

CHANGES IN AGRICULTURAL EMPLOYMENT STRUCTURE IN INDONESIA: EVIDENCE FROM 2013 AND 2023 AGRICULTURAL CENSUS

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Abstract

The agricultural sector remains an important source of employment in Indonesia, particularly in rural areas. However, structural transformation, urbanization, and technological change have significantly altered the role of agriculture as a labor absorber. This study aims to analyze changes in the structure of agricultural employment in Indonesia by comparing evidence from the 2013 and 2023 Agricultural Censuses. Specifically, the study examines changes in the size of the agricultural workforce, age structure, gender composition, and employment status. This research employs a descriptive-comparative quantitative approach using secondary microdata from the 2013 and 2023 Agricultural Censuses published by Statistics Indonesia (BPS). The analysis applies descriptive statistics, inter-census comparison, and simple structural change analysis to identify key employment dynamics over the ten-year period. The results show a substantial decline in agricultural employment, accompanied by a pronounced aging of the workforce, increasing participation of women, and a growing share of informal and vulnerable employment statuses. These findings indicate that agriculture is becoming less attractive to younger workers while facing challenges related to labor regeneration and employment quality. The novelty of this study lies in its use of the most recent agricultural census microdata to provide a comprehensive and comparative analysis of employment structure changes over time in Indonesia. The findings have important policy implications, highlighting the need for farmer regeneration strategies, gender-sensitive agricultural policies, and improved social protection to ensure the sustainability of agricultural employment in the future

Keywords: Agricultural employment; Agricultural census; Indonesia Structural transformation; Labor dynamics

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INTRODUCTION

The agricultural sector still plays an important role in the Indonesian economy, especially as an absorber of labor in rural areas. However, in the last two decades Indonesia has undergone a structural transformation marked by a decline in the contribution of the agricultural sector to the Gross Domestic Product (GDP) and a reduction in the proportion of agricultural labor. These changes are in line with increasing urbanization, technological modernization, and the shift of the workforce to the non-agricultural sector. Data from the 2013 Agricultural Census (ST) and ST 2023 released by the Central Statistics Agency (BPS) show significant changes in the number of agricultural business households, the age structure of farmers, and the characteristics of the agricultural workforce. Phenomena such as the aging of farmers, the reduced involvement of the young workforce, and changes in the scale of farming raise questions about the sustainability of the agricultural sector as a provider of employment. Recent studies (FAO, World Bank, IFPRI) emphasize that changes in the structure of agricultural employment have important implications for rural development, food security, and poverty alleviation. However, empirical studies that specifically compare changes in the structure of Indonesia's agricultural labor force between censuses are still relatively limited. Therefore, this study aims to analyze changes in the structure of agricultural employment in Indonesia by utilizing micro-data from the 2013 and 2023 Agricultural Census, in order to provide relevant empirical evidence for the formulation of agricultural and employment development policies. Analyzing changes in the structure of agricultural employment in Indonesia between ST 2013 and ST 2023, identifying the demographic dynamics of the agricultural workforce (age and gender), and providing policy implications for agricultural and employment development are the goals to be achieved. Several recent studies show that the agricultural sector in developing countries has experienced a decline in labor absorption due to structural transformation and modernization (World Bank, 2019; FAO, 2022). Headey and Jayne (2016–2021) found that the ageing of farmers and the scale of small businesses are the main challenges in Asian agricultural development. The IFPRI study (2023) emphasizes the importance of agricultural census data to understand changes in the structure of the workforce and its implications for economic development. This study complements these studies by using the latest Indonesian Agricultural Census data (ST 2013–2023) to comprehensively analyze employment changes.

The agricultural sector has historically played a central role in Indonesia's economic development, particularly as a primary source of employment and income for rural households. Despite its declining contribution to Gross Domestic Product (GDP), agriculture continues to function as a critical labor absorber, social safety net, and foundation for national food security. Over the past two decades, however, Indonesia has experienced a profound structural transformation characterized by rapid urbanization, industrial expansion, technological change, and a gradual reallocation of labor from agriculture to non-agricultural sectors. These dynamics have significantly altered the structure of agricultural employment, raising concerns about the long-term sustainability of the sector as a source of livelihoods and economic resilience. A growing body of international literature documents a consistent decline in agricultural employment across developing countries as economies modernize. Studies by the World Bank (2019, 2023) and FAO (2022) highlight that modernization, mechanization, and rural-urban migration reduce labor demand in agriculture while increasing productivity. At the same time, research emphasizes emerging structural challenges, including the aging of farmers, declining youth participation, feminization of agricultural labor, and increasing informality of employment (Headey et al., 2023; ILO, 2019). In the Asian context, these trends have been shown to influence not only agricultural productivity but also poverty reduction, food system sustainability, and rural development trajectories. In Indonesia, several studies have examined agricultural labor dynamics using survey data or macro-level indicators. These studies generally confirm a declining share of agricultural employment and highlight issues

such as land fragmentation, low farm incomes, and limited attractiveness of agriculture for younger generations.

However, most existing research relies on partial datasets, cross-sectional surveys, or indirect indicators. Comprehensive empirical studies that directly compare changes in the structure of agricultural employment across agricultural census periods—particularly using micro-level census data—remain limited. As a result, empirical evidence capturing long-term structural shifts in Indonesia's agricultural workforce is still fragmented and insufficient to fully inform policy formulation. This gap in the literature is particularly important given the availability of the 2013 and 2023 Agricultural Census (Sensus Pertanian) microdata released by the Central Statistics Agency (BPS). While prior studies acknowledge general trends such as labor decline and farmer aging, they often make broad or implicit claims without systematically quantifying how employment structures—by age, gender, and employment status—have changed over time. Moreover, existing findings are sometimes presented as stylized facts rather than empirically grounded comparisons across census periods. This study addresses these limitations by providing a direct, data-driven, and comparative analysis of changes in Indonesia's agricultural employment structure over a ten-year period. Agrarian differentiation theory explains how capitalist development in rural areas leads to social polarization among farmers. According to Bernstein (2010) and Byres (2004), structural factors such as land fragmentation, unequal access to capital, and market pressures cause a small group of farmers to accumulate land and resources, while the majority of smallholders experience declassing and loss of economic autonomy. As a result, many small farmers are compelled to sell their labor power and become agricultural wage workers. From this perspective, the declining proportion of owner-cultivators and the rising share of farm workers reflect class differentiation processes within the agricultural sector.

Another theory related to this topic is proletarianization refers to the transformation of farmers from independent producers into wage laborers due to the loss or insufficiency of productive assets, particularly land. Bryceson (2002) and Bernstein (2010) argue that in many developing countries this process is partial or "semi-proletarian," meaning that households retain small plots of land but cannot rely on farming alone for subsistence. Consequently, farm households combine subsistence farming with wage labor in agriculture or other sectors. The increasing number of farm workers and family laborers thus reflects a process of semi-proletarianization that intensifies income insecurity and livelihood vulnerability. Labour informalization theory highlights the expansion of employment relationships that lack formal contracts, legal protection, and social security. According to the ILO (2018) and Chen (2012), agriculture remains one of the most informal sectors of employment, characterized by seasonal work, low wages, and the absence of social protection. The growing proportion of agricultural wage workers indicates that employment in the sector is becoming increasingly informal, exposing workers to higher risks of income volatility, poor working conditions, and limited access to labor rights. Land Fragmentation and Farm Viability theory emphasizes that land fragmentation resulting from inheritance systems, population growth, and land market pressures reduces the economic viability of farming. Binswanger-Mkhize et al. (2014) and Deininger et al. (2014) argue that shrinking farm sizes limit economies of scale, productivity, and competitiveness. When farming is no longer economically sustainable, smallholders lose their capacity to remain independent producers and are pushed into wage labor or unpaid family work. Thus, land fragmentation directly contributes to the decline of owner-cultivators and the expansion of vulnerable agricultural employment. Rural household vulnerability theory focuses on households' exposure to multiple risks, including price fluctuations, crop failure, climate shocks, and economic crises. Ellis (2000) and Dercon (2005) argue that reliance on informal wage labor increases households' vulnerability because income is uncertain and largely unprotected by social safety nets. The increasing share of farm workers in the agricultural labor structure therefore reflects weakened household resilience and reduced adaptive capacity in the face of economic and environmental shocks.

Based on the theoretical and empirical literature on structural transformation, this study implicitly assumes that Indonesia's agricultural employment has undergone significant quantitative and qualitative shifts. These shifts include a reduction in total agricultural labor, an aging workforce due to weak generational renewal, increasing participation of women, and a movement toward more informal and vulnerable employment arrangements. These assumptions guide the analytical framework of the study, although they are not formulated as strict hypothesis-testing statements. The main objectives of this study are threefold. First, it aims to analyze changes in the size and structure of agricultural employment in Indonesia between the 2013 and 2023 Agricultural Censuses. Second, it seeks to examine demographic dynamics within the agricultural workforce, particularly changes in age and gender composition. Third, the study aims to identify shifts in employment status that reflect broader processes of informality and vulnerability, and to derive policy-relevant implications for agricultural and rural employment development. The originality and novelty of this study lie in its use of the latest Indonesian Agricultural Census microdata to conduct a systematic and comparative analysis of employment structure over time. Unlike previous studies that rely on aggregated indicators or single-period data, this research leverages two full census rounds to capture structural changes with greater precision and depth. By integrating demographic, gender, and employment status dimensions, the study contributes new empirical evidence to the literature on agricultural transformation in Indonesia and provides a stronger basis for designing policies related to farmer regeneration, rural employment, and inclusive agricultural development.

However, existing empirical studies remain significantly limited and insufficient for three major reasons. First, previous research (Timmer, 2017; World Bank, 2022) heavily relies on aggregated macro-level or cross-sectional survey data (such as Sakernas), which fails to capture the comprehensive structural shifts specifically rooted in complete agricultural census rounds. Second, while studies like Sitompul (2026) acknowledge the low interest of youth in farming, they are restricted to localized case studies and do not quantify the nation-wide demographic transitions across census periods. Third, previous literature has largely treated labor decline, farmer aging, and feminization as separate, fragmented phenomena rather than examining them as interconnected components of agricultural proletarianization and informalization. Consequently, prior research falls short in providing a data-driven, unified comparative framework using the latest national microdata. This study directly addresses this gap by utilizing the full microdata of both the 2013 and 2023 Indonesian Agricultural Censuses to evaluate how demographic, gender, and employment status configurations have co-evolved over a decade.

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METHODS

The research subjects consist of agricultural business households and agricultural workers in Indonesia as recorded in the 2013 and 2023 Agricultural Censuses. These subjects represent the population engaged in agricultural activities, including owner-cultivator farmers, farm laborers, and family workers across all agricultural subsectors covered by the census. This study adopts a descriptive-comparative quantitative research design. The research is descriptive because it aims to systematically describe the characteristics and structure of agricultural employment in Indonesia, and comparative because it compares

employment conditions across two different census periods, namely 2013 and 2023. The quantitative approach is applied to analyze numerical census data in order to identify patterns and structural changes in agricultural employment over time.

The primary data sources are the raw microdata from the 2013 Agricultural Census (ST2013) and the 2023 Agricultural Census (ST2023) published by Statistics Indonesia (BPS). The total number of observations analyzed includes 26.1 million agricultural households from ST2013 and 28.4 million agricultural households from ST2023. The primary unit of observation is individual agricultural workers aged 15 years and above engaged in any agricultural subsector (food crops, horticulture, plantation, livestock, fisheries, and forestry). To ensure cross-temporal consistency, variables were harmonized based on BPS classification standards:

1. Age is classified into three structural cohorts: Youth (<35 years old), Productive/Adult (35–54 years old), and Elderly/Aging (≥55 years old).
2. Gender is classified strictly into Male and Female.
3. Employment status is aligned into three uniform categories: Owner-Cultivators (independent farmers running their own farm), Farm Workers (agricultural wage laborers), and Family Workforce (unpaid family laborers assisting the household farm).

The research procedure was conducted through several stages. First, relevant microdata from the 2013 and 2023 Agricultural Censuses were obtained from the Central Statistics Agency (BPS). Second, the data were cleaned and harmonized to ensure consistency of variable definitions across census years. Third, variables relevant to demographic characteristics, employment status, and labor structure were selected and categorized. Finally, comparative and structural analyses were conducted to identify changes in agricultural employment patterns between the two census periods. This study relies exclusively on secondary data. The data were collected from the official Agricultural Census microdata published by the Central Statistics Agency (BPS) of the Republic of Indonesia. The census data provide comprehensive coverage of agricultural households and workers nationwide, making them a reliable source for analyzing long-term structural changes in employment. No primary data collection was conducted in this study.

The units of analysis consist of agricultural business households and individual agricultural workers, allowing for a comprehensive examination of employment structure at both household and labor levels. The analysis focuses on three main aspects. First, demographic aspects are examined through variables related to age and gender to capture changes in the composition of the agricultural workforce. Second, employment aspects are analyzed using employment status variables, including owner-cultivator farmers, farm laborers, and family workers, to assess shifts in job quality and vulnerability. Third, structural aspects are analyzed by comparing the total number and distribution of agricultural workers between the 2013 and 2023 census periods. The analytical techniques applied in this study include descriptive statistics to summarize key characteristics of agricultural employment, comparative analysis to identify inter-census changes. These methods enable a systematic comparison of employment patterns across census years without imposing causal assumptions. This study is subject to several limitations. Data analysis was carried out using several quantitative techniques. Descriptive statistical analysis was used to summarize key characteristics of agricultural employment, including total workforce size, age distribution, gender composition, and employment status. Comparative analysis was applied to examine differences between the 2013 and 2023 census results. In addition, structural change analysis, specifically a simple shift-share approach, was employed to assess changes in the composition and distribution of agricultural employment over time. The analysis focuses on identifying structural trends rather than establishing causal relationships. The analysis is restricted to the 2013 and 2023 Agricultural Census data and does not directly examine income levels, wages, productivity, or welfare outcomes of agricultural workers. Furthermore, the study focuses on

identifying structural changes rather than establishing causal relationships. Despite these limitations, the use of comprehensive census microdata provides robust empirical evidence on long-term changes in Indonesia's agricultural employment structure.

RESULTS AND DISCUSSION

Changes in the Agricultural Workforce

Over the ten-year period between 2013 and 2023, the number of agricultural workers in Indonesia declined sharply by approximately 26.8 percent, as presented in Table 1. This substantial reduction indicates that the agricultural sector is progressively losing its traditional role as the primary absorber of labor, reflecting the broader process of structural economic transformation. Similar trends have been widely documented in developing countries, where economic growth is accompanied by a reallocation of labor from agriculture to industry and services (World Bank, 2019; FAO, 2022; World Bank, 2023). In the Indonesian context, the decline amounted to approximately 10.7 million agricultural workers over the decade, signaling not only a contraction in labor absorption but also an acceleration of national structural transformation.

Table 1. Number of Agricultural Workers in Indonesia, 2013–2023

Year	Agricultural Workforce (million people)	Absolute Change	Change (%)
2013	40,0	-	-
2023	29,3	10,7	26,8

Source: Census of Agriculture, 2013 & 2023

This substantial drop of 10.7 million workers is driven by two main underlying structural forces. First, the expanding wage gap between the agricultural sector and urban service/manufacturing sectors acts as a massive "pull factor" drawing labor away from rural areas. Farming in Indonesia is increasingly plagued by low returns due to increasing production shocks and volatile market prices, forcing labor to migrate. Second, the "push factor" stems from accelerated micro-mechanization in rural areas. The widespread adoption of hand-tractors and mechanical combine harvesters over the last decade has significantly minimized manual labor requirements during land preparation and harvesting phases, particularly in major rice-producing regions like Java and South Sulawesi. While this boosts technical efficiency, it reduces the net capacity of the sector to act as a primary rural labor absorber.

Several interrelated factors contribute to this decline. Rural-urban migration has intensified as younger workers seek higher and more stable incomes in non-agricultural sectors, while the expansion of manufacturing and services has created alternative employment opportunities outside agriculture. At the same time, the adoption of relatively capital-intensive and labor-saving technologies in agriculture has reduced labor demand, particularly in certain subsectors (OECD, 2020; FAO, 2022). Previous studies by Headey and Jayne (2016) and Headey et al. (2023) emphasize that such labor shifts are common during transformation but pose significant challenges when productivity gains do not sufficiently compensate for declining employment. From one perspective, the reduction in agricultural labor may be interpreted as an indicator of increasing efficiency and modernization. However, from another perspective, it raises serious concerns regarding the long-term availability of agricultural labor, especially in food crop subsectors that remain highly dependent on manual

labor and smallholder farming systems. IFAD (2021) and the World Bank (2022) warn that excessive labor outflows from agriculture, when not balanced by productivity improvements and institutional support, can threaten food security and rural livelihoods. Furthermore, the reduction in agricultural employment has direct implications for the socio-economic structure of rural areas. Previous studies show that many rural workers leaving agriculture transition into informal and precarious non-agricultural employment, rather than stable wage jobs (McCullough, 2017; ILO, 2019). In Indonesia, this pattern has been associated with persistent rural underemployment and income insecurity (BPS, 2024; World Bank, 2022). Consequently, structural transformation has not been fully accompanied by the creation of inclusive, productive, and decent employment opportunities in rural areas. This finding aligns with broader evidence suggesting that uneven transformation may increase rural vulnerability and inequality if not supported by integrated rural development and labor market policies (Timmer, 2017; World Bank, 2023).

Changes in the Age Structure of the Agricultural Workforce

Table 2 shows a pronounced shift in the age structure of Indonesia's agricultural workforce over the 2013–2023 period. The proportion of young agricultural workers aged below 35 years declined sharply by 11 percentage points, while the share of workers aged 55 years and above increased substantially by 14 percentage points. This contrasting trend clearly indicates an accelerated aging of the agricultural workforce. Similar patterns have been widely documented in developing and emerging economies, particularly in Asia, where agriculture is increasingly dominated by older workers (Headey et al., 2023; FAO, 2020).

Table 2. Structure of Agricultural Labor Age (%)

Age Group	2013	2023	Changes (pp)
< 35 years old	32	21	–11
35–54 years old	45	42	–3
≥ 55 years old	23	37	+14

Source: Census of Agriculture, 2013 & 2023

The severe 11 percentage point contraction in young workers (<35) alongside the 14 percentage point surge in older workers (≥55) points directly to a failure in generational labor renewal. This rapid aging is caused by structural entry barriers for the youth: extreme rural land fragmentation makes inherited plots economically unviable, and young individuals lack the initial capital or formal collateral needed to acquire credit for agribusiness start-ups. Furthermore, farming is socially perceived by the younger generation as exhausting, low-status, and highly vulnerable to climate risks, offering no pathway for upward social mobility (Sitompul, 2026). Consequently, younger, more educated cohorts reject agriculture entirely, leaving elderly farmers—who possess low non-farm mobility and limited skills—to manage the sector until advanced ages.

The observed shift reflects a significant demographic transformation within the agricultural sector, characterized by a rapid withdrawal of younger cohorts and the prolonged participation of older farmers. Sitompul (2026) emphasizes that the aging of farmers represents one of the most critical challenges to the sustainability of agriculture in Asia, as it weakens the sector's capacity for renewal and long-term competitiveness. Empirical studies by the World Bank (2019) and ADB (2020) similarly report that younger generations are increasingly reluctant to engage in farming due to perceptions of low income, high production risks, and limited opportunities for social mobility. The phenomenon of farmer aging is closely linked to structural and institutional constraints faced by rural youth. FAO (2020, 2022) and IFAD (2021) highlight that limited access to land, financing, modern technology, and markets significantly reduces the attractiveness of agriculture as a career choice for younger workers. As a result,

many young people migrate to urban areas or seek employment in non-agricultural sectors, leaving agriculture increasingly reliant on older labor. This demographic imbalance has important implications for the future of agricultural development (Thomson, 2024). In the long term, an aging agricultural workforce may reduce the sector's capacity to adopt new technologies, embrace digital agriculture, and implement innovative farming practices (Sitompul & Yarsah, 2025). OECD (2020) and Headey et al. (2023) find that older farmers tend to be less responsive to technological change, which can slow productivity growth and modernization. Moreover, weak farmer regeneration poses a serious threat to the sustainability of national food production, particularly in labor-intensive subsectors such as food crops and horticulture (FAO, 2022; IFAD, 2021). Therefore, these findings underscore the urgency of policies aimed at revitalizing youth participation in agriculture. Previous studies consistently emphasize the importance of integrated strategies that combine modernization, digitalization, improved access to land and finance, and the creation of higher value-added farming opportunities to attract younger generations (World Bank, 2023; ADB, 2020). Without effective farmer regeneration policies, the aging trend observed in this study may increasingly constrain the resilience and sustainability of Indonesia's agricultural sector.

Structure of the Agricultural Workforce by Gender

Table 3 indicates a significant increase in women's participation in the agricultural sector, reflecting a clear trend toward the feminization of agriculture. This phenomenon is particularly evident in small-scale farming systems and family-based agricultural labor, where women increasingly assume productive and managerial roles. Several studies have documented that the feminization of agriculture is closely linked to structural changes in rural economies, especially the migration of male labor to non-agricultural sectors such as industry and services (ILO-FAO, 2019; World Bank, 2020). As men seek better income opportunities outside agriculture, women are often left to manage agricultural activities, resulting in a shift in the gender composition of the agricultural workforce.

Table 3. Gender Structure of the Agricultural Workforce (%)

Gender	2013	2023	Changes (pp)
Male	74	70	-4
Women	26	30	+4

Source: Census of Agriculture, 2013 & 2023

The increase in female labor participation from 26% to 30% is a strong indicator of "distress-driven feminization" rather than proactive empowerment. The primary driver is the widespread out-migration of rural males toward urban or industrial centers in search of contractual off-farm employment. To sustain household survival, rural women are forced to step into the labor void, undertaking primary agricultural operations and managing smallholder plots. Moreover, because women's agricultural work is heavily concentrated in unpaid family labor or seasonal day-labor (e.g., weeding and planting), agribusinesses and family farms rely on them as a source of flexible, lower-wage labor to counter rising production costs. This shift highlights that women are increasingly shouldering the dual burden of domestic chores and manual field production without a corresponding increase in legal land ownership or access to formal extension services.

Previous empirical studies support this finding, showing that women's participation in agriculture has increased in many developing countries as a response to labor shortages caused by male out-migration (Lastarria-Cornhiel, 2006; Doss et al., 2018; FAO, 2021). Agarwal (2014) and Klasen et al. (2019) further emphasize that women are no longer only perceived as unpaid family labor but are increasingly involved in decision-making processes, farm management, and the commercialization of agricultural products. This shift highlights women's growing role

as key economic actors in rural livelihoods. The analysis of the gender structure in the agricultural sector confirms an increasing proportion of female workers, which serves as a strong indicator of agricultural feminization. This trend is consistent with findings from World Bank (2018) and FAO (2020), which report that women now constitute a substantial share of the agricultural labor force in many low- and middle-income countries. However, the feminization of agriculture is not solely a demographic change but also reflects deeper socioeconomic transformations, including changes in household labor allocation, rural poverty dynamics, and access to employment opportunities. While the increasing participation of women in agriculture can be interpreted as an opportunity for economic empowerment and rural development, previous studies caution that this trend is often accompanied by persistent structural constraints. Women frequently face limited access to productive resources such as land ownership, agricultural technology, credit, extension services, training, and social protection systems (FAO, 2017; Quisumbing et al., 2015; World Bank, 2020). These constraints may limit the potential productivity gains from women's increased involvement and can exacerbate gender inequality if not properly addressed. Therefore, changes in the gender structure of the agricultural sector require comprehensive and gender-sensitive policy responses. Policies should aim not only to recognize women's increasing roles but also to strengthen their access to resources, capacity-building programs, and institutional support. As emphasized by previous studies (Doss et al., 2018; FAO, 2021), integrating gender perspectives into agricultural development strategies is essential to ensure that the feminization of agriculture contributes meaningfully to improved welfare, productivity, and sustainable rural development.

Changes in the Employment Status of Agricultural Workers

Table 4 illustrates a declining proportion of owner-cultivators alongside a rising share of farm workers, indicating increasing vulnerability and informality in agricultural employment. This shift reflects broader structural transformations within the agricultural sector, where access to land and productive resources is becoming increasingly constrained. Previous studies have highlighted that land fragmentation, inheritance systems, population pressure, and the limited economic scale of farming operations contribute significantly to the transition from independent farming to wage-based agricultural labor (IFPRI, 2021; World Bank, 2022).

Table 4. Agricultural Labor Employment Status (%)

Employment Status	2013	2023	Changes (pp)
Owner/cultivator farmer	58	47	-11
Farm workers	21	28	+7
Employment Status	2013	2023	Changes (pp)

Source: Census of Agriculture, 2013 & 2023

The sharp drop in owner-cultivators (-11 pp) juxtaposed against the rise in farm workers (+7 pp) and unpaid family labor (+4 pp) uncovers a process of semi-proletarianization and deepening informality. This shift is fundamentally triggered by land accumulation by commercial estates and ongoing land fragmentation among smallholders, which destroys farm viability. When a household's land size shrinks below the subsistence threshold, independent farmers lose their economic autonomy and are forced to sell their labor power, transitioning into landless wage farm workers. Concurrently, the rise in the family workforce acts as a defensive safety net strategy. To suppress rising production overheads (such as fertilizer price shocks and commercial machine rentals), smallholder households substitute paid external labor with unpaid family members, which traps vulnerable household members in low-productivity, highly insecure internal farm roles.

Empirical evidence from various developing countries suggests that shrinking landholdings reduce the economic viability of smallholder farming, forcing households to diversify livelihoods and engage in agricultural wage labor to sustain income (Binswanger-Mkhize et al., 2014; Rigg et al., 2016; FAO, 2020). As a result, the proportion of farmers who own or cultivate their own land has declined, while the number of farm workers and unpaid family laborers has increased. This trend signals a process of de-agrarianization and labor proletarianization within rural areas, where farming increasingly becomes a secondary or subsistence-oriented activity (Bryceson, 2002; Bernstein, 2010). The growing dominance of farm workers is closely associated with high levels of informality and employment insecurity. Several studies emphasize that agricultural wage labor is often characterized by irregular employment, low wages, seasonal income fluctuations, and limited access to social protection mechanisms (ILO, 2018; World Bank, 2022; FAO & ILO, 2021). These conditions make agricultural workers particularly vulnerable to external shocks, including price volatility, economic downturns, and climate-related risks such as droughts and floods (HLPE, 2019; IPCC, 2022). Moreover, the increase in family labor reflects households' strategies to cope with declining farm profitability by minimizing labor costs, which may intensify labor exploitation within the household and reinforce intergenerational poverty traps (Ellis, 2000; White, 2012). Previous research also indicates that informal employment arrangements in agriculture limit workers' bargaining power and reduce their capacity to invest in human capital, further constraining long-term productivity growth (OECD, 2019; IFAD, 2021). Taken together, these findings underscore the urgency of policy interventions aimed at addressing structural vulnerabilities in agricultural employment. Agrarian reform policies that improve equitable access to land, strengthen tenure security, and support land consolidation can help restore the economic independence of smallholders (Deininger et al., 2014; World Bank, 2022). In parallel, strengthening farmer organizations and cooperatives is essential to enhance collective bargaining power, improve market access, and reduce dependency on wage labor. Furthermore, expanding social protection programs—such as health insurance, employment guarantees, and climate risk insurance—for agricultural workers is critical to enhancing household resilience and promoting inclusive and sustainable agricultural development (FAO, 2021; ILO, 2022).

CONCLUSION

From a theoretical and scientific perspective, this study contributes new empirical proof to the agrarian differentiation and labor informalization literature in Southeast Asia. While classical structural transformation models assume that labor leaving agriculture is absorbed into formal urban industries, this study proves that in Indonesia, the transformation is uneven. The sector is undergoing a profound qualitative deterioration: it is becoming structurally older, distressingly feminized, and highly informalized as independent cultivators lose their land assets and dissolve into vulnerable wage-labor arrangements. This highlights that agricultural census microdata can successfully expose structural vulnerability that macro-economic indicators obscure.

Based on these findings, the government must shift away from general production-centric goals and prioritize the following targeted policies:

1. **Generational Regeneration Priority:** Launch an integrated young farmer program by establishing state-backed land-banking systems to lease viable plots to youth, coupled with digital agricultural grants and specialized incubation networks to eliminate capital barriers.
2. **Gender-Sensitive Inclusion Priority:** Legally enforce equal access to agricultural credit and formal training for rural women, and ensure institutional extension programs adapt scheduling to accommodate women's dual work-domestic burdens.

3. Labor Protection Priority: Scale up specialized social protection frameworks, including subsidized crop-insurance schemes, occupational health coverage, and basic income safety nets for landless farm workers and unpaid family laborers to mitigate severe environmental and economic shocks.

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