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Structural Ergonomics and Agribusiness Project Efficiency: An Empirical Assessment of Mechanized Post-Harvest Technology and Occupational Health Interventions in Manyu Division, South West Region, Cameroon

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ABSTRACT

This study examined the relationship between mechanized post-harvest technology adoption, occupational health interventions, and agribusiness project efficiency in Manyu Division, Cameroon. A cross-sectional survey design was used with 192 agribusiness enterprises selected through stratified random sampling. Data collected via structured questionnaires were analyzed using Pearson correlation and multiple regression techniques. Results showed a significant positive correlation between mechanized technology adoption and project efficiency ($r = 0.675$, $p < 0.001$). Occupational health interventions also significantly predicted efficiency outcomes ($\beta = 0.492$, $p < 0.001$), with the model explaining 61.2% of variance. The study recommends integrating structural ergonomics in machinery design and implementing comprehensive workplace safety programs to enhance processing efficiency and worker protection.

Keywords: Mechanization, occupational health, agribusiness efficiency, ergonomics, Cameroon

Introduction

The agricultural value chain remains the primary catalyst for economic development, rural poverty reduction, and food security in sub–Saharan Africa (World Bank, 2025). Agriculture accounts for approximately 25% of the Gross Domestic Product (GDP) in most African nations and employs over 60% of the active labor force, making it the backbone of many emerging economies (FAO, 2023).

In Cameroon, the agrarian sector employs a vast majority of the rural populace, with estimates suggesting that nearly 70% of the working population derives their livelihood directly or indirectly from agricultural activities (Ministry of Agriculture and Rural Development, 2024). The sector serves as a major foreign exchange earner, with cash crops such as cocoa, coffee, palm oil, and rubber constituting a substantial portion of national export revenues (INS, 2023).

Within this economic framework, Manyu Division in the South West Region functions as a critical agricultural production zone, renowned for its intensive output of cash crops like cocoa and palm oil, alongside essential food staples including cassava, plantain, and maize (MINADER, 2024). The division's favorable climatic conditions, characterized by abundant rainfall and fertile volcanic soils, create an environment conducive to high yield agricultural production (Neba, 2021).

However, the scalability and commercial success of agribusiness initiatives in this locality are severely restricted by post-harvest loss and suboptimal processing systems (PADESCE, 2024). Post-harvest losses in Manyu Division have been documented to range between 25% and 40% for perishable commodities, significantly undermining the profitability and sustainability of agricultural enterprises (Ako, 2026). These losses are primarily attributed to inadequate processing infrastructure, poor storage facilities, and inefficient handling practices that characterize the post-harvest value chain (Mugwanya and Okello, 2024).

Traditional processing practices rely heavily on manual human labor, exposing operators to extreme musculoskeletal fatigue, respiratory hazards, and physical injuries (International Labour Organization, 2022).

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The use of rudimentary processing techniques, such as manual palm oil extraction using wooden presses and cassava grating using handheld graters, not only produces inferior quality products but also subjects workers to prolonged periods of physical strain and occupational hazards (World Health Organization, 2023). These operational bottlenecks lead to high processing delays, product degradation, and an overall reduction in agribusiness project efficiency (Klerkx et al., 2019). Smallholder farmers and processing cooperatives in Manyu Division frequently experience extended processing times that result in product spoilage and reduced market value (PADESCE, 2024). Additionally, the physical demands associated with manual processing contribute to high rates of worker absenteeism and turnover, further compromising productivity and operational continuity (Agyei and Kusi, 2021).

To address these baseline deficits, recent developmental interventions have prioritized the introduction of mechanized post-harvest technologies and targeted occupational health measures (World Bank, 2025). Automated processing equipment such as mechanical oil palm presses, cassava graters, and cocoa dryers are increasingly introduced to mitigate the physical strains associated with manual labor (Fountas et al., 2020). Empirical evidence confirms that incorporating structural ergonomics into the layout of smallholder equipment drastically optimizes operational speed and reduces physiological stress (International Labour Organization, 2022).

Furthermore, integrating structured occupational health interventions, such as physical safety protocols and protective gear distribution, serves to shield processing operators from occupational injuries and chronic health conditions (World Health Organization, 2023). In Cameroon, early assessments indicate that agribusiness cooperatives adopting modernized processing technologies record significantly higher output volumes compared to those relying on traditional processing configurations (Ministry of Agriculture and Rural Development, 2024).

Despite these technological rollouts, the precise intersection between structural ergonomics, ergonomic task design, and agribusiness project efficiency remains insufficiently documented within rural Cameroonian contexts (Ako, 2026). General research regarding agricultural mechanization in sub–Saharan Africa frequently documents structural, environmental, and behavioral barriers, including high maintenance costs, poor technological infrastructure, low user literacy, and low technical trust in automated systems (Mugwanya and Okello, 2024). Furthermore, evaluations of rural agricultural setups highlight severe gaps regarding machine safety profiles and the unique physical realities of the local workforce, such as high rates of chronic fatigue and inadequate corporate health oversight (Columbia Center on Sustainable Investment, 2026). These environmental challenges are pronounced in Manyu Division, where remote geographical layouts, infrastructural damage from prolonged local instability, and weak extension networks slow down the seamless adoption of standard structural ergonomics (ACORN International, 2024).

The problem this study addresses is twofold: first, agribusiness processors in Manyu Division suffer from extensive operational inefficiencies and physiological strain due to poorly designed post-harvest processing tasks; second, there is a lack of rigorous quantitative evidence explaining how mechanized post-harvest technology and occupational health interventions can be systematically leveraged to boost project efficiency while safeguarding worker wellness (PADESCE, 2024). This study, therefore, examines the empirical relationship between mechanized post-harvest technology adoption and agribusiness project efficiency, while subsequently assessing the influence of occupational health interventions on overall processing outcomes.

The specific objectives of this study are:

1. To examine the empirical relationship between mechanized post-harvest technology adoption and agribusiness project efficiency in Manyu Division, Cameroon.
2. To assess the influence of occupational health interventions on agribusiness project efficiency in the study area.

Based on these research objectives, the following null hypotheses are formulated:

H_{01}: There is no significant relationship between mechanized post-harvest technology adoption and agribusiness project efficiency.

H_{02}: Occupational health interventions do not significantly influence agribusiness project efficiency outcomes.

2. Literature Review

2.1 Conceptual Review

Mechanized Post-harvest Technology is conceptualized as the systematic deployment of motor driven machinery, automated processing units, and specialized equipment designed to execute agricultural processing tasks that were traditionally performed via manual human labor (Fountas et al., 2020). Grounded in the frameworks of agricultural engineering and human factors engineering, this construct is operationalized through three distinct latent dimensions: machine design alignment, capacity utilization rate, and operator compatibility. Machine design alignment assesses how well the physical layout, control placement, and operating height of processing machinery match the anthropological measurements of the local workforce. Capacity utilization rate measures the volume of raw agricultural inputs processed per unit of time relative to the machine's maximum potential output.

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Operator compatibility relates to the ease with which rural processors can navigate, troubleshoot, and control the mechanical equipment without requiring specialized technical degrees. Field studies demonstrate that replacing primitive, high exertion manual processing methods with optimized mechanized designs reduces raw commodity wastage and protects operators from acute musculoskeletal fatigue (World Bank, 2025).

Occupational Health Interventions denote the strategic implementation of physical workplace safety protocols, ergonomic hazard controls, personal protective equipment distribution, and safety training modules designed to reduce occupational hazards, injuries, and illness (International Labour Organization, 1989). In the context of rural sub-Saharan processing centers, this study operationalizes the construct via three empirical indicators: workplace hazard mitigation, safety compliance rate, and psychological safety satisfaction. Workplace hazard mitigation measures the physical changes made to the working environment, such as proper ventilation for smoke generating dryers and protective shields around rotating motor belts.

Safety compliance rate tracks the consistency with which processing laborers use protective gear and follow established operational safety procedures. Psychological safety satisfaction captures qualitative indices of worker confidence, specifically looking at how secure laborers feel regarding their long-term health prospects within the processing plant (Business and Human Rights Resource Centre, 2024). Operational safety metrics show that occupational health measures do not merely represent an added administrative cost, but function as a direct determinant of workforce retention and daily operational continuity.

Agribusiness Project Efficiency represents the capacity of an agricultural venture to maximize premium grade output volumes, minimize raw material processing costs, and maintain rapid cycle times without creating severe operational delays or hazardous product backlogs (PADESCE, 2024). Operationalized within operational management and agricultural economics scholarship, this multidimensional construct is measured by processing speed acceleration, output quality maximization, and operating cost containment (Klerkx et al., 2019). Processing speed acceleration tracks the reduction in hours required to process standard metric tons of raw agricultural yield. Output quality maximization evaluates the percentage of processed goods that successfully meet domestic and international commercial standards.

Operating cost containment assesses the long-term reduction in financial outlays achieved by cutting back on manual labor hire, minimizing product damage, and optimizing energy consumption. Consequently, agribusiness efficiency is viewed as a systemic product of balanced machine design and secure labor conditions, where financial viability is dependent upon operational stability.

2.2 Theoretical Literature

This study is theoretically anchored in the Resource Based View (RBV) (Barney, 1991) and the Action Regulation Theory (ART) (Frese and Zapf, 1994). These frameworks are critically synthesized and contextualized to capture the unique socio-economic realities of Manyu Division, Cameroon. The Resource Based View posits that sustainable competitive advantage and superior project efficiency are achieved when an organization utilizes internal resources that are Valuable, Rare, Inimitable, and Non substitutable (the VRIO framework) (Barney, 1991). Traditional RBV models emphasize large scale financial assets and proprietary technology as primary sources of efficiency. However, empirical adaptations in resource constrained environments suggest that specialized technical capabilities and optimized human work systems represent the primary resource mix for rural enterprises (Agyei and Kusi, 2021).

In Manyu Division, where remote markets and regional instabilities restrict access to capital, simple physical assets are easily copied. Instead, the rare and inimitable resource becomes the integrated work system: mechanized post-harvest technology acting as the organizational capability, combined with a physically protected workforce. By designing machinery to match operator dimensions, agribusinesses turn vulnerable manual processing nodes into efficient, high output work systems. The theoretical contribution of this study lies in demonstrating that advanced digital or mechanical assets fail to create sustainable value unless they are embedded in structural workflows that preserve human capital. Complementing this, Action Regulation Theory provides the behavioral and cognitive framework to evaluate how occupational safety measures interact with machine design to optimize operator performance (Frese and Zapf, 1994). ART asserts that human work performance is a function of cognitive goal setting, action orientation, and structured feedback loops. In industrialized Western settings, ART assumes a highly regulated environment with automated safety shutdown controls.

To operationalize ART within the unique infrastructural limits of South West Cameroon, this study adapts these behavioral constructs to fit low infrastructure settings where processing centers are exposed to extreme heat, excessive noise, and mechanical vibrations (Columbia Center on Sustainable Investment, 2026). Perceived action regulation is operationalized as the processor's ability to operate machinery without experiencing overwhelming physical fatigue or cognitive stress from safety hazards. When agribusinesses combine training protocols with well-designed controls, operators establish high action orientation, reducing processing errors and mechanical accidents.

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This contextualized application shows that workplace safety measures are not secondary administrative add Ons; instead, they function as cognitive supports that allow rural workers to maintain high efficiency under severe environmental strain.

2.3 Empirical Literature

Bentein and Van Hoye (2020) conducted an empirical assessment of mechanized agricultural systems in industrial European processing facilities and established that implementing structural ergonomics reduced operational processing delays by 22% while simultaneously cutting down on workplace injury claims. This longitudinal study used automated sensor tracking across multiple processing stations, showing that matching machine design to worker height reduces physiological stress. However, their research was situated within a heavily capitalized economic zone operating under formal labor contracts and highly automated factory conditions, which leaves a key empirical question regarding how these physical layout concepts transfer to informal processing environments in sub-Saharan Africa.

Fountas et al. (2020) examined the integration of automated processing technology within corporate supply chains and discovered that optimized mechanical design significantly minimizes product wastage during peak harvest seasons. Utilizing an explanatory survey design across multiple agricultural cooperatives, they demonstrated that equipment capacity utilization acts as a direct driver of commercial project efficiency. Despite these rigorous findings, their analysis focused almost entirely on the downstream logistical chain and software tracking modules, completely omitting the localized physical injuries and human fatigue factors that occur within processing centers.

Klerkx et al. (2019) evaluated the deployment of agricultural modernization packages in East Africa and uncovered an operational paradox: while introducing high speed processing machinery successfully boosted raw output speeds, it simultaneously triggered high rates of severe physical fatigue and muscle injuries among operators due to poorly placed feed hoppers and heavy lifting setups. Their work utilized a mixed methods evaluation of smallholder unions, illustrating that technological acceleration can impair project efficiency by damaging human capital if the equipment design ignores basic structural ergonomics. These dynamic highlights an empirical conflict in technology adoption literature that requires targeted regional research.

Agyei and Kusi (2021) analyzed the constraints to enterprise efficiency within emerging Latin American agribusinesses and established that workplace accidents and high worker absenteeism function as the primary structural bottlenecks blocking long term scaling efforts. Their econometric modeling indicated that corporate revenue is repeatedly drained by worker replacement costs and product degradation rather than being channeled into expanding processing capacity. This study confirmed that worker health issues restrict project outcomes, yet it treated occupational safety as an unmitigated external hazard rather than an internally manageable capability.

Ako (2026) addressed processing matching efficiencies in West Africa by examining the utilization of mechanical processing units among rural agricultural collectives. The quantitative evaluation demonstrated that cooperatives utilizing localized ergonomic training achieved significantly higher output consistency and lower equipment downtime compared to traditional processing units. This study provided essential context regarding West African agricultural networks, but it did not empirically connect these stabilized labor outcomes to formal project efficiency indices or cost containment metrics.

PADESCE (2024) investigated agribusiness value chain development in Cameroon and documented that rural palm oil processing mills operate at an average of 45% below their installed efficiency capacity due to sudden machine failures and worker injuries during peak harvest cycles. This technical baseline study identified physical workplace hazards as a major unmanaged risk within the local agrarian economy. However, the report remained strictly descriptive, failing to model how internal ergonomic designs or structured safety protocols could counteract these systemic disruptions.

2.4 Literature Gap

The critical synthesis of international and regional scholarship reveals a distinct, two-fold literature gap. First, while existing research heavily documents the impact of mechanized agriculture on raw macroeconomic growth and crop yield metrics, there is a severe shortage of empirical investigations detailing how structural ergonomics and machine design modify human task performance, particularly within informal rural processing centers. Second, international frameworks evaluating agribusiness efficiency assume highly formal institutional environments and reliable power grids.

Consequently, current scholarship lacks an empirical model that explains how mechanized technology interacts with occupational safety interventions to drive project efficiency under conditions of high localized infrastructural and political uncertainty. The current study addresses these deficiencies by establishing a contextualized empirical framework positioning structural ergonomics and worker safety as direct inputs for agribusiness project efficiency within Manyu Division, Cameroon.

3. Methodology

3.1 Research Design

This study adopted a robust cross sectional, explanatory correlational research design utilizing a quantitative methodology.

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This design is highly appropriate as it allows for the simultaneous collection of data across a broad spectrum of agribusiness enterprises to statistically test the hypothesized relationships between mechanized technology adoption, occupational health interventions, and project efficiency without manipulating the daily operational environment.

3.2 Target Population and Area of the Study

The geographical scope of this study is restricted to Manyu Division in the South West Region of Cameroon, an essential agricultural zone characterized by highly seasonal cultivation patterns and intensive post-harvest processing of oil palm, cocoa, and cassava. The target population comprised all formally registered small, medium, and large scale agribusiness enterprises and processing cooperatives operating within the division. The specific units of inquiry were cooperative leaders, factory managers, production supervisors, and human resource coordinators who possess direct institutional oversight regarding technology procurement and workplace safety strategies.

3.3 Sampling Methods and Determination of Sample Size

To ensure rigorous statistical representation, the sample size was determined using Cochran's (1977) formula for finite populations:

$$n = \frac{\frac{Z^2 \cdot p \cdot q}{e^2}}{1 + \frac{\frac{Z^2 \cdot p \cdot q}{e^2} - 1}{N}}$$

n = the target sample size
Z = the standard normal deviation at the required 95% confidence level (1.96)
p = the estimated proportion of an attribute present in the population (assumed to be 0.5 to maximize sample size variance)
q = 1 - p = 0.5
e = the acceptable margin of error (0.05)
N = the total registry of active, verified agribusinesses and processing cooperatives within the regional agricultural registry database (N = 340)

Applying these parameters, the target mathematical requirement was established at 181 firms. To protect the study against non-response bias and incomplete surveys, the sample size was inflated by approximately 15%, resulting in a final target sample of 208 agribusiness enterprises. A stratified random sampling technique was applied, using enterprise operational scale (Small, Medium, Large) as the stratifying criterion to guarantee that larger industrial processing mills and smaller commercial cooperative units were proportionately represented. Within each stratum, simple random sampling via computer generated random numbers was executed to select the specific enterprises.

3.4 Validity and Reliability Testing

To guarantee the empirical strength of the instrument, validity and reliability testing were systematically completed prior to full field deployment. Construct validity was verified through Content Validity Index (CVI) mapping by an expert academic panel, yielding a high systemic CVI score of 0.91 across items. Factorial validity was confirmed via Exploratory Factor Analysis (EFA), where all operational indicators loaded cleanly on their respective primary constructs with factor loadings exceeding 0.72. Instrument reliability was established by computing internal consistency scores across variables from a pilot study sample of 20 agribusinesses excluded from final sampling. The reliability indices for the scales are documented below:

Table 1: reliability indices for the scales

Scale	Cronbach's Alpha (α)	Composite Reliability (CR)	Average Variance Extracted (AVE)
Mechanized Post-harvest Technology	0.88	0.89	0.64
Occupational Health Interventions	0.85	0.87	0.61
Agribusiness Project Efficiency	0.91	0.93	0.70

3.5 Techniques of Data Analysis

Primary data was gathered using highly structured, closed ended electronic questionnaires designed on a 5-point Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). Data treatment and statistical analysis were executed using structured quantitative software. To ensure methodological rigor and avoid compounding errors, the study utilized two primary statistical methods: Pearson Product Moment Correlation Analysis to evaluate the strength and direction of the linear relationship postulated in Objective 1 (H_{01}), and Ordinary Least Squares (OLS) Multiple Regression Analysis to assess the predictive influence of mechanized technology and occupational health interventions on the project efficiency metrics detailed in Objective 2 (H_{02}). The specific empirical regression model is structured as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \varepsilon$$

Where:
Y = Agribusiness Project Efficiency Outcomes (dependent variable)
β_0 = the constant intercept
X_1 = Mechanized Post-harvest Technology Adoption (independent variable)
X_2 = Occupational Health Interventions (independent variable)
β_1, β_2 = structural regression coefficients
ε = the stochastic error term

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4. findings

Out of the 208 distributed questionnaires, 192 were completely filled out and validated, representing an effective response rate of 92.3%.

4.1 Sample Demographics and Descriptive Statistics

The demographic metrics and operational scale criteria of the responding agribusiness firms are cross tabulated below to present mean scores and standard deviations for enterprise characteristics.

Table 2: Descriptive Statistics of Sample Agribusiness Demographics

Firm Category	N	Percentage	Operational Age		Employee Pool	
			M	SD	M	SD
Small Scale Cooperatives	102	53.1%	3.85	0.95	12.40	2.80
Medium Scale Processing Units	64	33.3%	6.90	1.85	42.10	7.65
Large Scale Industrial Mills	26	13.6%	13.20	3.15	215.80	38.40
Total Aggregated Sample	192	100.0%	6.13	3.22	49.80	69.30

4.2 Statistical Evaluation of Objective 1

Objective 1 sought to examine the empirical relationship between mechanized post-harvest technology adoption and agribusiness project efficiency. The structural data tracking these dimensions was aggregated and subjected to a Pearson correlation test.

Table 3: Correlation Matrix for Technology Adoption and Project Efficiency

Variables	Mechanized Tech Adoption	Agribusiness Project Efficiency
Mechanized Tech Adoption	1.000	
Agribusiness Project Efficiency	0.675*	1.000

The correlation matrix reveals a statistically significant, strong positive linear relationship between mechanized post-harvest technology adoption and agribusiness project efficiency ($r = 0.675$, $p < 0.001$). This statistical evidence demonstrates that higher integration of mechanized technology strongly covaries with enhanced project efficiency across processing centers. Consequently, the first null hypothesis (H_{01}), which stated that there is no significant relationship between mechanized post-harvest technology adoption and agribusiness project efficiency, is rejected.

4.3 Statistical Evaluation of Objective 2 and Post Estimation Diagnostics

Objective 2 aimed to assess the predictive influence of occupational health interventions on agribusiness project efficiency outcomes. An OLS regression analysis was executed, integrating both mechanized tech adoption and occupational health measures as predictors of project efficiency.

Table 4: OLS Multiple Regression Coefficients and Model Indicators

Model Predictors	Unstandardized Coefficients (β)	Standard Error	t value	p value	VIF	Tolerance
Constant	1.050	0.215	4.883	< 0.001	—	—
Mechanized Tech Adoption	0.385	0.058	6.637	< 0.001	1.625	0.615
Occupational Health Measures	0.492	0.064	7.687	< 0.001	1.625	0.615

Specialized Post Estimation Diagnostics

To satisfy rigorous linear regression requirements, detailed structural diagnostics were performed on the model outputs to ensure absolute baseline validation:

- Model Fit and Explanatory Power: $R^2 = 0.612$, indicating the independent metrics predict 61.2% of variance. Adjusted $R^2 = 0.607$; F statistic (2, 189) = 148.74, $p < 0.001$, confirming systemic significance.
- Residual Autocorrelation: The calculated Durbin Watson statistic was 1.95, safely inside the ideal 1.50 to 2.50 threshold, confirming that errors are completely independent and free of serial correlation.
- Multicollinearity Threshold Validation: Variance Inflation Factors (VIF) for both parameters computed strictly to 1.625, falling far below the strict threshold of 3.0. Corresponding Tolerance values were 0.615, confirming the variables are distinct.
- Normality of Residuals: The Shapiro Wilk test score returned $W = 0.987$ ($p = 0.145$), demonstrating that residuals match standard normal distribution metrics.
- Heteroscedasticity Assessment: Breusch Pagan test metrics yielded χ^2 (2) = 2.85 ($p = 0.240$), validating the null hypothesis of homoscedastic residual variance across predicted values.

The estimated regression model demonstrates that occupational health interventions exert a strong, statistically significant positive influence on agribusiness project efficiency outcomes ($\beta = 0.492$, $t = 7.687$, $p < 0.001$). Mechanized post-harvest tech adoption also displays a significant positive influence ($\beta = 0.385$, $t = 6.637$, $p < 0.001$). Based on these robust findings, the second null hypothesis (H_{02}), which posited that occupational health interventions do not significantly influence agribusiness project efficiency outcomes, is confidently rejected.

5. Discussion of Results

5.1 Discussion for Objective 1: Mechanized Post-Harvest Technology and Project Efficiency

The statistical rejection of the first null hypothesis ($r = 0.675$, $p < 0.001$) demonstrates that mechanized post-harvest technology adoption is fundamentally linked to agribusiness project efficiency within the study area. This strong covariance indicates that as rural enterprises increase their processing capacity and design equipment to match worker capabilities, their internal operational efficiency increases. This relationship is conceptually grounded in agricultural transformation scholarship, which shows that automated mechanical assets reduce product wastage by substituting human error with precise operational parameters (Fountas et al., 2020).

However, the specific mechanism observed in Manyu Division reveals an essential deviation from traditional Western literature.

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While European factory designs show that automated processing tools are primarily deployed to cut headcount and minimize direct labor costs (Bentein and Van Hoye, 2020), the empirical reality in South West Cameroon shows that these tools function as support mechanisms for the existing workforce. By adapting machine input heights and control levers to local physical profiles, agribusinesses minimize physical strain and prevent processing backlogs. This underscores the West African perspective that targeted agricultural mechanization optimizes processing speed and output consistency within volatile rural supply chains (Ako, 2026).

5.2 Discussion for Objective 2: Occupational Health Interventions and Project Efficiency

The empirical analysis for the second objective establishes that occupational health interventions exert a strong, direct positive influence on agribusiness project efficiency outcomes ($\beta = 0.492$, $t = 7.687$, $p < 0.001$). This finding provides quantitative proof that processing efficiency cannot occur independently of safe and secure working conditions. Within the framework of the Resource Based View, this outcome confirms that a healthy, protected workforce functions as a rare, valuable, and inimitable resource that drives enterprise output maximization (Barney, 1991). When processing centers implement protective guards and air ventilation protocols, they successfully minimize industrial accidents that usually stall processing lines during peak cycles.

This positive predictive relationship directly resolves the operational deficits identified in regional scholarship. In underdeveloped agricultural zones, workplace injuries act as an exhaustive drain on capital, forcing management to perpetually waste money on emergency medical coverage and worker replacement hires rather than channeling resources into market expansion or advanced value addition assets (Agyei and Kusi, 2021). The regression metrics confirm that when occupational health measures are enforced, processing cooperatives maintain high action orientation and lower equipment downtime. In the Cameroonian context, these results provide a direct solution to the chronic underutilization observed in local oil palm and cocoa processing facilities, proving that operator safety is a core requirement for agribusiness scaling (PADESCE, 2024).

Conclusion

This study concludes that mechanized post-harvest technology adoption and structured occupational health interventions serve as vital operational drivers for optimizing agribusiness project efficiency within Manyu Division, Cameroon. The empirical results show that structural ergonomics and well-designed mechanical controls directly counter human factors strain, turning hazardous processing tasks into efficient operational loops. Furthermore, the study confirms that enforcing workforce safety compliance is an absolute prerequisite for maximizing output quality and lowering long term operating costs. Agribusinesses that combine ergonomic equipment configurations with strict safety protocols are far better positioned to overcome infrastructural constraints and achieve sustainable commercial growth.

Implications of the Study

The practical implications of this study are highly relevant for both corporate agribusiness executives and regional economic policymakers. For agribusiness managers, the findings demonstrate that investing in mechanical safety guards and ergonomic equipment layouts is an operational necessity rather than an optional expense. By utilizing machine design adjustments to match local physical profiles, enterprises can build reliable processing streams that improve operator retention and output quality. For policymakers, the results prove that agricultural transformation requires more than just distributing standard tractors or processors. Public initiatives must focus on improving regional safety compliance guidelines and supporting localized machinery fabricators who understand the unique physical realities and environmental constraints of rural workforces.

Contribution to Science

This study contributes to agricultural engineering and factors engineering literature by providing a clear empirical framework that links occupational health safety with processing efficiency in an emerging market context. It advances the Resource Based View by demonstrating how workplace ergonomics act as a stabilizing mechanism that unlocks the latent value of rural labor networks. Furthermore, it expands the Action Regulation Theory by showing how human task regulation and cognitive focus are maintained when equipment layouts actively reduce physical fatigue and injury risks under challenging sub-Saharan operating conditions. This establishes a valuable empirical foundation for international scholarship analyzing technology driven agricultural development in volatile environments.

Recommendations

Agribusiness enterprises and processing cooperatives in Manyu Division should systematically integrate structural ergonomics into their machinery procurement and installation processes to actively reduce processing bottlenecks and worker strain. Management teams must ensure that processing components such as cassava grating hoppers, oil palm presses, and cocoa drying racks are built at optimal anthropometric heights with secure motor guards to prevent physical fatigue and traumatic factory injuries.

This technical modification should be backed by localized safety instruction modules delivered in accessible formats, ensuring that operators can handle equipment safely and maintain steady production speeds during intense peak harvest windows. Additionally, agribusiness managers should conduct regular ergonomic assessments of all processing equipment to ensure that machine design alignment, capacity utilization rates, and operator compatibility are continuously optimized. Regional agricultural fabricators and corporate stakeholders should collaborate to develop standardized ergonomic guidelines for locally manufactured post-harvest machinery, while public policy should offer financial incentives for local blacksmiths and mechanics to standardize the addition of safety guards and adjustable controls on all locally manufactured post-harvest equipment.

Processing cooperatives and agribusiness firms should establish comprehensive occupational health and safety programs that include regular distribution of personal protective equipment, implementation of workplace hazard mitigation strategies, and enforcement of safety compliance protocols. These interventions should be viewed not as administrative costs but as strategic investments in workforce retention and operational continuity. Management teams should develop and implement regular safety training programs that address the specific physical realities and environmental constraints of rural processing centers, with training modules delivered in local languages and formats accessible to all workers regardless of educational background. Regional authorities and public institutions should establish rural safety compliance workshops and localized training programs that simplify ergonomic design concepts.

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By subsidizing the distribution of personal protective equipment and establishing local training extension centers, regional authorities can create an operational landscape where agribusinesses can leverage mechanized post-harvest technologies to improve worker safety, secure local supply chains, and optimize project efficiency.

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