Research on World Agricultural Economy
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Labor Dynamics and Productivity in High-Value Crop Farming: Evidence from Melon Growers in Nueva Ecija, Philippines

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ABSTRACT

High-value melon farming in Nueva Ecija is a cornerstone of the province's agrarian economy and rural livelihoods, yet its sustainability is threatened by labor shortages, workforce aging, and youth disengagement. Understanding labor dynamics and their impact on productivity is essential for promoting inclusive and resilient agricultural growth. This study employed a descriptive-quantitative design, using Migration Theory and the Resource-Based View (RBV) to examine the labor status and productivity of 38 melon growers in Nueva Ecija, Philippines. Results from descriptive statistics and multiple linear regression analysis show that age, farming experience, skill level, and labor adequacy positively influence yield and profitability, highlighting the strategic importance of human capital. Conversely, rising wage costs, declining youth participation, and low succession interest constrain productivity, as the limited willingness of the next generation to continue farming reduces labor continuity, delays adoption of modern techniques, and weakens long-term farm management. These findings align with Migration Theory, illustrating how rural–urban and overseas migration exacerbate labor depletion and demographic imbalances. While experienced farmers maintain short-term productivity, limited succession interest threatens long-term competitiveness. Overall, labor composition, demographic shifts, and generational engagement critically shape agricultural

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ARTICLE INFO
Received: 28 October 2025 | Revised: 16 January 2026 | Accepted: 30 January 2026 | Published Online: 25 May 2026
DOI: https://doi.org/10.36956/rwae.v7i2.2873

CITATION
Pastorfide, D.M., 2026. Labor Dynamics and Productivity in High-Value Crop Farming: Evidence from Melon Growers in Nueva Ecija, Philippines. Research on World Agricultural Economy. 7(2): 562–580. DOI: https://doi.org/10.36956/rwae.v7i2.2873

performance and progress toward SDG 1 and SDG 8.

Keywords: Agricultural Sustainability; Agricultural Succession; Labor Dynamics and Productivity; Melon Farming; Migration Theory; Resource-Based View; SDG 1—No Poverty; SDG 8—Decent Work and Economic Growth

1. Introduction

Based on the recent report from the Organisation for Economic Co-operation and Development (OECD), agriculture remains a vital sector in the Philippines, employing roughly one-quarter of the labor force but contributing less than 10% to the Gross Domestic Product, highlighting a persistent gap in labor productivity [1]. Over recent decades, growers have aged significantly: Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA) [2] data place the average age of Filipino growers between 55 and 59 years old, with earlier reports estimating 57 years, though more recent registry data suggest a modest decline toward 49–50 years [3]. Such demographic shifts, coupled with declining farm incomes and migration pressures, pose serious risks to generational continuity in agriculture and threaten progress toward Sustainable Development Goal (SDG) 1 No Poverty, which underscores the need for inclusive rural livelihood opportunities, and SDG 8 Decent Work and Economic Growth, which promotes productive employment and equitable income generation in agrarian economies.

In Nueva Ecija, historically known as the "Rice Granary of the Philippines," melon farming has emerged as a high-value crop complementing staple production. Its relatively short growing cycle, favorable market prices during peak harvests, and increasing demand have positioned melon farming as a promising livelihood for rural households. Nonetheless, melon cultivation remains labor-intensive, requiring skilled and consistent labor for land preparation, pest management, and harvesting. Amid labor scarcity and rising production costs, sustaining productivity becomes increasingly challenging, thereby constraining agricultural competitiveness and the realization of SDGs 1 and 8, both of which rely on productive and inclusive rural workforces.

Although previous studies have addressed agricultural labor aging [4], rural–urban migration [5], and youth disengagement [6] in farming, there remains limited empirical evidence on how these labor dynamics specifically influence productivity in high-value crop farming, particularly melon production in Nueva Ecija. Specifically, little is known about (1) how workforce composition (age, skill, experience) correlates with yield and profitability; (2) the determinants of youth migration from melon-growing communities; and (3) the extent of youth interest and willingness to engage in high-value agriculture under current labor and market conditions.

To address these gaps, this study applies Migration Theory and the Resource-Based View (RBV). Migration Theory explains the push–pull forces driving rural labor outmigration and their implications for agricultural labor availability [7,8]. The RBV treats labor not merely as an input but as a strategic resource, where the quality, adaptability, and sustainability of human capital determine long-term farm productivity [9,10]. By integrating these theoretical perspectives, the study explores how labor mobility and human resource capacity jointly shape melon farm performance. The research aims to assess labor status, productivity, and youth engagement in melon farming, informing strategies that strengthen rural employment, enhance productivity, and contribute to the attainment of SDG 1 and SDG 8 through sustainable agricultural transformation.

The aims of the study are to assess the labor status in melon farming in Nueva Ecija by measuring workforce demographics (age, experience, skill), entry of new growers, and youth migration patterns [11]; to quantify productivity in melon farming via yield per hectare and profitability; to evaluate youth interest in agriculture as a livelihood; and to analyze how these labor dynamics affect productivity in melon farming. Findings are expected to inform policy and program interventions that support generational succession, improve labor efficiency, and enhance the long-term sustainability of high-value crop agriculture in the Philippines.

1.1. Theoretical Framework

This study is grounded in an integrated theoretical framework that combines the Resource-Based View (RBV) [9], labor migration theory [12], and agricultural labor and productivity theories to explain labor dynamics and productivity outcomes in high-value melon farming in Nueva Ecija, Philippines. Together, these perspectives provide a robust conceptual foundation for understanding how internal farm resources and external labor mobility interact to shape productivity, efficiency, and long-term sustainability in agricultural systems.

The RBV posits that the performance and competitiveness of firms and, by extension, farms are determined by their internal resources and capabilities that are valuable, rare, imperfectly imitable, and non-substitutable. In agriculture, human capital represents a critical intangible resource, encompassing farmers' technical skills, experiential knowledge, managerial ability, and adaptive capacity to environmental and market risks [13]. These attributes are particularly vital in high-value crop production, where productivity depends heavily on precise timing, labor coordination, and effective input management.

Empirical studies have consistently demonstrated that farmer experience, education, and labor quality significantly influence agricultural productivity and profitability. From an RBV perspective, sustained productivity advantages in farming systems arise when human capital is continuously renewed and effectively deployed. However, RBV also recognizes that competitive advantages erode when key resources become constrained or poorly replenished—an issue increasingly observed in agricultural regions experiencing workforce aging and declining youth participation.

Complementing RBV, labor migration theory provides a macro- and micro-level explanation for changes in agricultural labor availability. Classical and neoclassical migration models argue that individuals migrate in response to wage differentials, employment opportunities, and expected income gains between rural and urban areas [14]. In rural economies, these incentives often lead younger, more educated, and more mobile individuals to exit agriculture, resulting in selective labor out-migration.

The New Economics of Labor Migration (NELM) further conceptualizes migration as a household-level strategy aimed at income diversification and risk management in contexts characterized by imperfect credit, labor, and insurance markets [15]. Under this framework, remittances may be reinvested into agricultural production through the purchase of inputs, mechanization, or land, potentially mitigating the adverse effects of labor loss. Empirical evidence from China and other developing regions suggests that while migration reduces on-farm labor supply, productivity outcomes depend on whether remittances effectively substitute for lost labor through capital deepening or technological adoption [11].

The relationship between labor availability and agricultural productivity is further explained by labor allocation and farm production theories, which emphasize that both the quantity and quality of labor are central determinants of output efficiency. Labor shortages can lead to delayed farm operations, sub-optimal crop management, increased reliance on hired or part-time labor, and reduced supervision intensity, all of which may negatively affect yields and profitability [16].

Migration-induced labor restructuring also affects intergenerational knowledge transfer and innovation capacity within farming households. Studies have shown that the out-migration of younger cohorts weakens succession planning and limits the transmission of tacit farming knowledge, increasing dependence on aging farmers whose physical capacity and willingness to adopt new technologies may be declining [15]. In high-value and labor-sensitive crops, such disruptions can pose significant risks to productivity and farm continuity.

Integrating these theoretical perspectives, this study conceptualizes melon farming productivity in Nueva Ecija as a function of both internal human capital resources (RBV) and external labor mobility forces (labor migration theory). The interaction between labor status (e.g., full-time family labor, hired labor, part-time labor), migration-related labor constraints, and farmers' accumulated experience is theorized to influence operational efficiency, innovation adoption, and production outcomes. Where labor losses are not adequately compensated by capital investment or skill retention, pro-

ductivity is expected to decline. Conversely, farms with stronger human capital endowments and adaptive capacity may better withstand labor outflows.

This integrated framework provides the conceptual justification for examining labor status and migration-related variables as key determinants of productivity in the empirical analysis. It also aligns the study with Sustainable Development Goal 1 (No Poverty) by emphasizing the importance of productive, resilient agricultural livelihoods in sustaining inclusive rural development and mitigating poverty in agrarian regions.

1.2. Research Paradigm

The research paradigm (**Figure 1**) presents an integrated and theoretically grounded framework in which productivity outcomes in high-value melon farming are understood as the result of dynamic interactions between internal human capital endowments and external labor mobility pressures. Drawing on the Resource-Based View, the model critically conceptualizes farmers' age, accumulated experience, skills and training, and farm size as strategic resources that shape a farm's capacity to organize labor efficiently, adopt innovations, and sustain competitive performance. At the same time, labor migration theory situates these internal capabilities within broader labor-market dynamics, demonstrating how workforce composition, wage structures, youth participation, and succession interest condition the availability, continuity, and effective deployment of labor. Importantly, the paradigm moves beyond a static factor-based explanation by emphasizing that yield, profitability, efficiency, and sustainability emerge from the interaction between resource quality and labor stability rather than from any single determinant. In doing so, the model aligns with and extends international empirical literature on agricultural labor and productivity, particularly in labor-intensive and high-value cropping systems, by explicitly linking micro-level human capital constraints with macro-level migration processes. This integrative approach provides a strong analytical basis for hypothesis testing, enhances the external relevance of the findings beyond the local case, and contributes to a more nuanced understanding of how labor restructuring influences agricultural performance in developing-country contexts.

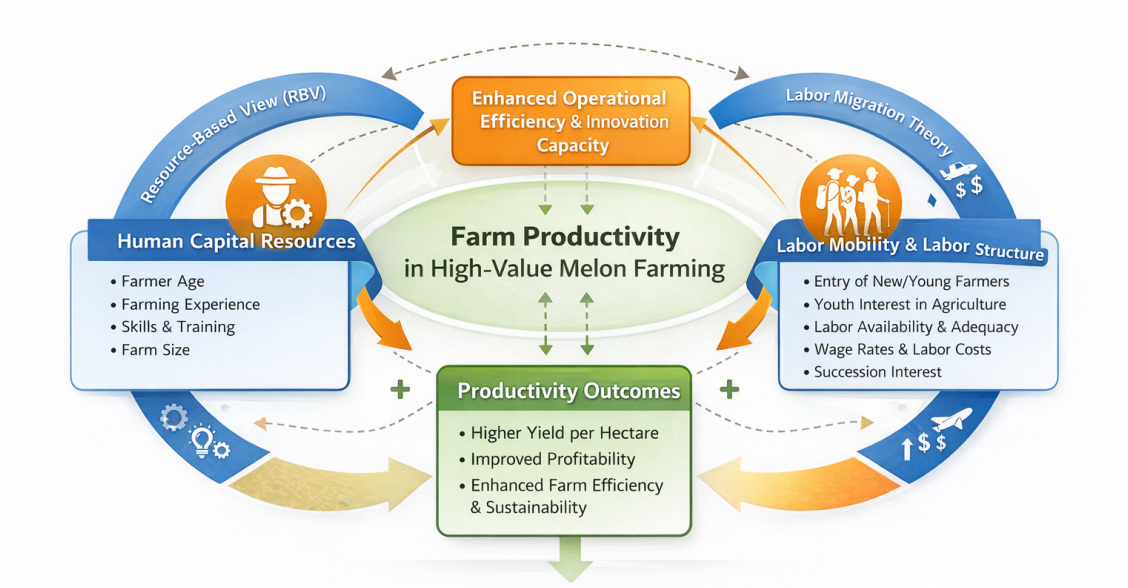

Figure 1. Conceptual Model for Resource-Based View and Labor Migration Theory in High Value Crops Melon.

1.3. Hypothesis

- **Melon Farm Yield**

H0. *Demographic characteristics, human capital attributes, labor structure, and labor market conditions do not significantly explain variations in yield per hectare among melon growers in Nueva Ecija.*

H1. *Demographic characteristics, human capital attributes, labor structure, and labor market conditions significantly explain variations in yield per*

hectare among melon growers in Nueva Ecija.

- **Melon Farm Profitability**

  H0. *Demographic characteristics, human capital attributes, labor structure, and labor market conditions do not significantly explain variations in profitability per hectare among melon growers in Nueva Ecija.*

  H1. *Demographic characteristics, human capital attributes, labor structure, and labor market conditions significantly explain variations in profitability per hectare among melon growers in Nueva Ecija.*

2. Materials and Methods

2.1. Research Design

This study used a descriptive quantitative design to assess labor status and productivity in high-value melon farming in Nueva Ecija, Philippines [17]. Grounded in Migration Theory and the Resource-Based View (RBV), it examined how labor availability, quality, and mobility affect productivity, emphasizing human capital as a key driver of farm efficiency and sustainability [7,9].

2.2. Research Locale

The study was conducted in Nueva Ecija, Central Luzon, a producer of high-value melon crops that support local agribusiness and rural employment. Research focused on melon-growing areas with high labor demand during peak farming seasons.

2.3. Respondents and Sampling Technique

The study involved all 38 registered melon growers in Nueva Ecija, identified through total enumeration sampling to ensure comprehensive population coverage and eliminate sampling bias. This method was chosen to represent the entire population of active melon farmers within the province, thereby enhancing the validity and generalizability of the findings [18]. The list of respondents was obtained with the assistance of local agricultural offices and farmer organizations, which verified farmer registration and eligibility.

The list of respondents was obtained in coordination with municipal agriculture offices and accredited farmer organizations, ensuring that only verified and active melon producers were included. This procedure enhanced the reliability and validity of the data by ensuring that the participants accurately represented the farming population within the province [19]. The use of total enumeration also allowed for more comprehensive comparative analysis across different demographic and production profiles, strengthening the study's overall analytical precision and empirical foundation.

2.4. Research Instrument

The primary research instrument was a self-constructed structured survey questionnaire, designed based on related literature and field observations on labor and productivity in high-value crop farming. The instrument consisted of two main parts:

- **Part I** gathered socio-demographic and farm profile information, including age, gender, years in melon farming, land size, and labor sources.
- **Part II** measured labor status (e.g., workforce composition, skill level, availability, and youth participation) and productivity indicators (e.g., yield per hectare, profitability, and perceived efficiency).

Responses were measured using a 4-point Likert scale (4 = *Strongly Agree*, 3 = *Agree*, 2 = *Disagree*, 1 = *Strongly Disagree*), allowing quantification of perceptions and experiences related to farm labor and productivity.

2.5. Validity and Reliability of Instrument

The research instrument was validated by three experts in agricultural economics and rural development, followed by a pilot test among non-sample melon growers to refine clarity and wording. Cronbach's Alpha values above 0.86 confirmed high internal reliability across all dimensions.

2.6. Data Collection Procedures

Data were collected through in-person administration of questionnaires, ensuring accuracy and completeness of responses. Participation was voluntary, and re-

spondents were informed about the study's objectives, confidentiality measures, and their right to withdraw at any time without penalty.

2.7. Data Analysis

Data analysis involved both descriptive and inferential statistical techniques. Descriptive statistics such as frequency, percentage, and mean were employed to summarize the socio-demographic characteristics of the respondents and describe the labor status in melon farming[20]. To determine the predictive influence of labor-related variables on productivity, the study utilized Multiple Linear Regression Analysis (MLRA)[21].

2.8. Ethical Approval

This study was approved by the San Isidro Campus RET Chairperson of Nueva Ecija University of Science and Technology using the Form Code NEUST-RSD F007 rev 04 (04.01.2024).

3. Results

This section presents the results of the survey conducted about the labor dynamics and productivity of high value crops melon in Nueva Ecija, Philippines.

3.1. Demographic Profile of Melon Growers

The demographic and farm-structure profile of melon growers in Nueva Ecija reveals a production system that is highly dependent on an aging and experience-intensive labor base (**Table 1**). The concentration of growers in older age cohorts, coupled with long farming tenure, indicates that melon production is sustained primarily by accumulated experiential knowledge rather than by continuous inflows of younger labor. While this depth of experience may support short-term stability and technical competence, it simultaneously signals demographic vulnerability, as limited participation from younger age groups constrains labor renewal and succession. The dominance of small-scale farm sizes further reinforces this vulnerability, as smallholder operations often lack the scale and capital flexibility needed to absorb labor shortages or invest aggressively in mechanization. Land ownership remains relatively high, which may enhance tenure security and production commitment, yet ownership alone appears insufficient to counterbalance demographic aging and labor attrition.

In terms of human capital and labor organization, the findings point to a paradox between self-assessed skill levels and limited formal capacity-building opportunities. Although most growers perceive themselves as highly skilled, the low incidence of formal agricultural training suggests that skill acquisition is largely informal and path-dependent, relying on traditional practices rather than systematic technological upgrading. This condition may limit adaptability to changing production and labor conditions, particularly in high-value cropping systems that require continuous innovation. The heavy reliance on family labor, alongside minimal use of hired workers, further underscores the embeddedness of melon farming within household labor structures, making productivity highly sensitive to demographic shifts and migration-related labor loss. Most critically, the very low interest of youth in farm succession signals a structural discontinuity that threatens the long-term viability of the sector. Taken together, these patterns suggest that melon farming in Nueva Ecija faces not only labor scarcity but also a weakening pipeline of human capital renewal, with direct implications for productivity, sustainability, and rural agricultural development.

Table 1. Demographic Profile of the Melon Growers.

Age Group	Frequency	Percentage
25 and Below	1	2.63%
26–35	3	7.89%
36–45	6	15.79%
46–55	9	23.68%
56–65	11	28.95%
66 and Above	8	21.05%
Total	38	100%

Table 1. *Cont.*

Age Group	Frequency	Percentage
Range (Years)		
1–5	2	5.26%
6–10	4	10.53%
11–15	6	15.79%
16–20	10	26.32%
21 years and above	16	42.11%
Total	38	100%
Level of Skills		
Highly Skilled (4–5)	22	57.89%
Moderately Skilled (3)	11	28.95%
Low Skilled (1–2)	5	13.16%
Total	38	100%
Formal Skills Training		
Attended Formal Training	6	15.79%
No Formal Training	32	84.21%
Total	38	100%
Farm Size		
1.00–1.50	14	36.84%
1.51–2.00	10	26.32%
2.01–2.50	7	18.42%
2.51–3.00	5	13.16%
Above 3.00	2	5.26%
Total	38	100%
Type of Land Tenure		
Owned Land	25	65.79%
Leased Land	9	23.68%
Shared Tenancy	4	10.53%
Total	38	100%
Labor Source		
Family Labor	29	76.32%
Hired Labor	6	15.79%
Combined (Family + Hired)	3	7.89%
Total	38	100%
Place of Residence		
Rural Area	38	100%
Urban Area	0	0%
Total	38	100%
Succession Interest		
Not interested in taking over	35	92.1%
Willing to take over	3	7.89%
Total	38	100%

3.2. Labor Dynamics and Participation in Melon Farming

The results in **Table 2** indicate a structurally constrained entry pathway into melon farming in Nueva Ecija, characterized by minimal participation of new and young growers and reinforced by strong outward labor preferences among rural youth. The dominance of long-established growers suggests that farm continuity relies heavily on incumbents, with limited generational inflow to replace aging labor. Youth employment preferences are markedly oriented toward urban and overseas work, reflecting strong push–pull migration dynamics that divert potential labor away from agriculture and weaken local succession pipelines. These patterns are compounded by widespread perceptions of labor inadequacy, with frequent and severe shortages reported by a substantial share of growers, indicating that labor scarcity is not episodic but systemic. Rising wage levels further reflect tightening labor markets, increasing production costs, and eroding margins in smallholder-dominated systems. The consistently low perceived interest of youth in agricultural work reinforces the risk of long-term labor depletion, suggesting that melon farming faces not only immediate labor constraints but also a deepening structural challenge to workforce renewal and productivity sustainability.

Table 2. Labor Dynamics and Participation of Melon Growers.

Entry of New and Young Growers	Frequency	Percentage
New Growers (1–3 years)	3	7.89%
Experienced Growers (4–10 years)	7	18.42%
Long-Term Growers (Above 10 years)	28	73.68%
Total	38	100%
Employment Preference of Rural Youth		
Urban Employment	24	63.16%
Overseas Employment (OFW)	9	23.68%
Agricultural Work	3	7.89%
Entrepreneurial (Non-farming) Work	2	5.26%
Total	38	100%
Labor Availability Status		
Adequate Labor Supply	5	13.16%
Occasionally Insufficient	12	31.58%
Frequently Insufficient	16	42.11%
Severely Lacking	5	13.16%
Total	38	100%
Weekly Wage Rate (in PHP)		
Below 700	3	7.89%
700–799	10	26.32%
800–899	18	47.37%
900 and Above	7	18.42%
Total	38	100%
Level of Interest in Farming		
Very High	1	2.63%
High	2	5.26%
Moderate	6	15.79%
Low	12	31.58%
Very Low	17	44.74%
Total	38	100%

3.3. Productivity Indicators of Melon Farming

The results in **Table 3** suggest that melon farming in Nueva Ecija operates within a narrow band of technical and financial performance, where productivity and profitability are moderate but uneven across growers. Yield levels cluster around mid-range outputs, indicating that most farms are able to meet acceptable production thresholds, but only a limited proportion achieve high-yield performance, which may reflect constraints related to labor quality, timing of farm operations, and input management. Profitability follows a similar pattern, with most producers earning modest returns that are sufficient for short-term viability but potentially vulnerable to cost shocks. This vulnerability is reinforced by the relatively high and concentrated production costs, particularly labor-related expenses, which compress profit margins and limit reinvestment capacity. The predominance of self-assessed moderate to low efficiency further suggests that existing production systems are operating below their optimal frontier, with limited technological upgrading and process innovation. Taken together, these findings indicate that while melon farming remains economically viable for many growers, its sustainability and competitiveness are constrained by cost pressures, efficiency limitations, and uneven productivity performance, underscoring the need for labor-saving technologies and human capital enhancement to move farms toward higher efficiency and profitability trajectories.

Table 3. Yield, Profitability, Cost, and Efficiency in Melon Farming.

Yield Range (kg/ha)	Frequency	Percentage
Below 20,000 kg	6	15.79%
20,000–24,999 kg	10	26.32%
25,000–29,999 kg	15	39.47%
30,000 kg and above	7	18.42%
Total	38	100%

Table 3. *Cont.*

Yield Range (kg/ha)	Frequency	Percentage
Profit Range (PHP)		
Below 400,000	5	13.16%
400,000–449,999	10	26.32%
450,000–499,999	16	42.11%
500,000 and above	7	18.42%
Total	38	100%
Total Cost (PHP)		
Below 800,000	4	10.53%
800,000–899,999	12	31.58%
900,000–999,999	17	44.74%
1,000,000 and above	5	13.16%
Total	38	100%
Perception Level		
Very High Efficiency and Sustainability	2	5.26%
High Efficiency	5	13.16%
Moderate Efficiency	14	36.84%
Low Efficiency	12	31.58%
Very Low Efficiency and Sustainability	5	13.16%
Total	38	100%

3.4. Effects of Labor-Related Factors on the Productivity of Melon Farming in Nueva Ecija

3.4.1. Multiple Regression Analysis on Factors Affecting Yield per Hectare of Melon Grower

The regression results in **Tables 4** and **5** indicate that yield performance in melon farming is strongly shaped by a combination of human capital, labor availability, and structural farm characteristics. The model demonstrates acceptable explanatory power, confirming that demographic and labor-related variables jointly account for a substantial share of yield variation. Positive and statistically significant effects associated with farming experience, skills and training, farm size, labor composition, and labor adequacy underscore the centrality of human capital quality and stable labor inputs in achieving higher productivity. The positive contribution of farmer age further reflects the productivity value of accumulated tacit knowledge in high-value crop management. In contrast, the negative influence of new or young farmer entry and rising wage and labor costs highlights structural barriers to productivity expansion, particularly in contexts where labor markets are tightening and generational transition remains weak. The significant negative association of low succession interest with yield reinforces concerns over farm continuity and investment incentives. Collectively, these results affirm that yield outcomes are not driven by single factors but by the interaction of labor quality, demographic structure, and cost pressures, with clear implications for productivity sustainability in melon farming systems.

Table 4. Regression Model Summary for Yield per Hectare of Melon Growers.

Statistic	Value
Multiple R	0.745
R^2	0.555
Adjusted R^2	0.512
Standard Error	2158.32
F	7.84
Significance F	0.00021

Table 5. Multiple Regression Analysis on Factors Affecting Yield per Hectare of Melon Growers.

No.	Variable	Coefficient (β)	*p*-Value	Interpretation
1	Age of Farmers	68.452	0.047	Significant
2	Years of Farming Experience	102.317	0.012	Significant
3	Level of Farming Skills/Training	91.684	0.028	Significant
4	Farm Size (hectare)	121.553	0.015	Significant

Table 5. *Cont.*

No.	Variable	Coefficient (β)	*p*-Value	Interpretation
5	Type of Land Tenure	−41.782	0.226	Not Significant
6	Labor Source and Workforce Composition	83.917	0.041	Significant
7	Entry of New/Young Farmers	−112.364	0.033	Significant
8	Availability and Adequacy of Farm Labor	148.251	0.006	Significant
9	Wage Rates and Labor Costs	−134.226	0.039	Significant
10	Level of Youth Interest in Agriculture	76.289	0.052	Significant
11	Succession Interest	−158.442	0.018	Significant

3.4.2. Multiple Regression Analysis on Factors Affecting Profitability per Hectare of Melon Growers

The regression results in **Tables 6** and **7** indicate that profitability among melon growers in Nueva Ecija is influenced by an interplay of human capital, farm resources, labor availability, and demographic factors. Positive and significant predictors—including farmer age, years of experience, skill levels, farm size, labor composition, labor adequacy, new farmer entry, and youth interest—highlight the critical role of accumulated knowledge, technical competence, adequate workforce, and intergenerational engagement in enhancing farm income. In contrast, rising wage rates and labor costs, along with low succession interest, exert significant negative effects, demonstrating that financial pressures and weak generational continuity can constrain profitability. Land tenure type remains insignificant, suggesting that ownership structure alone does not determine income outcomes. Collectively, these findings underscore that sustainable profitability in melon farming depends on the simultaneous optimization of human capital, labor support, and farm management, while addressing labor cost pressures and succession challenges is essential for long-term economic resilience.

Table 6. Regression Model Summary for Profitability per Hectare of Melon Growers.

Statistic	Value
Multiple R	0.712
R^2	0.507
Adjusted R^2	0.423
Standard Error	18540.22
F	6.04
Significance F	0.001

Table 7. Multiple Regression Analysis on Factors Affecting Profitability per Hectare of Melon Growers.

No.	Variable	Coefficient (β)	*p*-Value	Interpretation
1	Age of Farmers	1248.53	0.041	Significant
2	Years of Farming Experience	1984.66	0.022	Significant
3	Level of Farming Skills/Training	1567.49	0.015	Significant
4	Farm Size (hectare)	1879.32	0.009	Significant
5	Type of Land Tenure	−842.71	0.188	Not Significant
6	Labor Source and Workforce Composition	1124.27	0.047	Significant
7	Entry of New/Young Farmers	975.62	0.033	Significant
8	Availability and Adequacy of Farm Labor	2541.87	0.004	Significant
9	Wage Rates and Labor Costs	−1734.55	0.018	Significant
10	Level of Youth Interest in Agriculture	1428.69	0.026	Significant
11	Succession Interest	−2156.44	0.039	Significant

4. Discussion

4.1. Demographic Profile of Melon Growers in Nueva Ecija

The demographic profile of melon growers in Nueva Ecija reveals an aging labor force, with the majority of producers nearing their 60s and only a small proportion below 35 years old. This indicates limited youth participation in the sector and highlights that melon farming is sustained largely by middle-aged and elderly growers who possess substantial experience and tacit knowledge. From the perspective of the Resource-Based

View (RBV), these experiential assets, along with secure land tenure and long-standing buyer relationships, represent valuable and inimitable internal resources that contribute to productivity and competitiveness [18]. However, the dominance of older growers also presents challenges such as declining labor capacity and slower technology adoption. Comparable global patterns were observed in China, where labor aging negatively affected agricultural total factor productivity [22], while in Japan and South Korea, mechanization and cooperative systems mitigated these effects and sustained productivity [22,23].

The low participation of youth in melon farming aligns with Migration Theory, which explains how rural push factors such as low income, limited livelihood prospects, and social stagnation combine with urban pull factors like higher wages and upward mobility to drive young people away from agriculture [22]. This pattern results in an aging, risk-averse workforce that limits innovation and generational renewal. Globally, similar outcomes are evident, as reported that youth outmigration in Sub-Saharan Africa has accelerated agricultural aging and reduced productivity [24]. This demographic imbalance threatens progress toward SDG 1 and SDG 8, as the shrinking pool of young, skilled entrants weakens rural resilience, income potential, and the long-term sustainability of smallholder farming [25].

In terms of farming experience and skills, melon growers in Nueva Ecija largely depend on experiential learning rather than formal agricultural education. Within the Resource-Based View (RBV) framework, this reliance on implied knowledge enhances operational efficiency and represents a key internal asset that sustains productivity [25,26]. However, excessive dependence on informal experience restricts adaptability and limits the integration of modern farming technologies. Similar patterns have been observed in Bangladesh and Ghana as well as in Africa, where informally trained but experienced farmers sustained short-term efficiency yet struggled to adopt innovations [27,28]. This situation is consistent with the persistence of subsistence-based agricultural practices in many developing countries, where small farmers rely on traditional methods primarily for self-sufficiency rather than market-oriented productivity [29]. Globally, evidence from China and Japan shows that aging farmers without access to continuous skills upgrading experience stagnant productivity [19,30]. Therefore, transforming tacit knowledge into structured capacity-building through extension programs, intergenerational mentorship, and technology-driven training is vital to sustain competitiveness and advance the poverty- and employment-focused targets of SDG 1 and SDG 8.

Lastly, the structural characteristics of melon farming in Nueva Ecija smallholder operations, family labor, and secure land tenure reflect both strengths and vulnerabilities. Small farm ownership and family-based work arrangements serve as core internal resources that ensure production continuity and minimize costs, consistent with RBV principles. Yet, small farm sizes limit economies of scale, mechanization, and innovation, hindering productivity growth [31,32]. Similar cases in India and Indonesia show that while family labor systems stabilize livelihoods, they constrain scalability and modernization [33,34]. Moreover, as youth migration continues, the reliance on aging household labor threatens future sustainability, which also happens in Nigeria [35,36]. The unwillingness of the majority of the youth to take over the farming of melon and the fact that only a small portion is willing show the trend that more and more youth prefer to migrate, which contributes to low productivity of melon farming. The growing pattern of male outmigration from rural villages in Nepal has led to women taking additional responsibilities in farming resulting in a lowered use and productivity of land and a reduction in food production [37]. These interrelated dynamics underscore that achieving SDG 1 in the agricultural sector requires policies that balance traditional strengths such as experience, tenure, and family cohesion with innovations that attract youth participation, enhance labor productivity, and ensure inclusive rural development.

4.2. Labor Dynamics and Participation in Melon Farming

The labor dynamics of melon farming in Nueva Ecija show a sector heavily reliant on an aging, long-tenured workforce with limited entry from younger generations. Under the Resource-Based View (RBV), this

pattern highlights that human capital especially the experiential knowledge and decision-making abilities of veteran growers remains a valuable yet diminishing internal resource vital for sustaining productivity and competitiveness [38]. However, the lack of generational renewal restricts innovation and limits the adoption of modern technologies and entrepreneurial practices essential for long-term growth. Comparable demographic imbalances are evident globally, where aging farming populations in Asia and Europe have weakened innovation systems and reduced overall productivity [39,40]. Further, smallholders in East and Southeast Asia's are persisted in the face of rapid and profound social and economic transformation [41]. Meanwhile, Migration Theory explains the youth exodus as a response to push factors like low agricultural incomes and "pull" factors such as higher urban wages and better living conditions [42]. This trend, also observed in other developing regions, underscores how rural labor depletion hampers agricultural succession and slows progress toward SDG 1 and SDG 8 by constraining income opportunities and weakening rural livelihood sustainability [43].

The persistence of labor scarcity, low wage rates, and weak youth participation in melon farming highlights the fragility of the sector's human resource foundation. Within the Resource-Based View, skilled and adequate labor represents a rare and valuable resource essential for sustaining productivity and achieving competitive advantage [44]; yet its scarcity and undervaluation constrain these outcomes. From the perspective of Migration Theory, low rural wages and limited livelihood prospects serve as strong "push factors" motivating youth to migrate toward urban or overseas employment [45]. Similar labor dynamics are observed in other developing economies, where poor rural working conditions and stagnant farm incomes accelerate workforce aging and productivity decline [46,47]. This imbalance reinforces rural poverty traps and weakens agricultural resilience, hindering progress toward SDG 1 and SDG 8, both of which emphasize equitable employment, income generation, and sustainable livelihood opportunities in the agricultural sector.

Finally, the waning interest and engagement of rural youth in agriculture pose a serious threat to the sustainability of high-value melon farming in Nueva Ecija. Within the RBV framework, this decline represents the erosion of innovative human capital, the key intangible asset required to sustain productivity and competitiveness [48]. Migration Theory further explains this trend as a rational response to socio-economic disparities, where limited farm profitability and persistent stigma toward manual labor push younger generations toward urban and overseas employment [49]. Comparable patterns in Indonesia, Thailand, and Kenya demonstrate that youth outmigration accelerates aging in the agricultural labor force, leading to stagnation in productivity and innovation [50,51]. Consequently, Nueva Ecija's labor dynamics reflect a wider global challenge in agricultural renewal: the combined pressures of aging, migration, and undervalued rural labor undermine the realization of SDG 1 and SDG 8 by constraining inclusive employment, income generation, and long-term food security.

4.3. Productivity Indicator in Melon Farming

The overall productivity and profitability trends in melon farming in Nueva Ecija reflect a moderate performance constrained by structural, demographic, and resource-based limitations. From the Resource-Based View (RBV), this indicates that while growers possess valuable internal assets such as experience, land, and capital, these are not sufficiently mobilized or innovatively utilized to achieve optimal yields [35,45]. Limited access to skilled labor and technology reduces the efficiency and synergy of farm resources, leading to uneven productivity levels among growers. Globally, similar findings have been observed in India, Vietnam, and Ghana, where aging agricultural workforces and weak innovation systems hinder productivity growth despite expanding market opportunities [52]. This alignment highlights that the productivity constraints in Nueva Ecija are part of a broader global challenge tied to SDG 1 and SDG 8 as they impede rural income growth, decent employment generation, and the sustainability of agricultural livelihoods.

Profitability outcomes further emphasize the fragility of resource coordination in the sector. Under the RBV framework, farm profitability reflects the ca-

pacity to combine and manage key assets, labor, capital, and land for value creation [38]. However, findings show that melon farming yields only modest profits, largely due to rising production costs, input price volatility, and labor scarcity. The latter, viewed through Migration Theory, can be attributed to rural labor outmigration that inflates wage rates and reduces farm efficiency [51]. Comparable results from Vietnam and Kenya reveal that aging growers and high labor costs suppress net returns in high-value crop systems [52]; furthermore, these issues also happened and are reported in Central Thailand [53]. Thus, Nueva Ecija's moderate profitability mirrors global agricultural economies where demographic transitions and resource inefficiencies weaken smallholder profitability and slow poverty alleviation efforts.

The cost structure of melon farming in Nueva Ecija further reinforces its vulnerability, as high input, irrigation, and labor expenses significantly erode income margins. Similar to findings in the Middle East, where smallholder farmers face rising input expenses, inefficient irrigation systems, and economic pressures that collectively erode productivity and profitability [54]. From the RBV perspective, this demonstrates that while growers possess tangible resources, their potential is undermined by inefficiencies in resource use and limited technological adaptation [47,55]. Rising labor costs driven by rural outmigration and an aging workforce exemplify Migration Theory's core mechanism of human capital depletion [56]. This trend resonates with findings from Indonesia and across Africa, where declining youth participation and high labor costs restrict productivity and profitability [56,57]. Consequently, the persistence of high production costs and labor shortages directly affects rural income generation, posing a challenge to the realization of SDG 1 in agricultural communities.

Growers' perception of only moderate farm efficiency in Nueva Ecija underscores systemic challenges in achieving agricultural sustainability. The RBV framework suggests that although key resources, land, labor, and capital exist, their limited integration and modernization hinder the attainment of sustained competitive advantage. This situation parallels global trends wherein smallholder farms struggle with mechanization deficits, limited technical training, and weak digital adoption [56,57]. The FAO [56] notes that youth disengagement particularly undermines innovation and long-term productivity, while the OECD [57] emphasizes that skill and technology gaps perpetuate inefficiency. Addressing these limitations requires a strategic reconfiguration of internal farm resources through agricultural training, technology adoption, and youth inclusion to strengthen the productivity base of melon farming and support inclusive rural development, based on the same challenges faced by the agriculture in Indonesia [58]. Such efforts directly advance SDG 1 by enhancing rural income stability and SDG 8 by promoting productive employment and sustainable economic opportunities in the agricultural sector [59].

4.4. Effects of Labor-Related Factors on the Productivity of Melon Farming in Nueva Ecija

4.4.1. Multiple Regression Analysis on Factors Affecting Yield per Hectare of Melon Growers

The regression analysis underscores that labor-related and human-capital factors remain central determinants of melon productivity in Nueva Ecija. Even within a moderately performing model, the consistent significance of farming experience, skill development, and labor adequacy demonstrates that productivity outcomes continue to hinge on farmers' capacity to manage resources effectively and adapt to dynamic production conditions. These results reinforce the perspective that technological access alone does not guarantee improved farm performance; rather, the ability of farmers to interpret information, apply innovations, and execute timely production decisions remains decisive. As noted in recent literature, informatization and mechanization still rely heavily on human literacy and technical competence, as machines do not replace labor effectively unless users possess the skills to integrate these tools into the production system [60]. Seen through the lens of the Resource-Based View (RBV), these findings affirm that human capital embodies a strategic resource that sustains competitive advantage, particularly in labor-intensive systems like melon farming, where practical expertise directly influences field operations and crop

quality [61].

At the same time, the negative influence of youth entry challenges and rising labor costs highlights the structural vulnerabilities embedded in the local agricultural labor system. These patterns mirror broader demographic pressures, particularly aging farmers and declining rural labor supply commonly associated with rural-to-urban migration and the growing preference among younger populations for non-agricultural employment, as outlined in Migration Theory [56,59]. Such demographic shifts not only contribute to seasonal labor shortages but also reduce the sector's capacity to innovate, as fewer young individuals enter the industry with the energy and flexibility needed to support modernization. Comparative evidence from neighboring countries, such as Indonesia, similarly demonstrates how demographic transitions heighten labor scarcity and impede sustainable agricultural growth [62].

The negative relationship between succession willingness and productivity suggests that when future heirs or potential successors show limited commitment to continuing farming operations, current growers may invest less in long-term improvements, adopt fewer technologies, or delay major management upgrades. Low succession interest can therefore create uncertainty that disrupts planning horizons and discourages both innovation and capital reinvestment. This emerging trend points to a looming generational turnover crisis in which farms face weakened continuity, diminished transfer of tacit knowledge, and erosion of accumulated management experience. Evidence from Colombian coffee farmers indicates that stable income, parental encouragement, secure land tenure, participation in farmer associations, and access to labor positively influence farm succession, underscoring the importance of socio-economic and institutional support in maintaining generational continuity [63].

Taken together, the findings portray melon farming in Nueva Ecija as operating within a fragile human-resource environment where both the quality and sustainability of the labor pool shape farm performance. Without meaningful intervention, particularly in strengthening farmer competencies, incentivizing youth engagement, and supporting structured succession pathways, the sector risks long-term declines in technical capacity and competitiveness. These insights highlight the need for integrated strategies that blend skills upgrading, labor market improvements, and succession planning to support the goals of SDG 1 and SDG 8, ensuring that rural livelihoods remain productive, resilient, and socially inclusive amid long-term demographic shifts.

4.4.2. Multiple Regression Analysis on Factors Affecting Profitability per Hectare of Melon Growers

The regression analysis shows that melon farm profitability in Nueva Ecija is strongly influenced by intertwined labor and demographic factors, reflecting the critical role of human capital in sustaining agricultural performance. Aging growers, rising labor costs, and the persistent decline in youth participation significantly reduce profitability, signaling both a demographic imbalance and a structural labor inefficiency [64]. Older farmers, though experienced, often exhibit risk aversion and limited adoption of modern production and marketing technologies, leading to slower innovation and reduced economic returns [65]. These outcomes support Migration Theory, which explains how youth out-migration depletes the agricultural labor base, increases production costs, and weakens generational renewal. Similar global evidence demonstrates that aging agricultural workforces constrain productivity, profitability, and technological adaptation, which is happening in China [66,67].

In contrast, farming experience, technical skill, and farm size positively influence profitability, validating the Resource-Based View (RBV), which underscores the strategic value of human capital and efficient resource utilization in achieving competitive advantage. Experienced and technically capable growers exhibit stronger decision-making in resource allocation, pest management, and market timing, allowing them to minimize costs and stabilize yields even under fluctuating labor and input conditions [68]. This reinforces that profitability in high-value melon farming is not merely a function of capital investment but depends on the quality and adaptability of its labor resources. Further, the negative result of low succession interest among youth affects the productivity of farms in terms of yield, as fewer en-

gaged successors lead to reduced labor availability, delayed adoption of modern cultivation techniques, and limited investment in long-term farm improvements [69]. This lack of generational commitment can slow innovation, disrupt crop management practices, and ultimately lower overall output, reinforcing the link between succession willingness and both short-term productivity and the long-term sustainability of farming operations [70].

Overall, the findings indicate that labor constraints, demographic aging, and uneven skill distribution collectively limit agricultural competitiveness and impede progress toward SDG 1 and SDG 8. Addressing these structural challenges through youth reintegration, labor upskilling, and farm efficiency programs is essential to ensure that high-value crop production remains both economically viable and socially inclusive within rural communities, which is the same situation that happens in Uganda, where policy support for agricultural extension, seed access, and market linkages was found necessary to stimulate technology adoption and rural inclusion [71].

5. Conclusions

This study demonstrates that high-value melon farming in Nueva Ecija is at a critical juncture, shaped by aging human capital, persistent youth out-migration, rising labor costs, and limited technological adoption. While the accumulated experience of senior growers supports short-term productivity, weak generational renewal and constrained labor availability threaten long-term efficiency, innovation, and competitiveness. The findings empirically link the Resource-Based View (RBV) with labor migration theory, highlighting that human capital remains the central driver of productivity, and that labor outflows—if not offset by capital investment or technological adoption—can undermine farm performance. Sustainable yield and profitability are therefore contingent on the combined effect of farmer capability, labor adequacy, and farm-scale resources, while structural issues such as low youth engagement and succession interest pose significant risks to continuity and growth.

Practically, the results underscore the need for targeted labor renewal strategies, including technical training, youth engagement, apprenticeship programs, and labor-saving technologies, alongside supportive policies on compensation and innovation incentives to attract and retain skilled agricultural workers. These interventions are crucial not only for enhancing farm-level productivity but also for advancing broader development goals, including SDG 1 (No Poverty) and SDG 8 (Decent Work and Economic Growth). The study is limited by its cross-sectional design, focus on a single province, and omission of variables such as remittance use, mechanization intensity, and gendered labor roles. Future research should consider longitudinal and comparative studies across crops and regions, as well as qualitative approaches, to capture dynamic labor transitions, succession planning, and household decision-making, thereby strengthening the evidence base for sustaining high-value agriculture in rural economies.

Funding

This work received no external funding.

Institutional Review Board Statement

This study was approved by the San Isidro Campus RET Chairperson of Nueva Ecija University of Science and Technology using the Form Code NEUST-RSD F007 rev 04 (04.01.2024).

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Acknowledgments

The author sincerely acknowledges the Nueva Ecija University of Science and Technology (NEUST) for its continued support and guidance to faculty researchers. The institution's commitment to research excellence has been instrumental in the completion of this study. All data utilized in this research are included in the manuscript.

Conflicts of Interest

The author declares no conflict of interest.

References

[1] Organisation for Economic Co-operation and Development (OECD), 2023. Agricultural Policy Monitoring and Evaluation 2023: Adapting Agriculture to Climate Change. OECD Publishing: Paris, France. DOI: https://doi.org/10.1787/b14de474-en

[2] Southeast Asian Regional Center for Graduate Study and Research in Agriculture, 2023. Aging Farmers Could Add to Food Insecurity. Available from: https://www.searca.org/press/aging-farmers-could-add-food-insecurity (cited 15 October 2025).

[3] Department of Agriculture, 2023. PH Farmers Getting Younger – DA. Available from: https://mirror.pia.gov.ph/press-releases/2023/10/16/ph-farmers-getting-younger-da (cited 15 October 2025).

[4] Asis, M.B.M., 2020. Sowing Hope: Agriculture as an Alternative to Migration for Young Filipinos? Scalabrini Migration Center: Quezon City, Philippines. Available from: https://smc.org.ph/wp-content/uploads/2020/03/SOWING-HOPE.pdf (cited 15 October 2025).

[5] Manalo, J.A., van de Fliert, E., 2013. Push and Pull Factors in Rural Filipino Youth's Outmigration from Agricultural Communities. Asian Journal of Agriculture and Development. 10(2), 59–73. DOI: https://doi.org/10.22004/ag.econ.199418

[6] Philippine Rice Research Institute, 2023. Social Scientists Present Trends in Youth and Agriculture Engagements in the Philippines. Available from: https://www.philrice.gov.ph/social-scientists-present-trends-in-youth-and-agriculture-engagements-in-the-philippines/ (cited 15 October 2025).

[7] de Haas, H., 2021. A Theory of Migration: The Aspirations-Capabilities Framework. Comparative Migration Studies. 9(1), 8. DOI: https://doi.org/10.1186/s40878-020-00210-4

[8] Todaro, M.P., Smith, S.C., 2020. Economic Development, 13th ed. Pearson: Harlow, UK.

[9] Barney, J.B., Clark, D.N., 2007. Resource-Based Theory: Creating and Sustaining Competitive Advantage. Oxford University Press: Oxford, UK. DOI: https://doi.org/10.1093/oso/9780199277681.001.0001

[10] Crook, T.R., Todd, S.Y., Combs, J.G., et al., 2011. Does Human Capital Matter? A Meta-Analysis of the Relationship between Human Capital and Firm Performance. Journal of Applied Psychology. 96(3), 443–456. DOI: https://doi.org/10.1037/a0022147

[11] Li, L., Wang, C., Segarra, E., et al., 2013. Migration, Remittances, and Agricultural Productivity in Small Farming Systems in Northwest China. China Agricultural Economic Review. 5(1), 5–23. DOI: https://doi.org/10.1108/17561371311294739

[12] Ge, D., Long, H., Qiao, W., et al., 2020. Effects of Rural–Urban Migration on Agricultural Transformation: A Case of Yucheng City, China. Journal of Rural Studies. 76, 85–95. DOI: https://doi.org/10.1016/j.jrurstud.2020.04.010

[13] Fuglie, K.O., Rada, N.E., 2013. Resources, Policies, and Agricultural Productivity in Sub-Saharan Africa. United States Department of Agriculture: Washington, DC, USA. Available from: https://www.ers.usda.gov/sites/default/files/_laserfiche/publications/45045/35520_err145.pdf?v=30474

[14] Addai, G., Guodaar, L., Dinye, R.D., et al., 2025. Advancing agricultural diversification within rural regions: The dynamic role of interregional rural–rural migration. Habitat International. 156, 103273. DOI: https://doi.org/10.1016/j.habitatint.2024.103273

[15] Harris, J.R., Todaro, M.P., 1970. Migration, Unemployment and Development: A Two-Sector Analysis. American Economic Review. 60(1), 126–142. Available from: https://www.aeaweb.org/aer/top20/60.1.126-142.pdf

[16] Binswanger-Mkhize, H., McCalla, A.F., 2010. The Changing Context and Prospects for Agricultural and Rural Development in Africa. In: Evenson, R., Pingali, P. (Eds.). Handbook of Agricultural Economics, Vol. 4. Elsevier: Amsterdam, The Netherlands. pp. 3571–3712.

[17] Aggarwal, R., Ranganathan, P., 2019. Study Designs: Part 2 – Descriptive Studies. Perspectives in Clinical Research. 10(1), 34–36. DOI: https://doi.org/10.4103/picr.PICR_154_18

[18] Taherdoost, H., 2016. Sampling Methods in Research Methodology; How to Choose a Sampling Technique for Research. International Journal of Academic Research in Management. 5(2), 18–27.

[19] International Center for Community-Driven Development, n.d. The Role of Community Engagement

in Achieving Sustainable Rural Development. Available from: https://icrrd.com/blog-article/3529/the-role-of-community-engagement-in-achieving-sustainable-rural-development#:~:text=Community%20engagement%20is%20the%20bedrock,equitable%2C%20and%20long%2Dlasting (cited 15 October 2025).

[20] Ali, Z., Bhaskar, S.B., 2016. Basic Statistical Tools in Research and Data Analysis. Indian Journal of Anaesthesia. 60(9), 662–669. DOI: https://doi.org/10.4103/0019-5049.190623

[21] Schroeder, L.D., Sjoquist, D.L., Stephan, P.E., 2017. Understanding Regression Analysis: An Introductory Guide, 2nd ed. SAGE Publications: Thousand Oaks, CA, USA. DOI: https://doi.org/10.4135/9781506361628

[22] Israel, B., Siwandeti, M., 2024. Agri-food supply chain capabilities and smallholders' on-farm economic viability: A moderated mediation analysis of subsidy schemes and dynamic pricing. Cogent Food & Agriculture. 10(1), 2391565. DOI: https://doi.org/10.1080/23311932.2024.2391565

[23] Tong, T., Ye, F., Zhang, Q., et al., 2024. The Impact of Labor Force Aging on Agricultural Total Factor Productivity of Farmers in China: Implications for Food Sustainability. Frontiers in Sustainable Food Systems. 8. DOI: https://doi.org/10.3389/fsufs.2024.1434604

[24] Lui, J., Fang, Y., Wang, G., et al., 2023. The Aging of Farmers and Its Challenges for Labor-Intensive Agriculture in China: A Perspective on Farmland Transfer Plans for Farmers' Retirement. Journal of Rural Studies. 100, 103013. DOI: https://doi.org/10.1016/j.jrurstud.2023.103013

[25] Su, G., Chen, Z., Li, W., et al., 2024. Study on the Impact of the Rural Population Aging on Agricultural Total Factor Productivity in China. Agriculture. 14(12), 2175. DOI: https://doi.org/10.3390/agriculture14122175

[26] Peralta, E.P., Ancho, I., Pelegrina, D., 2024. Migration theories and development: A focus on push & pull factors of Filipino migrants. Journal of Administrative Science. 21(1), 169–188. Available from: https://journal.uitm.edu.my/ojs/index.php/JAS/article/view/2457

[27] Jayne, T.S., Yeboah, K., Chamberlin, J., et al., 2021. Africa's Changing Farmland Ownership: Causes and Consequences. Available from: https://www.foncier-developpement.fr/publication/africas-changing-farmland-ownership-causes-and-consequences/ (cited 15 October 2025).

[28] Byerlee, D., Fanzo, J., 2019. The SDG of Zero Hunger 75 Years On: Turning Full Circle on Agriculture and Nutrition. Global Food Security. 21, 52–59. DOI: https://doi.org/10.1016/j.gfs.2019.06.002

[29] Reyes Jr., R.V., 2025. Enhancing Sustainability and Profitability in the Melon Industry Value Chain of Talavera, Nueva Ecija, Philippines. Available from: https://ssrn.com/abstract=5175333 (cited 15 October 2025).

[30] Dhillon, R., Moncur, Q., 2023. Small-Scale Farming: A Review of Challenges and Potential Opportunities Offered by Technological Advancements. Sustainability. 15(21), 15478. DOI: https://doi.org/10.3390/su152115478

[31] Bhuiyan, M.M.R., Maharjan, K.L., 2022. Impact of Farmer Field School on Crop Income, Agroecology, and Farmer's Behavior in Farming: A Case Study on Cumilla District in Bangladesh. Sustainability. 14(7), 4190. DOI: https://doi.org/10.3390/su14074190

[32] Dompreh, E.B., Manyise, T., Lazo, D.L., et al., 2024. Exploring the Potential of Decentralized Extension Models on the Sustainability of Livelihoods: A Food Security Lens on Aquaculture Farmers in Bangladesh. Frontiers in Sustainable Food Systems. 8, 1499081. DOI: https://doi.org/10.3389/fsufs.2024.1499081

[33] Fawzy, F., Shedeed, S., 2020. Subsistence Farming towards Sustainable Economic Agriculture of Small Farmers in the Developing Countries. NASS Journal of Agricultural Sciences. 2(1). Available from: https://journals.nasspublishing.com/index.php/NJAS/article/view/16

[34] Fuhrmann-Aoyagi, M.B., Miura, K., Watanabe, K., 2024. Sustainability in Japan's Agriculture: An Analysis of Current Approaches. Sustainability. 16(2), 596. DOI: https://doi.org/10.3390/su16020596

[35] Lowder, S.K., Skoet, J., Raney, T., 2016. The Number, Size, and Distribution of Farms, Smallholder Farms, and Family Farms Worldwide. World Development. 87, 16–29. DOI: https://doi.org/10.1016/j.worlddev.2015.10.041

[36] Food and Agriculture Organization of the United Nations, 2014. The State of Food and Agriculture 2014: Innovation in Family Farming. Food and Agriculture Organization of the United Nations: Rome, Italy. Available from: http://www.fao.org/3/i4040e/i4040e.pdf

[37] Crowley, M.Z., 2020. Foreign Labor Shortages in the Malaysian Palm Oil Industry: Impacts and Recommendations. Available from: https://ideas.repec.org/a/ags/phajad/307975.html (cited 15 October 2025).

[38] Wang, D., Chen, C., Findlay, C., 2023. A Review of Rural Transformation Studies: Definition, Measurement, and Indicators. Journal of Integrative Agriculture. 22(12), 3568–3581. DOI: https://doi.org/10.1016/j.jia.2023.10.038

[39] Batista, C., Vicente, P.C., 2020. Improving Access to Savings through Mobile Money: Experimental Evidence from African Smallholder Farmers. World Development. 129, 104905. DOI: https://doi.org/10.1016/j.worlddev.2020.104905

[40] Adesugba, M., Mavrotas, G., 2016. Youth Employment, Agricultural Transformation, and Rural Labor Dynamics in Nigeria. Available from: https://cgspace.cgiar.org/server/api/core/bitstreams/e11a6460-a303-43f0-b6b1-027dcfc1199d/content (cited 15 October 2025).

[41] Tamang, S., Paudel, K.P., Shrestha, K.K., 2014. Feminization of Agriculture and Its Implications for Food Security in Rural Nepal. Journal of Forest and Livelihood. 12(1), 20–32. Available from: https://www.mendeley.com/catalogue/e3d5bfcf-dc93-3779-8801-b6107b6ff794/

[42] Grant, R.M., 2024. Contemporary Strategy Analysis, 12th ed. Wiley: Hoboken, NJ, USA. Available from: https://www.perlego.com/book/4617583/contemporary-strategy-analysis-pdf

[43] Consentino, F., Vindigni, G., Spina, D., et al., 2023. An Agricultural Career through the Lens of Young People. Sustainability. 15(14), 11148. DOI: https://doi.org/10.3390/su151411148

[44] Food and Agriculture Organization of the United Nations (FAO), 2022. The State of Food and Agriculture 2022: Leveraging Agricultural Automation for Transforming Agrifood Systems. FAO: Rome, Italy. Available from: https://openknowledge.fao.org/items/98a4c80a-b4d3-403c-8557-d8536c8316ee

[45] Rigg, J., Salamanca, A., Thompson, E.C., 2020. The Puzzle of East and Southeast Asia's Persistent Smallholder. Journal of Rural Studies. 43, 118–133. DOI: https://doi.org/10.1016/j.jrurstud.2015.11.003

[46] International Labour Organization, 2024. Policy Brief: Elevating the Potential of Rural Youth: Paths to Decent Jobs and Sustainable Futures. International Labour Organization: Geneva, Switzerland. Available from: https://www.ilo.org/sites/default/files/2024-06/Policy%20Brief%20-%20Rural%20Youth%20Employment%20-%20v05_0.pdf

[47] Christiaensen, L., Rutledge, Z., Taylor, J., 2020. The Future of Work in Agriculture: Some Reflections. World Bank Group: Washington, DC, USA. Available from: https://documents1.worldbank.org/curated/en/777731585054424384/pdf/The-Future-of-Work-in-Agriculture-Some-Reflections.pdf

[48] Junior, C.H., 2019. Performance, farmer perception, and the routinisation (RO) moderation on ERP post-implementation. Heliyon. 5(6), e01784. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC6587053/

[49] Morales Jr., G., Villaronte, R.K., Yap, M.C., et al., 2022. The Relationship between Rural–Urban Migration and the Agricultural Output of the Philippines. International Journal of Social and Management Studies. 3(1), 62–74. Available from: https://ijosmas.org/index.php/ijosmas/article/view/88

[50] Mizik, T., Nagy, J., Molnár, E.M., et al., 2025. Challenges of Employment in the Agrifood Sector of Developing Countries—A Systematic Literature Review. Humanities and Social Sciences Communications. 12, 62. DOI: https://doi.org/10.1057/s41599-024-04308-3

[51] Ryan, M., 2023. Labour and Skills Shortages in the Agro-Food Sector. Organisation for Economic Cooperation and Development (OECD): Paris, France. Available from: https://www.oecd.org/publications/labour-and-skills-shortages-in-the-agro-food-sector-ed758aab-en.htm

[52] Barney, J.B., Ketchen Jr., D.J., Wright, M., 2021. Resource-based theory and the value creation framework. Journal of Management. 47(7), 1931–1955. DOI: https://doi.org/10.1177/0149206321 1021655

[53] United Nations Department of Economic and Social Affairs, 2023. World Social Report 2023: Leaving No One Behind in an Ageing World. United Nations Department of Economic and Social Affairs: New York, NY, USA. Available from: https://www.un-ilibrary.org/content/books/9789210019682

[54] Food and Agriculture Organization of the United Nations (FAO), 2023. Youth and Agriculture: Key Challenges and Concrete Solutions. FAO: Rome, Italy. Available from: https://openknowledge.fao.org/server/api/core/bitstreams/408708f0-82dc-418e-b92b-e2d7ec0cd2e6/content

[55] Musa, S.F.P.D., 2019. A Study on Youth Aspiration and Perception of Agriculture and Its Policy Implication. In: Vasile, A.J., Subic, J., Grubor, A., et al. (Eds.). Handbook of Research on Agricultural Policy, Rural Development, and Entrepreneurship in Contemporary Economies. IGI Global: Hershey, PA, USA. pp. 441–453. Available from: https://www.igi-global.com/gateway/chapter/243952

[56] Food and Agricultural Organization of the United Nation (FAO), 2016. Migration, Agriculture and Rural Development: Addressing the Root Causes of Migration and Harnessing Its Potential for Development. FAO: Rome, Italy. Available from: https://openknowledge.fao.org/server/api/core/bitstreams/3c5d85c4-9949-44a9-9d47-63b84c9bef83/content

[57] Szabo, S., Apipoonyanon, C., Pramanik, M., et al., 2021. Agricultural Productivity, Aging Farming Workforce, Sustainable Agriculture, and Well-Being: Household Survey Data from Central Thailand. Frontiers in Sustainable Food Systems. 5,

728120. DOI: https://doi.org/10.3389/fsufs.2021.728120

[58] Ghanayem, A., Mohd Nor, R., 2025. Reviewing Agricultural Challenges and Solutions for Empowering Smallholders in the Middle East. Research on World Agricultural Economy. 6(3), 684–705. DOI: https://doi.org/10.36956/rwae.v6i3.1688

[59] Wu, J., Zhang, M., Yang, X., et al., 2024. Effects of Land and Labour Costs Growth on Agricultural Product Prices and Farmers' Income. Land. 13(11), 1754. DOI: https://doi.org/10.3390/land13111754

[60] Food and Agriculture Organization of the United Nations (FAO), 2025. The Status of Youth in Agrifood Systems. FAO: Rome, Italy. Available from: https://www.fao.org/newsroom/detail/the-status-of-youth-in-agrifood-systems--new-fao-report-shines-light-on-pitfalls-and-prospects-for-1.3-billion-young-people/en

[61] Organisation for Economic Co-operation and Development (OECD), 2023. OECD–FAO Agricultural Outlook 2023–2032. OECD Publishing: Paris, France. Available from: https://openknowledge.fao.org/server/api/core/bitstreams/30a4511b-6b25-47e9-be3e-751bbfa86057/content

[62] Ngadi, N., Zaelany, A.A., Latifa, A., et al., 2023. Challenge of Agriculture Development in Indonesia: Rural Youth Mobility and Aging Workers in Agriculture Sector. Sustainability. 15(2), 922. DOI: https://doi.org/10.3390/su15020922

[63] Zero Carbon Analytics, 2023. Smallholder Farmers, Agricultural Sustainability and Global Food Security. Available from: https://zerocarbon-analytics.org/archives/food/smallholder-farmers-agricultural-sustainability-and-food-security (cited 15 October 2025).

[64] Zhang, C., Xiang, J., Chang, Q., 2023. Does Informatization Cause the Relative Substitution Bias of Agricultural Machinery Inputs for Labor Inputs? Evidence from Apple Farmers in China. Research on World Agricultural Economy. 4(3), 92–107. DOI: https://doi.org/10.36956/rwae.v4i3.900

[65] Baiyegunhi, L.J.S., 2024. Examining the impact of human capital and innovation on farm productivity in the KwaZulu-Natal North Coast, South Africa. Agrekon. 63(1–2), 51–64. DOI: https://doi.org/10.1080/03031853.2024.2357072

[66] Das, S., Ray, M.K., Panday, D., et al., 2023. Role of Biotechnology in Creating Sustainable Agriculture. PLOS Sustainability and Transformation. 2(7), e0000069. DOI: https://doi.org/10.1371/journal.pstr.0000069

[67] Bavorová, M., Ullah, A.G., Garcia, Y.A., et al., 2024. Factors Influencing Farm Succession Decisions: Evidence from Coffee Farmers of Colombia. Environment, Development and Sustainability. 27, 13215–13234. DOI: https://doi.org/10.1007/s10668-023-04433-0

[68] Zidana, R., Kaliati, F., Shani, C., 2020. Assessment of Youth Engagement in Agriculture and Agribusiness in Malawi: Perceptions and Hindrances. Journal of Entrepreneurship and Management. 9(2), 19–28. Available from: https://www.mendeley.com/catalogue/0892b801-6bd7-3d5a-a549-88482221b2a0/

[69] Cavicchioli, D., Bertoni, D., Pertolani, R., 2018. Farm Succession at a Crossroads: The Interaction among Farm Characteristics, Labour Market Conditions, and Gender and Birth Order Effects. Journal of Rural Studies. 61, 73–83. DOI: https://doi.org/10.1016/j.jrurstud.2018.06.002

[70] World Bank, 2025. Agriculture and Food. Available from: https://www.worldbank.org/en/topic/agriculture/overview (cited 15 October 2025).

[71] Kassie, M., Shiferaw, B., Muricho, G., 2011. Agricultural Technology, Crop Income, and Poverty Alleviation in Uganda. World Development. 39(10), 1784–1795. DOI: https://doi.org/10.1016/j.worlddev.2011.04.023