

Labour Dynamics and Scarcity in Ghana's Cocoa Sector: A Comparative Analysis of Non- Mining and Mining-Affected Communities Across GCFRP HIAs

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Abstract

Labour availability is a critical yet underexplored constraint affecting sustainability transitions in smallholder cocoa systems. This study examines how labour scarcity is reshaping cocoa production in mining-affected and non-mining landscapes within Ghana's Cocoa Forest REDD+ Programme (GCFRP). Using mixed methods including surveys of 485 farmers, key informant interviews, and focus group discussions across six hotspot intervention areas, the study analyses labour availability, wage dynamics, and competing livelihood opportunities. The findings reveal pronounced labour shortages across cocoa-growing communities, with significantly higher scarcity reported in mining-affected areas. Drawing on Labour Market Segmentation Theory, the results indicate that small-scale mining activities attract young and able-bodied workers away from agriculture, thereby weakening the rural agricultural labour pool. Farmers in mining communities reported greater difficulty securing workers for critical farm operations such as weeding and harvesting, often resulting in delayed farm management activities. The study also identifies rising labour costs in mining-affected areas, reflecting intensified competition between cocoa farming and extractive sectors for the same labour force. In response to these constraints, farmers adopt various coping strategies, including increased reliance on household labour, migrant workers, and adjustments to farm management practices. The implications of these labour dynamics extend beyond farm productivity to the broader sustainability of cocoa landscapes. Labour shortages may limit farmers' ability to implement labour-intensive practices required for sustainable intensification and climate-smart cocoa production. The study therefore highlights the need for integrated rural development strategies that address labour market distortions while strengthening agricultural livelihoods to support sustainable cocoa production systems and compliance with REDD+ and national Nationally Determined Contributions targets.

Introduction

Cocoa remains one of the world's most important agricultural commodities, supporting the livelihoods of millions of farmers across tropical regions where it is grown. The cultivation of cocoa is mostly done by smallholder farmers and heavily relies on manual labour. Availability of labour therefore plays a central role in determining productivity and farm profitability (Abdulai et al., 2020). In many cocoa producing regions, however, farmers are increasingly facing labour shortages as broader structural shifts in rural economies, particularly youth migration and the emergence of more attractive income opportunities, continue to draw workers away from agriculture (Mithöfer et al., 2017; Abdulai et al., 2020; Barrientos, 2019). Understanding labour availability in cocoa communities is therefore essential for profitability and sustainable cocoa production (Raynolds, 2014; van Rijn et al., 2020; LeBaron & Gore, 2020).

Ghana is the world's second largest cocoa producer, with the crop being a cornerstone of rural livelihoods and national revenue. Historically, Ghana's cocoa sector relied on migrant labour and sharecropping systems such as "Abunu" and "Abusa," where Abunu involves an equal (50:50) division of output and Abusa allocates one-third of output to the sharecropper and two-thirds to the landowner, arrangements that underpinned cocoa expansion but are now evolving under changing labour conditions

(Hill, 1961; Barrientos, 2014; Torvikey, 2021; Kissi & Herzig, 2020). Ghana's cocoa landscapes are undergoing profound change as farming areas increasingly overlap with expanding mining activities. The sector now links rural livelihoods, global commodity value chains, and climate commitments under REDD + and jurisdictional emission reduction frameworks (Saeed, 2018; Nyarko & Ashiagbor, 2025; Osei, 2025). There is also report of labour shortages gradually intensifying across many communities (Agyapong et al., 2024).

Over the past decade, illegal mining, widely known as “galamsey”, has spread into many cocoa producing regions (Owusu et al., 2025). Although the environmental consequences of galamsey, including land degradation, forest loss, and water pollution, are widely recognised, its influence on farm labour has received far less attention. This issues is particularly important within the Ghana Cocoa Forest REDD+ Programme (GCFRP), which seeks to promote climate-smart cocoa production and reduce deforestation across key forest landscapes. Many of the programme's Hotspot Intervention Areas are now affected by mining activities, potentially creating new pressures on labour supply. Given that GCFRP and similar initiatives rely on labour-intensive practices such as pruning, pest control, and shade management, labour shortages pose a structural risk to achieving productivity and conservation goals (Baruah, 2017; Tennhardt et al., 2024; Scudder et al., 2022).

Existing studies have extensively documented labour challenges in cocoa systems, particularly highlighting farm-level operational constraints, rising labour costs, and difficulties in accessing hired labour (Agyapong et al., 2024; Kissi & Herzig, 2020; Bymolt et al., 2018). Other studies have examined the broader structure of rural labour systems in the Global South, emphasizing their embeddedness within complex institutional, social, and economic arrangements, as well as evolving migrant labour dynamics characterized by increasing precarity and negotiation complexities (Bernstein, 2011; Barrientos, 2019; Amfo et al., 2022). However, despite these contributions, there remains limited empirical evidence that comparatively examines labour availability between mining-affected and non-mining cocoa communities, especially within emission reduction landscapes. As a result, the specific ways in which mining-induced labour shifts influence productivity, management practices, and broader sustainability outcomes remain insufficiently understood.

This paper responds to these gaps by examining patterns of labour scarcity and rural labour allocation in cocoa-producing communities across the GCFRP landscape. Specifically, it: 1) assesses patterns of labour availability across mining-affected and non-mining Hotspot Intervention Areas, 2) analyses how illegal mining influences rural labour allocation, wage dynamics, and farm labour costs, and 3) evaluates the implications of labour shortages for cocoa productivity, farm management practices, and broader sustainability outcomes within the GCFRP landscape. The findings contributes to emerging debates on how labour dynamics shape the effectiveness of sustainability interventions in tropical commodity landscapes.

Theoretical Framework

Labour Market Segmentation Theory

This study applies Labour Market Segmentation Theory, which challenges the classical economic assumption of a unified labor market where wages and working conditions are determined solely by supply and demand. The theory posits that labour markets are divided into distinct segments, each operating under different rules and dynamics, often influenced by industry, occupation, or demographic characteristics (Leontaridi, 1998; Piore, 1983). In cocoa-producing landscapes of Ghana, labour is sourced through multiple arrangements, including family labour, communal labour exchanges like sharecropping systems such as “Abunu” and “Abusa”, hired seasonal workers, and government-supported programmes (Agyapong et al., 2024). These diverse labour channels operate under different incentives, responsibilities, and vulnerabilities, creating systematic inequalities in access, reliability, and working conditions, which in turn influence productivity and the adoption of sustainable cocoa practices.

A central feature of labour market segmentation is the distinction between primary and secondary labour markets. The primary segment includes stable, well-remunerated jobs with security, benefits, and advancement opportunities, often requiring specialized skills or training. In the cocoa sector, activities such as skilled pruning, pest management, or hand pollination can reflect primary labour conditions, typically undertaken by trained or contracted workers. Conversely, the secondary segment is characterized by low wages, limited security, and precarious working conditions, common among casual day labourers, seasonal harvesters, and migrant workers. Mining activities, particularly illegal small-scale operations, exacerbate pressures on secondary labour by offering higher immediate remuneration, diverting workers from cocoa farms, increasing wage disparities, and disrupting farm management. Segmentation theory thus provides a framework to understand how socio-economic factors influence labour access and productivity in rural cocoa systems (Morrison et al., 2012; Marchand & Weber, 2018; Emtage & Herbohn, 2012).

The theory’s application in this study allows for a systematic exploration of how labour scarcity emerges across cocoa-producing communities and how competing livelihood opportunities, such as mining, shape labour allocation. Previous research has applied labour segmentation approaches to natural resource management, including landholder engagement in conservation programs, to better target interventions and enhance both efficiency and equity (Morrison et al., 2012; Emtage & Herbohn, 2012). By distinguishing between segments of the labour market, this framework highlights structural barriers to equitable access and highlights opportunities for designing structured labour support mechanisms, such as pooled labour schemes, youth employment initiatives, and fair wage structures. Consequently, labour scarcity may constrain farmers’ ability to undertake labour-intensive farm management practices required for sustainable cocoa production and climate-smart agricultural initiatives. The theory also provides a critical lens to link workforce dynamics with farm performance, sustainable production, and broader climate and development outcomes in cocoa landscapes (Piore, 1983; Leontaridi, 1998).

Methodology

Study Area Description

The study was conducted across the six priority Hotspot Intervention Areas (HIAs) under the Ghana Cocoa Forest REDD+ Programme (GCFRP), launched in 2019, which target key cocoa-forest landscapes for deforestation reduction and climate-smart cocoa production. The six HIAs include the Ahafo Ano HIA, Asunafo–Asutifi HIA, Kakum HIA, Sefwi Wiawso–Bibiani HIA, Juaboso–Bia HIA, and Atewa HIA, located across the major cocoa-producing regions of the country. These landscapes were purposively selected because they capture diverse ecological, socio-economic, and governance conditions within Ghana's high forest zone while remaining central to national climate mitigation efforts under REDD+. Importantly, the HIAs represent landscapes where cocoa production, forest conservation, and emerging pressures such as illegal small-scale mining intersect, making them appropriate contexts for examining labour dynamics, land-use pressures, and sustainability challenges in cocoa systems (NCRC, 2020). While some landscapes such as Atewa and Ahafo Ano experience relatively higher levels of mining activities due to mineral deposits, others such as Kakum and Sefwi Wiawso–Bibiani are more strongly characterized by agricultural expansion and forest conservation pressures (Dugasseh et al., 2024). This diversity provides a comprehensive representation of the socio-ecological conditions influencing cocoa production and rural livelihoods across the GCFRP landscapes.

Within each HIA, six communities were purposively selected to capture differences in socio-economic conditions and variation in cocoa production intensity, proximity to forest reserves, and exposure to mining or other competing land uses. Out of the 36 communities surveyed, 16 were identified as mining-affected, while 20 communities had no reported mining activities. This distribution enabled the study to compare labour dynamics between mining-affected and non-mining cocoa landscapes.

The selection also considered communities actively engaged in cocoa production and participating in GCFRP-related landscape governance structures such as Community Resource Management Areas (CREMAs) and local farmer networks. In the Asunafo-Asutifi HIA, the communities selected were Owusukrom, Gambia, Kwakuduakrom, Aphantamo Kese, Suntreso, and Mfema. In the Atewa HIA, the study covered Subriso, Sankubenase, Apampatia, Bodua, Nyamabekyere, and Sagyimase. For the Juaboso-Bia HIA, the communities included Danyame, Juaboso Nkwanta, Asempaneye, Kojoaba, Dominebo, and Kwamebikrom. In the Kakum HIA, the communities were Ayitsey, Abodweseso, Homaho. Beenu yie Nkwanta, Amoabeng, Fosu Dunkwah. Within the Ahafo Ano HIA, the selected communities were Aburaso, Abesewa, Akuapem, Tano Odumasi, Kwekuduakrom, and Wioso. Finally, in the Sefwi Wiawso-Bibiani HIA, the study focused on Nkwadum, Chiraano, Debiso, Ahokwaa, Adobewura No. 2, and Asanteman (Fig. 1).

These communities were selected to capture spatial and socio-economic diversity within each HIA and reflect broader GCFRP landscape dynamics. Located in cocoa–forest mosaics, they face competing land uses such as farming, timber extraction, and illegal mining, offering insights into how farmers navigate labour constraints, environmental pressures, and sustainability interventions.

Research Design

A research design provides the overall framework that guides the systematic collection, analysis, and interpretation of data to address a research problem effectively. It outlines the procedures through which evidence is gathered and analyzed, thereby enhancing the reliability and validity of the study findings (Bloomfield & Fisher, 2019). This study adopted a mixed-method research design, integrating both quantitative and qualitative approaches to examine labour dynamics within cocoa-producing communities across the GCFRP Hotspot Intervention Areas (HIAs). The mixed-method approach is suitable for investigating complex socio-economic and environmental issues because it allows researchers to combine numerical data with contextual insights derived from respondents' experiences and perspectives (Creswell & Creswell, 2017).

The quantitative component enabled the analysis of patterns of labour availability, labour costs, and farm management practices across the selected communities, while the qualitative component provided insights into farmers' experiences regarding labour scarcity and the influence of competing livelihood activities such as illegal mining. Through the combination of these approaches, the study was able to triangulate evidence and provide a detailed understanding of labour allocation and its implications for cocoa production and sustainability outcomes. Similar mixed-method approaches have been widely used in studies examining governance, livelihoods, and sustainability in cocoa landscapes, including research on REDD+ interventions and farmer perceptions in the Juabuso-Bia cocoa forest landscape (Dugasseh & Zandersen, 2025), demonstrating the relevance of this methodological approach for analysing complex rural development and environmental challenges.

Data Collection Methods and Sampling

The study utilized both primary and secondary data sources to address the research objectives. Primary data were collected through face-to-face interviews, structured questionnaires, key informant interviews, and focus group discussions (FGDs). The combination of qualitative and quantitative approaches enabled the study to capture measurable labour patterns while also exploring the contextual experiences and perspectives of actors within cocoa landscapes. Secondary data were obtained through a review of policy documents, programme reports, and scholarly literature on cocoa production, REDD+ governance, rural labour markets, and illegal mining, which provided background information and supported the interpretation of the primary data. Field data were collected between January and February 2026 across selected communities within the six GCFRP Hotspot Intervention Areas (HIAs).

Key informant interviews were conducted with individuals who possess knowledge of cocoa production systems, labour arrangements, and local governance processes. These included cocoa purchasing clerks, farm labourers, community leaders and chiefs, COCOBOD officers, cocoa farmer association leaders, and GCFRP HIA executives. Such individuals play important roles in shaping labour mobilization, farm management decisions, and cocoa marketing systems within rural communities. The interviews explored respondents' experiences and perspectives regarding labour availability, wage dynamics,

migration, and the influence of alternative livelihood activities such as illegal mining on cocoa farm labour. The interview guide was organized into four thematic areas: (i) socio-demographic characteristics of participants to contextualize their perspectives; (ii) labour sources, availability, migration patterns, and wage dynamics; (iii) the influence of illegal mining on rural labour allocation; and (iv) implications for cocoa productivity and landscape sustainability under the GCFRP framework. Qualitative interviews are useful for generating insights into complex socio-economic processes and institutional dynamics (Foley, 2021).

Quantitative data were collected using structured questionnaires administered to cocoa farmers across the selected communities. The questionnaire captured information on socio-economic characteristics, farm management practices, labour sourcing strategies, labour costs, and perceptions of labour scarcity and competing livelihood opportunities. The use of standardized questionnaires allowed for statistical analysis of labour patterns and farm management practices across different communities. The integration of survey data with qualitative interviews strengthened the reliability of the findings through data triangulation.

Respondents for the survey were selected using purposive sampling, focusing on cocoa farmers who had lived in the communities for at least 10 years and had engaged in cocoa farming for more than 10 years. This criterion ensured that participants possessed sufficient experience and historical knowledge of labour trends, farming practices, and livelihood changes within the cocoa landscapes. Local coordinators and community leaders assisted in identifying eligible respondents, which facilitated access to knowledgeable participants and improved the reliability of the information gathered.

The sample size for the survey was determined using Cochran's (1977) formula for calculating sample sizes in large populations in order to ensure statistical reliability and representativeness. The formula is expressed as:

$$n_{\infty} = \frac{Z^2 \times p \times (1-p)}{e^2}$$

$$= \frac{2.170^2 \times 0.5 \times 0.5}{0.05^2} = 471$$

where:

n_{∞} is the sample size,

Z is the Z-value (2.170 for 97% confidence level),

p is the estimated proportion of an attribute that is present in the population (0.5)

e is the desired level of precision (margin of error) which is set at 0.05 (5%).

Substituting these values produced a minimum sample size of 471 respondents. However, a total of 485 completed questionnaires were retained after data cleaning, thereby increasing the robustness of the dataset and improving the reliability of the statistical analysis.

In addition to individual interviews and surveys, six focus group discussions (one in each HIA) were conducted to capture community-level perspectives on labour dynamics and livelihood changes. Each focus group comprised 6–10 participants, representing diverse social groups including community opinion leaders, HIA executives, youth, migrants, persons with disabilities, men, and women. The FGDs were moderated by trained facilitators using semi-structured interview guides and were conducted in the local languages commonly spoken within the communities. An assistant facilitator was responsible for note-taking and audio recording to ensure accurate documentation of the discussions. Focus group discussions provide a platform for participants to collectively reflect on shared experiences, enabling researchers to observe how community members negotiate and interpret issues through social interaction (Nyumba et al., 2018). Discussions were held in open and respectful environments that encouraged free expression of opinions, including dissenting viewpoints, thereby capturing the diversity of community perspectives regarding labour shortages, wage changes, and livelihood shifts associated with mining activities. Data collection continued until thematic saturation was reached, indicated by the repetition of key themes and the absence of new substantive insights across interviews and group discussions.

Prior to the commencement of fieldwork, the research team engaged local authorities and traditional leaders within the selected communities to obtain permission and ensure community support for the study. Ethical considerations were strictly observed throughout the research process. Participants were informed about the objectives of the study, assured of confidentiality and anonymity, and provided voluntary consent before participating in the interviews or discussions. These procedures ensured that the research adhered to ethical standards of transparency, respect, and accountability while enabling the collection of rich and reliable data on labour dynamics within cocoa-producing landscapes.

Data Analysis

The quantitative data collected through questionnaires were organized using Microsoft Excel and subsequently analyzed with Statistical Package for Social Sciences (SPSS) version 27. Descriptive statistics such as frequencies, percentages, and means were used to summarize respondents' characteristics and community responses. Inferential statistical techniques were also applied to further examine relationships within the data. Chi-square tests were used to assess associations between key variables such as mining status, labour availability, and labour-related outcomes across the GCFRP Hotspot Intervention Areas (HIAs). In addition, binary logistic regression analysis was conducted to identify the factors influencing the likelihood of productivity decline in cocoa farms.

For the qualitative data, thematic analysis was used to analyze responses from interviews and open-ended questionnaire items. The qualitative data were first transcribed and carefully reviewed, after which relevant statements were coded and grouped into emerging themes that capture community perspectives, experiences, and contextual explanations regarding labour availability and management within cocoa farming systems. Integrating both quantitative and qualitative findings helped to produce a detailed understanding of the labour challenges and coping strategies within the study areas.

Results

Demographic Characteristics of the Respondents

Table 1 presents the socio-demographic characteristics of the 485 respondents surveyed across the six GCFRP Hotspot Intervention Areas (HIAs). The distribution of respondents across the HIAs was fairly even, with each area contributing about 16–17% of the total sample. Illegal mining activities were reported by 44.1% of the surveyed respondents, while 55.9% indicated that such activities were not present. Females constituted a slightly higher proportion of respondents (54.64%) compared to males (46.36%). Majority of the respondents were aged between 36–45 years (38.1%) and 46–60 years (29.3%). In terms of educational attainment, a substantial proportion of respondents (40.4%) had no formal education, while 21.9% had primary education and 19.8% had completed junior high school. Household characteristics show that over half of the respondents (51.3%) had household sizes of between 0–4 members, while 41.4% reported households of 5–8 members. Cocoa farming was identified as the primary source of income for the majority of respondents (71.9%), and most of the respondents were married (64.1%). In terms of farm and labour characteristics, most farmers cultivated small farms of 1–5 acres (45.6%), and household labour availability was limited, with 56.1% reporting only 0–3 members engaged in cocoa farming. Additionally, 66.8% of respondents belonged to farmer associations or cooperatives while the remaining 33.2% were not part of such associations.

Table 1
Socio-Demographic Characteristics of Respondents (N = 485)

Variable	Category	Number of Respondents	Percentage (%)
GCFRP HIA	Ahafo Ano	83	17.1
	Asunafo	80	16.5
	Kakum	80	16.5
	Sefwi Wiawso–Bibiani	81	16.7
	Juaboso–Bia	80	16.5
	Atewa	81	16.7
Illegal Mining Present in Community	Yes	214	44.1
	No	271	55.9
Gender of Respondent	Male	220	46.36
	Female	265	54.64
Age	18–25 years	28	5.8
	26–35 years	72	14.8
	36–45 years	185	38.1
	46–60 years	142	29.3
	61 years and above	58	12.0
Education Level	No formal education	196	40.4
	Primary	106	21.9
	Junior High School	96	19.8
	Senior High School	63	13.0
	Tertiary	24	4.9
Household Size	0–4	249	51.3
	5–8	201	41.4
	9–12	35	7.2
Primary Source of Income	Cocoa farming	349	71.9
	Other farming activities	78	16.1

Variable	Category	Number of Respondents	Percentage (%)
	Trading/business	55	11.3
	Mining-related activities	3	0.6
Marital Status	Single	92	19.0
	Married	311	64.1
	Divorced/Separated	41	8.5
	Widowed	41	8.5
Household Labour Availability	0–3 members	272	56.1
	4–6 members	189	39.0
	7–9 members	24	4.9
Farm Size (acres)	1–5	221	45.6
	6–10	156	32.2
	11–15	71	14.6
	16 or more	37	7.6
Membership in Farmer Association/Cooperative	Yes	324	66.8
	No	161	33.2

Perceived Labour Availability for Cocoa Farming by GCFRP HIA

Labour availability across the GCFRP HIAs generally appears to be limited, with most respondents indicating that labour is inadequate or very inadequate in their communities. In the Ahafo Ano HIA, about 52% of respondents reported labour as inadequate, while 27% considered it very inadequate, compared to only 3% who described labour availability as very adequate. A similar pattern is observed in Atewa, where 50% indicated inadequate labour and 31% reported very inadequate labour availability.

In Juaboso–Bia, half of the respondents (50%) reported inadequate labour, with an additional 26% describing it as very inadequate. However, slightly better labour availability was observed in Asunafo, Kakum, and Sefwi Wiawso–Bibiani, where a relatively higher proportion of respondents rated labour as adequate or very adequate. For instance, in Kakum, 34% reported adequate labour and 12% very adequate, while in Sefwi Wiawso–Bibiani, 33% indicated adequate labour and 11% very adequate (Fig. 2).

Labour Availability Compared to 10 Years Ago by Hotspot Intervention Area

The results indicate a general decline in labour availability in cocoa-producing communities across the GCFRP Hotspot Intervention Areas (HIAs) over the past decade. In Ahafo Ano, a substantial proportion of respondents reported worsening labour conditions, with 46.3% indicating labour availability has become worse and 32.9% stating it has become much worse, while only 7.3% perceived any improvement. Similar trends were observed in Juaboso-Bia and Atewa, where 48.8% and 46.9% respectively reported that labour availability has worsened, with an additional 30.0% in Juaboso-Bia and 37.0% in Atewa indicating that it has become much worse.

Although some improvement was noted in Asunafo, Kakum, and Sefwi Wiawso–Bibiani, the overall perception still leaned toward deterioration. For instance, in Kakum, 33.8% reported that labour availability had worsened and 15.0% reported it had become much worse, compared to 27.5% who perceived some improvement. Similarly, in Sefwi Wiawso-Bibiani, 56.8% of respondents reported worsening labour conditions compared to about 20.9% who reported improvements (Fig. 3).

Labour Availability in Mining and Non-Mining Communities

Figure 4 presents respondents' perceptions of labour availability in mining and non-mining communities within the study areas. In mining communities, the majority of respondents reported significant labour shortages, with 49% indicating that labour is inadequate and 30% describing it as very inadequate. Only 21% (5% very adequate and 16% adequate) perceived labour availability as sufficient. In contrast, labour availability appears relatively better in non-mining communities. A larger proportion of respondents (63%) reported labour as either adequate (39%) or very adequate (24%), while 37% still considered labour availability to be inadequate or very inadequate.

Chi-square analysis revealed a significant association between labour availability and mining status ($\chi^2 = 8.2$, $df = 3$, $p = 0.041$), indicating that communities affected by mining experience more pronounced labour shortages. Labour availability also varied significantly across GCFRP HIAs ($\chi^2 = 25.3$, $df = 15$, $p = 0.048$), reflecting differences in local labour dynamics and socio-economic conditions. However, changes in labour over the past ten years showed a marginal association with mining presence ($\chi^2 = 7.2$, $df = 4$, $p = 0.121$), indicating a potential trend where mining activities may influence labour availability over time, though this relationship is not statistically significant at the 5% level (Table 2).

Table 2
Chi-Square Tests Examining Labour Dynamics

Test Variables	χ^2	df	p-value
Labour availability x Mining status	8.2	3	0.041*
Labour availability x GCFRP HIA	25.3	15	0.048*
Labour change over 10 years x Mining status	7.2	4	0.121
* Significant at $p < 0.05$			

Patterns of Labour Availability and Drivers of Labour Scarcity

Qualitative responses from the key informants supported the survey results and revealed clear differences in labour availability between mining and non-mining communities. Farmers in mining-affected communities consistently reported serious labour shortages. Many respondents explained that a large number of young and able-bodied workers had moved to nearby illegal mining sites, leaving fewer people available to work on cocoa farms, especially during peak farming periods such as weeding and harvesting.

One farmer from a mining-affected community explained:

“Most of the young men who used to work on our cocoa farms have moved to the galamsey sites. Farming is harder and the money comes slowly, but in mining they get cash every day.” - (Cocoa farmer, Aburaso, Ahafo Ano HIA, 18th February, 2026)

Another farmer described the growing difficulty in finding workers for farm activities:

“Now when you need workers for weeding or harvesting, it is very difficult to find them. The few people who can work are already busy at the mining sites, so farmers struggle to get help on time.” - (Cocoa farmer, Danyame, Juabeso-Bia HIA, 19th February, 2026)

A COCOBOD officer explained that the limited number of available workers were often already engaged on other farms, which resulted in delays in important farm operations. He further explained that farmers sometimes had to search for labour in neighbouring communities when workers were not available locally. Across several communities, farmers and farm labourers also mentioned the declining involvement of young people in cocoa farming. Respondents explained that many youths now pursue other livelihood activities such as “Okada” and motorcycle transport services or migrate to mining areas to work in galamsey operations. It was also revealed that the movement of people from rural areas to towns and cities for formal or informal jobs such as trading, transport, or other services reduces the availability of labour for cocoa farming, even in communities without mining activities.

In addition, a cocoa purchasing clerk mentioned that educational policies such as the introduction of the Free Senior High School Policy in 2017 have encouraged families to keep their children in school rather than engaging them in farm activities. Furthermore, awareness campaigns by licensed buying companies, NGOs, and sustainability initiatives have discouraged the use of children in cocoa farm labour due to concerns related to Child Labour in Cocoa Production. These developments have collectively reduced the traditional supply of household labour for cocoa farming.

In contrast, farmers in non-mining communities generally described labour shortages as less severe. Many respondents indicated that local labour arrangements, including assistance from relatives and neighbours, still play an important role in supporting cocoa farming activities.

One farmer explained:

"We still depend on our neighbours and relatives to help during the peak farming season. Labour is not always easy to find, but it is manageable." - (Cocoa farmer, Gambia, Asunafo-Asutifi HIA, 20th February, 2026)

Another respondent added:

"Young people here still see farming as important because there are no mining activities nearby to attract them away. Most of them still assist their families and some even own farms. Because there are fewer alternative jobs in this area, farming remains one of the main livelihood options for the youth" - (Chief farmer, Abodweseso, Kakum HIA, 17th February, 2026)

These narratives highlight how mining activities reshape rural labour markets by diverting agricultural labour towards more lucrative but environmentally damaging activities, thereby intensifying labour scarcity for cocoa production in mining-affected communities. The rural labour market therefore becomes divided between a higher-return mining sector and a lower-paid agricultural sector, leading workers to migrate toward the segment offering better immediate financial rewards.

Wage Dynamics and Labour Cost Implications

Labour Sources by Community Mining Status

In mining-affected communities, household labour (50%) and migrant labour (35%) dominate due to scarcity of local hired workers and communal support. In contrast, non-mining communities rely more on local hired labour (35%) and communal support (30%). Contract labour remains moderately used in both contexts (Fig. 5).

Changes in Cocoa Farm Wages Over the Last 5–10 Years

The results show that cocoa farm wages have generally increased over the past 5–10 years, with mining communities experiencing more pronounced wage hikes. In mining areas, 56% of respondents

reported significant increases in wages, and 38% indicated slight increases, while only 6% perceived no change. Conversely, in non-mining communities, 39% reported significant increases, 43% slight increases, and 18% observed no change (Fig. 6).

Labour Cost Comparison for Cocoa Farm Operations in Mining and Non-Mining Communities

Labour costs for cocoa farm operations were generally higher in mining-affected communities compared to non-mining areas. For instance, weeding cost an average of GH₵1500 (\$138.25) per acre in mining communities, compared to GH₵1200 (\$110.60) in non-mining areas. Similarly, harvesting/plucking and gathering pods were more expensive in mining communities, with averages of GH₵120 (\$11.06) and GH₵100 (\$9.22) per day, respectively, as against GH₵100 (\$9.22) and GH₵80 (\$7.37) in non-mining areas. Pruning and pod-breaking costs were similar across communities (GH₵100 (\$9.22) and GH₵50 (\$4.61), respectively, while spraying operations averaged GH₵30 (\$2.76) per day in both settings, depending on the equipment and chemical use. Transportation costs (using *Aboboyaa*) were not fixed and varied depending on farm location and distance. The exchange rate used was 1 USD = 10.85 GH₵, based on Bank of Ghana rates for March 2026. It is important to note that in some communities, farmers measure their farms using ‘poles’ rather than acres, with four poles considered equivalent to one acre. This conversion was also considered for estimating farm sizes in the study (Table 3).

Table 3
Mean Labour Costs (GH₵/ USD) per acre/Operation by Mining Status

Cocoa Farm Operation per acre	Mining Communities (GH₵ / USD)	Non-Mining Communities (GH₵ / USD)
Weeding	1500 (\$138.25)	1200 (\$110.60)
Pruning	100 (\$9.22)	100 (\$9.22)
Harvesting/Plucking Pods	120 (\$11.06)	100 (\$9.22)
Gathering Pods	100 (\$9.22)	80 (\$7.37)
Breaking Pods	50 (\$4.61)	50 (\$4.61)
Spraying Operations	30 (\$2.76)	30 (\$2.76)
Transportation (Aboboyaa)	Not fixed	Not fixed
1 USD = 10.85 GH₵, based on Bank of Ghana rates for March 2026		

Labour Market Segmentation and Mobility in Cocoa Farm Labour

Key informants highlighted the challenges of labour scarcity and reliance on migrant workers in mining-affected and remote cocoa communities. A cocoa purchasing clerk from Atewa noted: *“Even if we have money, labourers are already on other farms, so sometimes we have to wait or go to other villages to hire them, which increases our costs”* (Purchasing Clerk, Atewa HIA, 22nd February, 2026). This reflects segmentation, as workers prioritize higher-paying or less demanding tasks. A farm labourer from Kakum stated: *“Many of us move from farm to farm depending on who pays faster”* (Farm Labourer, Ayitsey, Kakum HIA, 17th February, 2026).

A COCOBOD officer stated that:

“Migrant labourers from northern Ghana and neighbouring countries such as Togo often support cocoa farming activities during peak periods. However, their services are typically temporary, and farm operations may sometimes be delayed when these workers are completing tasks on other farms before moving to new locations. In some cases, migrant labourers agree to work first and receive payment later. Labour charges also increase when the cocoa farmgate price rises” (COCOBOD officer, Kakum HIA, 17th February, 2026).

This shows the existence of a secondary, more mobile labour segment in the rural cocoa sector. A community leader in Ahafo Ano reported: *“Sometimes we even have to pay for transport and accommodation to bring workers from neighbouring towns because local labour is scarce, especially during weeding and harvesting. In some cases, because workers know we urgently need them, they charge whatever price they want, which becomes very costly and burdensome for farmers”* (Community leader, Ahafo Ano HIA, 18th February, 2026). This shows a segmented rural labour market where local and migrant labour respond differently to wage incentives and working conditions, consistent with Labour Market Segmentation Theory.

Implications of Labour Scarcity on Cocoa Farm Productivity and Farm Management

Effect of Labour Shortage on Cocoa Farm Productivity

The results show that labour shortages have a more severe impact on cocoa farm productivity in mining-affected communities. Majority of respondents in mining communities (58%) reported that labour shortages have significantly reduced farm productivity, compared to 29% in non-mining communities. In contrast, a larger proportion of farmers in non-mining communities (35%) reported no effect on productivity, indicating relatively better labour availability in those areas (Fig. 7).

Determinants of Cocoa Farm Productivity Decline

The binary logistic regression results indicate that mining status is a strong predictor of cocoa farm productivity decline. Farmers located in mining communities are 2.44 times more likely to report reduced productivity compared to those in non-mining communities ($\beta = 0.89$, $p < 0.001$). Farm size and farmer age also show significant positive relationships with productivity decline, suggesting that larger farms

and older farmers are more likely to experience labour-related productivity challenges. Conversely, household labour availability significantly reduces the likelihood of productivity decline ($\beta = -0.41$, $p = 0.015$). Gender of the farmer was not statistically significant in predicting productivity outcomes (Table 4).

Table 4
Factors Predicting Probability of Cocoa Farm Productivity Decline

Predictor Variable	Coefficient (β)	Std. Error	Wald χ^2	p-value	Odds Ratio (Exp β)
Mining status (1 = Mining community)	0.89	0.23	14.87	0.000***	2.44
Farm size	0.12	0.05	5.76	0.016*	1.13
Gender (1 = Male)	-0.18	0.19	0.92	0.337	0.84
Farmer age	0.03	0.01	4.62	0.032*	1.03
Household labour availability	-0.41	0.17	5.86	0.015*	0.66
Constant	-1.37	0.41	11.18	0.001	-
* Significant at $p < 0.05$					

Changes in Farm Management Due to Labour Shortages

Farm management adjustments were more pronounced in mining communities. A larger proportion of farmers in mining-affected areas reported reducing weeding frequency (71%), delaying harvesting (59%), and reducing pruning or general farm maintenance (63%) compared to farmers in non-mining communities (Fig. 8).

Coping Strategies for Labour Shortages

Farm management adjustments were more pronounced in mining communities. A larger proportion of farmers in mining-affected areas reported reducing weeding frequency (71%), delaying harvesting (59%), and reducing pruning or general farm maintenance (63%) compared to farmers in non-mining communities (Fig. 9).

Qualitative accounts from key informants further reinforced the quantitative patterns, revealing how labour shortages are shaping farm management decisions and productivity outcomes in cocoa-growing communities. Respondents emphasized that labour scarcity has intensified during peak farming periods, especially in mining-affected areas where many young workers are drawn into more lucrative mining activities. Most farmers explained that even when they are willing to pay higher wages, farm labourers are not always available.

A cocoa farmer in one mining-affected community explained the constraints associated with farm operations:

“Even when you have the money, getting labour is the problem. Sometimes you want to spray your farm but the spraying machines are not even enough in the community. The few that are available are already booked by other farmers, so you have to wait or miss the spraying period.” (Cocoa farmer, Bodua, Atewa HIA, 20th February, 2026)

Seasonal labour shortages were also reported to delay critical farm operations such as harvesting. During peak cocoa harvesting periods, the demand for labour far exceeds supply, forcing farmers to postpone harvesting activities, which can affect bean quality and farm productivity. One community leader stated:

“During the main harvest season everybody is harvesting at the same time. The labourers are very few, and they move from one farm to another depending on who calls them first. Sometimes your pods are ready but you have to wait because there is nobody to help.” (Community leader, Suntreso, Asunafo-Asutifi HIA, 2nd February, 2026)

Farmers also indicated that labour shortages have forced them to adjust their farm management practices, especially in relation to weeding and general farm maintenance. In several communities, farmers reported reducing the frequency of weeding due to high labour costs and limited labour availability. One farmer described this change as follows:

“In the past, I used to weed my farm about three or four times in a year to keep it clean. But now labour is expensive and difficult to get, so I weed only once or twice a year. The farm is not as clean as before, but that is what we can manage now.” (Cocoa farmer, Kwekuduakrom, Ahafo Ano HIA, 18th February, 2026)

Similarly, a GCFRP executive highlighted that farmers increasingly depend on household labour as a coping strategy when hired labour is unavailable. However, he noted that household labour alone is often insufficient to meet the labour demands of cocoa production.

“Many farmers now depend on their wives and children to work on the farm because hiring labour is too costly and sometimes you cannot even find workers. But family labour cannot do everything, especially on larger farms.” (GCFRP executive, Kakum HIA, 17th February, 2026)

This account shows how labour shortages are reshaping labour allocation and farm management practices in cocoa communities, with farmers increasingly relying on household labour, reducing farm maintenance activities, and delaying key operations.

Discussion

Structural Labour Market Shifts and Cocoa Farm Labour Availability

The findings highlight a structural transformation in rural labour markets within cocoa-producing landscapes, particularly in areas where extractive activities coexist with agriculture. Drawing on Labour Market Segmentation Theory, the observed labour shortages can be interpreted as a shift of workers from the lower-wage agricultural segment to higher-return sectors such as artisanal and small-scale mining. In segmented labour markets, workers are likely to migrate toward employment opportunities offering immediate and higher financial rewards, even when such activities are environmentally unsustainable. The qualitative accounts of farmers reporting that young workers prefer mining because “the money comes every day” reflect this dynamic. The empirical results further show that labour shortages are more pronounced in mining-affected communities, where the majority of respondents reported labour as inadequate or very inadequate, compared to relatively better labour availability in non-mining communities. Similar patterns have been documented in other resource-dependent regions where natural resource extraction reshapes local labour markets and diverts labour away from traditional agricultural activities (Marchand & Weber, 2018; Michaels, 2010). In the context of cocoa systems, such labour reallocation weakens the agricultural labour pool, creating structural shortages that constrain farm operations and reduce productivity potential. This reinforces earlier observations that access to labour remains one of the key barriers to sustainable intensification (SI) in smallholder farming systems across Sub-Saharan Africa, including cocoa production (Abdulai et al., 2020; Tennhardt et al., 2024). The significant association found between mining presence and labour availability further illustrates how mining activities intensify labour scarcity in cocoa landscapes by attracting young and able-bodied workers away from farming.

Beyond mining, broader socio-economic transformations also appear to be reshaping labour availability in cocoa landscapes. Rural-urban migration, the emergence of alternative livelihood opportunities such as motorcycle transport (“okada”), and increasing school enrolment under educational reforms collectively reduce the supply of household labour that historically supported cocoa production. These trends align with studies indicating that labour drift and youth migration are major contributors to labour scarcity in Ghanaian cocoa communities (Agyapong et al., 2024). Although labour shortages were reported across both mining and non-mining communities, farmers in non-mining areas generally described the situation as more manageable, often relying on social networks such as relatives and neighbours to support peak farm operations. When household labour declines, farmers become increasingly dependent on hired labour, which may be expensive or unavailable during peak periods (Bymolt et al., 2018; Mithöfer et al., 2017). The implications extend beyond labour availability to farm management outcomes. Limited labour supply can lead to delayed weeding, harvesting, and post-harvest processing, which may negatively affect cocoa quality and market competitiveness (Agyapong et al., 2024). Similar labour constraints have been reported in other cocoa-producing countries such as Nigeria, Cameroon, and Côte d’Ivoire, where labour shortages reduce farm efficiency and limit farmers’

ability to maintain optimal production practices (Akanni & Dada, 2012; Ngang et al., 2020; Coulibaly & Erbao, 2019; Oluyole & Lawal, 2010).

These labour dynamics also have broader implications for sustainability transitions within cocoa value chains. Sustainable intensification and certification initiatives often require labour-intensive practices such as pruning, shade management, and timely harvesting. However, when labour availability is constrained, farmers may struggle to implement these practices consistently. As noted by Martin et al. (2018) and Tennhardt et al. (2024), labour scarcity disproportionately affects resource-constrained farmers, limiting their participation in sustainability initiatives and potentially trapping them in low-productivity systems. The disparities observed between mining and non-mining communities suggest that farmers in mining-affected areas may face greater structural barriers to adopting sustainable cocoa practices due to persistent labour shortages and rising labour costs. This creates a structural inequality within cocoa value chains, where better-resourced farmers with greater access to labour or capital are more capable of adopting sustainability standards. Furthermore, shifts in labour demand associated with extractive industries may produce broader spillover effects on rural economies, including population movements and changes in local employment structures (Marchand & Weber, 2018). In this study, the concentration of labour shortages in mining communities illustrates how extractive sector expansion can crowd out agricultural labour and weaken the labour base required for cocoa production. These labour constraints pose a critical governance challenge because climate mitigation strategies such as those promoted under the Ghana Cocoa Forest REDD+ Programme (GCFRP) rely heavily on improved farm management and sustainable intensification practices that are inherently labour-intensive. If labour shortages persist, farmers may struggle to implement recommended practices such as shade management and timely farm maintenance, potentially undermining emission reduction targets and landscape restoration goals. The findings therefore show the importance of integrated rural development strategies that address labour market distortions while strengthening agricultural livelihoods.

Wage Dynamics and Rising Farm Labour Costs in Cocoa Production

The findings point to important transformations in rural wage dynamics within cocoa-growing landscapes, particularly in areas where mining and agriculture coexist. The rising cost of farm labour reflects increasing competition between cocoa farming and alternative economic sectors for the same rural workforce. In mining-affected communities, extractive activities create a higher-return employment segment that attracts local labour and pushes agricultural wages upward as farmers compete to retain workers. The observed higher labour costs for operations such as weeding and harvesting in mining communities illustrate this competitive pressure, where farmers must offer higher payments to secure workers during peak periods. Similar labour market distortions have been documented in other natural-resource-dependent regions, where resource extraction reshapes local wage structures and reallocates labour away from traditional agricultural sectors (Marchand & Weber, 2018). Within cocoa systems, labour represents one of the largest production costs, with studies suggesting that up to 37% of farm

expenditures are allocated to hired labour (Folefack et al., 2021). Consequently, rising wages may significantly affect farm profitability and the capacity of smallholders to maintain labour-intensive practices required for productivity and sustainability.

The differentiated reliance on labour sources between mining and non-mining communities also reflects the strategies farmers employ in response to labour market pressures. In mining communities, the greater reliance on household and migrant labour suggests that farmers increasingly depend on alternative labour arrangements when local hired workers become scarce or expensive. This pattern is consistent with the historical importance of migrant labour in Ghana's cocoa economy, where migrants from northern Ghana and neighbouring countries such as Togo and Burkina Faso have long supported farm establishment and expansion (Kissi & Herzig, 2024). However, the mobility of migrant labourers also introduces uncertainty in labour availability, as workers often move between farms depending on wage incentives and timing of payments. In contrast, non-mining communities appear to retain stronger communal labour arrangements such as '*nnoboa*' and greater reliance on local hired workers, which may buffer farmers against the extreme labour shortages observed in mining landscapes. Household labour remains a critical input in cocoa farming because hired labour is expensive and often unreliable (Fountain & Huetz-Adams, 2020; Vigneri et al., 2016). When household labour becomes insufficient, farmers must resort to hired labour or migrant workers, which increases production costs and exposes farmers to labour market fluctuations (Bymolt et al., 2018). Similar patterns have been observed in other cocoa-producing regions such as Cameroon, Nigeria, and Indonesia, where labour availability and labour contracts significantly influence farm productivity and efficiency (Ngang et al., 2020; Akanni & Dada, 2012; Effendy et al., 2019).

These evolving wage dynamics also carry broader implications for the sustainability and competitiveness of cocoa production systems. Rising labour costs may discourage farmers from performing labour-intensive farm operations such as frequent weeding, pruning, and timely harvesting, which are essential for maintaining cocoa yields and quality. Evidence from Ghana suggests that labour shortages and increasing wage costs can lead to delayed farm operations, contributing to quality deterioration and reduced productivity (Agyapong et al., 2024). The situation appears particularly acute in mining-affected communities, where higher wages and labour mobility create additional financial pressure on farmers who must sometimes pay transport, accommodation, or premium wages to attract workers. Comparable labour cost challenges have been reported in other smallholder tree-crop systems, where wage increases linked to competing sectors can significantly influence production decisions and farm management strategies (Coulibaly & Erbao, 2019; Rahim et al., 2020). These dynamics illustrate how rural labour markets respond to structural economic shifts, with agricultural sectors often competing with more lucrative industries for labour. As noted by Tennhardt et al. (2024), access to labour remains a critical constraint for sustainable intensification in cocoa systems, especially among resource-constrained farmers. Addressing these challenges therefore requires integrated policy responses, including labour-saving technologies, improved mechanisation services, and rural development interventions that strengthen the economic attractiveness of agriculture while reducing excessive labour costs for smallholder cocoa producers.

Implications of Labour Scarcity on Cocoa Farm Productivity and Management Practices

The findings illustrate the critical role of labour availability in shaping cocoa farm productivity and management practices, particularly within landscapes where agriculture competes with extractive activities. The higher likelihood of productivity decline among farmers in mining communities highlights how competition for labour between mining and agriculture can generate structural constraints on farm performance. The results also indicate that larger farm sizes and older farmers face greater vulnerability to labour-related productivity challenges, while the availability of household labour significantly reduces the risk of productivity decline, highlighting the role of family labour in sustaining cocoa farm operations (Bymolt et al., 2018).

In cocoa systems specifically, labour remains a fundamental input for key farm operations such as pruning, weeding, pest control, and harvesting, all of which are essential for maintaining yields and crop health (Scudder et al., 2022). Consistent with this, Agyapong et al. (2024) reported a near-unanimous consensus among cocoa farmers regarding the significant impact of labour shortages on critical farm operations, highlighting how labour scarcity can undermine productivity across the entire cocoa sector rather than at the level of individual farms alone. Consequently, when labour becomes scarce, farmers may struggle to implement recommended management practices consistently, thereby undermining productivity outcomes.

The differentiated experiences between mining and non-mining communities further demonstrate how local labour market conditions shape farm management decisions. Farmers in mining-affected areas appear to adopt more drastic adjustments to farm operations, including reducing weeding frequency, delaying harvesting, and limiting routine farm maintenance. These adjustments reflect coping strategies in response to labour scarcity and rising labour costs. However, such strategies may have negative agronomic consequences, as inadequate weeding and delayed harvesting can reduce cocoa yields and affect bean quality. Previous studies in West African cocoa systems have similarly highlighted the strong relationship between labour availability and productivity outcomes. For instance, Vigneri et al. (2016) found that cocoa yields in Ghana and Côte d'Ivoire are closely linked to the availability of adult household labour, while Bymolt et al. (2018) emphasised that investments in proper farm management such as pruning and timely maintenance are highly dependent on labour availability. Demographic factors further complicate this situation, as ageing farmer populations and declining youth participation in agriculture reduce the availability of household labour that traditionally supported cocoa farming (Mithöfer et al., 2017; Abdulai et al., 2020). This challenge appears pronounced in mining communities where younger workers are more likely to exit agriculture, leaving older farmers with limited capacity to manage labour-intensive farm activities.

The results also have important implications for broader sustainability transitions within the cocoa sector. Modern cocoa production increasingly requires labour-intensive practices associated with improved farm management, organic production, and sustainability certification schemes. These

systems often demand additional labour for pest management, shade regulation, and phytosanitary measures (Folefack et al., 2021; Meier et al., 2020). However, labour shortages may limit farmers' ability to adopt or maintain such practices. For example, Tennhardt et al. (2024) observed that farmers fear yield losses when they cannot adequately spray or manage pests, yet labour shortages and limited access to inputs often prevent timely interventions. Similarly, while improved management practices can enhance productivity, they may not always be economically viable when labour costs are high or labour availability is limited (Scudder et al., 2022). Agyapong et al. (2024) further emphasize the financial implications of rising labour costs, highlighting that the high expenses associated with hiring farm labour can compromise the economic viability of cocoa production and reduce farmers' profitability. The stronger labour constraints observed in mining-affected communities therefore suggest that farmers in these areas may face greater barriers to implementing sustainable cocoa management practices compared to those in non-mining communities where labour conditions appear relatively more stable. These labour constraints have broader implications for landscape-level initiatives such as the Ghana Cocoa Forest REDD+ Programme (GCFRP), which seeks to promote climate-smart cocoa production while reducing deforestation and forest degradation. If farmers lack sufficient labour to implement recommended practices such as shade management, pruning, and sustainable land-use management, the achievement of Ghana's REDD+ commitments and Nationally Determined Contributions (NDCs) under the Paris Agreement may be undermined.

Conclusion

This study provides important insights into how labour dynamics shape the sustainability and productivity of cocoa production systems in landscapes where agriculture coexists with extractive activities. The findings demonstrate that labour scarcity, especially in mining-affected communities, has significant implications for cocoa farm productivity, labour costs, and farm management practices. Farmers in such contexts face increasing competition for labour, leading to higher wage demands, delayed farm operations, and reduced implementation of key management practices such as weeding, pruning, and timely harvesting. These dynamics highlight how structural shifts in rural labour markets can directly influence the performance of smallholder agricultural systems. Beyond the local context, the study contributes to broader global discussions on agricultural labour shortages in smallholder farming systems, particularly in regions where alternative livelihood opportunities divert labour away from agriculture. The findings therefore reinforce the relevance of Labour Market Segmentation Theory in explaining how competing economic sectors reshape rural labour allocation and influence agricultural productivity outcomes in resource-dependent economies.

The study also shows the need for integrated rural development strategies that address labour market distortions within cocoa-growing landscapes. Strengthening agricultural labour supply through youth engagement, labour-saving technologies, and improved mechanization services could help reduce production constraints faced by smallholder farmers. In addition, promoting alternative livelihood strategies that complement rather than compete with cocoa farming can help diversify rural incomes while maintaining labour availability for agriculture. Such interventions are important for achieving the

goals of climate and sustainability initiatives such as the Ghana Cocoa Forest REDD+ Programme (GCFRP), which rely on the consistent implementation of labour-intensive farm management practices. The study further advances the application of labour market perspectives within agricultural and environmental governance research by demonstrating how labour segmentation influences not only economic outcomes but also the feasibility of sustainability transitions in commodity production systems. Addressing labour scarcity in cocoa landscapes will therefore be essential for enhancing farmer livelihoods, maintaining global cocoa supply chains, and supporting broader climate and forest conservation commitments within tropical agricultural regions.

Declarations

Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Ethical Consideration and Human Consent

Ethical approval was obtained from the Review Board of the Department of Silviculture and Forest Management at Kwame Nkrumah University of Science and Technology (KNUST) in accordance with the ethical principles outlined in the Declaration of Helsinki and established guidelines for social science research involving human participants. Participation was voluntary, and respondents were informed of the study's purpose, with confidentiality, anonymity, and informed consent assured throughout the research process.

Data Availability

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

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Author Contributions

Prince Owusu: Conceptualization, Methodology, Formal analysis and investigation, Writing – original draft preparation

Lawrence Damnyag: Methodology, Writing – review and editing

Joana Akua Serwaa Ameyaw: Methodology, Writing – review and editing

Michael Ansong: Formal analysis and investigation, Writing – review and editing

Isaac Nunoo: Writing – review and editing

Mike Sefa Boachie: Formal analysis and investigation, Writing – review and editing

Leonard Akutu: Writing – review and editing

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Figures

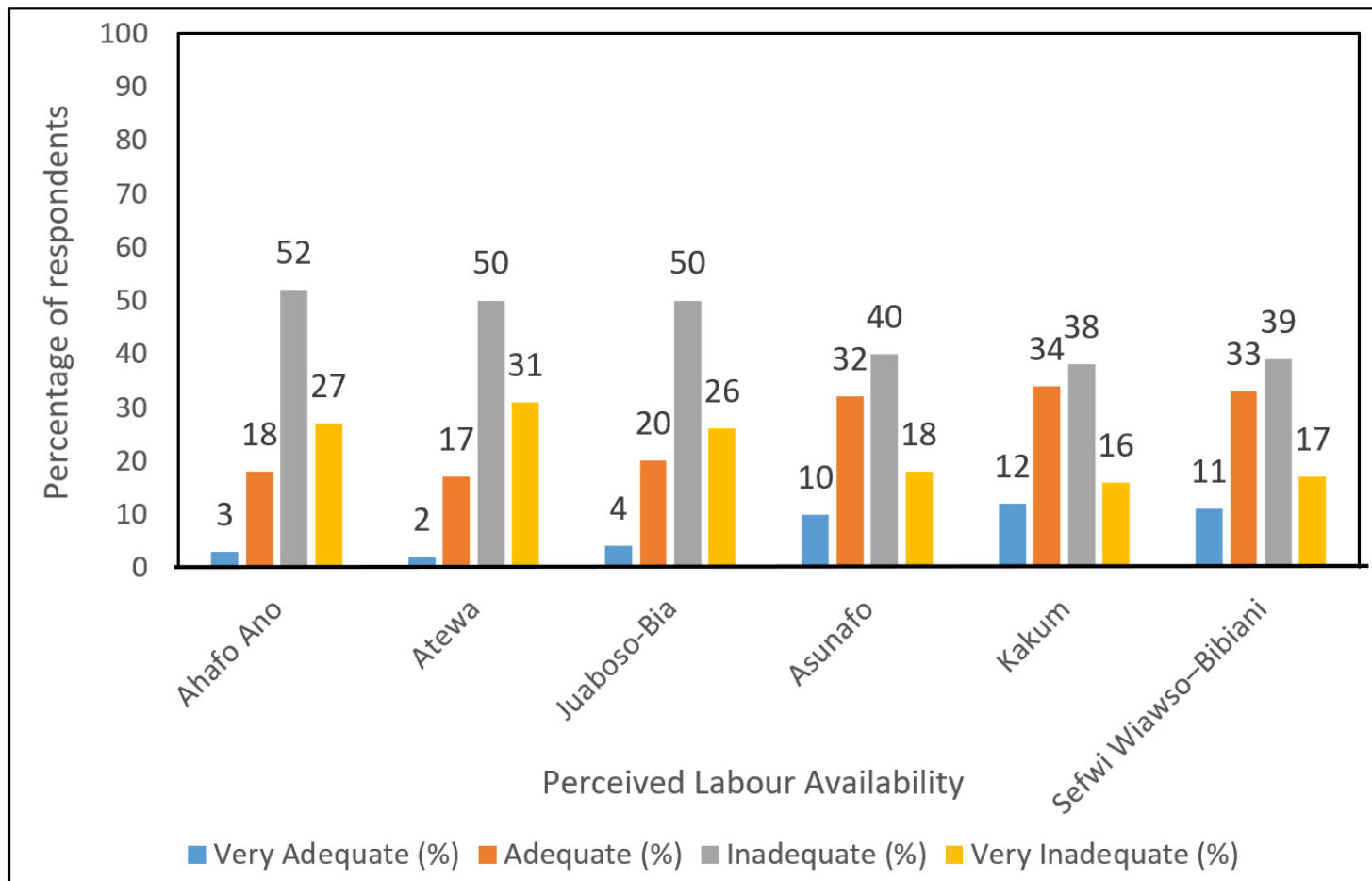


Figure 2

Perceived Labour Availability for Cocoa Farming by Respondents within GCFRP HIA

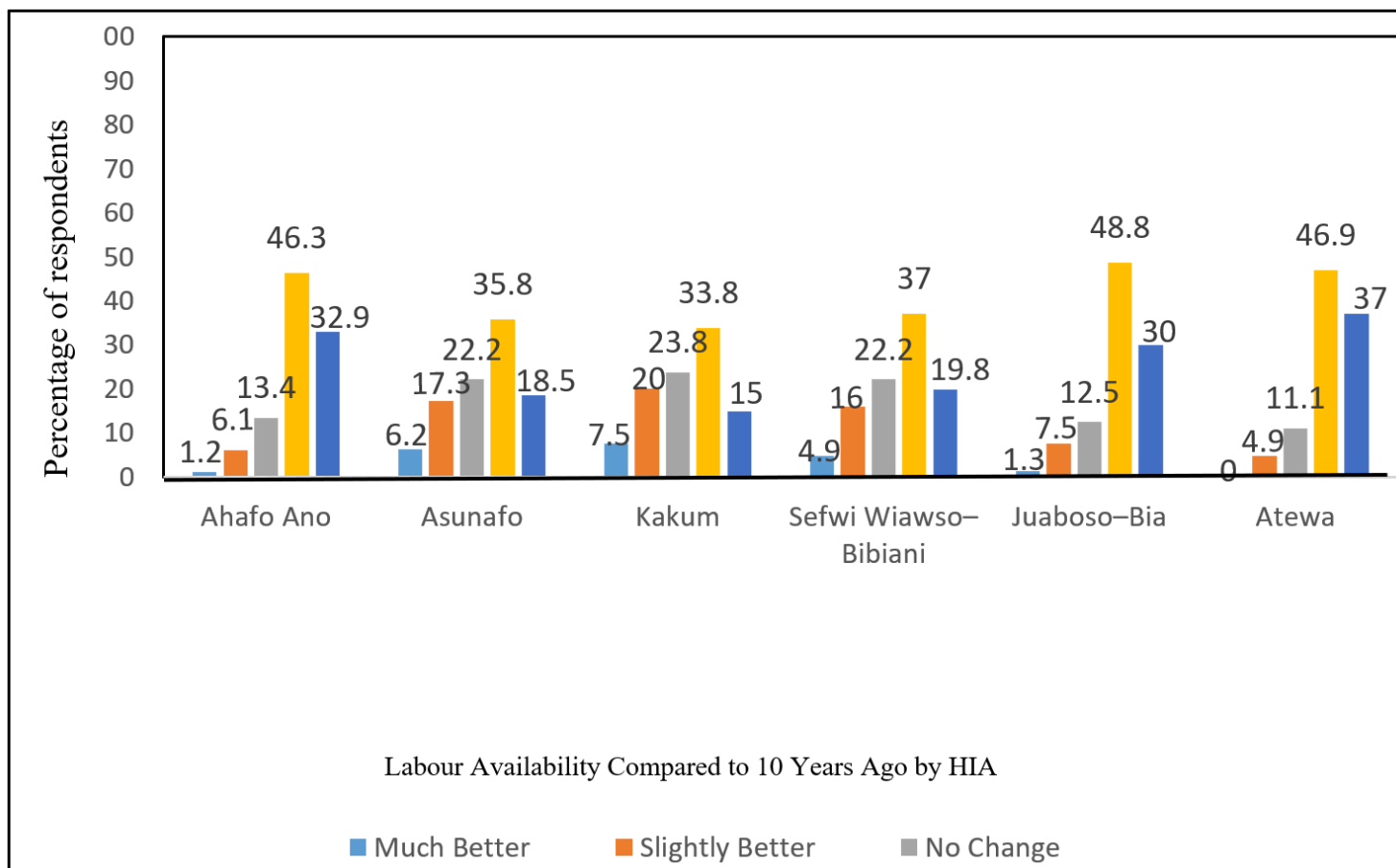


Figure 3

Perceptions on Labour Availability Compared to 10 Years Ago by GCFRP HIA

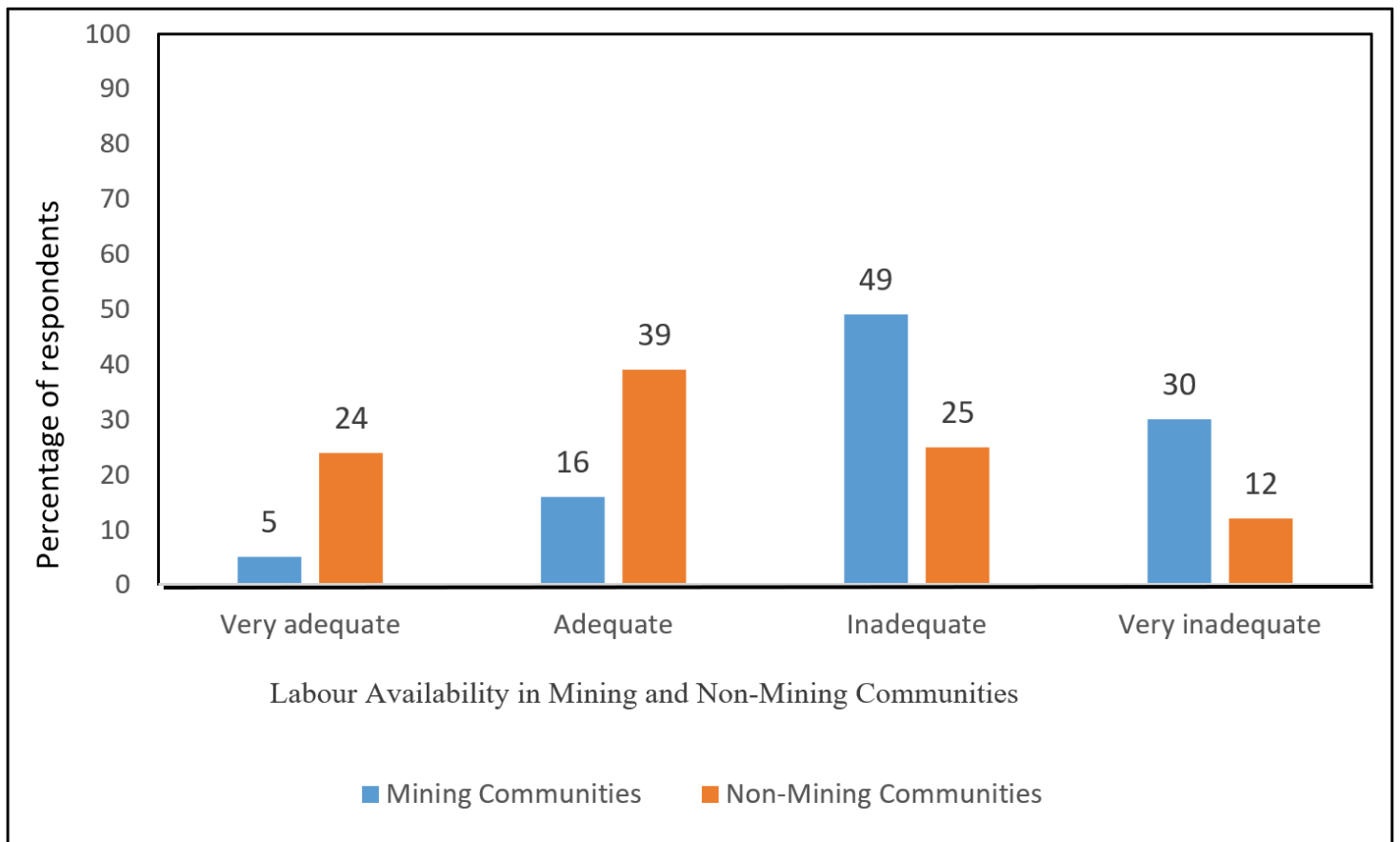


Figure 4

Labour Availability in Mining and Non-Mining Communities

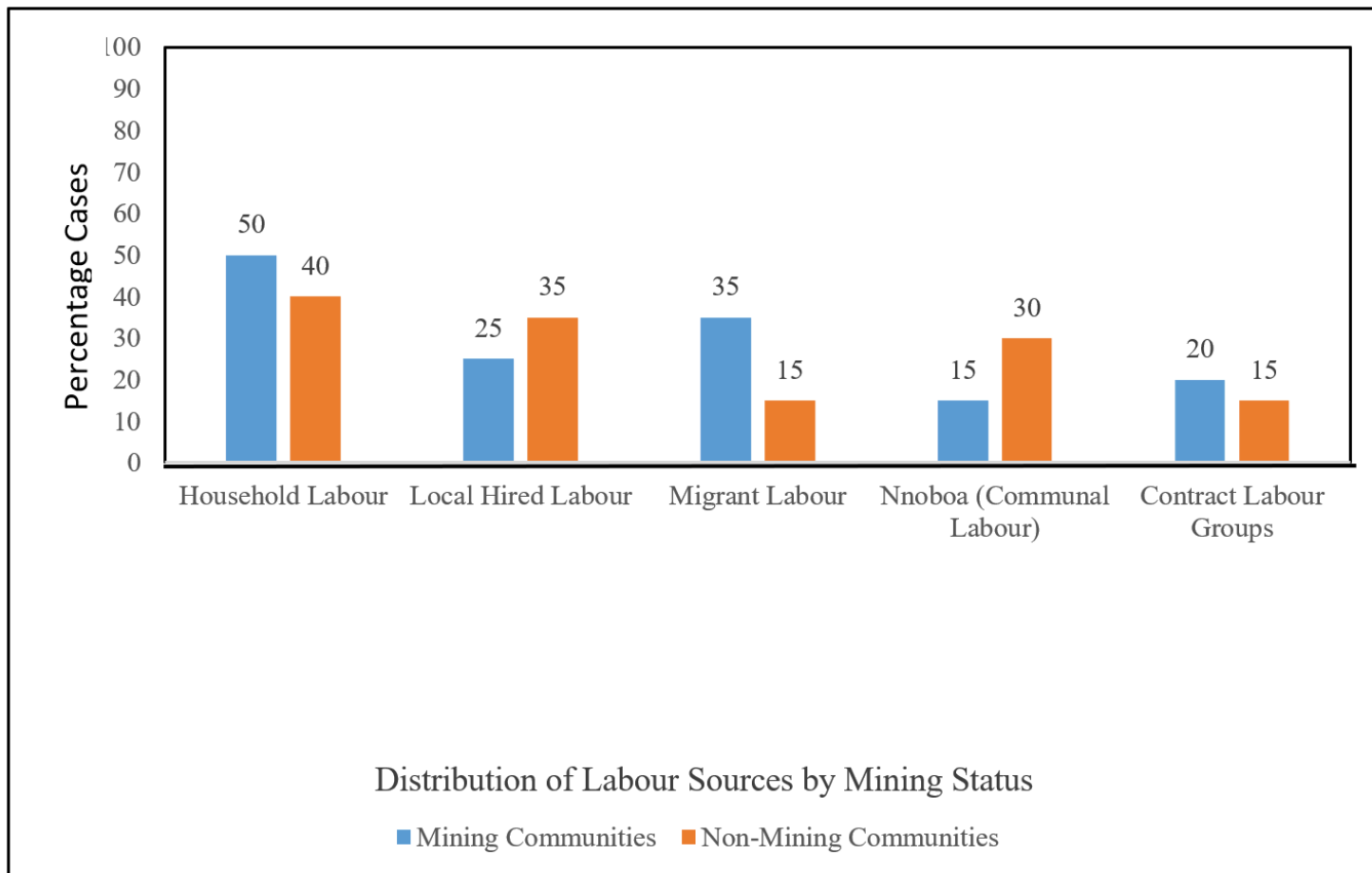


Figure 5

Sources of Labour by Community Mining Status

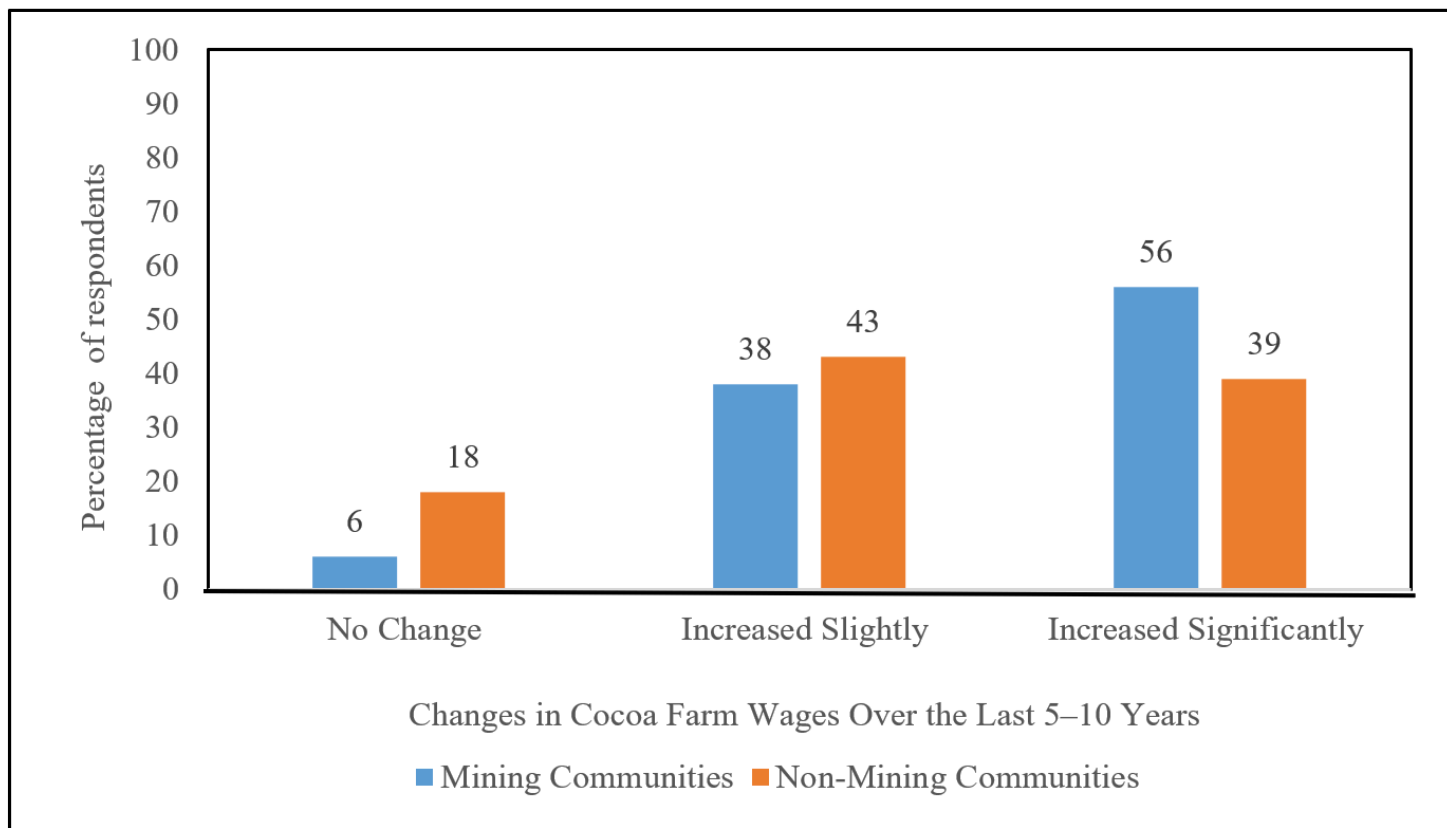


Figure 6

Changes in Cocoa Farm Wages Over the Last 5–10 Years

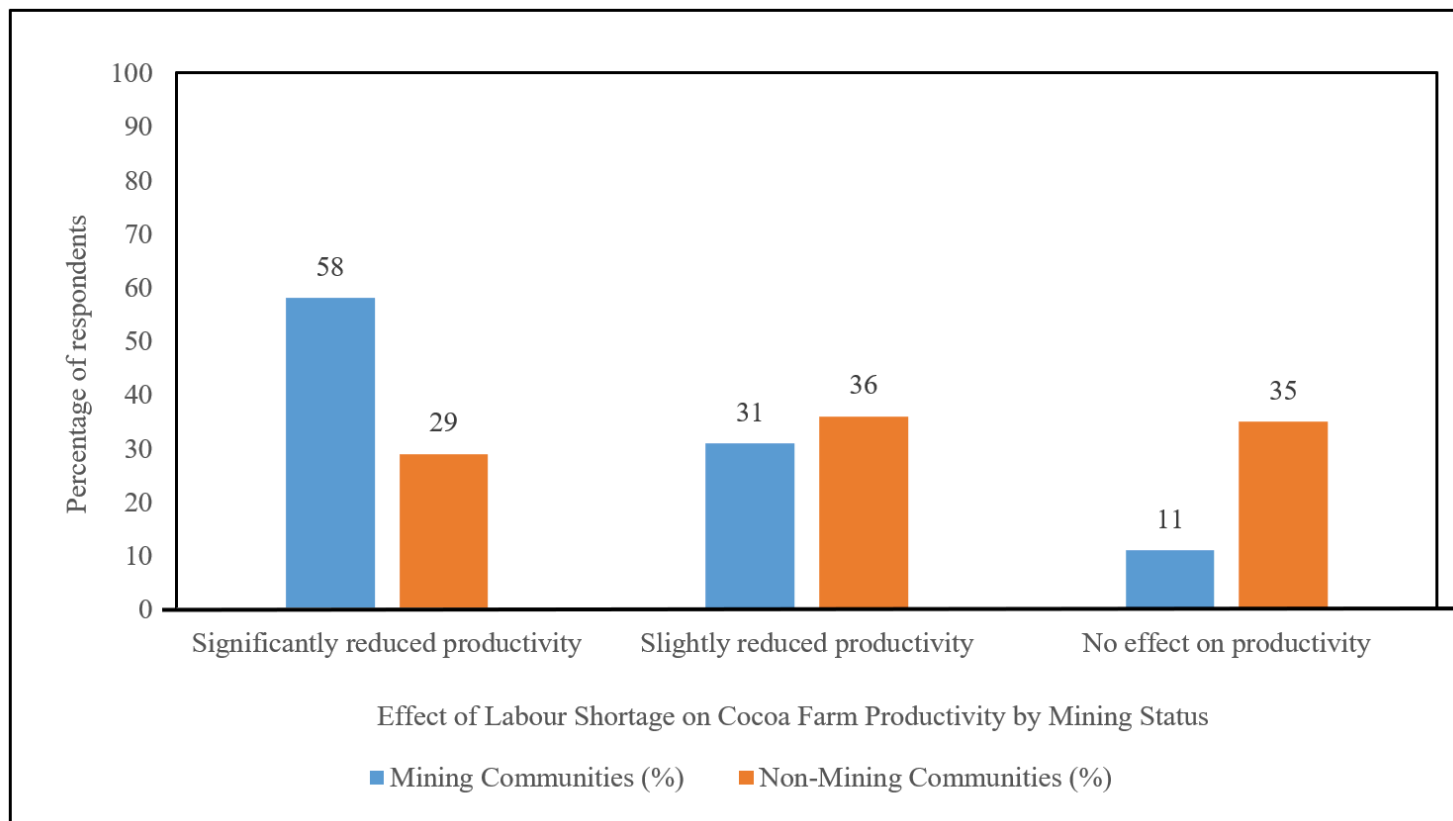


Figure 7

Effect of Labour Shortage on Cocoa Farm Productivity

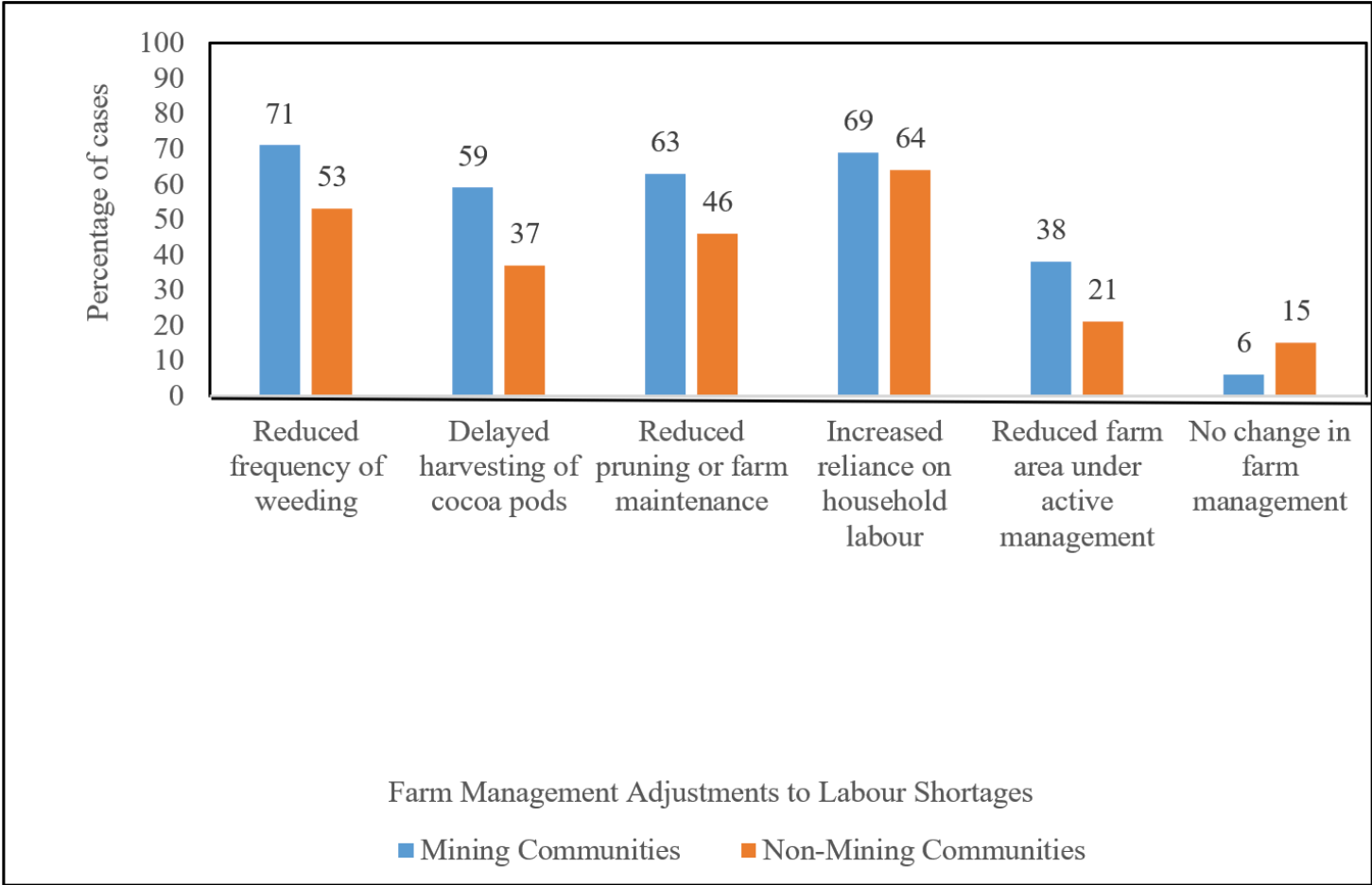


Figure 8

Farm Management Adjustments to Labour Shortages by Mining Status

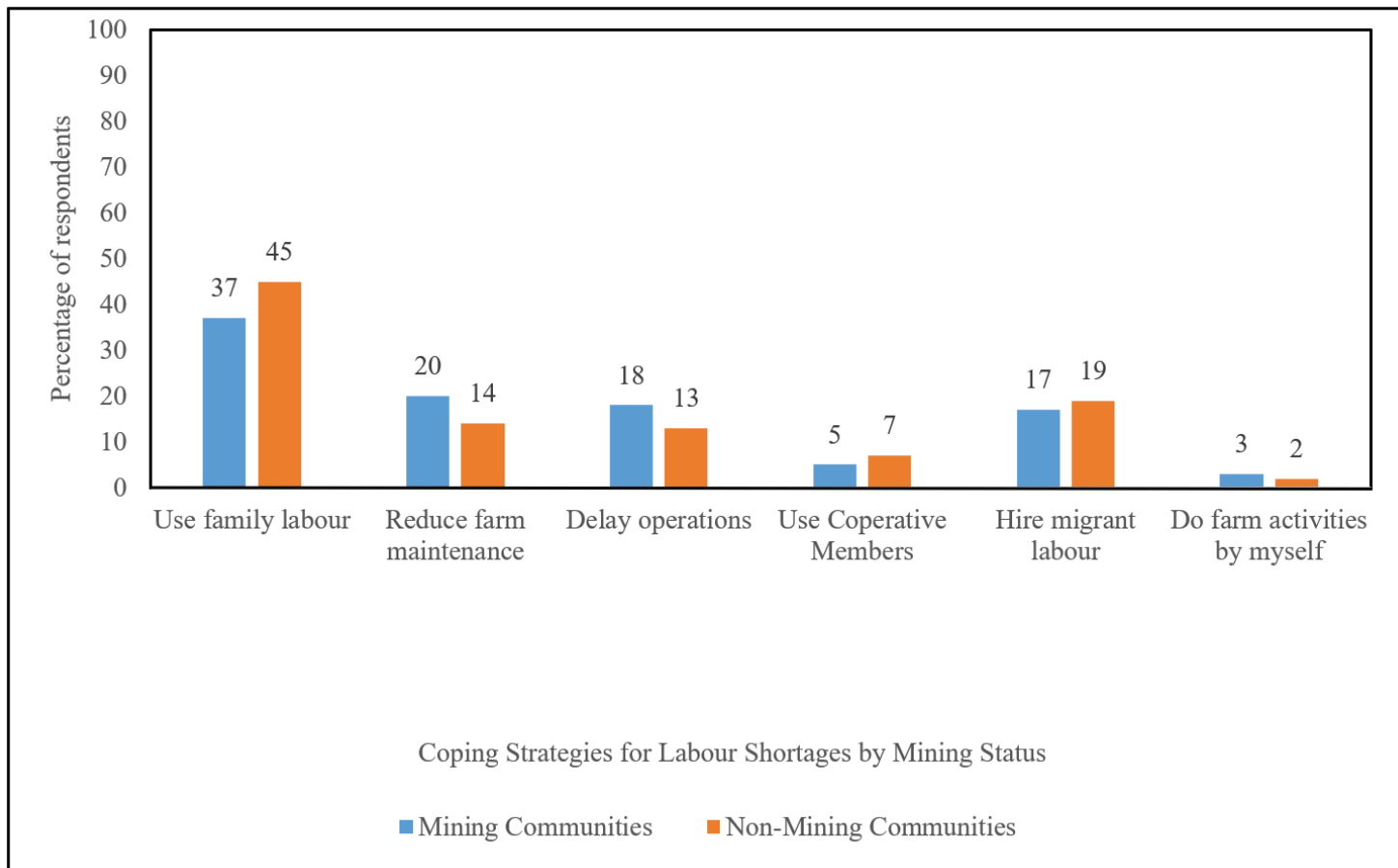


Figure 9

Coping Strategies for Labour Shortages by Mining Status