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# RESILIENCE MODEL FOR THE EMPOWERMENT OF YOUNG COFFEE AGRIPRENEURS IN NAVIGATING BUSINESS ENVIRONMENT UNCERTAINTIES

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**Abstract.** The resilience of entrepreneurial capacity was crucial for young agripreneurs in facing the challenges of uncertainty, such as climate change and economic fluctuations. Institutional capacity and the adoption of appropriate technology enabled adaptation and innovation, enhancing competitiveness and sustainability, although this relationship has not yet been explored in-depth. This study aimed to analyze the influence of environmental uncertainty on the resilience of young agripreneurs, with institutional capacity and the adoption of appropriate technology serving as mediating variables. This research utilized primary data collected through questionnaires distributed to 110 respondents, consisting of upstream-to-downstream coffee agripreneurs in Jember Regency, using purposive sampling. Data analysis was performed using SEM-PLS. The results showed that environmental uncertainty significantly influenced institutional capacity, the adoption of appropriate technology, and business resilience, with positive coefficients for all three and p-values below 0.05. Institutional capacity also positively affected the adoption of appropriate technology and business resilience. Moreover, institutional capacity moderated the impact of environmental uncertainty on the adoption of appropriate technology, while uncertainty, through institutional capacity and the adoption of appropriate technology, positively affected the resilience of young agripreneurs.

**Keywords:** appropriate technology adoption, business resilience, environmental uncertainty, institutional capacity

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## INTRODUCTION

Young agripreneurship presents a promising opportunity for creating new job opportunities. Young agripreneurs tend to be more flexible in hiring local workers and supporting domestic economic growth. However, young agripreneurs consistently face challenges related to uncertainty in the business

environment. Economic fluctuations, climate change, and intense competition are some of the key factors that hinder the sustainability of young agripreneurs (Hamid, 2017; Kholidi Hadi, 2022; Rwigema, 2020). Climate change poses a challenge to food security and livelihoods worldwide, requiring farmers to adapt to its impacts (Kangogo et al., 2021). To overcome this uncertainty, young agripreneurs need to build strong institutional capacity within farmer groups, enabling rapid adaptation to environmental changes.

Business resilience is the ability of young agripreneurs to survive, adapt, and recover from challenging situations (Kulig et al., 2008). In this context, resilience becomes an essential requirement for young agripreneurs, particularly in facing uncertainties such as economic fluctuations, regulatory changes, and intense competition (Bouloiz, 2020; Rai et al., 2021). Factors such as changing consumer preferences, financial uncertainty, and competition demand innovative adaptation strategies (Atanassova & Bednar, 2022; Mukherjee, 2018). Moreover, appropriate technology offers opportunities for product diversification and broader market access, enhancing the resilience of young agripreneurs in responding to the dynamics of the business environment (Djaakum, 2019; Sunardi et al., 2022). By integrating technology and institutional capacity, young agripreneurs can create business models that are more adaptive and resilient in facing global challenges (Singh et al., 2019). By integrating technology and institutional capacity, young agripreneurs can create business models that are more adaptive and resilient in facing global challenges (Singh et al., 2019). Business resilience measured through agility, redundancy, flexibility, visibility, robustness, awarness, is an adaptation developed from several previous studies (Gligor et al., 2019; Singh et al., 2019; Pettit et al., 2010; Putritamara et al., 2023; Jain et al., 2017).

Research on the resilience of young agripreneurs is of great importance because they serve as the backbone of the agricultural economy (Prakash et al., 2021). Understanding the factors that influence the resilience of young agripreneurs helps in designing effective policy strategies to support the growth and sustainability of agricultural businesses. Resilience analysis provides valuable insights into how young agripreneurs respond to environmental uncertainties and crises, which is essential for building a strong foundation for the development of local and global agricultural economies.

Institutional capacity, measured through sensing (identifying opportunities and risks), seizing (capitalizing on opportunities), and reconfiguring (adjusting resources), plays a crucial role in influencing the resilience of young agripreneurs (Khan et al., 2021; Meyana et al., 2023). Sensing helps young agripreneurs detect environmental changes, allowing them to respond quickly. Seizing enables them to capture new market opportunities or adjust their business models. Reconfiguring empowers young agripreneurs to flexibly adjust resources and operational processes, supporting their resilience in facing challenges and crises, ultimately enhancing their ability to thrive amidst business uncertainties (Peñarroya-Farell & Miralles, 2022).

Although institutional capacity plays a crucial role in business resilience, there is a need to further understand other factors that influence resilience, especially with the development of appropriate technology (Khurana et al., 2022). By integrating technology, young agripreneurs can enhance their resilience, tackle external challenges, and strengthen their business foundation in the face of environmental uncertainties through adaptive approaches (Suryawati et al., 2023). Institutional capacity has been highlighted as a key factor in strengthening resilience within the coffee sector. For example, how public, private, and civil society institutions in Ethiopia play critical roles in providing information, financial support, and leadership to enhance farmers' resilience under climate change pressures (Megerssa et al., 2025). However, this study focuses on general coffee producers and institutions rather than young agripreneurs, leaving a gap in understanding how institutional support specifically shapes resilience pathways for youth-led coffee enterprises. The role of appropriate technology adoption in mediating resilience remains underexplored. The nature-based solutions such as agroecosystem management and shade-based cultivation enhance adaptive capacity among Mexican coffee farmers.

While this provides evidence for the importance of technology and innovation, the study does not explicitly analyze how these practices interact with institutional capacity or respond to external uncertainties in the context of young coffee entrepreneurs (Ruiz-garcía & Monterroso-rivas, 2025).

Studies such as Jawo et al. (2023) emphasize farmers' perceptions of environmental uncertainty and their subsequent adaptation strategies. While these insights are crucial, the research primarily addresses smallholder farmers' adaptive behaviors, without sufficiently examining how younger generations perceive uncertainty and integrate technology and institutions into their resilience strategies (Jawo et al., 2023). The research by Rodriguez-camayo et al. (2025) links poverty and food insecurity to the vulnerability of coffee farmers, suggesting that external uncertainties negatively affect resilience. Yet, these findings mainly highlight socioeconomic vulnerability rather than offering a comprehensive model that connects environmental uncertainty, institutional capacity, and technology adoption as joint determinants of resilience (Rodriguez-camayo et al., 2025). Although recent studies have advanced the understanding of coffee farmers' resilience, several gaps remain when linking environmental uncertainty, institutional capacity, and adoption of appropriate technology to the resilience of young agripreneurs in coffee entrepreneurship.

This research offers novelty in its focus on the resilience of young agripreneurs managing the coffee supply chain, specifically by emphasizing sensitivity to business environmental uncertainties and exploring strategies for adopting appropriate technology. Additionally, this study lays the conceptual foundation by integrating key aspects of business resilience, institutional capacity, and the adoption of relevant technology for young agripreneurs. This holistic approach aims to provide in-depth insights into how young agripreneurs can build operational resilience and enhance their competitiveness through the combination of institutional capacity and the implementation of suitable technology adoption strategies. Therefore, this research is expected to contribute significantly to the development of relevant and sustainable resilience strategies for young agripreneurs managing the upstream and downstream coffee business in Jember Regency.

## METHOD

This research is a quantitative study with a cross-sectional design. The quantitative analysis method used is Structural Equation Modeling Partial Least Squares (SEM-PLS). SEM-PLS is employed to analyze the impact of environmental uncertainty on the business resilience of young agripreneurs, with institutional capacity and the adoption of appropriate technology as mediators. The data used in this study is primary data, obtained through questionnaires/surveys. The population consists of young agripreneurs in Jember Regency. The sampling technique used is non-probability sampling with a purposive sampling approach. The criteria for selecting samples include: 1) respondents are young agripreneurs who utilize appropriate technology, 2) respondents are young agripreneurs registered in coffee farmer groups in Jember, and 3) respondents are managers of upstream and downstream coffee businesses operating in collaboration with coffee farmer groups. A total of 110 young agripreneurs in Jember Regency completed the survey, and all of them were included as samples. The definition of operational of variables is in Table 1.

The data processing method in this study was based on the Structural Equation Modeling (SEM) model equations. The analysis was conducted in two main stages: the outer model and the inner model (Ghozali & Latan, 2016). The outer model analysis was used to test the validity and reliability of the questionnaire used, ensuring that valid and reliable data were obtained. Validity was measured using convergent and discriminant validity, while reliability was assessed with composite reliability. A parameter was considered valid if it had an AVE above 0.5 or showed that all the outer loadings of the variable dimensions had a loading value greater than 0.5 (Ghozali & Latan, 2016). In addition, the cross-loading for each variable had to be greater than 0.7. Reliability was assessed using the Cronbach alpha value, and it was considered reliable if the Cronbach alpha value was greater than 0.7. The structural

inner model was evaluated using t-significance tests (p-value), path coefficient parameters, R-square, predictive relevance, and quality index. This research model tested the effect of total company assets on tax avoidance, with current tax burden and pre-tax profit as intervening variables. The equation used in SEM PLS were in equation 1 to 4.

**Table 1. Operational Definition of Variables**

| Variable | Definition | Indicators |
|---|---|---|
| Environmental Uncertainty (X)<br><br>(Hamid, 2017; Kholidi Hadi, 2022; Rwigema, 2020) | The inability to predict outcomes accurately, influenced by dynamic external conditions. | - Changing consumer preferences<br>- Financial uncertainty<br>- Supply chain instability<br>- Technological changes<br>- Competition |
| Business Resilience (Y)<br><br>(Singh et al., 2019; Gligor et al., 2019; Pettit et al., 2010; (Putritamara et al., 2023); Jain et al., 2017) | The capacity of an individual, group, or community to resist, prevent, recover, and adapt to challenges. | - Agility - Redundancy<br>- Flexibility<br>- Visibility<br>- Robustness<br>- Awareness |
| Institutional Capacity (Z1)<br><br>(Khan et al., 2021) | The ability of an organization to integrate, develop, and adjust its resources and competencies in response to market and environmental changes. | - Sensing<br>- Seizing<br>- Reconfiguring |
| Adoption of Appropriate Technology (Z2)<br><br>(Khurana et al., 2022) | A strategy involving the use of technology to transform entrepreneurial practices, both in production operations and consumer services. | - Adoption of modern production machinery<br>- Digital marketing<br>- Digital transactions<br>- Online sales platforms |

Source: Hamid, (2017); Kholidi Hadi, (2022); Rwigema, (2020); Singh et al., (2019); Gligor et al., (2019); Pettit et al., (2010); Putritamara et al., (2023); Jain et al., (2017); Khan et al., (2021); Khurana et al., (2022)

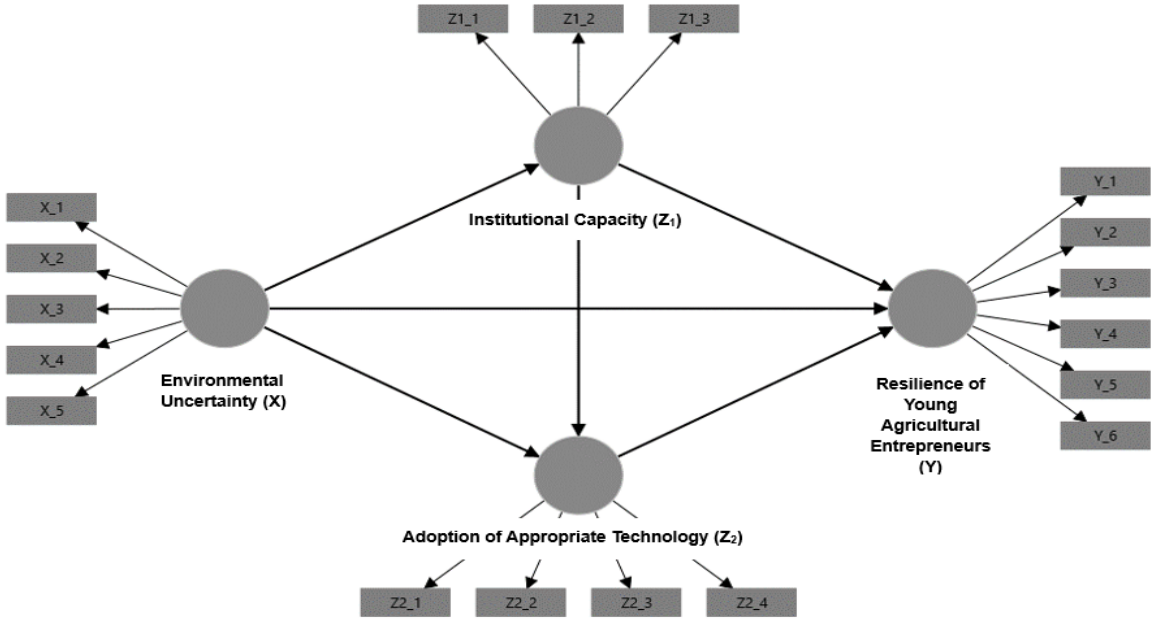


**Figure 1. Structural Model**
Source: Data Processed, 2024

$$Z1_{it} = \rho_{1it} X_{it} + \varepsilon_1 \quad (1)$$

$$Z2_{it} = \rho_{2it} X_{it} + \varepsilon_2 \quad (2)$$

$$Z2_{it} = \rho_{3it} Z1_{it} + \varepsilon_3 \quad (3)$$

$$Y_{it} = \rho_{4it} Z1_{it} + \rho_{5it} X_{it} + \rho_{6it} Z2_{it} + \varepsilon_4 \quad (4)$$

Where,
$Y_{it}$ : Resilience of young agricultural entrepreneurs (Y)
$X_{it}$ : Environmental uncertainty (X)
$Z1_{it}$ : Institutional capacity ($Z_1$)
$Z2_{it}$ : Adoption of appropriate technology ($Z_2$)
$a$ : Constant
$\rho_{1\text{-}6}$ : Path coefficients
$i$ : Sample n
$t$ : Time
$\varepsilon$ : *Standard error*

## RESULT AND DISCUSSION

The data was directly obtained from young agricultural entrepreneurs who met the inclusion criteria. All the distributed questionnaires were completed in full, allowing the data to be fully utilized for analysis. The total number of respondents was 110 young agricultural entrepreneurs in Jember Regency. The results of the evaluation of the outer model for the research parameters are presented in the table and figure 2.

**Table 2. Outer loading, AVE, and CR value evaluation results**

| Parameter | Outer Loading >0.5 | Results | AVE >0.5 | CR >0.7 | Results |
|---|---|---|---|---|---|
| X_1←Business Environment Uncertainty (X) | 0.903 | Valid | 0.756 | 0.939 | Reliable |
| X_2←Business Environment Uncertainty (X) | 0.877 | Valid | | | |
| X_3←Business Environment Uncertainty (X) | 0.947 | Valid | | | |
| X_4←Business Environment Uncertainty (X) | 0.932 | Valid | | | |
| X_5←Business Environment Uncertainty (X) | 0.656 | Valid | | | |
| Y_1←Resilience of Young Farmer Entrepreneurs (Y) | 0.822 | Valid | 0.680 | 0.927 | Reliable |
| Y_2←Resilience of Young Farmer Entrepreneurs (Y) | 0.897 | Valid | | | |
| Y_3←Resilience of Young Farmer Entrepreneurs (Y) | 0.858 | Valid | | | |
| Y_4←Resilience of Young Farmer Entrepreneurs (Y) | 0.641 | Valid | | | |
| Y_5←Resilience of Young Farmer Entrepreneurs (Y) | 0.853 | Valid | | | |
| Y_6←Resilience of Young Farmer Entrepreneurs (Y) | 0.853 | Valid | | | |
| Z1_1←Institutional Capacity (Z1) | 0.904 | Valid | 0.698 | 0.873 | Reliable |
| Z1_2←Institutional Capacity (Z1) | 0.889 | Valid | | | |
| Z1_3←Institutional Capacity (Z1) | 0.697 | Valid | | | |
| Z2_1←Adoption of Appropriate Technology (Z2) | 0.862 | Valid | 0.619 | 0.866 | Reliable |
| Z2_2←Adoption of Appropriate Technology (Z2) | 0.853 | Valid | | | |
| Z2_3←Adoption of Appropriate Technology (Z2) | 0.736 | Valid | | | |
| Z2_4←Adoption of Appropriate Technology (Z2) | 0.681 | Valid | | | |

Source: Smart-PLS 4.0 output

The results of the outer loading test show the results of the convergent validity examination for the variables in the study. Convergent validity measures the extent to which the parameters in a construct correlate with the construct being measured. The results show that all parameters have outer loadings values exceeding the set cut-off value, which is 0.5. This indicates that these parameters have a very strong relationship with the construct being measured, indicating very good convergent validity. The Composite Reliability (CR) value exceeds the cut-off value of 0.70. This indicates that these constructs have very good reliability in measuring the variables being measured. In addition, the Average Variance Extracted (AVE) value for all constructs exceeds the cut-off value of 0.50. This shows that these constructs have very large variance and can be measured well. Overall, the results of the convergent validity examination show that the constructs in this study have very good validity and reliability, so they can measure the variables being measured.

The results of the measurement model evaluation (Inner Model) aim to assess the strength and direction of the relationship between latent constructs in the structural model. This evaluation begins with the analysis of path coefficients, which shows how strong and positive the relationship is between the independent and dependent variables, with values approaching 1 indicating a strong relationship. Furthermore, the T-statistics value is used to assess the significance of the relationship, where values above 1.96 indicate that the relationship is significant at the 5% significance level. P-Values are also analyzed, with values below 0.05 indicating that the results did not occur by chance. Then, R-squared ($R^2$) is calculated to evaluate how much the independent variables are able to explain the variance of the dependent variable, with $R^2$ values approaching 1 indicating a good model (Ghozali & Latan, 2016).

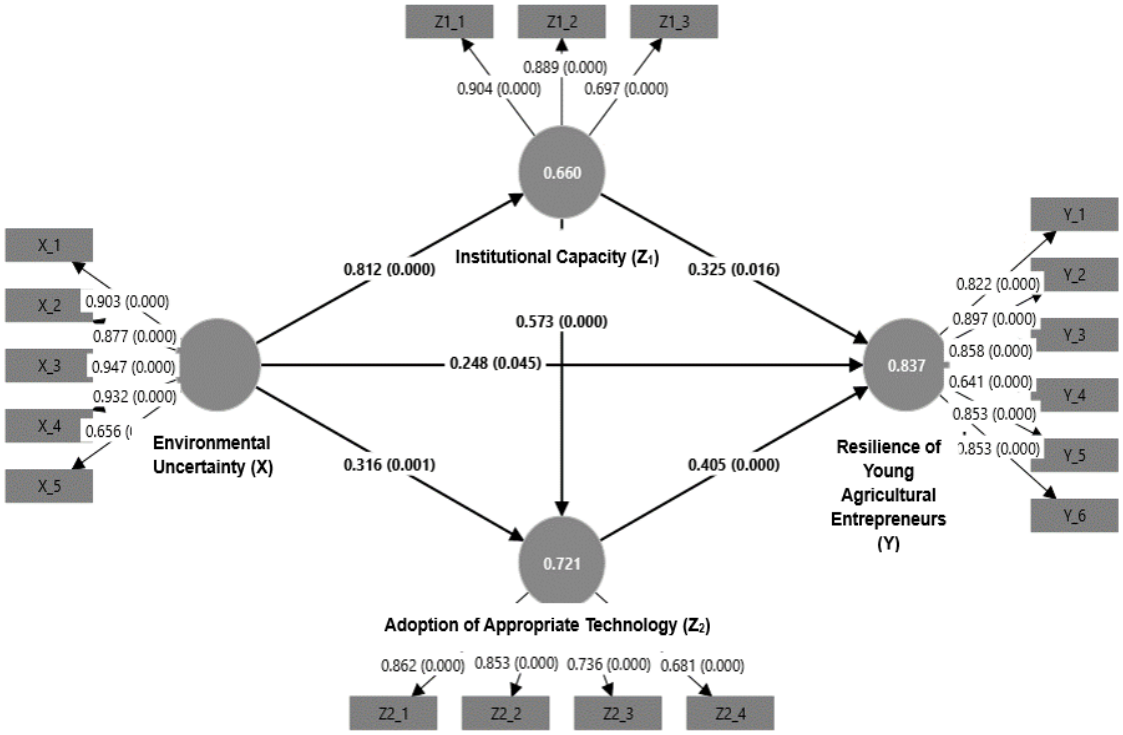


**Figure 2. Test Results Inner Model**
Source: Data processed, 2024

The t-test aims to test whether there is a significant influence between variables. Meanwhile, R-squared ($R^2$) is calculated to evaluate how much the independent variables can explain the variance of the dependent variable, with an $R^2$ value close to 1 indicating a good model. After testing the outer model and inner model, the next step is to test the feasibility of the model. The feasibility test of the model in this study uses the goodness of fit approach in the SEM-PLS model. Goodness of fit in the SEM-PLS (Structural Equation Modeling with Partial Least Squares) model aims to assess the extent to which the model built matches the data used. Although PLS does not rely on direct goodness of fit testing like covariance-based SEM models (for example, using the Chi-square test), there are several measures used to assess the extent to which the model successfully represents the relationship between variables. The model feasibility test is R-square, F-square, Q-square and GoF.

**Table 3. Path coefficient estimation results**

| | Original sample (O) | T statistics (\|O/STDEV\|) | P values | Results |
|---|---|---|---|---|
| **Direct Effect** | | | | |
| Uncertainty _Business Environment (X)→ Institutional Capacity (Z1) | 0.812*** | 24,754 | 0,000 | Significant |
| Uncertainty _Business Environment (X)→ Adoption of Appropriate Technology (Z2) | 0.316** | 3,218 | 0.001 | Significant |
| Institutional Capacity (Z1)→Adoption Appropriate Technology (Z2) | 0.573*** | 5,962 | 0,000 | Significant |
| Institutional Capacity (Z1)→Resilience Young Entrepreneur Farmer (Y) | 0.325* | 2,402 | 0.016 | Significant |
| Adoption of Appropriate Technology (Z2)→ Resilience Young Entrepreneur Farmer (Y) | 0.405*** | 5,881 | 0,000 | Significant |
| Uncertainty _Business Environment (X)→ Resilience of Young Farmer Entrepreneurs (Y) | 0.248* | 2,005 | 0.045 | Significant |

**Table 3. Path coefficient estimation results (continue)**

| | | | | |
|---|---|---|---|---|
| **Indirect Effect** | | | | |
| Uncertainty _Business Environment (X)→ Institutional Capacity (Z1)→Adoption Appropriate Technology (Z2) | 0.465*** | 5,547 | 0,000 | Significant |
| Uncertainty _Business Environment (X)→ Adoption of Appropriate Technology (Z1)→ Resilience of Young Farmer Entrepreneurs (Y) | 0.264* | 2,306 | 0.021 | Significant |
| Uncertainty _Business Environment (X)→ Adoption of Appropriate Technology (Z2)→ Resilience of Young Farmer Entrepreneurs (Y) | 0.128* | 2,507 | 0.012 | Significant |
| Uncertainty of Business Environment (X) -> Institutional Capacity (Z1) -> Adoption Appropriate Technology (Z2) -> Resilience Young Entrepreneur Farmer (Y) | 0.189*** | 4,683 | 0,000 | Significant |

Note: *p<0.05; **p<0.01; ***p<0.0001.

Source: Data processed by, 2024

**Table 4. Model Feasibility Test Results**

| *No.* | *Criteria* | *Cut-off Value* | *Estimation Results Model* | *Model Conclusion* |
|---|---|---|---|---|
| 1 | *R-Square*($R^2$) | Values closer to 1 indicate a model that is better at explaining data variability.$R^2$<br>- $R^2 > 0.75$: Strong<br>- $0.50 < R^2 \leq 0.75$: Currently<br>- $R^2 \leq 0.50$: Weak | $R^2$ Z1 = 0.660<br>$R^2$ Z2 = 0.721<br>$R^2$ Y = 0.837 | Currently<br>Currently<br>Strong |
| 2 | *F-Square* ($f^2$) | - $F^2 < 0.02$: Small effect (not significant).<br>- $0.02 \leq F^2 < 0.15$: Medium effect (quite significant effect).<br>- $F^2 \geq 0.15$: Large effect (significant and strong influence). | - Institutional Capacity (Z1): ($F^2$ = 0.401)<br>- Adoption of Appropriate Technology (Z2): ($F^2$ = 0.280).<br>- Business Environment Uncertainty (X): ($F^2$ = 0.114) and ($F^2$ = 1.939) | Significant and strong influence |
| 3 | *Q2 predictive relevance* | $Q^2 > 0$: The model has good predictive relevance.<br>$Q^2 = 0$: The model is only able to predict sample data.<br>$Q^2 < 0$: The model cannot predict well. | Q2 = 1- (1-0.660) (1-0.721) (1-0.837) = 0.985×× | Good |
| 4 | *Quality Index (GoF)* | - GoF > 0.36: Good model quality (for large and complex models).<br>- 0.25 < GoF ≤ 0.36: Medium model quality.<br>- GoF ≤ 0.25: Model quality is poor | 0.524 | Good |

Source: Data Processed, 2024

Based on the results of the model estimation, there are several findings that indicate the quality and suitability of the model. First, the R-Square ($R^2$) values for the variables Institutional Capacity (Z1) and Adoption of Appropriate Technology (Z2) are each in the medium range ($R^2 = 0.660$ and $R^2 = 0.721$), which means that the model can explain most of the data variations in these two variables, although not completely. However, for Young Farmer Entrepreneur Resilience (Y), the $R^2$ value = 0.837 shows significant strength, indicating that the model is very good at explaining variations in the main dependent variable. Furthermore, the F-Square ($F^2$) values for Institutional Capacity (Z1) ($F^2 = 0.401$) and Adoption of Appropriate Technology (Z2) ($F^2 = 0.280$) show a significant influence, with Z1 having a large influence on resilience, while Z2 has a moderate influence. For Business Environment Uncertainty (X), although the direct effect on resilience is small ($F^2 = 0.114$), its effect on institutional capacity is very large ($F^2 = 1.939$), indicating its greater indirect role. The $Q^2$ (Predictive Relevance) result of 0.985 indicates that the model has very good predictive relevance, indicating that the model can accurately predict data that is not in the sample. Finally, the Quality Index (GoF) of 0.524 indicates good model quality, indicating that the model has a strong fit and can be relied on for further analysis. this model demonstrates good quality in explaining data variability and has high predictive relevance.

The results of the hypothesis test provide empirical support for the theoretical argument that uncertainty in the business environment drives the development of institutional capacity. The significant positive relationship between these two variables ($p < 0.000$, path coefficient = 0.812) indicates that young farmer entrepreneurs facing high levels of uncertainty are encouraged to be more adaptive, responsive, and proactive. This is due to the need for young farmer entrepreneurs to continuously identify new opportunities, make strategic decisions quickly, and utilize new technologies in order to maintain competitiveness in a volatile environment. Institutional capacity helps entrepreneurs adapt quickly to external changes and challenges (Dipierri & Zikos, 2020; Kangogo et al., 2020; Malherbe et al., 2024; Steenwerth et al., 2014; Yanore et al., 2024). In the context of coffee entrepreneurship, institutional capacity has been highlighted as a key factor in strengthening resilience. For example, public, private, and civil society institutions in Ethiopia play critical roles in providing information, financial support, and leadership to enhance farmers' resilience under climate change pressures (Megerssa et al., 2025). However, such studies focus on general coffee producers and supporting institutions, leaving a gap in understanding how institutional support specifically shapes resilience pathways for youth-led coffee enterprises. Likewise, the role of appropriate technology adoption in mediating resilience remains underexplored. Nature-based solutions such as agroecosystem management and shade-based cultivation have been shown to enhance adaptive capacity among Mexican coffee farmers (Ruiz-garcía & Monterroso-rivas, 2025). While these findings highlight the importance of technology and innovation, they do not explicitly analyze how such practices interact with institutional capacity or respond to external uncertainties in the context of young coffee entrepreneurs.

Uncertainty in the business environment has a significant effect on the adoption of appropriate technology, as evidenced by the p value which is smaller than the alpha level, which is $0.001 < 0.05$. The path coefficient from uncertainty in the business environment to adoption of appropriate technology is 0.316, indicating a positive effect. This implies that when uncertainty in the business environment increases, adoption of appropriate technology also increases. The significance of uncertainty in the business environment on the adoption of appropriate technology arises from the need for young farmer entrepreneurs to adapt quickly to market and technological changes in order to remain competitive. Companies are encouraged to adopt appropriate technology to increase their efficiency, flexibility, and responsiveness in uncertain conditions, such as shifts in consumer preferences or fluctuations in raw material prices. Utilizing technology is a strategic step to reach a wider market, while digital payment solutions facilitate business operations (Hong et al., 2024; Magableh et al., 2024; Manning, 2024;

Sartono et al., 2024; Steenwerth et al., 2014). In other words, the adoption of appropriate technology acts as an important tool for companies to survive and thrive amidst uncertainty.

Moreover, uncertainty in the business environment has a significant positive impact on resilience of business empowerment ($p < 0.045$, path coefficient = 0.248). Young coffee farmer entrepreneurs operating in dynamic and unpredictable environments are more likely to develop the ability to withstand shocks and adapt to changing conditions. They employ strategies such as building safety stocks, diversifying coffee varieties, expanding their customer base, and pursuing certifications (organic, fair trade, or geographic indications). These adaptive practices strengthen resilience and long-term competitiveness (Dombroski et al., 2020; Kangogo et al., 2020; Sundstrom et al., 2023).

Institutional capacity was found to have a significant positive impact on the adoption of appropriate technology ($p < 0.000$, path coefficient = 0.573). This indicates that young farmer entrepreneurs with a higher capacity to detect, utilize, and reconfigure internal and external resources to suit rapid environmental changes are more likely to successfully adopt and integrate appropriate technology. Young farmer entrepreneurs with strong institutional capacity are better equipped to identify emerging and long-term appropriate technologies that can improve business performance, such as product differentiation, e-commerce platforms, and social media. In addition, these firms are able to make timely strategic decisions regarding technology adoption and allocate resources effectively to maximize the benefits of adopting appropriate technology (T. Zhang et al., 2024). Thus, institutional capacity accelerates the process of adopting appropriate technology and enables entrepreneurs to remain competitive in the ever-changing business landscape (Gibson, 2023). Institutional capacity enables organizations to detect, utilize, and reconfigure technological resources to support the adoption of appropriate technologies (Haque et al., 2024; de Boon et al., 2024; Li et al., 2024).

Institutional capacity has a significant effect on the resilience of business empowerment, with a p value of 0.016, indicating a strong relationship. The positive path coefficient of 0.325 indicates that higher institutional capacity increases the resilience of business empowerment. This capability enables young farmer entrepreneurs to quickly adapt to external changes and challenges, identify new opportunities, and manage resources effectively. For example, young farmer entrepreneurs who are able to quickly adjust their strategies during a crisis become more resilient and readier to survive in the long term. Thus, institutional capacity helps entrepreneurs remain flexible, reduce risk, and thrive despite unexpected challenges, thereby strengthening overall resilience (Malherbe et al., 2024; L. Zhang et al., 2023; Ullah et al., 2016; Steenwerth et al., 2014).

The adoption of appropriate technology has a significant impact on business resilience, with a p-value of 0.000, indicating that the value is smaller than the alpha level of 0.05. The positive path coefficient of 0.405 indicates that the higher the level of adoption of appropriate technology, the higher the business resilience. This significant effect occurs because the adoption of appropriate technology allows businesses to be more flexible and adaptive in facing challenges and changes. Digitalization provides access to real-time market information, expands customer reach through online platforms, and optimizes operations through automation and efficient technology. In addition, the adoption of appropriate technology increases business resilience in the face of uncertainty, ensuring operational continuity (Ayamga et al., 2024).

Uncertainty in the business environment significantly affects the adoption of appropriate technology through institutional capacity, as indicated by the p-value of 0.000, which is smaller than the alpha level of 0.05. The path coefficient from uncertainty in the business environment to adoption of appropriate technology through institutional capacity is 0.465, indicating a positive effect. This indicates that the higher the uncertainty in the business environment, the better the institutional capacity is developed, which ultimately increases the adoption of appropriate technology. Such as Yanore et al. (2024) uncertainty in the business environment encourages companies to adapt and innovate in order to maintain competitiveness thus emphasizing the importance of institutional capacity in facing challenges

and exploiting opportunities for technological advancement. In the face of rapid changes, such as shifts in consumer preferences and market conditions, firms with strong institutional capacity can quickly identify and exploit new appropriate technologies to improve their operations and services. This institutional capacity enables firms to better respond to uncertainty, adopt relevant technological solutions, and transform to meet customer needs. Therefore, environmental uncertainty not only drives firms to adopt appropriate technologies but also relies on institutional capacity to effectively and efficiently.

Uncertainty in the business environment significantly affects the resilience of young farmer entrepreneurs through institutional capacity, as indicated by the p-value of 0.021, which is smaller than the alpha level of 0.05. The path coefficient from uncertainty in the business environment to resilience of young farmer entrepreneurs through institutional capacity is 0.264, indicating a positive effect. These results indicate that uncertainty in the business environment can be a trigger for young farmer entrepreneurs to strengthen their institutional capacity, for example by improving organizational capabilities, resource management, or institutional cooperation. This strong institutional capacity then helps young farmer entrepreneurs face challenges, adopt adaptive strategies, and maintain the sustainability of their businesses, thereby increasing resilience to various pressures in the business environment. This positive effect indicates that the role of institutional capacity is very important in bridging the impact of uncertainty in the business environment on the resilience of young farmer entrepreneurs.

Uncertainty in the business environment significantly affects the resilience of young farmer entrepreneurs through the adoption of appropriate technology, as indicated by the p-value of 0.012, which is smaller than the alpha level of 0.05. The path coefficient from business environment uncertainty to the resilience of young farmer entrepreneurs through the adoption of appropriate technology is 0.128, indicating a positive effect. These results indicate that in conditions of uncertainty, such as market fluctuations, climate change, or supply chain disruptions, young farmer entrepreneurs tend to seek innovative solutions through technology that suits their needs. Appropriate technology, for example in the form of modern agricultural tools or digital platforms, helps them increase efficiency, reduce risks, and strengthen competitiveness (Bashiru et al., 2024; Guo et al., 2024; Hassan et al., 2023; Hokmabadi et al., 2024). Thus, the adoption of this technology becomes an important intermediary that connects the impact of business environment uncertainty with the ability of young farmer entrepreneurs to survive and adapt to environmental pressures. This positive influence underlines the importance of technological innovation as an adaptation strategy (Kakkavou et al., 2024).

Uncertainty in the business environment significantly affects business resilience through institutional capacity and adoption of appropriate technology, with a p-value of 0.000, which is smaller than the alpha level of 0.05. The path coefficient from uncertainty in the business environment to adoption of appropriate technology through institutional capacity is 0.189, indicating a positive influence. This means that the higher the uncertainty in the business environment, the more developed the institutional capacity, adoption of appropriate technology, and business resilience are, which in the long term improves the performance of young farmer entrepreneurs (Elia et al., 2021; Trieu et al., 2023; Faisal & Abd Rashid, 2023; de Boon et al., 2024; Ayamga et al., 2024; Karbo et al., 2024; Manning, 2024). Uncertainty in the business environment encourages increased resilience of business empowerment through institutional capacity because uncertain situations require companies to develop adaptive and responsive capabilities. When companies face changes in consumer preferences, market fluctuations, or supply chain disruptions, institutional capacity allows them to recognize and respond to these challenges quickly. These capabilities include the ability to innovate, manage risk, and adjust strategies as needed to maintain operations and performance (Haque et al., 2024). Thus, environmental uncertainty not only encourages firms to improve their institutional capacity but also contributes to increasing the resilience of business empowerment (Malherbe et al., 2024; Budiman et al., 2024). This

resilience of empowerment enables companies to survive and thrive despite challenging conditions, maintaining operational continuity and competitiveness amidst change.

Previous studies provide valuable insights into farmers' adaptive behaviors but often overlook the perspectives of young agripreneurs. For instance, Jawo et al. (2023) examine farmers' perceptions of environmental uncertainty and their adaptation strategies, yet their focus is primarily on smallholder farmers rather than youth-led enterprises. Similarly, Rodriguez-camayo et al., (2025) link poverty and food insecurity to the vulnerability of coffee farmers, emphasizing socioeconomic fragility but not offering a comprehensive model that integrates environmental uncertainty, institutional capacity, and technology adoption as joint determinants of resilience. By contrast, the present study offers a more integrated perspective by explicitly examining how environmental uncertainty affects the resilience of young coffee entrepreneurs through institutional capacity and appropriate technology adoption. The findings show that institutional capacity allows young entrepreneurs to reorganize resources, make strategic decisions, and coordinate collective action, while the adoption of appropriate technology enhances operational flexibility, efficiency, and market reach. Together, these two factors mediate the effects of uncertainty and significantly strengthen business resilience, addressing gaps left by previous research. Although prior studies have advanced the understanding of coffee farmers' resilience, gaps remain in linking environmental uncertainty, institutional capacity, and technology adoption to the resilience of young agripreneurs. This study addresses that gap by demonstrating the critical role of institutional support and technology adoption in building sustainable, youth-led coffee businesses, providing both theoretical insights and practical guidance. These results suggest that young coffee entrepreneurs can enhance their long-term competitiveness and resilience by strengthening institutional networks with cooperatives, local governments, and private actors; investing in appropriate technologies such as modern production machinery, digital marketing platforms, and online payment systems; and developing adaptive strategies, including diversification of coffee varieties, risk management practices, and sustainability certifications to effectively respond to environmental and market uncertainties.

## CONCLUSIONS

Uncertainty in the business environment have a positive effect on institutional capacity, adoption of appropriate technology, and resilience of young farmer entrepreneurs. Institutional capacity plays a major role in bridging the relationship between uncertainty in the business environment and technology adoption, as well as increasing business resilience. In addition, adoption of appropriate technology has been shown to have a significant positive impact on business resilience, enabling entrepreneurs to be more flexible and adaptive in facing challenges. Overall, the results of the study emphasize the importance of institutional capacity and technological innovation in strengthening the resilience of young farmer entrepreneurs in a dynamic business environment. Uncertainty encourages entrepreneurs to increase adaptive capacity, such as utilizing technology and managing resources effectively. These findings indicate that adaptive strategies based on institutional capacity and appropriate technology not only increase competitiveness but also help entrepreneurs maintain long-term business sustainability.

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