

PLURIACTIVITY AND THE PARADOX OF TECHNOLOGY ADOPTION IN URBAN AGRICULTURAL REGENERATION: A STUDY OF YOUNG FARMERS IN SUKABUMI CITY

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ABSTRACT

Farmer regeneration is a crucial challenge for sustainable food security, particularly in urban areas where the agricultural sector competes strictly with industrial sectors. This study aims to analyze the profile of young farmers in Sukabumi City based on socio-demographic characteristics, economic rationality, and technology adoption behavior. This study utilizes a mixed-methods design, primarily employing a quantitative descriptive approach. A proportionate stratified random sample of 79 respondents was drawn from a population of 363 young farmers in Sukabumi City. The results indicate that young urban farmers are predominantly productive-age individuals with relatively high levels of education. An economic rationality phenomenon known as pluriactivity was observed, in which the majority of respondents treat agriculture as a secondary source of income to mitigate economic uncertainty. Furthermore, a behavioral paradox was identified, characterized by high digital literacy for market information access but low adoption of physical production technology and financial inclusion due to risk aversion toward banking credit schemes. These findings imply that urban agribusiness development policies must be adaptive to the characteristics of part-time farmers through low-risk technology investment schemes.

Keywords: Adoption behavior; pluriactivity; urban farming; young farmers..

ABSTRAK

Regenerasi petani merupakan tantangan krusial bagi keberlanjutan ketahanan pangan, khususnya di wilayah perkotaan di mana sektor pertanian berkompetisi ketat dengan sektor industri. Penelitian ini bertujuan untuk menganalisis profil petani muda di Kota Sukabumi ditinjau dari karakteristik sosiodemografi, rasionalitas ekonomi, dan perilaku adopsi teknologi. Penelitian menerapkan desain mixed methods dengan pendekatan deskriptif kuantitatif. Pengambilan sampel menggunakan teknik Proportionate Stratified Random Sampling terhadap 79 responden yang merepresentasikan populasi 363 petani muda di Kota Sukabumi. Hasil penelitian menunjukkan bahwa petani muda urban didominasi oleh kelompok usia produktif dengan tingkat pendidikan yang relatif tinggi. Ditemukan fenomena rasionalitas ekonomi berupa pluriactivity, di mana mayoritas responden menjadikan pertanian sebagai sumber pendapatan sekunder untuk memitigasi ketidakpastian ekonomi. Selain itu, teridentifikasi adanya paradoks perilaku, yaitu tingginya literasi digital untuk pencarian informasi pasar, namun rendahnya adopsi teknologi produksi fisik dan inklusi keuangan akibat penghindaran risiko terhadap skema kredit perbankan. Temuan ini mengimplikasikan bahwa kebijakan pengembangan agribisnis perkotaan harus adaptif terhadap karakteristik petani paruh waktu melalui skema investasi teknologi yang minim risiko.

Kata kunci: Perilaku adopsi; petani muda; pertanian perkotaan; pluriactivity

INTRODUCTION

Farmer regeneration has become a crucial issue for sustainable

agricultural development in Indonesia, given the ongoing aging of farmers without a commensurate replacement

rate from the younger generation (Susilowati, 2016; Haryati et al., 2024). The agribusiness sector's inability to attract a young workforce directly impacts national food productivity and the continued adoption of modern agricultural technologies (Arvianti et al., 2019). This challenge becomes even more complex when integrated into the urban context, where the agricultural sector must compete fiercely with the service and manufacturing sectors for land and labor resources (Putra, 2025). In urban areas, agriculture is often considered a marginal sector, marginalized by rapid urbanization and massive land conversion (Pribadi & Pauleit, 2016; Sundari et al., 2026).

Sukabumi City represents a crisis in agricultural regeneration in quite extreme conditions. Data from the 2023 Agricultural Census indicates a sharp demographic disparity in the agricultural workforce structure in this region. The number of Agricultural Business Households (RTUP) in the young farmer category (aged under 39) was recorded at only 363. This figure is significantly disproportionate compared to the population of older farmers (aged 40 or older), which reached 3,850 (Sukabumi City Statistics Office, 2023). This situation is exacerbated by stagnant sectoral

contributions, with the agricultural sector accounting for only approximately 4.08% of the total workforce in Sukabumi City in 2023 (Sukabumi City Statistics Office, 2024). This low youth participation indicates structural and cultural barriers hindering the transformation of urban agriculture into an inclusive sector for the new generation (Mansur et al., 2015).

The fundamental problem is not only quantity but also the lack of a clear profile map of the characteristics of the remaining young farmers (Sitanggang et al., 2025). Sukabumi Mayoral Regulation Number 16 of 2023 concerning the Sukabumi City Regional Development Plan (RPD) for 2024-2026 (2023) has prioritized urban agribusiness development, but these efforts are hampered by the lack of comprehensive baseline data on the profiles of these 363 young farmers. Without a thorough understanding of who they are, their level of technology adoption, and their business sustainability orientation, policy interventions such as training and capital assistance risk misdirection and inefficiency (Fauzia et al., 2025). Therefore, mapping the profiles of young farmers is urgently needed to

formulate evidence-based regeneration policies (Soedarto & Ainiyah, 2022).

Theoretically, numerous studies on farmer regeneration have been conducted, but gaps remain regarding location context and depth of analysis. The majority of previous studies, such as those conducted by Nurarifin & Kurniawan (2025) in Sumatra, primarily focused on the characteristics of young farmers in rural areas with a strong agricultural base and relatively extensive land availability. There is limited literature specifically examining the profile of young farmers under ecological and economic pressures in urban administrative areas characterized by limited land and high land rental values (Erfrissadona et al., 2020). Furthermore, previous research is often partial, focusing on aspects of entrepreneurship or resilience in isolation, without integrating socioeconomic dimensions, technological behavior, and sustainability into a coherent analytical framework (Ramadayanti et al., 2025; Sundari et al., 2025).

This study aims to address this gap in the literature by presenting a comprehensive descriptive analysis of the socioeconomic profile, technology adoption rate, and sustainability orientation of young farmers in

Sukabumi City using a mixed-methods approach. These findings are expected to make empirical contributions and serve as a strategic foundation for stakeholders in designing relevant, targeted urban agribusiness empowerment programs.

RESEARCH METHODS

This study employed a mixed-methods design, with a quantitative descriptive approach predominating. This approach was chosen to provide a comprehensive overview of young farmers' profiles. Quantitative data served as the primary basis for mapping characteristics, while qualitative data deepened the interpretation of the numerical findings (Creswell & Creswell, 2018). The study was conducted in Sukabumi City, West Java. This location was selected based on the unique characteristics of Sukabumi City, a peri-urban area facing challenges related to land conversion but with strategic market potential for agribusiness development (BPS Sukabumi City, 2025). Field data collection took place from December 2025 to January 2026.

The population in this study was young farmers in Sukabumi City as recorded in the 2023 data from the Food Security, Agriculture, and Fisheries

Agency (DKP3), with a total population of 363 people. The sampling technique used was Proportionate Stratified Random Sampling, in which the population is stratified by administrative area (district), and samples are drawn proportionally from each stratum to ensure regional representation (Hardani et al., 2020). Sample size was determined using the Slovin formula with a 10% margin of error. A 10% margin of error is considered acceptable in descriptive social research for mapping general population patterns, while balancing the efficiency of researchers' time and resources without significantly reducing the representativeness of the data (Riyanto & Hatmawan, 2020). Based on these calculations, a total of 79 respondents were selected.

The data collected included both primary and secondary sources. Primary data were obtained through structured interviews using a Likert-scale questionnaire and in-depth interviews with key informants. The questionnaire underwent validity and reliability testing to ensure consistent measurement of the variables (Ghozali, 2021). Observed variables included demographic characteristics, livelihood strategies, technology adoption, and sustainability orientation. Data analysis

was conducted using descriptive statistics, including frequency distribution, percentages, and mean scores. To interpret the achievement level of each variable, an interval analysis technique was used with a scale range of 0.80, dividing the data into five categories: Very Low (1.00 - 1.80), Low (1.81 - 2.60), Medium (2.61 - 3.40), High (3.41 - 4.20), and Very High (4.21 - 5.00) (Sugiyono, 2022). The quantitative findings were then further analyzed by comparing them with qualitative narratives and relevant theories to answer the research objectives.

RESULT AND DISCUSSION

Mapping the profiles of young farmers in urban areas is key to unraveling the complexity of the agricultural regeneration crisis. This analysis goes beyond mere statistical descriptions and also seeks to understand the economic rationale and structural constraints faced by young actors in maintaining farming businesses amid the pressures of urban land conversion. This section will examine three key research findings: the paradoxical demographic and asset characteristics, the pluriactivity strategy as a defense mechanism, and the gap between digital literacy and financial inclusion.

Socio-Demographic Profile of Young Urban Farmers

The results of a survey of 79 young farmer respondents in seven districts of Sukabumi City indicate a shift in the quality of agricultural human resources compared to the

previous generation. However, this increase in human resource capacity clashes sharply with the limitations of the primary production asset, namely land. A comprehensive breakdown of respondent characteristics is presented in Table 1.

Table 1. Sociodemographic Characteristics of Young Farmers in Sukabumi City

Cost Components	Category	Persons	Percentage (%)
Age Group	19 – 24 years old	10	12.66
	25 – 30 years old	29	36.71
	31 – 35 years old	27	34.18
	36 – 39 years old	13	16.46
Education Level	Primary School/equal	6	7.59
	Junior High School/equal	9	11.39
	Senior High School/equal	54	68.35
	Above Senior High School	10	12.66
Land Cultivated Area	Narrow (< 0,03 Ha)	14	17.72
	Intermediate (0.03-0.05 Ha)	46	58.23
	Large (> 0,05 Ha)	19	24.05
Land Ownership Status	Rent	18	22.78
	Profit sharing	4	5.06
	Lahan Pinjam Pakai	5	6.33
	One's own	52	65.82

Source: Processed primary data, 2026

The data in Table 1 confirm that young farmers in Sukabumi City are predominantly in the 25–35 age group (70.89%), with the majority having a high/vocational school/equivalent education level (68.35%). This finding challenges the classic stigma often attached to the agricultural sector as a "residual sector" filled only by low-educated workers. The high proportion of young farmers with secondary or higher education indicates significant potential for adopting innovations and

more modern farming management practices. The human capital of these young urban farmers is relatively superior to that of the average conventional farmer in rural areas, a phenomenon consistent with the theory of agricultural regeneration, which posits that new actors tend to enter with higher literacy levels (Haryati et al., 2024).

However, this potential human capital is challenged by the reality of limited land assets that is characteristic

of urban agriculture. The majority of respondents (58.23%) manage medium-sized land, followed by 24.05% with land over 500 m², and the remaining 17.72% with small plots of land under 300 m². Although 65.82% of respondents own their own land, the predominance of cultivated areas in the 0.03–0.05-hectare range remains a challenge. From a commercial agribusiness perspective, this size is not yet ideal for achieving efficient economies of scale. Land fragmentation in urban areas forces farmers to adopt labor-intensive technologies rather than heavy mechanization, and demands extra-strict cost-efficiency strategies to maintain profit margins (Susilowati, 2016).

This situation creates a paradox: Young farmers in Sukabumi City have the "brains" (education) ready for modern agriculture, but their "legs" (land) are bound by the limitations of urban space. This imbalance between

the quality of human resources and the limited quantity of land assets has led to the formation of a unique economic adaptation pattern, in which agriculture is no longer the sole source of livelihood but rather part of a fragmented livelihood portfolio.

Economic Rationality: The Phenomenon of Pluriactivity

An analysis of the income structure of young farmers in Sukabumi City reveals a dynamic economic reality in which agriculture is no longer the sole source of livelihood. Data shows that the majority of respondents consider agriculture a significant secondary source of income (a decent side job) while still maintaining other jobs in the non-agricultural sector. This phenomenon of dual livelihood patterns, or pluriactivity, is clearly illustrated by the distribution of agricultural sector income contributions to the total household income of young farmers, as presented in Table 2..

Table 2. Contribution of Agricultural Income to Total Household Income

Agricultural Income Contribution	Persons	Percentage (%)
< 25% (Just a small side income)	14	17.72
25% - 50% (Good side income)	40	50.63
50% - 75% (Main source of income, but have other jobs)	17	21.52
> 75% (Income is highly dependent on agriculture)	8	10.13
Total	79	100.00

Source: Processed primary data, 2026

Table 2 shows that more than half of respondents (50.63%) are moderately

dependent on the agricultural sector. This group views farming as an

economic safety net that complements income from the formal or informal urban sectors. This finding aligns with research by Junaedi and Sawitri (2021), which states that pluriactivity in peri-urban areas is an adaptive defense mechanism to mitigate the risks of harvest uncertainty and market price fluctuations that frequently plague the agribusiness sector.

Only a small proportion of young farmers (10.13%) rely solely on the agricultural sector for their livelihood (over 75%). This low percentage of full-time farmers can be explained through the rational choice perspective proposed by Haryati et al. (2024), where young people tend to abandon farming as their sole occupation, not because they are anti-agricultural, but rather because of a rational calculation of the low economic returns of small plots of land compared to the city's minimum wage (MSMEs). This condition is also supported by Susilowati (2016) and Sundari et al (2023), who stated that the allocation of young labor will naturally shift to the service or trade sectors when

marginal productivity in the agricultural sector declines.

The choice to engage in pluriactivity is also supported by the open nature of the labor market in Sukabumi City. The location of farms in peri-urban areas allows young farmers to access jobs in other sectors without having to migrate from their land. In this context, income from the non-agricultural sector is often used as a cross-subsidy to finance agricultural inputs in the following planting season (Dewi & Wahyudy, 2022; Sundari, 2025). While this strategy provides short-term economic stability, the dominance of part-time farmers (68.35% in the <50% category) could hinder professional farm management and the adoption of intensive technologies that require daily supervision.

The Paradox of Technology Adoption and Financial Inclusion

The transformation of agriculture 4.0 in urban areas is often associated with advanced technology and massive digitalization. However, field findings indicate a paradox in the behavior of young farmers in Sukabumi City. A survey of 79

respondents revealed a striking gap between the use of digital technology for information and the adoption of physical technology, as well as financial courage. Details of the distribution of responses related to technology and financial indicators are presented in Table 3.

Table 3. Behavioral Indicators of Technology Adoption and Financial Inclusion

Behavioral Indicators	Strongly Disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly Agree (%)	Mean	Category
Searching for Information on the Internet	5.06	8.86	32.91	27.85	25.32	3.59	H
Online Product Marketing	5.06	13.92	31.65	36.71	12.66	3.38	M
Application of Modern Production Technology	1.27	21.52	37.97	27.85	11.39	3.27	M
Courage to Take Credit Risks	20.25	25.32	32.91	1013	11.39	2.67	M

Source: Processed primary data, 2026

Based on Table 3, the Internet Information Search indicator had the highest average score (3.59) in the High category. A total of 53.17% of respondents (those who selected Agree or Strongly Agree) actively used the internet to support their farming businesses. This finding aligns with the research by Rahmawati et al. (2022), which found that young farmers have greater digital adaptability than their predecessors, enabling them to independently mitigate market information asymmetry. The use of social media and marketplaces demonstrates that digital literacy has become a new social capital for urban farmers.

However, high digital literacy does not necessarily translate to financial inclusion. A paradox is evident in the "Credit Risk Taking" indicator, which had the lowest score (2.67).

Nearly half of respondents (45.57%) disagreed or strongly disagreed with taking on debt for business development. This attitude aligns with the study by Wahyuni et al. (2020), which found that despite the availability of People's Business Credit (KUR), psychological barriers, such as risk aversion and perceptions of complex banking bureaucracy, led young farmers to prefer limited independent financing.

A gap also exists in the adoption of on-farm physical technology. The adoption of modern production technology is only in the moderate category (3.27). Young farmers tend to adopt a wait-and-see attitude towards high-risk, capital-intensive physical technologies. This supports the argument of Marini & Deviani (2025) that the main obstacle to adopting agricultural machinery technology

(alsintan) is not simply technical knowledge, but rather strict profit-loss calculations on small plots of land. As a result, there is a phenomenon in which young farmers are highly proficient in the virtual world (digital marketing) but remain traditional in the physical production process due to a lack of capital support (Sukma & Ruslan, 2024).

This situation indicates that millennial farmers in Sukabumi City are not always identified with modern, capital-intensive agriculture. There is a disconnect between the ability to access digital information and the ability to execute physical innovations that require capital support. Without policy interventions that address investment de-risking and financial literacy, young farmers will remain trapped in the "half-tech trap": sophisticated on social media but traditional in production processes.

CONCLUSION

Young farmers in Sukabumi City are adaptive actors who pursue a pluriactivity strategy, with agriculture serving as a secondary source of income. Despite their high digital literacy, a "pseudo-modernization" phenomenon occurs because on-farm technology and financial inclusion are stagnant, driven by risk aversion to bank credit. Therefore, policies must focus on investment de-risking schemes.

Practical steps include digital footprint-based reform of the People's Business Credit (KUR) and the implementation of a shared economy model for agricultural machinery to realize the transformation of Agriculture 4.0.

DECLARATION

Consent to participate

Authors are agreed

Consent to publication

The authors agree to publish this data

Conflict of interest

The authors declare no conflict of interest

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