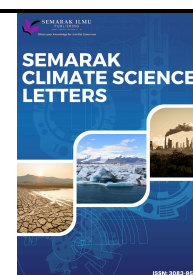




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Exploring Underutilised Crops for Food Security and Economic Resilience: Insights from the ASSESSCROP Project's Pilot Community Intervention

Advina Julkifle^{1,*}, Hilda Hussin¹, Nurul 'Ain Azizan¹, Cheng Shi Hui¹, Anita Chakrabarty², Susan Azam-Ali³, Ong Sze Pheng⁴, Lim Yin Sze¹

¹ School of Bioscience, Faculty of Science and Engineering, University of Nottingham Malaysia, 43500, Semenyih, Selangor, Malaysia

² Nottingham University Business School, Faculty of Social Sciences, University of Nottingham Malaysia, 43500, Semenyih, Selangor, Malaysia

³ School of Biosciences, University of Nottingham, Sutton Bonington Campus, Nr Loughborough, LE12 5RD, United Kingdom

⁴ Department of Chemical and Environmental Engineering, Faculty of Science and Engineering, University of Nottingham Malaysia, 43500, Semenyih, Selangor, Malaysia

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ABSTRACT

In Malaysia, food and nutrition insecurity still exists, especially amongst lower-income households. Studies have shown that underutilised crops, known for their nutrient rich profile, present an opportunity to address nutrient deficiencies while potentially contributing to economic improvement. However, their adoption remains limited, due to lack of awareness and market integration. The ASSESSCROP Phase 2 project introduces a pilot community intervention programme to raise awareness about underutilised crops, enhance their adoption, and assess their impact on income levels. The intervention targeted women entrepreneurs from the bottom 40% (B40) income household to lead the transformation and market integration of underutilised crops. This paper will examine the impact of the programme on the underutilised crops adoption and participants' income levels, as well as assessing the overall feasibility of the intervention. The pilot intervention followed a mixed-method approach with six key components including entrepreneurship skills training, product development workshops and providing a support system. The pilot community intervention programme demonstrated the positive impact of promoting underutilised crops. Participants exhibited a better understanding of the value of underutilised crops, leading to improvements in their income levels and business growth. Additionally, participants reported positive changes in their lifestyle, health, and social relationships. Overall, the intervention empowered participants by enhancing their economic outcomes, business expansion, and well-being. The feasibility of the programme was also demonstrated through these positive results, with recommendations for future enhancement. This intervention had demonstrated the potential of underutilised crops to boost economic opportunities, particularly for marginalised groups. Future interventions should consider expanding the outreach to a more diverse population, addressing logistical challenges such as access to raw material, and providing additional support to caregivers. These findings offer valuable insights for integrating underutilised crops into resilient food systems and fostering sustainable food entrepreneurship.

Keywords:

Underutilised crops; adoption; income generation; entrepreneurship

* Corresponding author.

E-mail address: hbxaj1@nottingham.edu.my

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1. Introduction

Food and nutrition security remains a pressing global issue, with significant disparities evident across income groups. In Malaysia, the bottom 40% (B40) income households face acute challenges, often constrained to calorie-dense but nutrient-poor diets [1] mainly due to limited financial resources. These dietary deficiencies perpetuate malnutrition, exacerbating cycle of poverty and health-related consequences within this vulnerable group [2,3].

Underutilised crops offer a promising avenue to address these dual challenges. Known for their resilience to diverse climatic conditions and rich nutritional profiles [4–7] underutilised crops are a valuable resource for diversifying diets and reducing dependency on conventional staples. Despite their potential, these crops remain largely underrepresented in mainstream food systems. Limited public awareness, inadequate research, and weak market integration have hindered their adoption, leaving their nutritional and economic benefits untapped [8].

However, existing research predominantly focuses on the agronomic and nutritional advantages of underutilised crops, with limited attention to their integration into community-level food and economic systems. Furthermore, there is a lack of evidence on practical, scalable frameworks that demonstrate how underutilised crops can empower marginalised groups, such as B40 households, to improve food security while simultaneously boosting income.

The ASSESSCROP project was developed to address these gaps by promoting the adoption of underutilised crops as a method to improve nutrition and create economic empowerment for marginalised groups. The project consisted of two phases. In Phase 1, the project successfully demonstrated the viability of underutilised crops in enhancing dietary diversity. Building on these outcomes, Phase 2 introduces a pilot community intervention programme aimed at empowering B40 women entrepreneurs to become agents of change in their communities. By enhancing their entrepreneurial skills, these women can transform social and economic resources into thriving commercial opportunities, boosting incomes on both the micro and macro levels [9].

These women entrepreneurs, with their unique understanding of local food ecosystems and community preferences, are well-suited to spearhead this transformation. Their ability to design culturally relevant and nutritionally enriched food products increases the likelihood of community acceptance and adoption [10]. However, systematic barriers such as lack of resources, funding, training, and access to technology often limit their potential [11,12].

This study evaluated the impact of a pilot programme on underutilised crops adoption, income generation and overall programme feasibility. By combining educational outreach with entrepreneurial initiatives, the research successfully bridged a critical knowledge gap, providing actionable insights for creating a resilient and inclusive food system. The findings demonstrated the potential of such a system to address Malaysia's urban nutrition challenges while empowering B40 women entrepreneurs as catalysts for change. The study offers a practical framework for scaling similar interventions, highlighting the significance of community-driven and culturally sensitive approaches to improving food and nutrition security.

2. Methodology

2.1 Pilot Intervention Study Design, Settings and Participants Selection

The pilot study adopted a mixed-method approach combining qualitative and quantitative methods to gather insights into various aspects of the impact of underutilised crops on nutrition awareness and livelihood improvement.

The community selected for this project consisted of women entrepreneurs in the food and beverage industry residing in low-cost flats at Taman Medan Cahaya, Petaling Jaya, Malaysia. A total of 25 participants were recruited for the pilot phase based on specific criteria to ensure the appropriate participant type for the study. Inclusion criteria are that the participants are women residing in the low-cost flats at Taman Medan Cahaya, with a household income below RM 4,850 (as of 2021). They were required to be actively involved as entrepreneurs, sellers, or business owners in the food and beverage industry and voluntarily participated in the programme.

The pilot study involved the recruitment of participants, community engagement, delivery of entrepreneurial and skills training, and an income interview, carried out in collaboration with a local non-governmental organization, Women Of Will (WOW).

2.2 Pilot Community Intervention Programme Details

The pilot community intervention programme was structured into a multi-faceted approach designed to incorporate hands-on experience, skills development, and support mechanisms to equip participants with the knowledge of underutilised crops, as well as food innovation and entrepreneurship skills. The intervention components consist of the following

I. Entrepreneurship and Skills Training – The participants were offered a comprehensive entrepreneurship training aimed to equip them with essential business skills. The entrepreneurship training covered several key areas, including business management, finance literacy and marketing strategies. Alongside the entrepreneurship training, the participants received personal skills development to improve their overall capabilities in running the food and beverage business. This training included personal grooming, baking and nutrition knowledge.

II. Underutilised Crops Food Development Workshop – The food development workshop aimed to introduce various underutilised crop varieties and showcase food products with market potential using these crops. The workshop was conducted twice, each lasting approximately five hours. Each workshop included a briefing on underutilised crops such as moringa, split gill mushrooms, and lablab beans, highlighting their culinary applications, examples of marketable products, and nutritional benefits. This was followed by two hands-on training sessions focused on the preparation of products made from these underutilised crops.

III. Handbooks and Recipe Sharing – The handbooks were developed to provide participants with guide to recognise locally available underutilised crops, their culinary applications, nutritional benefits, and recipes. The participants received 1 handbook detailing the culinary applications of 60 underutilised crops available in the market, and 3 handbooks on the guide for processing and utilising moringa, lablab beans and split gill mushrooms. Additionally, 8 recipes were shared with the participants for them to try out.

IV. Capital Loan and Raw Material Supplies – A capital loan and raw material supplies were provided to support participants' business investments and trials in incorporating underutilised crop products into their business models. Each participant received a capital loan, with the requirement to repay 30% of the total amount received. The returned funds were reinvested to support community development initiatives. Additionally, raw materials were supplied to participants, along with the 8 recipes shared, ensuring that the ingredients for each recipe were provided to encourage participants to experiment with and implement the recipes in their businesses.

V. Food Innovation Competition and Recipe Book Creation – The competition and recipe book creation aimed to encourage the development of innovative underutilised crops food products. This component served as a way for participants to contribute to the knowledge-sharing strategy and collaboration. During the competition, participants presented their product innovation and received

valuable feedback from industry experts. For the recipe book creation, each participant contributed a recipe which was compiled into two recipe books. These books were distributed to participants, serving as learning tools to further enhance their skills and product development.

VI. Coaching and Technical Support – This component aimed to support the progress of the participants. The coaching sessions mainly focused on enhancing entrepreneurial skills by monitoring participants' progress and addressing any challenges they encountered in implementing their business plans. In parallel, technical support for the product development via WhatsApp group chats and individual communication, allowing for continuous guidance and problem-solving tailored to the participants' specific needs.

2.3 Data Collection Instrument

In this study, data collection was conducted through surveys and interviews to assess the impact of the intervention programme. The use of both methods enables for more holistic evaluation of the overall programme and specific activity.

2.3.1 Survey

At the beginning of the programme, participants attended an introductory briefing on the project, followed by a baseline survey. Data was collected using a close ended question in a structured questionnaire administered individually, with assistance provided to participants as it was important to ensure accurate responses. Key areas of inquiry focused on identifying the participants' business operations and income levels, providing the essential baseline data for the study.

At the beginning of underutilised crops related activities, the participant completed a General Nutrition Questionnaire. The questionnaire comprised of four sections covering Dietary Intake Recommendations, Food Groups and Classes, Food Choices and Preparation, and Diet and Weight Management. The content aligned with the Malaysian Dietary Guidelines 2020 and the Malaysian Secondary School Curriculum (KSSM) for Form 2 and Form 5 science textbooks.

During the workshop, a Likert scale survey was administered to assess the impact of the workshop on the participants. The survey covered key areas including self-assessment of cooking skills, awareness of underutilised crops, business potential and readiness for underutilised crops products, and the intent to adopt underutilised crops. Participants completed the survey before and after attending the workshop to evaluate any changes in the participants' perception, knowledge and intent.

2.3.2 Interviews

Throughout the programme the participants were interviewed monthly via phone to assess the effect of the programme on their income levels. The participants also underwent face-to-face, in-depth interviews to gain deeper insights into their personal experiences and perspective of the programme. The interview was focused on (i) changes experienced by participants and their families because of producing and selling underutilised crops products, (ii) the participants' motivation to remain in the programme, and (iii) suggestions for improving the programme experience.

2.4 Data Analysis

The quantitative data was analysed using descriptive statistics and frequency analysis. Paired t-tests were conducted to compare pre- and post-workshop survey results. All quantitative data analyses were performed using SPSS version 29. The qualitative data were analysed through thematic analysis, utilizing NVivo software to identify key themes and insights.

2.5 Ethical Approval

Ethical approval involving human subjects was obtained from the Science and Engineering Research Ethics Committee of Nottingham University Malaysia, SEREC reference AJ130323 and HH300623.

3. Results and Discussion

3.1 Demographic and General Nutritional Knowledge

Table 1 presents the demographic profile of the participants. The participants were 30 to 49 years old, and most of them completed their formal education up to the secondary school level (75%). The common household size among the participants was between 5 to 7 people. Out of all the participants, about 79% oversaw food at home, and approximately 67% were responsible for preparing food for their business. Participants mostly sold 'Baked Goods, Desserts, and Local Snacks' including cakes, octopus balls, and sweet delicacies, as well as 'Local Dishes' such as mixed rice and satay. None of the respondents have nutrition-related qualifications. Overall, the knowledge of general nutrition among the respondents can be classified as moderate (62.5%) to poor (37.5%). Similarly, Adhianata *et al.*, [13] also found that the nutritional knowledge among chefs of restaurants in Surabaya, Indonesia, was inadequate. Understanding the participants' level of knowledge is crucial, as nutritional knowledge plays a significant role in fostering a positive attitude towards a healthy diet [14]. This is particularly relevant given that most participants are responsible for meal preparation, either for their households or as part of their food-related businesses. Their knowledge and attitudes toward nutrition could significantly influence their decisions to adopt underutilised crops as part of their dietary or business practices.

Table 1

Participant demographic profile and General Nutritional Knowledge level (n=24)

| | | N | % |
|---|------------------------------|----|------|
| Age | 30-39 | 11 | 45.8 |
| | 40-49 | 8 | 33.3 |
| | 50-59 | 5 | 20.8 |
| Highest education completed | Primary school | 3 | 12.5 |
| | Secondary school | 18 | 75.0 |
| | Tertiary education | 3 | 12.5 |
| Household size | 1 | 1 | 4.2 |
| | 2-4 | 6 | 25.0 |
| | 5-7 | 15 | 62.5 |
| | >7 | 2 | 8.30 |
| The main person who prepares food at home | Self | 19 | 79.2 |
| | Spouse/partner | 1 | 4.2 |
| | Together with spouse/partner | 2 | 8.3 |
| | Other family members | 1 | 4.2 |

| | | | |
|--|--|----|-------|
| The main person who prepares food for business | Purchase from outside | 1 | 4.2 |
| | Self | 16 | 66.7 |
| | Together with spouse/partner | 5 | 20.8 |
| | Other family members | 2 | 8.3 |
| Type of food products sold | Purchase from outside | 1 | 4.2 |
| | Baked goods, Desserts and Local snacks | 12 | 50.0 |
| | Confectioneries and Snacks | 5 | 8.3 |
| | Local Dishes | 12 | 20.8 |
| | Health Foods | 2 | 50.0 |
| | Frozen Foods | 2 | 8.3 |
| | Ice Creams and Beverages | 3 | 12.5 |
| Any nutrition-related qualifications | Yes | 0 | 0 |
| | No | 24 | 100.0 |
| General Nutrition Knowledge level | Poor (scoring <51%) | 9 | 37.5 |
| | Moderate (scoring 51-74%) | 15 | 62.5 |
| | Good (scoring >74%) | 0 | 0 |

3.2 Impact on Confidence and Income

The food development workshop introduced the culinary potential of underutilised crops. Participants reported increased confidence in their cooking skills because of the workshop (Table 2). Additionally, the impact of the workshop was evident in participants' enhanced awareness of underutilised crops ($p<0.05$) and a slight improvement in their understanding of the nutritional benefits associated with these crops. Participants also indicated improved perceptions of the business potential of underutilised crop products. However, they still demonstrated limited readiness in terms of skills related to product preparation and idea development. While the intention to adopt underutilised crops in business slightly increased, participants' intention to include underutilised crops in their household dietary intake showed a slight decrease.

Table 2

Likert scale pre and post survey of underutilised crops food development workshop ($n=10$)

| | Question and Statements | Pre-Survey Mean \pm SD | Post-Survey Mean \pm SD | Sig. |
|--|---|-----------------------------|------------------------------|------|
| Self-Assessment of Cooking Skills | On a scale of 1 to 10, how would you rate your cooking skills? | 6.40 \pm 1.35 | 7.30 \pm 1.34 | 0.00 |
| Awareness of Underutilised Crops | I know what underutilised crops are. | 3.90 \pm 0.74 | 4.50 \pm 0.53 | 0.02 |
| | I understand the nutritional benefit of underutilised crops. | 3.90 \pm 0.74 | 4.10 \pm 0.74 | 0.34 |
| Underutilised Crops Product Business Potential and Readiness | I believe food products made from underutilised crops have market potential. | 4.10 \pm 0.74 | 4.55 \pm 0.82 | 0.05 |
| | I have the knowledge and skills to prepare food from underutilised crops for my business. | 3.40 \pm 0.70 | 3.70 \pm 0.67 | 0.39 |
| | I have ideas to develop food products from underutilised crops. | 3.60 \pm 0.52 | 3.60 \pm 0.70 | 1.00 |
| Intent to Adopt Underutilised Crops | I would like to add more underutilised crops to my household diet. | 4.40 \pm 0.52 | 4.30 \pm 0.48 | 0.68 |
| | I would like to add more underutilised crops to my business. | 4.00 \pm 0.67 | 4.10 \pm 0.74 | 0.73 |

Note: Statistical significance ($p<0.05$)

These findings suggest that while the workshop successfully improved participants' awareness and boosted their confidence in cooking with underutilised crops, it was insufficient to significantly increase their readiness to adopt underutilised crops in their business ventures or incorporate them into their household diets. Garcia *et al.*, [15] highlighted that while culinary interventions can improve food literacy and cooking confidence, particularly among vulnerable, low-income groups, their effectiveness in altering eating behaviours is less consistent. Nevertheless, the participants' belief in the market potential of the underutilised crops shows opportunities for further investment in the production of underutilised crop products as an income source [16]. Additional workshop sessions may need to be included to ensure the impact becomes evident. This finding is consistent with participants' feedback, as they expressed a strong interest in more cooking classes, aligning with the discussion in Section 3.5 Recommendations for Programme Enhancement.

The average monthly income of the participants is presented in Figure 1. The figure displays two graphs representing two groups of participants: one group ($n=14$) had incorporating underutilised crops into their business model after the first workshop and another group ($n=10$) not incorporating underutilised crops. On baseline, the average income of participants ranged from RM 88 to RM 100. All the participants show a gradual increase in income over time. This suggests a positive impact of the entrepreneurship training interventions towards their income. Such programmes are vital, as they equip participants with financial literacy and business management skills. Malik *et al.*, [17] highlight that high financial literacy—encompassing budgeting, cash flow management, and strategic decision-making—is strongly associated with enhanced revenue growth.

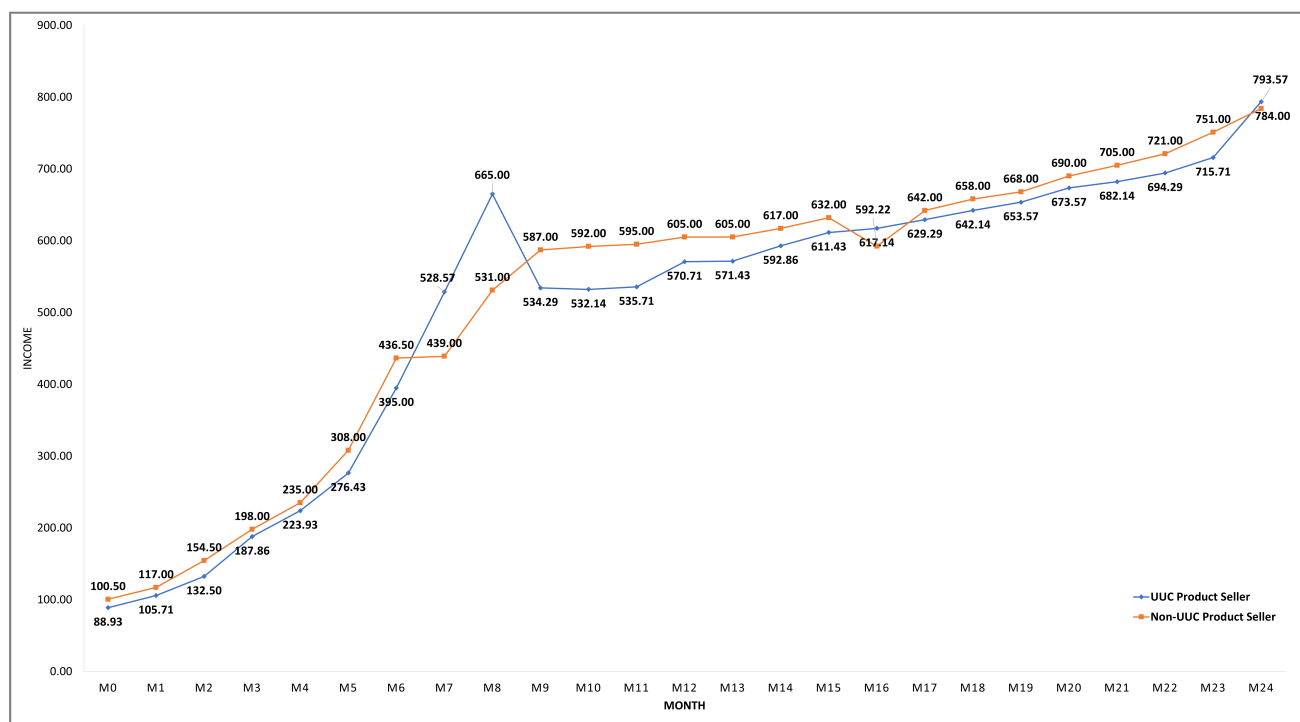


Fig. 1. Average monthly personal income of UUC Product Sellers against Non-UUC Product Sellers from baseline to 24 months of intervention programme

A sharp increase was observed in the UUC Product Seller group after Month 6, potentially due to the market traction gained by underutilised crops products as the product was made and sold more consistently over a longer period. However, the income level for this group experienced a drop compared to the Non-UUC Product Seller group. The decrease in income could be attributed to the difficulty in sourcing raw materials and the higher production costs, as the expenses for raw materials

can be high. For example, fresh split gill mushrooms in the market can sell for up to RM 75 per kilo, while fresh butterfly pea flower can go up to RM 200 per kilo. A community engagement initiative in Kecamatan Grati, Pasuruan Regency, Indonesia, highlighted that sourcing raw materials was a significant challenge for the micro, small, and medium enterprises in the food and beverage sector [18]. Despite the decline, the income of the UUC Product Seller group continued to grow in the subsequent month. Meanwhile, the Non-UUC Product Seller group showed steady income growth throughout the programme possibly due to the established market demand for their existing products.

These findings suggest that integrating underutilised crops with value addition could expand business opportunities while diversifying income streams by meeting consumer expectations for high-quality products [16]. Similarly, an initiative in Palopo, South Sulawesi, that empowered farmers to develop local snacks and drinks using local ingredients has led to a significant rise in income by enabling new market access [19]. Furthermore, marketing underutilised crop products in urban areas presents a greater opportunity as urban consumers value underutilised crops for their health benefits, authenticity, safety, and seasonality [16] [20]. Nevertheless, further investigation and trials are required to improve production efficiency to support sustainable growth.

3.3 Participant Experiences and Transformations

Figure 2 presents the results of the changes experienced by participants because of producing and selling underutilised crops food-based products. The diagram categorises these changes into two main themes: (1) Positive Change; and (2) Negative Change. The positive change represents the beneficial outcomes experienced by the participants, whereas the negative change highlights the challenges and adverse effects encountered in their business endeavors.

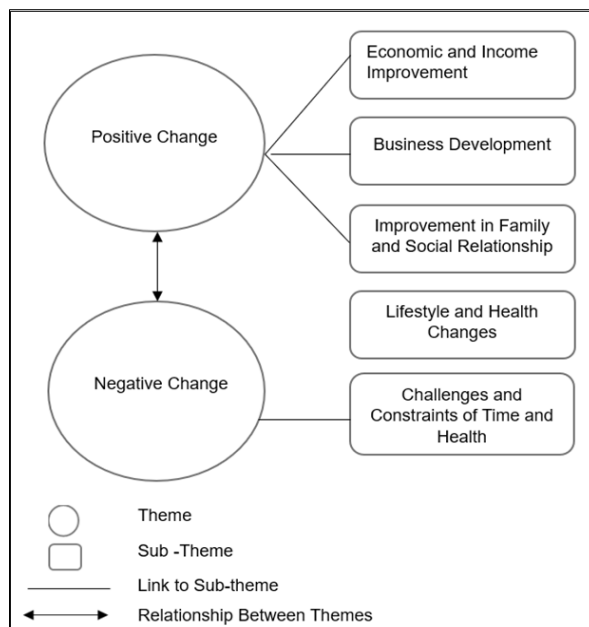


Fig. 2. Changes experienced by participants from producing and selling underutilised crops food-based products

Theme 1: Positive Change

There are three sub-themes identified under this theme: (1a) Economic and Income Improvement; (1b) Business Development; and (1c) Improvement in Family and Social Relationship Harmony. Participants reported an improvement in their economic situation, attributed to increased crop sales and product diversification, which subsequently contributed to the development of their business strategies and expansion. In this programme, the participants were introduced to a variety of underutilised crops, including moringa, which were not culturally familiar to them. However, they successfully produced a range of food products, such as moringa buns, moringa ice cream, moringa cake, and moringa *nasi lemak*. This suggests that despite their unfamiliarity with these crops, the participants' innovations could help enhance their acceptance. While traditional and underutilised crops are often deeply tied to cultural backgrounds [6]. However, some of these crops lack such connections and could benefit from innovative food products that resonate with local communities, thereby enhancing their acceptance [21]. Badriyah *et al.*, [18] also highlighted the importance of community-based interventions in the food sector for enhancing skills and knowledge, improving product quality, adding value, expanding markets and ensuring business continuity for micro-, small- and medium scale businesses. Furthermore, participants indicated that their involvement in the business fostered stronger social connections and enhanced family dynamics, often resulting from collaborative efforts or improved living conditions. Molina [22] explained that family dynamics and entrepreneurial motivation are interconnected, with motivation being either necessity-driven or opportunity-driven, both influencing and benefiting from family relationships. Presented below is a sample of statements provided by the participants

I.Sub-theme 1a - Participant No. 17:

"Income has increased, and I am able to save money, which is different from before."

II.Sub-theme 1b - Participant No. 20:

"There is less business competition, and customers are increasing because there are more products."

III.Sub-theme 1c - Participant No. 19:

"Family relationships have improved because of the increased income."

Theme 2: Negative Change

Regarding the negative change, participants reported experiencing undesirable situations, which can be categorized into two sub-themes: (2a) Lifestyle and Health Changes; and (2b) Challenges and Constraints of Time and Health. Participants shared that their routines had changed, often resulting in a negative impact on both their physical well-being and family dynamics. This suggests that underutilised crop production may demand significant time investment, which could lead to adverse health outcomes. If these challenges persist, they may further affect participants' health and family relationships. To mitigate these issues, participants must take proactive steps, such as adopting ergonomic work practices and implementing effective time management strategies. For example, Beheshti *et al.*, [23] recommended including introducing ergonomic workstations and wheeled carts, training individuals in proper posture and load handling, implementing rest cycles and stretching exercises to reduce the risk of musculoskeletal disorder. These strategies can help prevent discomfort and promote long-term well-being. Presented below is a sample of statements provided by the participants:

I.Sub-theme 2a - Participant No. 17:

"Less time with the children and family because of being busy."

II.Sub-theme 2b - Participant No. 12:

"My feet ache quickly because of standing a lot."

3.4 Factors Influencing Continued Engagement

The results presented in Figure 3 illustrate the factors influencing participants' decision to remain in the programme. The programme's duration, which participants had not previously experienced, is notable. It is significant that the retention rate continues to be high, with only one participant withdrawing due to unavoidable events, specifically family transfer out of the location of the programme. The factors can be categorized into four major themes: (1) Learning and Knowledge Enhancement; (2) Experience and Programme Satisfaction; (3) Positive Impact on Business and Sense of Responsibility; and (4) Opportunities and Social Networking. These key themes collectively contribute to the overall satisfaction and effectiveness of the programme.

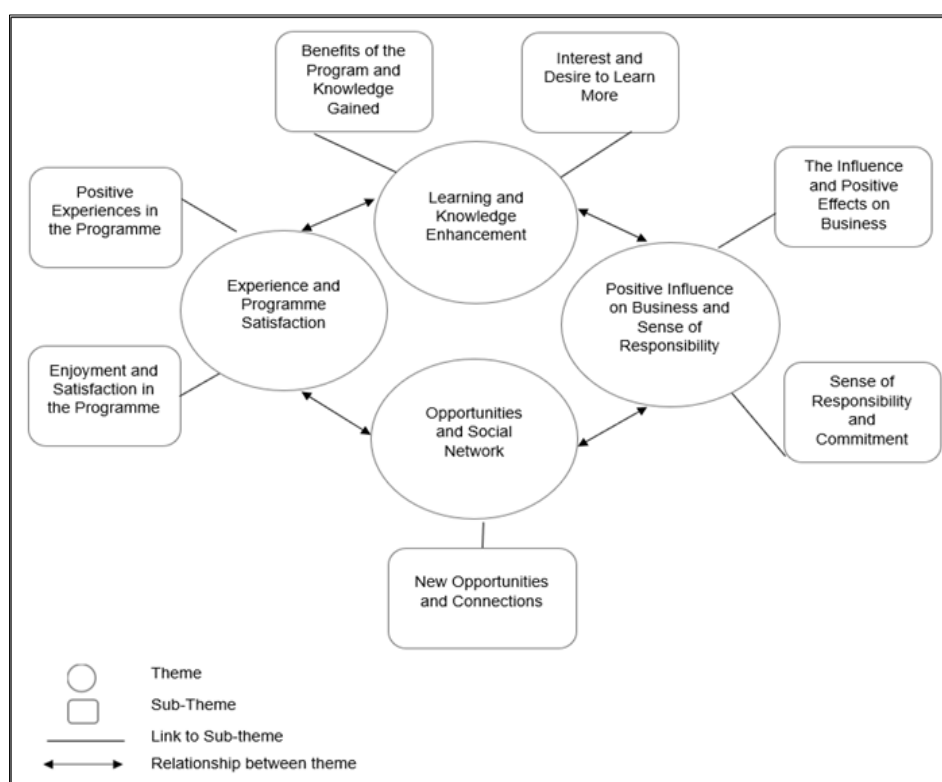


Fig. 3. Factors influencing continued participation in the programme

Theme 1: Learning and Knowledge Enhancement

Two sub-themes arise under this factor: (1a) The Benefits of The Programme and the Knowledge Gained; and (1b) The Interest and Desire to Learn More. Participants have expressed that their motivation to continue participating in the programme is driven by the knowledge and advantages they have gained. This is supported by Chen and Hung [24] where individuals become confident in their social status and values when they discover the benefits of knowledge sharing. Additionally, they demonstrate a sustained interest in underutilised crops, indicating that the programme not only enhances their knowledge but also aligns with their personal interests. Moreover, participants view

the programme as a valuable activity that contributes positively to their lives, further reinforcing their commitment to continued involvement. Presented below is a sample of statements provided by the participants

I.Sub-theme 1a - Participant No. 19:

"I have gained a lot of new knowledge and experience."

II.Sub-theme 1b - Participant No. 13:

"I want to learn more about underutilised crops. Additionally, with this programme, I have activities to engage in."

Theme 2: Experience and Programme Satisfaction

This theme encompasses two sub-themes: (2a) Positive Experiences in The Programme; and (2b) Enjoyment and Satisfaction with the Programme. Participants have expressed that their positive experiences and enjoyment derived from the programme have contributed to their decision to remain involved. They perceive the programme as unique, offering opportunities that few others have had the chance to experience. Furthermore, the programme meets participants' needs by providing them with a platform to exchange ideas with others, which contrasts with their usual routine of working independently in home-based businesses. This social interaction is particularly valuable, as it allows them to expand their perspectives beyond their solitary work environment. The presented below is a sample of statements provided by the participants

I.Sub-theme 2a - Participant No. 8:

"I feel happy because not everyone gets an opportunity like this."

II.Sub-theme 2b - Participant No. 11:

"I feel happy as I get to exchange ideas with other participants."

Theme 3: Positive Influence on Business and Sense of Responsibility

Two sub-themes emerged from this theme: (3a) The Influence and Positive Effects on Business; and (3b) The Sense of Responsibility and Commitment. Participants emphasised that the programme significantly influenced their business practices, motivating them to remain engaged and actively participate in the programme. Additionally, they highlighted that their continued involvement was driven by a strong sense of responsibility and commitment. This sense of obligation stemmed from their recognition of being selected participants, which reinforced their dedication to fulfilling their roles and contributing to the programme's success. Presented below is a sample of statements provided by the participants

I.Sub-theme 3a - Participant No. 21:

"Being able to expand the business by using unique food that has not been recognised by others."

II.Sub-theme 3b - Participant No. 12:

"The sense of responsibility and commitment as a participant gives motivation to continue joining the programme."

Theme 4: Opportunities and Social Network

Under this main theme, only one sub-theme was identified: (4a) New Opportunities and Connections. Participants highlighted that the programme served as an effective platform for social networking. Despite residing in the same residential area, many participants had never met or interacted with one another prior to the programme. The initiative successfully facilitated opportunities for participants not only to build connections with each other but also to engage with experts through the training sessions and workshops organized as part of the programme. Presented below is a sample of statements provided by the participants

I. Sub-theme 1a - Participant No. 16:

"The activities in the programme provide an opportunity to meet and get to know new people."

3.5 Recommendations for Programme Enhancement

Figure 4 illustrates the participants' recommendations for enhancing the programme, which resulted in the emergence of four main themes: (1) Organizing Promotion and Education on Underutilised Crops; (2) Conducting Cooking Activities and Underutilised Crops Competitions; (3) Implementing Marketing and Product Development; and (4) Managing Administration and Ensuring Programme Discipline. The recommendations focus on improving the programme in the future and increasing its overall quality. They emphasised the need for greater awareness and education on underutilised crops, engaging activities such as cooking and competitions to promote these crops, the development of robust marketing strategies and product innovation, and the importance of streamlined administration and adherence to programme rules for better overall management

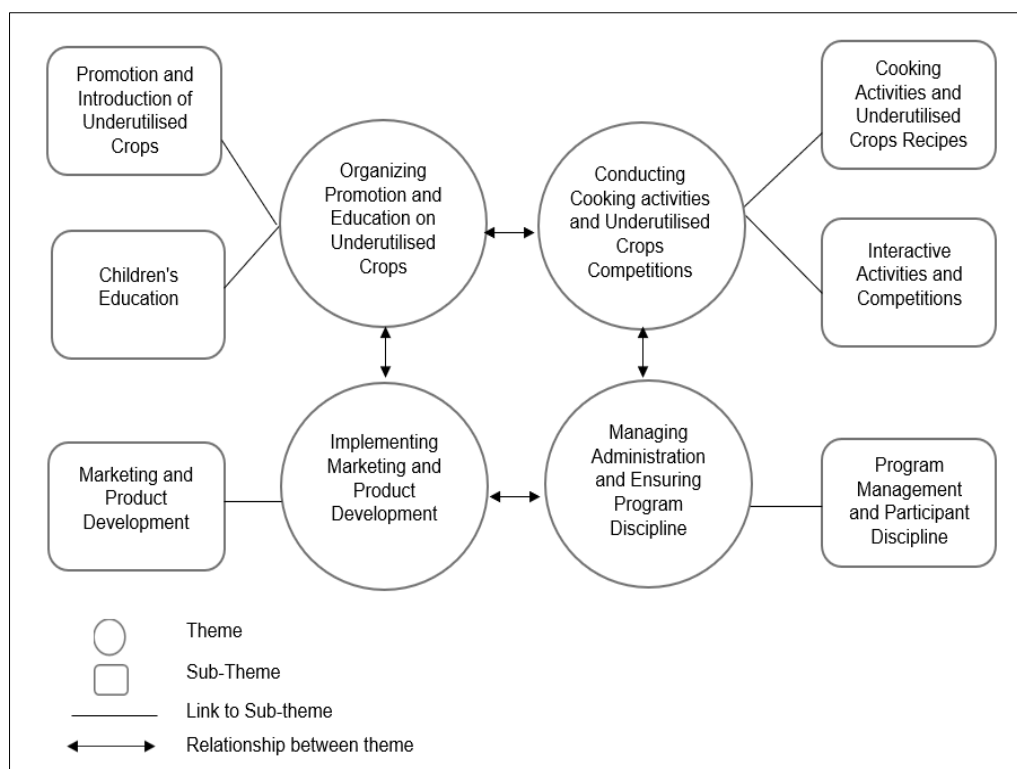


Fig. 4. Programme enhancement recommendations based on participant input

Theme 1: Organising Promotion and Education on Underutilised Crops

Two sub-themes were identified under this theme: (1a) Promotion and Introduction of Underutilised Crops; and (1b) Children's Education. These sub-themes emphasise the participants' recommendations to expand the programme's promotional efforts to reach a broader audience. Specifically, participants suggested increasing efforts to engage children and the surrounding community to raise awareness and familiarity with underutilised crops. By educating children and potential customers, the programme can foster greater understanding and appreciation of these crops, thereby enhancing their acceptance and usage within the community. Presented below is a sample of statements provided by the participants:

I.Sub-theme 1a - Participant No. 11:

"We introduce it to outsiders or the local community because, until now, the community has not been aware of what underutilised crops are, so they can learn about them and become interested in purchasing the products sold."

II.Sub-theme 1b - Participant No. 15:

"Underutilised crops need to be promoted from an early stage, starting with kindergarten children. Include underutilised crops in kindergarten textbooks so that they are familiar with these plants from a young age."

Theme 2: Conducting Cooking activities and Underutilised Crops Competitions

Another set of recommendations falls under the following sub-themes: (2a) Cooking Activities and Underutilised Crops Recipes; and (2b) Interactive Activities and Competitions. Participants expressed a desire for additional activities, such as cooking classes and competitions, which they believe would strengthen their engagement with underutilised crops. They also highlighted the need for more recipes tailored to their cultural background and preferences, such as Malay cuisine, desserts, or dish-based recipes. While the programme provided a variety of recipes to encourage diversification, participants suggested expanding the range further to offer greater choice and appeal. Presented below is a sample of statements provided by the participants:

I.Sub-theme 2a - Participant No. 12:

"Add cooking classes and teach traditional Malay recipes."

II.Sub-theme 2b - Participant No. 6:

"Organise competitions after participants try the provided recipes. This way, everyone will make the recipes."

Theme 3: Implementing Marketing and Product Development

Marketing and Product Development. Participants emphasised the importance of acquiring up-to-date skills necessary for becoming innovative food business entrepreneurs. They suggested that the programme includes training on creating effective content to enhance their business, such as leveraging social media platforms. This finding is relevant as social media, and digitalisation has been shown to improve business growth [25–27]. Lestari *et al.*, [28] demonstrated that 76% of SME respondents used social media for marketing, with WhatsApp and Instagram being the most impactful platforms, effectively increasing sales, broadening customer reach, and providing cost-effective tools for small businesses to compete with larger corporations. By equipping participants

with these skills, the programme can provide them with a significant advantage in reaching a broader customer base beyond their immediate area, thereby increasing the potential for business growth. Presented below is a sample of statements provided by the participants:

I.Sub-theme 3a - Participant No. 20:

"Conduct classes where participants are taught to become content creators with the aim of promoting underutilised crop products on social media."

Theme 4: Managing Administration and Ensuring Programme Discipline

The final sub-theme identified is (4a) Programme Management and Participant Discipline. Participants recommended implementing stricter management measures for those who fail to make an effort to attend the programme consistently. They observed that some participants frequently provided excuses for their absence, which created dissatisfaction among the more committed participants who actively engaged in fulfilling the programme activities. This lack of commitment from certain individuals hindered the development of a cohesive and strong group dynamic, leading to frustration among dedicated participants. As such, stricter enforcement of participation and accountability was suggested to improve group cohesion and overall programme effectiveness.

I.Sub-theme 4a - Participant No. 6:

"We noticed a problem with the participants. They are reluctant to cooperate, so the organisers should be firm to ensure participants comply with the programme."

4. Challenges, Limitations and Future Recommendations

The programme faces two key challenges, mainly due to geographical and personal constraints. The first challenge arises from participants being located far from the programme organisers, which limits opportunities for regular visits, personalized support, and effective monitoring. This distance reduces communication and oversight, making it harder to maintain consistent engagement. The second challenge relates to participants' personal and lifestyle factors, including time limitations, family responsibilities, health issues, and work or business commitments. This constraint hinders their ability to fully participate in programme activities, such as workshops and competitions, and restrict their involvement in events outside their local communities, ultimately affecting the programme's reach and effectiveness.

To address these issues effectively, a well-rounded and flexible strategy is essential to ensure participants can fully benefit from the programme and maximize its advantages. For the geographical challenge utilizing digital resources like video calls, progress-tracking applications, and recorded meetings can offer adaptable choices for communication, assessment, and involvement. These tools would enable participants to take part in activities and workshops from a distance, minimizing the necessity for regular travel. Meanwhile, for the individual and lifestyle difficulties, the programme can offer adaptable scheduling and different participation options to fit diverse time limitations and obligations. Providing sitter allowances for caregivers, especially those caring for children or elderly relatives, could reduce the participants' responsibilities. Creating peer support networks in the community can promote collaboration and sharing of resources, alleviating individual burdens.

This programme had two main limitations: the small sample size and the lack of ethnic diversity. The sample size was relatively small, which limited the statistical power of the analysis. Increasing the sample size in future iterations would strengthen the reliability and generalizability of the results.

The limitation in ethnic diversity arose from the voluntary nature of participant recruitment, which resulted in a homogenous sample primarily from a single ethnicity. This lack of diversity potentially restricted the range of food styles and perspectives represented. Future studies should aim to reach a more diverse audience, representing the full spectrum of ethnic groups in Malaysia. This would ensure a more comprehensive understanding of the various food traditions and cultural perspectives across the country.

In future studies, to measure the impact of the overall intervention, it could also include pre- and post-intervention surveys and focus group discussions. Additional key metrics should include sustainability and long-term adoption by tracking participants' continued application of the knowledge gained, adoption of innovative products, and the maintenance or growth of their businesses over time. This approach will provide a comprehensive understanding of the programme's effectiveness and its lasting impact on participants and communities.

5. Conclusions

This study highlights the significance impact of the intervention on promotion of underutilised crops. Participants experienced an increase in income level from the intervention and a boost when underutilised crops were introduced. Participants demonstrated a better understanding of the value of underutilised crops, with a notable improvement on their business ventures. Beyond financial benefits, the participants also reported positive outlook on their lifestyles, health, and social and family relationships. Overall, the pilot intervention study empowered participants by promoting the adoption of underutilised crops, resulting in notable improvements in their economic outcomes, business expansion, and personal well-being. The feasibility of the programme was also demonstrated through these positive outcomes, while highlighting areas for future enhancement to strengthen the programme.

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