Research Article

# Improvement Model Framework of Urban Agriculture Program in Malaysia: PLS-SEM Analysis

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**Abstract** | The Malaysian government has introduced the Urban Agriculture Program to improve the performance of urban and rural agriculture in Malaysia. The Urban Agriculture Program was implemented by the Department of Agriculture (DOA), Malaysia in 2010. Such agricultural extension programs may significantly affect the effectiveness of adopting urban agriculture practices, which eventually help the participants with better living standards and productivity. This study aims to evaluate the effectiveness of urban agriculture programs. Primary data was collected from 230 urban agriculture program participants registered under the DOA Malaysia. The data was analysed using the PLS-SEM analysis method with the help of SMART-PLS software version 3.0. Findings revealed a positive association between all CIPP factors and Effectiveness. These findings showed that the DOA should prioritise process and product as the agriculture extension provider (stakeholders). This study suggests that policymakers should improve the implementation of urban agriculture programs in context, input, process, and product at a community level to improve food security and nutrition by 2030.

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## Introduction

Urban agriculture has gained prominence in Malaysia to address food security and nutrition challenges from urbanisation and globalisation. The Ministry of Agriculture and Food Security (MAFS) Malaysia, has introduced Urban Agriculture program (UAP) and the Department of Agriculture (DOA) has launched the program aimed at mitigating the issue of land shortage, while simultaneously encouraging urban residents to engage in agriculture as a means of augmenting both food production and income. The program is set and is designed to address the challenges of urban agriculture, which has the potential to play a critical role in meeting the world's growing food demands. Through this program, the DOA is seeking to incentivize city dwellers to take up farming, and will provide guidance on best practices, as well as technical assistance, to ensure the successful implementation of this initiative. The Department of Agriculture (DOA) Malaysia is pivotal in supporting and implementing the Urban Agriculture Program.

The Urban Agriculture Division operates under the Department of Agriculture (DOA) and was founded in 2010. Its primary objective is to reduce the cost of living and help households in urban areas earn additional income. The program comprises different categories, such as individual and community-based projects, as well as institutional partnerships. Integrating agriculture into urban planning is essential for sustainable development and to address the diverse needs of urban areas.

Despite its potential benefits, the urban agriculture program in Malaysia faces challenges. These encompass limited access to suitable land, capital, and efficient irrigation systems. Moreover, the reliance on food imports also heightens the importance of establishing a robust urban agriculture system. Other challenges include legal frameworks, stakeholder coordination, and the necessity for well-considered planning and implementation strategies. The significance of the urban agriculture program is profound, as it holds the potential to address food security concerns, improve access to locally produced food, and mitigate the multifaceted impacts of rapid urbanisation (McClintock, 2010; Mougeot, 2005; FAO, 2018). With Malaysia's urban population steadily increasing, urban agriculture becomes crucial in ensuring a sustainable and resilient future.

Malaysia's Urban Agriculture Division empowers urban communities by enabling and supporting urban agricultural activities. By promoting agriculture, reducing the cost of living, generating additional revenue, and upholding food safety and quality, urban dwellers are inspired to create a sustainable and prosperous future.

The department of agriculture is crucial in advancing urban agriculture through several key functions. Firstly, it manages the planning, coordination, implementation, and monitoring of various programs and activities within urban areas (DOA, 2023). Additionally, the Department is committed to endorsing and applying pertinent agricultural techniques specific to urban environments. It provides essential advisory services, technical assistance, consultations, and relevant training in urban agriculture. To ensure effective reporting and data management, the Department oversees developing and regularly updating information on urban agricultural activity.

In the context of urban agriculture programs, the Department conducts extension activities that encompass advisory services to ensure quality and effective support to the urban community. It also provides training and courses that facilitate transferring technological insights based on project methods. The Department also employs demonstrations to enable effective learning by combining theoretical knowledge with practical application. Finally, it employs exhibitions to promote urban agriculture, fostering interest and engagement in farming practices.

The Urban Agriculture Program (UAP) is an agricultural extension program supported and established by the Department of Agriculture (DOA). The Department of Agriculture (DOA) provides agricultural extension and development services while the Urban Agriculture Program (UAP) disseminates appropriate knowledge and utilises extension workers to transfer technology to urban farmers .The extension activities that the DOA has carried out to the urban agriculture community include consultation, courses and training, demonstration, and exhibition (DOA, 2023). Effective agricultural extension services rely on technically competent staff to disseminate modern production technologies to farmers, thereby boosting productivity (Jamil *et al*., 2023).

In addition, extension programs are sets of actions to achieve outcomes for specific groups (Sanchez, 2016). The development of agricultural extension programs involves a continuous and interconnected series of processes (Wahab *et al*., 2023). Program development involves assessing farmer needs, selecting appropriate methods, managing delivery, monitoring processes, and evaluating results (Tiraieyari *et al*., 2010). These assessing processes are part of the program evaluation.

An extension program is a set of carefully defined goals intentionally designed after thorough study of the situation, to be achieved through extension teaching activities (Leagans, 1961). Meanwhile, Lawrence and Roger (1974) described an extension program as encompassing all the activities and efforts of a county extension service, including program planning, written program statements, work plans, program implementation, results, and evaluation. These programs and course materials are aimed to foster a dedicated agricultural community and ensure food security. Collaboration between agriculture agencies, particularly the Department of Agriculture (DOA), and community leaders is essential to tailor programs to their needs. Each program should be comprehensively evaluated.

Evaluating the performance of the Urban Agriculture Program (UAP) can be challenging, both during and after the course. It is recommended that the program be evaluated four to five years after participants have completed the program. This evaluation should measure the impact on the participants' knowledge, skills, and production, and whether knowledge was transferred to the communities. Conducting evaluations is a great way to discover areas where we can improve. It also ensures that our program is meeting the needs of the agricultural industry and supports our country's mission to enhance food security.

*Literature review*

Malaysia has recently embraced the urban agriculture program as a strategic approach to ensure food security and nutrition by 2030, as rapid urbanisation and globalisation trends drive population growth in urban areas. Several studies have investigated various aspects of urban agriculture in Malaysia, including its importance, factors influencing urban residents' participation, and strategies for expansion. This discussion synthesis the findings of these studies while acknowledging their respective sources.

Tiraieyari *et al*. (2019) conducted a study to examine the relationship between Theory of Planned Behaviour (TPB) predictors and volunteering in urban agriculture. In addition, they investigated community perceptions and participation in urban agriculture activities among 200 participants hailing from residential areas situated in Kuala Lumpur, Putrajaya, and Shah Alam, Malaysia. In parallel, Ibrahim (2018) embarked on a quantitative study among 1365 urban residents in Klang Valley, Malaysia, to identify the factors that influence their intention to partake in urban agriculture.

Additionally, Ramaloo *et al*. (2018) emphasised the value of community agriculture in promoting dietary diversity, strengthening food security, boosting food quality, and enhancing the standard of living for urban households. They engaged with fifteen community members in Penang, Malaysia, through in-depth interviews and observations as part of a qualitative investigation. Simultaneously, Ngahdiman *et al*. (2017) investigated the reasons why city people choose to engage in urban agriculture, concentrating on stratum homes in Putrajaya, Kuala Lumpur, and the Putrajaya perimeter. Similarly, Rezai *et al*. (2016) conducted a quantitative study with 360 households in Putrajaya, Malaysia, and found a positive statistical correlation between urban gardening and obtaining enough food and maintaining good nutrition.

Even with these enlightening findings, there is still a definite need for more investigation and evaluation, especially with regard to the urban agricultural programmes that Malaysia's Department of Agriculture has started. A proposal by Yusuf *et al*. (2022) asks for a thorough evaluation of the Malaysian Department of Agriculture's (DOA) urban agriculture programme and its participants. Examining how well it conforms to the constantly changing needs of the agriculture industry is the goal. In addition, the manual for developing modules, as presented by UTHM (2011), suggests that the first group of programme participants be evaluated on a regular basis, every four to five years. The objective of this recurring evaluation is to assess and oversee the applicability and efficiency of the program's material.

The CIPP model, developed by Stufflebeam (1983), provides a framework for effective evaluation planning by considering context, input, process, and product. This model's primary goal is improvement through CIPP evaluations. It comprises four interrelated components: context, input, process, and product, prioritizing meaningful insights for decision-makers.

Several studies have used the CIPP model to evaluate agriculture programs. Gurning *et al*. (2019) used the CIPP model to evaluate the performance of agribusiness microfinance institutions in Gunungkidul district, Indonesia. Their evaluation indicated that the Rural Agribusiness Development Program performed well and met the criteria set by the CIPP model. Apart from that, Man (2010) employed the CIPP model to evaluate the Women Economic Development (WEDA) program in Sarawak, Malaysia, focusing on women entrepreneurs involved in agricultural activities. The study identified both strengths and weaknesses of the program and highlighted areas for improvement in income diversification and business development.

Additionally, Ishak (2019) used the CIPP approach to evaluate the My Kampung My Future (MKMF) programme in Malaysia. Their research emphasized the importance of evaluating and improving program processes to ensure long-term viability and effectiveness. Meanwhile, Muhamad and Man (2014) noted that the CIPP model's adaptability and simplicity in conducting evaluation makes it a valuable tool for monitoring and improving programs at different stages.

Additionally, Khanson *et al.* (2015) used the CIPP model to evaluate the operational success of weavers' community enterprises in the Thailand province of Udon Thani. Their findings provided a holistic understanding of the enterprises' context, input, process, and product to guide capacity-building efforts. Alibaygi *et al.* (2011) assessed the "Facilitating Transfer of Research Findings Project" from the viewpoint of Iranian farmers in the Kermanshah province using the CIPP model. Their study indicated that although the project was moderately success, there was room for improvement in various dimensions, including context, input, process, and product.

Beyond that, agricultural extension services are essential for sharing knowledge and technology to improve agricultural productivity and incomes for communities worldwide (Yusuf *et al.*, 2021). Evaluating these programs can be difficult due to different perspectives and conclusions. Evaluation involves setting objectives, designing evaluation, and systematically analysing outcomes and impacts.

Some studies suggest a positive correlation between agricultural extension and farm productivity, while others compare farmers with and without access to extension agents. Government policies, incentives, and funding greatly influence the effectiveness of extension services, which is becoming increasingly important as budgets shrink and demands accountability grow.

In Malaysia, the Department of Agriculture oversees urban agriculture and aims to provide agricultural extension services based on Good Agricultural Practices (GAP). The Urban Agriculture Division's focus on promoting agriculture in urban communities and has been ongoing for over a decade and requires regular monitoring and evaluation to ensure its relevance and impact. In particular, this paper highlights the significance of assessing and refining the impact measurement of agricultural extension programmes for Malaysian urban agriculture.

In summary, the CIPP model has demonstrated its effectiveness in evaluating and enhancing agriculture programs in different settings and at different stages of implementation. Its adaptability and capacity to offer valuable insights for program improvement make it a crucial resource in the evaluation of agricultural programs. Hence, it is imperative to use this model to draw the attention of stakeholders towards enhancing the urban agriculture program in the urban garden community in Malaysia. By delineating the constructs that can comprise an evaluation model for the implementation of urban agriculture activities, this study contributes to the body of knowledge.

*Model of CIPP evaluation*

This research has used the CIPP (Context, Input, Process, Product) Evaluation Model, which was first created by Stufflebeam (1983). This decision is supported by several factors:

**Comprehensive evaluation framework:** The CIPP model provides a comprehensive framework for evaluating any educational programs, which is especially important for complex programs like the UA (Urban Agriculture) program. It covers multiple dimensions, including the program's context, inputs, processes, and outcomes (products). This comprehensive approach is suitable for evaluating the diverse and multifaceted aspects of UA programs.

**Alignment with program goals:** The CIPP model aligns well with the goals of the evaluation, which are not to prove but to improve. This focus on improvement is crucial in extension programs like UA, where the goal is to enhance the knowledge and skills of participants. CIPP helps in identifying areas for improvement in each phase of the program.

**Applicability in different contexts:** The research cites various studies from various fields, including agriculture and education, that successfully used the CIPP model. This demonstrates the model's versatility and suitability for evaluating a wide range of programs, including UA.

**Emphasis on decision-making:** The CIPP model emphasizes gathering information to facilitate decision-making. In the context of UA programs, this information can be instrumental in making decisions about program continuance, modification, or termination, which is vital for program success.

**Effectiveness and impact assessment:** The CIPP model's "Product" dimension focuses on assessing the effectiveness and impact of a program. This aligns with the research's goals of evaluating the UA program's effectiveness and determining its impact on participants and the community.

**Practice-based evidence:** The model has been tested and applied in practice in various research studies, which provides empirical evidence of its effectiveness as an evaluation tool. This practical application supports its use in the research.

A part from that, the research also highlights some theoretical, research, and practice gaps in the use of the CIPP model. These gaps include:

**Theoretical gaps:** Limited application of the CIPP model in the context of agricultural extension programs, especially in urban agriculture, suggests a theoretical gap in its use. The model has primarily been applied in educational contexts.

**Research gaps:** A lack of research utilises the CIPP model for evaluating UA programs, particularly in the Malaysian context. This represents a research gap, indicating a need for more studies.

**Practice gaps:** The research identifies ambiguities in applying the CIPP model in agricultural program evaluation. This suggests a practice gap in terms of clear and standardised methodologies for using the model.

To summarize, the selection of the CIPP Evaluation Model for the research is well-founded due to its all-inclusive nature, conformity with program objectives, and workable applicability. Nevertheless, the identified shortcomings emphasize the need for further research and improvement of the model's use, particularly in the specific context of Urban Agriculture programs in Malaysia.

*Program effectiveness*

The efficiency of an organization greatly depends on the effectiveness of its program, which in turn, relies on the skills of its staff (Smith, 2015). The evaluation of program effectiveness is crucial for managing programs at all levels (Jones, 2018), and monitoring during the process is imperative (Brown, 2019). The main objective of evaluating effectiveness is to regulate the program, and identifying strengths and weaknesses can aid in program improvement (Clark, 2019). Program outcomes consider the overall impact of UA programs, such as increasing local food security through educating people on food sources and distributing produce in the area (Anderson, 2020). The UAP has helped enhance food security by distributing produce to participants and their families (Lee, 2018), ultimately leading to a healthier diet and reducing certain health problems (Garcia, 2017). Hence, the development of healthy and productive citizens contributes to national progress (Wang, 2019).

*Research hypothesis*

Ho. There is no positive relationship between context and program effectiveness

Ho. There is no positive relationship between input and program effectiveness

Ho. There is no positive relationship between process and program effectiveness

Ho. There is no positive relationship between product and program effectiveness

## Materials and Methods

*Summary of research method*

This study used a questionnaire survey to collect data quantitatively. In order to collect data, the study used cluster random sampling, contacting participants in the Urban Agriculture Programme (UAP) in Peninsular Malaysia's northern (Penang), central (Kuala Lumpur), eastern (Terengganu), and southern (Johor) regions. A comprehensively organised survey was developed and conducted through in-person meetings with active urban agriculture practitioners in their individual neighbourhoods. Throughout the process of gathering data, the Department of Agriculture provided invaluable assistance and collaboration. Following the G*Power software's recommended minimum sample size of 85, the gathered data was subjected to Structural Equation Modelling (SEM) analysis using the SMART-PLS 3 software, which resulted in the proposal of a framework model for UAP improvement. By using questionnaires, in-person interviews, and observational techniques, the study thoroughly investigated the traits of the research subject. The comprehensive approach used to conduct the study is illustrated in the research framework that is provided (Figure 1).

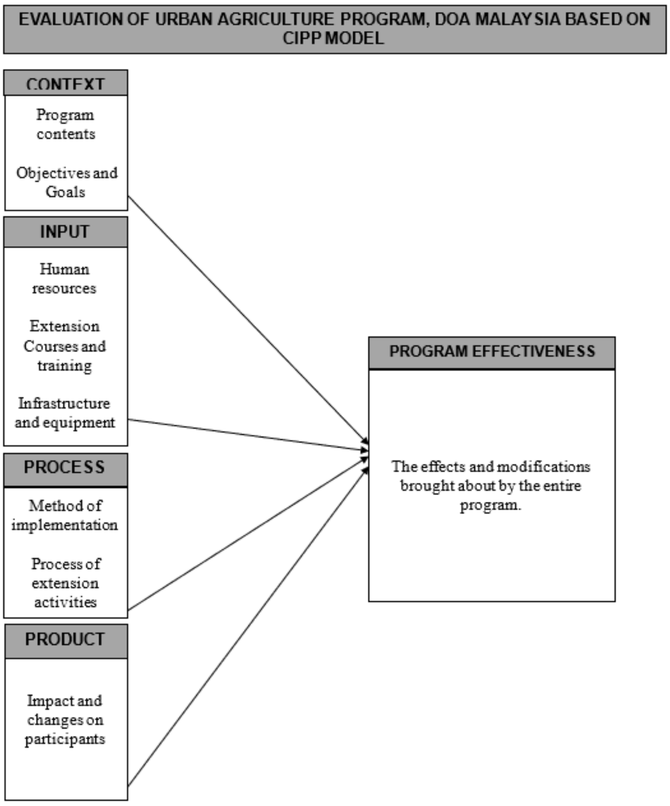


**Figure 1:** *The research framework.*

*Analysis method*

**Quantitative analysis:** The SMART PLS Version 3.0 software was utilised to facilitate the Partial Least Square Structural Equation Modelling (PLS-SEM) analysis, which was conducted to address variables influencing the effectiveness of the Urban Agriculture Programme in Peninsular Malaysia. The researchers created an assessment framework for improving the Urban Agriculture Programme (UAP) using Smart-PLS software.

The following formula was used in this study:

Y1 is composed of $\beta0$, $\beta1\chi^1$, $\beta2\chi^2$, $\beta3\chi^3$, $\beta4\chi^4$, and e.
Whereas

Y1 = Programme Effectiveness for Urban Agriculture
$\beta$ = Constant, e = Error standard, $\chi1$ = Context, $\chi2$ = Input, $\chi3$ = Process, $\chi4$ = Product

This method made it possible to thoroughly investigate the variables affecting the Urban Agriculture Program's efficacy. PLS-SEM analysis was used in this study to improve the Urban Agriculture Programme (UAP) implementation framework by introducing the variable of effectiveness for achieving the program's overarching objectives. The sample size for the study is 230 people, and the data is not normally distributed. The decision to use PLS-SEM analysis, as with previous research endeavours by Ishak (2019), is rooted in the need to accommodate the atypical characteristics of the data at hand. As a result, the following criteria support the decision to use PLS-SEM analysis:

**Research goals:** For identifying important "driver" constructs or predicting important target constructs, PLS-SEM is recommended. As a result, it works well when the aim of the study is to forecast important target constructs. Programme improvement frameworks in this research context can be produced by using PLS-SEM analysis to identify important target constructs.

**Managing non-normal data:** When handling data that is not normally distributed, PLS-SEM is recommended. Unlike Covariance-Based SEM (CB-SEM), which has strict data distribution assumptions, PLS-SEM can handle data that do not meet normality assumptions, making it a better choice for studies with non-normal data.

**Explained variance optimization:** PLS-SEM is a prediction-oriented modeling approach that optimizes independent variables' explained variance (R2 value) in predicting the dependent variable.

**Exploratory research for theory development:** PLS-SEM is a preferred exploratory research method aiming to develop or extend existing theories. It is suitable when the research goal is to predict key target variables.

In contrast, regression analysis may not be sufficient for this research problem due to its limitations in handling non-normal data, small sample sizes, and the development of new framework. With its flexibility and robustness, PLS-SEM is better equipped to address these challenges, making it a suitable choice for this study's objectives and characteristics.

## Results and Discussion

*Analysis of partial least squares structural equation modelling (PLS-SEM)*

Four (four) constructs make up the research model, which includes the variables Context (X1), Input (X2), Process (X3), Product (X4), and UA Programme Effectiveness (Y1). An important step is to evaluate the reflective measurement model, with the goal of determining each construct's internal consistency, discriminant validity, and convergent validity.

*Reliability and internal consistency*

Internal consistency is determined by comparing the sum of factor loadings of the latent variable to the sum of factor loadings plus error variance (Werts *et al*., 1974). Based on the factor loadings, the items of each variable were examined to determine the reliability of the indicators. Table 1 demonstrates that each variable (variable: context, product, process, and programme effectiveness) was retained because its loadings values exceeded 0.7008. In accordance with Gefen *et al.* (2000) recommendation, composite reliability was evaluated to ascertain internal consistency. Nunally and Bernstein (1994) advised that the intended composite reliability value for the threshold should be greater than 0.6 but less than 0.95. The composite reliability of each construct ranged from 0.864 to 0.915, which is acceptable.

**Table 1:** *Cronbach's alpha and composite reliability.*

| Variables | Cronbach's alpha | Composite reliability |
|---|---|---|
| Context | 0.811 | 0.864 |
| Input | 0.894 | 0.914 |
| Process | 0.897 | 0.915 |
| Product | 0.791 | 0.857 |
| Program effectiveness | 0.860 | 0.891 |

*Convergent validity*

The degree to which an item shows a positive correlation with other items that have similar attributes is known as convergent validity. Convergent validity is assessed using the Average Variance Extracted (AVE). To establish convergent validity, researchers must make sure that the outer loading value is greater than the threshold of 0.7008, as per the guidelines provided by Hair *et al.* (2017). This value of 0.708 squared is equal to the value of 0.5, which indicates the extracted average variance (AVE). To attain an AVE value of 0.5, for instance which represents at least 50% of the variance of each item, one should consider removing the outer loading value between 0.40 and 0.70 in order to increase the AVE value. According to Fornell and Larcker (1981), the recommended values for AVE are respectively 0.5. The AVE scores for every latent variable in this study ranged between 0.51 and 0.53, indicating that convergent validity was attained for every construct.

**Table 2:** *Average variance extracted of variables (AVE).*

| Variables | Average variance extracted (AVE) |
|---|---|
| Context | 0.514 |
| Input | 0.544 |
| Process | 0.521 |
| Product | 0.546 |
| Effectiveness | 0.506 |

*Discriminant validity*

To test the developed model, the researcher followed the recommendations of Anderson and Gerbing (1988) by using a two-step approach. First, the researcher tested the measurement model for the validity and reliability of the instruments used, following the guidelines of Hair *et al.* (2022) and Ramayah *et al.* (2018). Then, the structural model was run to test the hypothesis.

The researcher evaluated the measurement model by looking at the loadings, average variance extracted (AVE), and composite reliability (CR). The loadings should be at least 0.5, the AVE should be at least 0.5, and the CR should be at least 0.7. Table 3 displays that all AVEs are above 0.5 and all CRs are above 0.7. Most of the loadings meet the acceptable criterion of 0.708, according to Hair *et al.* (2022).

The researcher used the HTMT criterion to evaluate the discriminant validity in the second phase of the study, following the recommendations made by Henseler *et al.* (2015) and Franke and Sarstedt (2019). The less strict criterion permitted values up to ≤ 0.90, but the stricter criterion required HTMT values to be ≤ 0.85. The findings, which are shown in Table 4, showed that there was a distinct separation between the four constructs in the participants' comprehension because all HTMT values were below the lenient criterion. Strong confirmation of the measurement instrument's validity and reliability is given by these evaluations.

**Table 3:** *Cross loadings of variables.*

| | Items | Loadings | AVE | CR |
|---|---|---|---|---|
| Context | A11 | 0.672 | 0.514 | 0.864 |
| | A2 | 0.735 | | |
| | A5 | 0.757 | | |
| | A6 | 0.709 | | |
| | A8 | 0.705 | | |
| | A9 | 0.720 | | |
| Input | B1 | 0.616 | 0.544 | 0.914 |
| | B10 | 0.768 | | |
| | B3 | 0.641 | | |
| | B4 | 0.783 | | |
| | B5 | 0.760 | | |
| | B6 | 0.742 | | |
| | B7 | 0.722 | | |
| | B8 | 0.793 | | |
| | B9 | 0.790 | | |
| Process | C1 | 0.729 | 0.915 | 0.521 |
| | C10 | 0.636 | | |
| | C2 | 0.651 | | |
| | C3 | 0.784 | | |
| | C4 | 0.794 | | |
| | C5 | 0.741 | | |
| | C6 | 0.635 | | |
| | C7 | 0.688 | | |
| | C8 | 0.776 | | |
| | C9 | 0.757 | | |
| Product | D10 | 0.768 | 0.857 | 0.546 |
| | D4 | 0.677 | | |
| | D7 | 0.770 | | |
| | D8 | 0.678 | | |
| | D9 | 0.792 | | |
| Program effectiveness | E10 | 0.663 | 0.891 | 0.506 |
| | E2 | 0.717 | | |
| | E3 | 0.729 | | |
| | E4 | 0.630 | | |
| | E5 | 0.792 | | |
| | E6 | 0.678 | | |
| | E7 | 0.748 | | |
| | E8 | 0.722 | | |

**Table 4:** *Results of heterotrait-monotrait ratio (HTMT).*

| | Context | Input | Process | Product | Effectiveness |
|---|---|---|---|---|---|
| Context | | | | | |
| Input | 0.681 | | | | |
| Process | 0.612 | 0.865 | | | |
| Product | 0.591 | 0.592 | 0.638 | | |
| Effectiveness | 0.743 | 0.767 | 0.791 | 0.809 | |

*SEM model evaluation*

**Collinearity assessment: Analysis of variance inflator factor:** Partial least squares (PLS) modelling was used in the study to analyse the measurement and structural model using Smart PLS 3 (Ringle *et al*., 2022). This software tool is particularly well-suited for the analysis of survey research data, as it does not necessitate the assumption of data normality, a condition often absents in such datasets (Chin *et al*., 2003).

As per the recommendations of Kock and Lynn (2012) and Kock (2015), the researcher tackled the problem of Common Method Bias by conducting an extensive collinearity assessment, given that all the data came from a single source. The results of this collinearity analysis, as indicated by VIF values, are shown in Table 5. Hair *et al*. (2016) suggested a criterion of 5 for VIF values, whereas Diamantopoulus and Sigouw (2006) recommended a VIF threshold of less than 3.3. The VIF values in this study were all less than 3.3, indicating that our dataset did not support serious concerns about single-source bias.

**Table 5:** *Full collinearity testing.*

| Construct/Indicator | VIF |
|---|---|
| Input | 1.792 |
| Process | 2.964 |
| Product | 2.964 |
| Context | 1.886 |
| Program Effectiveness | 3.095 |

*Testing hypotheses for direct effects*

The purpose of hypothesis testing is to determine whether exogenous variables have a direct impact on endogenous variables. The significance test can be known through the p-value. This study has used methodologies supported by reputable scholars, such as Hair *et al*. (2022) and Cain *et al*. (2017), to delve into the complexities of multivariate skewness and kurtosis through precise and thorough analysis. The results, which are shown in Figure 2, revealed that the multivariate skewness (β = 3.796, p < 0.01) and multivariate kurtosis (β = 50.089, p < 0.01) of the dataset gathered for this study do not match the expectations of multivariate normality. We have provided a thorough report on the path coefficients, standard errors, t-values, and p-values for the structural model, adhering to the suggestions of Becker *et al.* (2023). As recommended by Ramayah *et al.* (2018), a rigorous resampling bootstrapping procedure involving 10,000 samples was used to conduct this assessment. Moreover, we have considered the criticism made by Hahn and Ang (2017) regarding the insufficiency of conducting hypothesis testing using only p-values. As a result, we took a comprehensive approach, evaluating the viability of the proposed hypotheses using parameters like p-values, confidence intervals, and effect sizes. Table 6 provides a brief summary of these evaluation criteria specifics.

```
Sample size:  230
Number of variables:  5

Univariate skewness and kurtosis
                        Skewness SE_skew Z_skew Kurtosis SE_kurt Z_kurt
CONTEXT                    0.176    0.16  1.095   -0.381    0.32 -1.191
INPUT                     -0.764    0.16 -4.762    2.022    0.32  6.326
PROCESS                   -0.197    0.16 -1.225    0.755    0.32  2.363
PRODUCT                   -0.009    0.16 -0.059    0.350    0.32  1.094
PROGRAM.EFFECTIVENESS      0.145    0.16  0.901    0.077    0.32  0.240

Mardia's multivariate skewness and kurtosis
                b         z       p-value
Skewness  3.795995 145.51313 1.998401e-15
Kurtosis 50.089378  13.67591 0.000000e+00
```

**Figure 2:** *Output of Skewness and kurtosis calculation.*

**Table 6:** *Results of path coefficient.*

| Hy-potheses | Relationship | Std Beta (β) | t value | p values <0.05 | Decision |
|---|---|---|---|---|---|
| H1a | Context > Program effectiveness | 0.217 | 4.147 | 0.000 | Supported |
| H2a | Input > Program effectiveness | 0.200 | 2.600 | 0.010 | Supported |
| H3a | Process > Program effectiveness | 0.228 | 2.905 | 0.004 | Supported |
| H4a | Product >Program effectiveness | 0.330 | 4.717 | 0.000 | Supported |

*Coefficient of determination ($R^2$)*

The coefficient of determination, or $R^2$, is an indispensable tool for evaluating a model's predictive accuracy. This measure offers invaluable insights by analysing the correlation between the actual values of the independent variable and the predicted value of the dependent variable. First, the researcher tested the effect of the 4 predictors on Program Effectiveness, the $R^2$ was 0.677 ($Q^2$ = 0.359) which shows that all 4 predictors explained 67.7% of the variance in Program Effectiveness as illustrated in Table 7. This means that the $R^2$ value suggests that the independent constructs can explain 67.7% of the variation in the dependent construct of the research. These variables explain more than 50% variance of the program's effectiveness. Therefore, any agricultural extension program evaluation should focus on these four variables (Context, Input, Process and Product) in order to increase program effectiveness.

**Table 7:** *R Square ($R^2$).*

| Variable | $R^2$ |
|---|---|
| Program effectiveness | 0.677 |

*Effect size ($f^2$)*

The effect size ($f^2$) is determined by the value of R square ($R^2$). The $f^2$ measures the strength of the relationship between a predictor and an endogenous variable (Cohen, 1988). Reporting both effect size and p-value is essential (Sullivan and Feinn, 2012). The size effect of variables is calculated using this formula:

$$f^2 = \frac{(R^2 included - R^2\ excluded)}{(1 - R^2\ included)}$$

The magnitudes of effect sizes are classified as follows: 0.00 ≤ f2 < 0.15 signifies a small effect, 0.15 ≤ $f^2$ < 0.35 indicates a moderate effect, and $f^2$ ≥ 0.35 indicates a large effect. As a result, the analysis results shown in Table 8 show that the product variable has a significant impact, as evidenced by the $f^2$ value being greater than 0.35. On the other hand, the variables context, input, and process have relatively small effects on the $R^2$ for programme effectiveness; their respective $f^2$ values are 0.087, 0.041, and 0.056 (0.00 ≤ $f^2$ < 0.15). According to Ramayah *et al.* (2018), when an external factor plays a significant role in explaining an internal factor, the $R^2$ can increase significantly, resulting in a high $f^2$.

**Table 8:** *The effects of size ($f^2$).*

| Factor (exogenous) | Endogenous | $f^2$ | Effect size |
|---|---|---|---|
| Product | Effectiveness | 0.813 | Large effect |
| Context | Effectiveness | 0.087 | Small effect |
| Input | Effectiveness | 0.041 | Small effect |
| Process | Effectiveness | 0.056 | Small effect |

*Predictive relevance ($Q^2$)*

The $Q^2$ value is calculated at the end of the structural model assessment (Stone, 1974; Geisser, 1975). Prediction relevance testing is necessary to demonstrate that the evaluated model makes accurate predictions. The blindfolding procedure (Chin, 1998) is used to assess predictive relevance ($Q^2$). A $Q^2$ value greater than zero indicates that the model's predictions are valid (Fornell and Cha, 1994). As indicated in Table 9, $Q^2$ value of 0.359 satisfies the requirement that it be greater than 0 (Q2>0). This outcome validates the constructed model's predictive relevance. Furthermore, the structural model intended to improve the urban agriculture programme is shown graphically in Figure 3.

**Table 9:** *Predictive relevance, $Q^2$.*

| *Construct/Indicator* | $Q^2$ |
|---|---|
| Effectiveness | 0.359 |

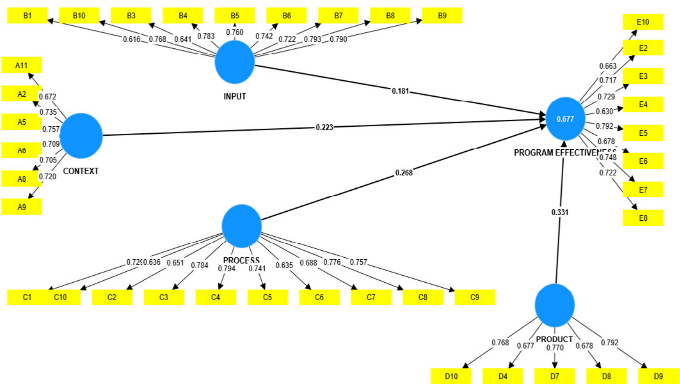


**Figure 3:** *Urban agriculture program improvement model.*

*Importance-performance map analysis (IPMA)*

IPMA is a technique that uses latent variable scores to expand on the results of basic PLS-SEM analysis. The goal is to identify the most important factors with relatively low performance for target variables such as context, input, process and product. According to the IPMA analysis (Figure 4), product is the most crucial factor in enhancing the UA program's effectiveness, while process is an additional force factor in improving the program's performance due to its high-performance level.

The primary objective of Importance-Performance Map Analysis (IPMA) is to identify the antecedents that exhibit high importance in the overall effects of the structural model while demonstrating low performance in relation to the average values of latent variable scores for target variables such as context, input, process, and product. This analysis helps identify important areas in the model that need to be carefully thought through and addressed.

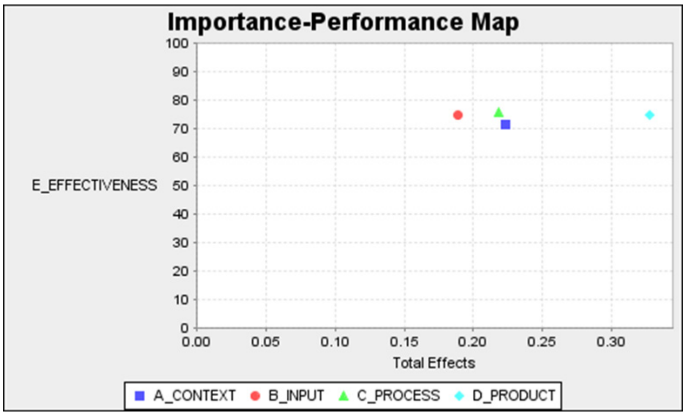


**Figure 4:** *IPMA analysis.*

The analysis presented in the previous section provides a comprehensive overview of the Structural Equation Modeling (SEM) results, categorizing findings into several key dimensions. The previous section analysed the results of Structural Equation Modeling (SEM) in different dimensions. Table 10 shows the "Context" dimension indicates the effectiveness of the Urban Agricultural Program (UAP) in producing sufficient sustenance, supporting food supply, reducing the import of agricultural products, and improving Malaysia's agriculture sector. The "Input" and "Process" dimensions highlighted the effectiveness of incentives and the implementation process. In the "Product" dimension, room for improvement was identified in certain areas. Finally, the "Effectiveness" dimension outlined opportunities for improvement in entrepreneurship, easy access to food sources, systematic farm management, and understanding of downstream products. Overall, the SEM results showed the effectiveness of various elements within the UA program.

The program improvement model for urban agriculture community participants in Malaysia shows practical predictability (Refer to Figure 5). The CIPP and programme effectiveness were positively correlated in this study. The effectiveness of the UA program is influenced by context, input, process, and product, especially when participants feel satisfied and comfortable to be involved with the community garden. These findings are similar to Tuan (2017) findings. The congruence in the findings between this study and those conducted by Tuan (2017) can be attributed to a shared recognition of the influential factors governing program effectiveness, particularly these

**Table 10:** *Summary on SEM results.*

| Dimension | Elements | Findings |
|---|---|---|
| **Context** (Relevance of UAP Objective and purpose) | A1- UAP help to reduce participant cost of living | Need to improve |
| | A2- Produce sufficient sustenance | Remained |
| | A3- Produce quality and safe food | Need to improve |
| | A4- Create social interaction in the community | Need to improve |
| | A5- Support food supply | Remained |
| | A6- Reduce import of agricultural product | Remained |
| | A7- Instil the interest to cultivate crop | Need to improve |
| | A8-Production of sustainable food sources | Remained |
| | A9- Improve household economy | Remained |
| | A10-Create harmonious and prosperous community relations | Need to improve |
| | A11- Advancing Malaysia agriculture sector | Remained |
| **Input** (Incentives provided) | B1-Technological facilities | Remained |
| | B2-Incentives and assistance | Remained |
| | B3-Consultation to solve crop problem | Remained |
| | B4-Training/courses | Remained |
| | B5- Agriculture Demonstrations | Remained |
| | B6- Agriculture Exhibitions | Remained |
| | B7- Virtual Agriculture Exhibitions | Remained |
| | B8- Experienced Agriculture Extension Officers assigned | Remained |
| | B9-Verbally skilled of Agriculture Extension Officers assigned | Remained |
| | B10- Active and highly committed agriculture extension officers assigned | Remained |
| **Process** (Implementation process) | C1- Frequent monitoring by DOA | Remained |
| | C2-Concept of downstream product | Remained |
| | C3-Agriculture Officer (AO) involvement in planning farm activity | Remained |
| | C4- Continuous support from AO | Remained |
| | C5- Encouragement to sustain by AO | Remained |
| | C6- Farm record monitoring | Remained |
| | C7- Involvement of AO with participants in method demonstrations. | Remained |
| | C8-Technology recommendation | Remained |
| | C9-Various platform to communicate | Remained |
| | C10-Clear feedback | Remained |
| **Product** (Impact and changes on participants) | D1- Self-knowledge on agriculture | Need to improve |
| | D2- Knowledge on downstream product | Need to improve |
| | D3- Vegetable expenses management | Remained |
| | D4-Skill to teach others | Remained |
| | D5- Vegetable expenses reduced | Need to improve |
| | D6- Side income | Need to improve |
| | D7- Gain good communication between community | Remained |
| | D8- Close relationship | Need to improve |
| | D9- Concern and charity | Remained |
| | D10- Health improvement | Remained |
| **Effectiveness** (Impact and changes on overall program) | E1- Entrepreneur opportunity | Need to improve |
| | E2-Environmentally safe | Remained |
| | E3-Youth early exposure on agriculture | Remained |
| | E4-Easy access to food source | Need to improve |
| | E5-Number of community garden increased | Remained |
| | E6- Systematic farm management | Need to improve |
| | E7-Production of agriculture in city increased | Remained |
| | E8- Food security guaranteed | Remained |
| | E9-Understanding of downstream product | Need to improve |
| | E10-UAP Successfully promoted and recognized | Remained |


Links Researchers

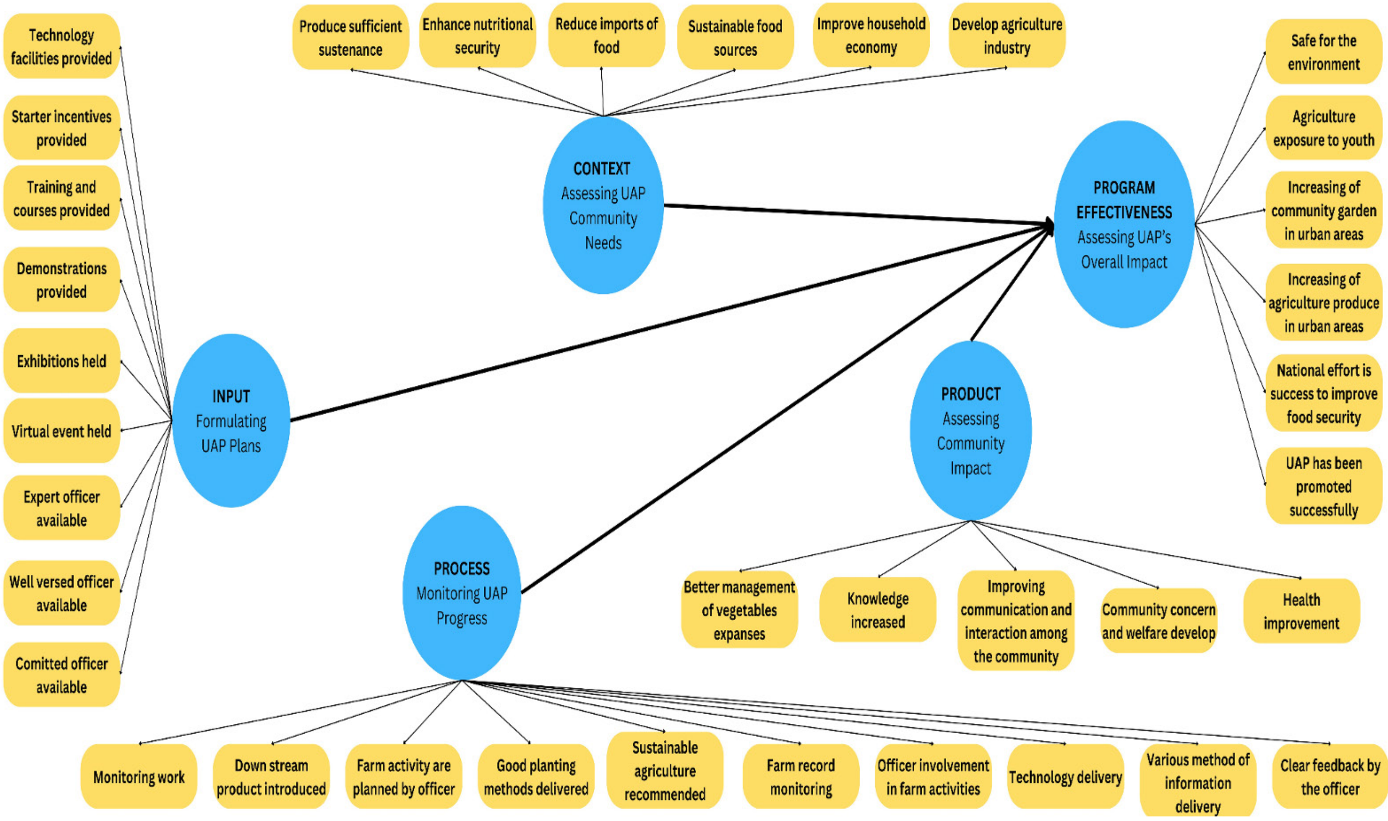


**Figure 5:** *Recommendation of UA program improvement framework.*

studies collectively underscore the significance of the Context, Input, Process, Product (CIPP) framework as a pivotal determinant. The CIPP framework elucidates that program effectiveness is contingent upon the interplay of various components. It is exciting to note that James and Margaret (2012) highlight the importance of program participants' familiarity with the subject matter and ability to apply their newfound knowledge. This optimistic view emphasizes the potential for success in program outcomes. Evaluating a program's input and process dimensions is essential to ensure its success. As Berry (2015) suggests, having the right infrastructure can make all the difference for an agricultural program. Interestingly, research by Leelanayagi (2018) has shown that participants who are happy with the program are more likely to stay involved in the community garden project. We can create a thriving program that benefits everyone involved by identifying resources, tracking implementation, and overcoming challenges. Therefore, it would be a great opportunity for everyone to work together and successfully implement the plans.

## Conclusions and Recommendations

Improving programme effectiveness is the main goal of evaluation research. Furthermore, the development of a new programme improvement model has the potential to significantly and positively impact the body of literature already in existence in the evaluation research field. This model demonstrates that the effectiveness of urban agriculture programs can be conceptualised according to four important factors: (a) assessing UAP community needs using context evaluation (b) formulating UAP plans using input evaluation, (c) monitoring the progress of the UAP using process evaluation, (d) assessing the impact on the community using product evaluation.

In order to strengthen this model, more research should be done in order to conduct a Confirmatory Factor Analysis (CFA). The goal of this CFA is to support the significance of the observed relationships between the factors and validate the established model. Research is needed to monitor the sustainability of urban agriculture participants in community gardens. This will help to evaluate the economic viability of the program in terms of reducing the cost of vegetables and generating additional income.

Besides, further research works need to be discovered more on evaluation model with different approaches and perspectives among agricultural extension program that contribute to program effectiveness by agricultural agencies.

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## Novelty Statement

This research is an evaluation study that develops a new framework for urban agriculture program improvement. The impact of this study is that researchers can identify which elements of the program need to be refined and emphasized. Furthermore, the potential beneficiaries of this study will be the agricultural policymakers, project development managers, extension agents, researchers, and agricultural development agencies, both public and private.

## Author's Contribution

**Munifah Siti Amira:** Served as the principal author and conducted research, collected data, analyzed it, and wrote up the finding's manuscript.
**Norsida Man:** Contributed to validating the research framework and supervised the research work.
**Nur Bahiah Mohamed Haris:** Contributed to validating the instrument and research framework.
**Ismi Arif Ismail:** Contributed to the research framework.
**Siaw Shin Yee:** Contributed to editing the manuscript.
**Tengku Halimatun Sa'adiah T Abu Bakar:** Provided technical guideline.

*Conflict of interest*
The authors have declared no conflict of interest.

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