect behavioral adoption, Table 9 examines specific environmental, operational, and structural practices associated with the green social enterprise. Over 80% of respondents confirmed the direct, active use of aquaponics technology (81.25%, Item G4a) and a social entrepreneurship approach (78.75%, Item G4d). Efficient water resource management registered the highest practical application rate at 87.50% (Item G4b), highlighting the system's resilience in water-scarce rural settings. Active environmental conservation practices were also highly integrated at 85.00% (Item G4c). At the macro-community level, 68.75% reported that their villages have broadly accepted and applied these innovations (Item G5), and 75.00% express a clear intention to continue applying and expanding these green technologies after the formal university funding window closes (Item G6).

Table 9: Specific Environmental, Operational and Structural Practices

Specific Innovation Application (Part G)	***Yes (%)***	***Unsure (%)***	***No (%)***
G4a. Direct adoption and operation of aquaponics technology	*81.25*	*18.75*	*0.00*
G4b. Operationalization of efficient water resource management	*87.50*	*12.50*	*0.00*
G4c. Engagement in active environmental conservation and care	*85.00*	*15.00*	*0.00*
G4d. Active deployment of social entrepreneurship frameworks	*78.75*	*21.25*	*0.00*
G5. Full community-level acceptance and system integration	*68.75*	*31.25*	*0.00*
G6. Solid intention to sustain system operation post-funding	*75.00*	*25.00*	*0.00*

3.7 Barriers and Constraints in Innovation Adoption

Despite positive adoption indices, rural communities face critical systemic bottlenecks when integrating advanced socio-technical innovations. Table 10 details these constraints. Financial limitations represent the most acute hurdle, with

97.50% of respondents agreeing that capital constraints severely restrict their capacity to sustain or scale up system operations (Item H1b). Logistical access issues, including poor rural road infrastructure and lack of distribution networks, were identified as severe barriers by 96.25% of respondents (Item H1c). Furthermore, 90.00% agreed that insufficient initial technical knowledge hindered smooth operation, particularly during water quality anomalies or biological disease outbreaks in the lobster tanks (Item H1a). Time and labor constraints were also widely acknowledged (88.75%, Item H1d). Consequently, 93.75% of stakeholders expressed an urgent need for ongoing institutional support, including technical mentoring and advanced operational training (Item H2).

Table 10: Barriers and Constraints in Innovation Adoption

Perceived Adoption Challenge (Part H)	*Strongly Disagree (%)*	*Disagree (%)*	*Neutral (%)*	*Agree (%)*	*Strongly Agree (%)*
H1a. Insufficient technical knowledge and skill base	*0.00*	*0.00*	*10.00*	*40.00*	*50.00*
H1b. Strict capital, funding, and financial constraints	*0.00*	*0.00*	*2.50*	*40.00*	*57.50*
H1c. Deficiencies in logistical access and infrastructure	*0.00*	*0.00*	*3.75*	*46.25*	*50.00*
H1d. Individual time, labor, and management constraints	*1.25*	*1.25*	*8.75*	*40.00*	*48.75*
H2. Critical need for advanced training and tech mentoring	*0.00*	*0.00*	*6.25*	*46.25*	*47.50*

3.8 Community Empowerment and Sustainability Capacity

A primary objective of community-based social enterprises is fostering complete operational self-reliance, eventually removing the need for external university or state support. Table 11 provides a sobering look at these self-reliance dynamics. When asked if the community is competitive enough to execute new development projects independently, agreement dropped to 62.50%, with 18.75% expressing explicit disagreement (Item I1). Similarly, 70.00% believe that the community can sustain system operations without ongoing academic (UiTM) support (Item I2), while 15.00% disagree or remain highly unsure. Additionally, 73.75% of respondents feel that their acquired technical knowledge and skills are sufficient to run the hatcheries independently (Item I3), indicating a critical gap between possessing technical skills and having the operational confidence to manage a commercial enterprise without institutional backing.

Table 11: Community Empowerment and Sustainability Capacity

Sustainability & Self-Reliance (Part I)	***Strongly Disagree (%)***	***Disagree (%)***	***Neutral (%)***	***Agree (%)***	***Strongly Agree (%)***
I1. Community is highly competitive to run projects independently	*6.25*	*12.50*	*18.75*	*25.00*	*37.50*
I2. Community is capable of sustaining operations without UiTM	*6.25*	*8.75*	*15.00*	*38.75*	*31.25*
I3. Acquired technical skills are sufficient for independent operation	*7.50*	*6.25*	*12.50*	*42.50*	*31.25*

This self-reliance deficit is further analyzed in Table 12, which measures specific community actions and dependencies. Grassroots coordination remains weak: only 37.50% of villages have established structured management schedules (Item I4a), 36.25% conduct regular community coordination meetings (Item I4b), and 37.50% actively collect community maintenance funds (Item I4c). Furthermore, only 40.00% have taken steps to train other community members independently (Item I4d). Correspondingly, dependency profiling reveals that while technical dependence is moderate

(28.75%, Item I5a), financial dependence (37.50% 'Yes', Item I5b) and marketing/supply chain dependence (46.25% 'Yes', Item I5c) remain very high, highlighting that marketing and sales are the most challenging components for community-based producers.

Table 12: Specific Community Actions and Dependencies

Action & Dependency Profiling (Part I)	*Yes (%)*	*Unsure (%)*	*No (%)*
I4a. Established structured project management schedules	*37.50*	*37.50*	*25.00*
I4b. Hold regular community-wide coordination meetings	*36.25*	*31.25*	*32.50*
I4c. Active collection of community operational/maintenance funds	*37.50*	*25.00*	*37.50*
I4d. Independently train and mentor other community members	*40.00*	*17.50*	*42.50*
I5a. Ongoing dependence on UiTM/Agencies: Technical Support	*28.75*	*22.50*	*48.75*
I5b. Ongoing dependence on UiTM/Agencies: Financial/Capital Support	*37.50*	*27.50*	*35.00*
I5c. Ongoing dependence on UiTM/Agencies: Marketing/Value-Chain Access	*46.25*	*16.25*	*37.50*

3.9 Long-Term Sustainability Challenges and Commitment

To safeguard the long-term viability of the community enterprise, the final section of the survey explored perceived challenges to independent operations. As shown in Table 13, the primary operational threat is the lack of operating capital, with 85.00% identifying it as a critical challenge (Item J1a). A lack of advanced operational skills and knowledge was also flagged as a major barrier by 85.00% of respondents (Item J1b), emphasizing that standard training is insufficient for complex, long-term commercial operations. Market instability and price fluctuations also represent a major concern for 77.50% (Item J1d). Interestingly, the lack of local community project leaders was less of a concern, with 51.25% identifying it as a barrier and 33.75% disagreeing (Item J1c), indicating that while rural leadership exists, it lacks the operational and financial tools to succeed. Despite these steep challenges, community commitment remains solid: 62.50% of stakeholders are highly committed to sustaining the project (Item J2). Furthermore, a strong majority of 63.75% are highly interested in expanding the FLP-GAPS project to new participants and neighboring communities (Item J5), demonstrating that the model's social value is deeply appreciated despite its financial hurdles.

Table 13: Long-Term Sustainability Challenges and Commitment

Sustainability Challenge (Part J)	*Strongly Disagree (%)*	*Disagree (%)*	*Neutral (%)*	*Agree (%)*	*Strongly Agree (%)*
J1a. Insufficient operational and working capital	*0.00*	*0.00*	*15.00*	*35.00*	*50.00*
J1b. Lack of advanced technical and troubleshooting skills	*2.50*	*2.50*	*10.00*	*35.00*	*50.00*
J1c. Shortage of local, dedicated community project leaders	*18.75*	*15.00*	*15.00*	*25.00*	*26.25*
J1d. Severe market instability and output price fluctuations	*1.25*	*1.25*	*20.00*	*42.50*	*35.00*
J2. Solid community commitment to ensure project continuation	*6.25*	*8.75*	*22.50*	*37.50*	*25.00*

Note: Item J5 ('Interest in expanding the project to more participants/communities') was evaluated using a categorical scale: 63.75% answered Yes (Ya), 25.00% answered Unsure (Tidak Pasti), and 11.25% answered No (Tidak) (N=80).

4. Discussion: Critical Success Factors and Implementation Gaps

To successfully translate academic-led aquaculture models into self-sustaining, community-based green enterprises, it is essential to analyze both the systemic drivers of project success and the practical challenges encountered on the ground. This section synthesizes the quantitative metrics with qualitative observations collected during the six-month commercial operations of the six Living Lab hatcheries in Sabah, outlining critical success factors and key implementation gaps.

4.1 Critical Success Factors (CSFs) of the FLP-GAPS Model

The impact study identified several primary Critical Success Factors (CSFs) that underpinned the successful launch, pandemic navigation, and commercial transition of the FLP-GAPS initiative. These factors provide a blueprint for similar university-community partnerships in emerging agricultural markets:

a. Institutional Synergy & Funding Security: The RM3.5 million grant under TERAJU's Dana Pembangunan Usahawan Bumiputera (DPUB19) provided the necessary financial cushion to survive severe macroeconomic shocks. High-level institutional backing allowed UiTM Sabah Branch to maintain research continuity, absorb pandemic-induced cost overruns, and supply high-grade technical assets to rural sites without burdening B40 households.
b. Strategic Community Partnerships & Land Mobilization: The project leveraged a unique community partnership model where six local landowners voluntarily contributed private land for hatchery construction. This land mobilization bypassed expensive commercial acquisitions and fostered deep community ownership, integrating local families directly into the project's spatial footprint.
c. Decentralized 'Living Lab' Infrastructure: The establishment of six distinct hatchery hubs across the West Coast Division (Kg. Bantayan, Kg. Ratau, Kg. Kayu Madang, Kg. Duvanson, Kg. Muhibbah, and Kg. Shabandar) created highly visible local 'Living Labs'. These labs served as operational demonstration hubs, driving community trust and lowering technical adoption barriers for surrounding rural households.
d. Establishment of KoPeKuLS as a Special Purpose Vehicle (SPV): A major governance success of the project was the creation of the Koperasi Pembangunan Komuniti Usahawan Lobster Sabah Berhad (KoPeKuLS). This formal cooperative structure aggregates small-scale rural micro-producers, providing them with legal recognition, collective bargaining power, and a structured vehicle to access broader national market channels independently.
e. Adaptive Technical Interventions: Recognizing water pressure deficits in rural villages, the project team deployed engineering solutions, including customized water boreholes ('boring systems'). These water systems stabilized hatchery operations and provided clean water to the surrounding villages, greatly boosting community-wide goodwill and support.

4.2 Primary Implementation Gaps and 'Pain Points'

While the FLP-GAPS project achieved notable technical milestones, qualitative analysis of survey comments and operational audits revealed severe, persistent challenges. Addressing these 'pain points' is critical to ensuring the long-term survival of the cooperative model once university oversight is fully removed:

a. Severe Rural Basic Infrastructure Deficits: Hatchery operations were frequently disrupted by unreliable rural basic infrastructure. Extreme water pressure drops and unstable electricity supplies directly threatened the life support systems of the freshwater lobsters, which require continuous water aeration and stable thermal conditions. Unpaved rural roads also limited logical access, increasing transport times and mortality rates for live products.
b. The 'Subsidy Mentality' and Self-Reliance Hurdles: A major cultural barrier was the persistent 'subsidy mentality' among some participants. Accustomed to government-led assistance programs, several direct beneficiaries struggled to transition from passive grant recipients to active, self-financing entrepreneurs. This dependency explains why only 37.5% of villages actively collect maintenance funds or run structured management schedules independently.
c. Strict Regulatory Bureaucracy (MyGAP Certification): A major operational bottleneck was navigating the highly stringent and slow-moving Malaysian Good Agricultural Practice (MyGAP) certification process managed by the Department of Fisheries. The rigid standards and lengthy approval bureaucracy delayed the commercial sale of freshwater lobsters, leaving micro-producers unable to access formal retail and export markets during critical periods.
d. Disruptive Pandemic Shock and Budget Reallocations: The onset of the COVID-19 pandemic during the project's launch in March 2020 forced the team to adjust its business model and divert scarce financial resources. Delays in

milestone completions led to tight operational budgets, forcing the university to scale down planned technical assets and hatchery capacities to stay within budget boundaries.

e. Land Tenure Security Restrictions: For many B40 participants, the lack of private land around their residences represented a major barrier. Since hatchery installations rely on the generosity of the six land contributors, individual participants could not expand production capacities near their own homes, stifling micro-scale household-level economic expansion.

5. Policy and Practical Recommendations

To scale green social enterprises successfully and secure their long-term viability, several key policy adjustments and strategic interventions are proposed for state authorities, higher education institutions, and funding bodies:

a. Gazettement of Dedicated Rural Agricultural Parks: State and district offices must play an active role in gazetting dedicated agricultural parks (Taman Pertanian Komuniti) equipped with commercialization centers in rural sub-districts. This spatial planning ensures secure land tenure for landless B40 households and provides stable infrastructure, such as dedicated water and electricity grids for high-tech micro-farming.

b. Direct Startup Funding Pathways for University Spin-offs: To bridge the gap between academic technology transfer and commercial startup operations, funding agencies like TERAJU and state ministries should channel research-to-community startup capital directly to university-born spin-off companies and community cooperatives (such as KoPeKuLS). This bypassed commercial financing hurdles, allowing micro-ventures to scale up and transition from 'proof-of-concept' into competitive SMEs.

c. Streamlining Halal and MyGAP Certification Bureaucracy: State agencies and the Department of Fisheries must establish fast-track, simplified compliance lanes for micro, nano, and pico-scale rural producers seeking Halal and MyGAP certifications. Providing dedicated on-site audit support and lowering regulatory fees will enable small-scale farmers to access high-value national and global supermarket chains.

d. Establishment of rural 'Sandbox Outlets' and Mentorship Hubs: Instead of centering creative and technical sandboxes in major urban centers, state governments should fund localized, rural 'Sandbox Outlets' in remote villages. These centers should be staffed by dedicated technical coaches and mentors who can provide hands-on troubleshooting, business advice, and active matchmaking with downstream buyers, smoothing the community's transition to self-reliance.

6. Conclusion

The impact study of the RM3.5 million FLP-GAPS community project highlights the immense potential of green, community-based social enterprises to uplift rural B40 and hard-core poor households in Sabah. By integrating high-value freshwater lobster rearing with ecological vertical aquaponics, the initiative successfully delivered robust economic, educational, and environmental benefits to 80 direct stakeholders and six rural villages. Despite facing steep logistical, infrastructure, and cultural obstacles, including water supply disruptions, the 'subsidy mentality', and complex regulatory certification procedures, the community demonstrated high resilience, culminating in the historic formation of the KoPeKuLS cooperative as a long-term commercial exit strategy. Ultimately, the critical success factors identified in this study—strong institutional collaboration, community land mobilization, decentralized Living Labs, and cooperative governance—demonstrate that university-led technological transfer can build resilient, independent green agricultural ecosystems. To fully realize this vision, policymakers must complement technical training with targeted land gazettement, streamlined certification pathways, and rural commercialization sandboxes. In doing so, sustainable, technology-driven agriculture can serve as a cornerstone of socio-economic empowerment and regional food security, supporting Sabah's development goals and charting a clear path toward poverty eradication.

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