Scripta Economica:
Journal of Economics, Management, and Accounting
Vol 2 No 2 November 2026, Hal 118-132
ISSN: 3110-0848 (Print) ISSN: 3109-970X (Electronic)
Open Access: https://scriptaintelektual.com/scripta-economica

Short-Run Production Theory and Labor Efficiency in Purbalingga's False-Eyelash Industry

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Article Info :
Received:
16-10-2026
Revised:
26-10-2025
Accepted:
02-11-2026

Abstract

The false-eyelash industry in Purbalingga Regency represents a labor-intensive manufacturing sector in which productivity depends on workforce utilization and production capacity. This study aimed to examine the application of short-run production theory to labor efficiency and productivity, emphasizing the relationships among Total Product (TP), Average Product (AP), Marginal Product (MP), and diminishing marginal returns. A descriptive qualitative literature review was conducted using journal articles and academic conference proceedings addressing production theory, technical efficiency, labor productivity, manufacturing operations, and employment conditions. Sources were selected according to topical relevance, identifiable publication information, and verifiable academic content. The literature was analyzed through thematic classification, methodological comparison, and conceptual synthesis. The findings established that labor productivity and technical efficiency represent distinct performance dimensions and cannot be interpreted interchangeably. Workforce expansion may increase aggregate output, but its marginal contribution depends on equipment capacity, raw-material availability, employee capabilities, working conditions, and production coordination. The synthesis also identified limitations in existing evidence concerning firm-level marginal productivity and optimal workforce allocation. The study contributes an integrated conceptual framework for interpreting labor utilization under short-run production constraints. Empirical assessment requires comparable observations of output, labor input, working hours, equipment utilization, and material consumption.

Keywords: false-eyelash industry, labor efficiency, labor productivity, Purbalingga, short-run production theory

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INTRODUCTION

The false-eyelash industry in Purbalingga Regency, Central Java, represents a labor-intensive manufacturing activity whose economic significance extends beyond production output to employment continuity, household income, and the organization of local industrial work. Its dependence on manual operations creates a production environment in which workforce allocation, equipment availability, material supply, and workflow coordination may influence the relationship between labor input and manufactured output. Syafiq and Haryanti (2022) examined the institutional arrangements supporting industrial continuity in Purbalingga, while Satria (2025) situated employment in the false-eyelash and hairpiece industries within broader conditions of labor precarity and social risk. These concerns are particularly relevant to short-run production decisions, where enterprises may adjust labor utilization without immediately expanding machinery, workspace, or other relatively fixed productive resources. The distinction between variable and fixed inputs is fundamental because increasing employment does not necessarily generate proportional output growth when production capacity remains constrained, as explained through short-run production functions and Cobb–Douglas-based analyses (Damayanti & Kurniati, 2024; NingTyas et al., 2025). Developments in manufacturing research have further emphasized the relationships among technological organization, labor productivity, and resource efficiency, indicating that workforce performance cannot be assessed independently of the production systems in which employees operate (Dinlersoz & Wolf, 2024; Zhu, M., et al., 2024). The central economic issue for Purbalingga's false-eyelash industry is consequently not limited to the availability of labor but concerns how variable

labor inputs interact with constrained productive capacity and whether existing production arrangements support efficient utilization of available resources.

The existing literature provides three complementary approaches to understanding industrial efficiency: production-frontier analysis, labor-productivity assessment, and operational examination of manufacturing processes. Research directly addressing Purbalingga has investigated technical efficiency through stochastic frontier analysis, identifying production-input combinations as a central analytical concern, whereas studies of labor productivity have examined worker characteristics, compensation, discipline, motivation, and organizational conditions (Amaliyah et al., 2022; Rakhmawati & Karsinah, 2021; Fauziah et al., 2023; Filani et al., 2024; Finissa et al., 2024). Comparable research in Indonesian manufacturing has extended the analysis toward industrial openness, foreign investment, research and development, and technological heterogeneity, demonstrating the diversity of mechanisms through which productive performance can be examined (Sugiharti et al., 2022; Yasin, 2022, 2024; Yasin & Sari, 2022). At the sectoral level, studies of garment manufacturing have emphasized production-line balancing, workflow information, lean manufacturing, and physical workplace conditions as operational dimensions of productivity improvement (Jung et al., 2024; Sarnadi & Sulistyowati, 2024; Teshome et al., 2024). Research on technological innovation efficiency in textile and apparel enterprises similarly distinguishes organizational and technological capabilities from conventional assessments of labor output (Chen & Chen, 2024; Zhu, X., et al., 2022). Broader studies of productivity and firm performance indicate that efficiency is sensitive to industrial characteristics, resource allocation, ownership conditions, market exposure, and analytical measurement choices rather than being reducible to a single labor-related determinant (Afin et al., 2025; Geylani, 2024; Yasin, 2023). Taken together, these research streams establish a substantial basis for analyzing labor efficiency, although their different units of observation and measurement frameworks require careful conceptual separation before their findings can be applied to Purbalingga's false-eyelash production activities.

The principal research gap lies in the limited integration of short-run production theory with the heterogeneous evidence on technical efficiency, worker productivity, and operational constraints in Purbalingga's false-eyelash industry. Local studies have established several relevant analytical dimensions, including technical efficiency, productivity determinants, and worker-level performance, but their respective indicators do not directly explain how Total Product (TP), Average Product (AP), and Marginal Product (MP) should be interpreted jointly under fixed-input constraints (Amaliyah et al., 2022; Rakhmawati & Karsinah, 2021; Widyawati & Adrianto, 2026). Research on women workers in related hairpiece production and studies of compensation, skills, and workplace conditions provide evidence concerning labor-related determinants, yet their analytical emphasis differs from the marginal input–output relationships central to short-run production theory (Aisyah & Oktavilia, 2020; Fauziah et al., 2023; Finissa et al., 2024). A comparable distinction arises in studies of industrial efficiency and productivity in Indonesian micro and small enterprises and East Java manufacturing, where broader industrial measurements cannot be transferred directly to the production characteristics of individual false-eyelash enterprises in Purbalingga (Asrizal, 2018; Andita et al., 2025). Although research on construction labor productivity and national technological development identifies additional explanatory dimensions, differences in industrial processes, labor organization, and production technology restrict the extent to which these findings can represent local false-eyelash manufacturing (Nurhendi & Bastam, 2023; Ningsih, 2024). The theoretical literature explains short-run production relationships, while empirical manufacturing studies examine efficiency through frontier estimation, productivity ratios, or operational performance indicators, leaving their conceptual relationships insufficiently consolidated for interpreting the local industry (Damayanti & Kurniati, 2024; NingTyas et al., 2025; Chen & Chen, 2024). The resulting gap is primarily conceptual and contextual rather than evidence of an unmeasured decline in efficiency: the available literature does not provide a sufficiently integrated account of how labor utilization, relatively fixed production inputs, and diminishing marginal returns can be interpreted together without treating distinct efficiency and productivity measures as equivalent.

The absence of an integrated analytical framework has implications for interpreting industrial performance and evaluating labor-allocation decisions in enterprises characterized by substantial manual production activities. Increasing the number of workers may expand production capacity under favorable operating conditions, but the additional contribution of labor depends on whether

materials, equipment, workspace, and production sequences can accommodate higher labor utilization, a relationship consistent with short-run production theory (NingTyas et al., 2025; Damayanti & Kurniati, 2024). Studies of garment-production optimization and assembly-line balancing indicate the analytical relevance of workflow coordination and production sequencing, while research on lean manufacturing emphasizes the connection between production arrangements, working conditions, and employee productivity (Jung et al., 2024; Teshome et al., 2024; Sarnadi & Sulistyowati, 2024). For Purbalingga, these operational considerations must be interpreted alongside the socioeconomic circumstances of workers, including family conditions and employment insecurity, without assuming that social vulnerability constitutes direct evidence of lower technical efficiency (Anistiarini et al., 2021; Satria, 2025). Industrial sustainability also involves institutional support and market access, as demonstrated by research on stakeholder coordination and digital-market development among local eyelash-related enterprises, although these dimensions cannot independently establish the productivity effects of additional labor inputs (Syafiq & Haryanti, 2022; Hidayah et al., 2025). Wider manufacturing research provides further justification for distinguishing productive capacity from workforce expansion because technological change, organizational capability, and research investment represent separate dimensions of efficiency improvement (Dinlersoz & Wolf, 2024; Sugiharti et al., 2022; Yasin, 2024). A theoretically consistent interpretation of these relationships is necessary to prevent unsupported managerial conclusions that equate additional employment with proportionate production growth or assume that higher output per worker necessarily reflects greater technical efficiency.

This study is positioned at the intersection of microeconomic production theory, industrial efficiency analysis, and labor-productivity research, with Purbalingga's false-eyelash industry serving as the specific analytical setting. Its proposed novelty consists of organizing existing evidence within a unified short-run production framework that explicitly differentiates aggregate production, average labor productivity, marginal labor contribution, and technical efficiency rather than treating them as interchangeable indicators. This approach differs from the stochastic-frontier analysis of local eyelash and hairpiece production and from worker-level productivity studies because it examines the conceptual relationships among production inputs, relatively fixed productive resources, and output responses without undertaking a new firm-level efficiency estimation (Amaliyah et al., 2022; Filani et al., 2024; Rakhmawati & Karsinah, 2021). It also differs from broader investigations of manufacturing productivity, industrial openness, and firm performance by prioritizing the interpretation of short-run labor utilization in a specific labor-intensive production setting rather than explaining cross-industry productivity differences or enterprise survival (Afin et al., 2025; Geylani, 2024; Yasin, 2022, 2023). Evidence from textile innovation, garment production, and intelligent manufacturing is incorporated as a comparative basis for understanding productive constraints and organizational efficiency, without assuming that technological conditions in these industries are identical to those of Purbalingga's false-eyelash enterprises (Chen & Chen, 2024; Zhu, M., et al., 2024; Zhu, X., et al., 2022). Methodologically, the contribution takes the form of a descriptive qualitative literature synthesis that distinguishes direct local evidence from supporting theoretical and cross-sectoral research, thereby addressing differences in indicators, analytical assumptions, and units of observation. The originality claimed is consequently an integrated conceptual interpretation of existing findings, not the discovery of a previously undocumented production relationship or an empirical determination of current efficiency levels within individual enterprises.

This study aims to examine the application of short-run production theory to labor efficiency and productivity in Purbalingga's false-eyelash industry through a descriptive qualitative review of relevant academic literature. Specifically, it seeks to explain the analytical relationships among Total Product, Average Product, Marginal Product, and diminishing marginal returns when labor input varies while other productive resources remain relatively fixed. The study also aims to synthesize evidence concerning technical efficiency, labor productivity, workforce characteristics, production organization, and technological constraints, while distinguishing findings derived directly from the local industry from those obtained in other manufacturing settings. Its theoretical contribution lies in clarifying the boundaries and complementary functions of short-run production indicators and technical-efficiency measures within a labor-intensive industrial setting. Its methodological contribution consists of a structured interpretation of heterogeneous research findings that preserves distinctions among theoretical propositions, empirical measurements, and contextual explanations

without generating unsupported firm-level estimates. The practical contribution is an analytical basis for evaluating workforce allocation in relation to available equipment, materials, working time, and production organization, while identifying the additional enterprise-level observations required to assess marginal labor productivity and actual production efficiency.

RESEARCH METHODS

This study employed a descriptive qualitative literature-review design to examine the relationship between short-run production theory, labor efficiency, and productivity in Purbalingga's false-eyelash industry. The research relied exclusively on secondary academic sources, comprising journal articles and scholarly conference proceedings addressing production theory, technical efficiency, labor productivity, industrial operations, and employment conditions. Studies specifically examining the false-eyelash and hairpiece industries in Purbalingga constituted the principal empirical evidence, while publications concerning Indonesian manufacturing and comparable labor-intensive industries provided theoretical and sectoral references. Relevant literature was identified through available academic publications, journal publishers' websites, and Google Scholar search results using Indonesian search terms corresponding to short-run production theory, production efficiency, labor productivity, the false-eyelash industry, and Purbalingga. Sources were selected according to their relevance to the research objectives, identifiable publication information, and availability of verifiable academic content. Publications concerning industrial stakeholders, marketing activities, and workers' social circumstances were retained as contextual evidence rather than treated as direct measurements of production efficiency. The review did not involve primary data collection, worker surveys, interviews, experimental interventions, or direct observations of manufacturing operations.

The analytical procedure consisted of four stages: identifying the objectives and principal findings of each publication, classifying the literature into relevant analytical themes, comparing evidence across research methods and industrial settings, and interpreting the findings through short-run production theory. The synthesis focused on Total Product (TP), Average Product (AP), Marginal Product (MP), and diminishing marginal returns to distinguish aggregate production, output per unit of labor input, and incremental output associated with changes in labor utilization. Evidence concerning technical efficiency, workforce characteristics, raw materials, equipment, technological conditions, and production organization was examined according to the indicators and analytical approaches reported in the original studies. Particular attention was given to distinguishing technical efficiency from labor productivity and to separating findings obtained directly from Purbalingga's false-eyelash industry from those originating in other manufacturing sectors. Analytical rigor was maintained through thematic comparison, examination of methodological differences, and interpretation restricted to claims supported by the reviewed publications. Findings from individual enterprises or other industries were not generalized to the entire false-eyelash industry without sufficient supporting evidence. Because comparable firm-level observations of production output, workforce size, working hours, and other inputs were unavailable, the study did not calculate production functions, estimate marginal productivity, or determine current technical-efficiency levels for individual enterprises.

RESULTS AND DISCUSSION

Run Production Theory and the Relationship Between Labor Input and Output in Purbalingga’s False-Eyelash Industry

Short-run production theory provides an analytical foundation for examining how labor utilization relates to manufacturing output when certain productive resources cannot be adjusted immediately. In Purbalingga's false-eyelash industry, labor represents a potentially adjustable production input, whereas equipment, workspace, and installed production capacity may remain relatively fixed within a particular operating period. NingTyas et al. (2025) explain that short-run production decisions involve changes in variable inputs under constraints imposed by fixed factors, while Damayanti and Kurniati (2024) examine the relevance of production-function relationships to short-run and long-run production analysis. These theoretical distinctions indicate that workforce expansion and output growth should be treated as related but nonproportional possibilities rather than as mechanically equivalent outcomes.

The relationship between labor input and manufacturing output can be differentiated through Total Product (TP), Average Product (AP), and Marginal Product (MP), each representing a distinct dimension of productive performance. TP denotes aggregate production, AP expresses output relative to labor input, and MP represents the additional output associated with an incremental change in labor utilization while other production factors remain constant. Research on technical efficiency and productivity in Indonesian manufacturing demonstrates the importance of distinguishing productive output from the efficiency with which available resources are utilized (Asrizal, 2018; Yasin, 2022). Applied to false-eyelash manufacturing, these indicators provide a framework for interpreting production performance without presuming that an increase in the number of employees necessarily improves output per worker or the marginal contribution of additional labor.

The principle of diminishing marginal returns offers a more specific explanation of why labor expansion may eventually produce progressively smaller additions to output under fixed-capacity conditions. Additional workers may initially support greater task specialization and more continuous production, but their incremental contribution may decline when machinery, workspace, material availability, or workflow capacity becomes restrictive. Amaliyah et al. (2022) examined technical efficiency in Purbalingga's false-eyelash and hairpiece industries using Stochastic Frontier Analysis, providing locally relevant evidence that productive performance must be considered through combinations of production inputs rather than labor alone. Their methodological approach differs from marginal-product analysis, however, because technical efficiency relative to an estimated production frontier does not directly identify the additional output generated by successive units of labor.

An analytical distinction is also required between changes in labor productivity and improvements in the technical efficiency of production. Labor productivity may increase because employees produce more output per working period, while technical efficiency concerns the relationship between observed production and the attainable output represented by a specified production technology. Rakhmawati and Karsinah (2021) investigated determinants of labor productivity in Purbalingga's artificial-eyelash industry, whereas Yasin and Sari (2022) examined manufacturing efficiency and productivity in relation to foreign investment and technological intensity. These studies support the treatment of labor productivity and technical efficiency as complementary analytical dimensions whose measurements cannot be substituted for one another without considering their respective input definitions and estimation procedures.

The conceptual relationships identified in the reviewed literature are organized in Table 1 to distinguish short-run production indicators from efficiency measures and to clarify their relevance to labor allocation in false-eyelash manufacturing. The table presents an analytical classification rather than new observations of workforce size, production volume, or company-level efficiency. Its interpretation is grounded in short-run production theory and the distinction between labor-productivity measures and production-frontier analysis established in the relevant literature (Damayanti & Kurniati, 2024; Amaliyah et al., 2022).

Table 1. Analytical Relationships Between Short-Run Production Indicators and Labor Efficiency in False-Eyelash Manufacturing

Production indicator	Analytical expression or principle	Interpretation for false-eyelash manufacturing	Evidence required for empirical assessment
Total Product (TP)	\(TP = Q\)	Aggregate quantity of output produced during a specified period	Comparable production-volume records
Average Product (AP)	\(AP = Q/L\)	Average production output per unit of labor input	Output and workforce data for the same period
Marginal Product (MP)	\(MP = \Delta Q/\Delta L\)	Additional output associated with an increase in labor input, holding other factors constant	Comparable observations of changes in labor and output under controlled production conditions

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Diminishing marginal returns	Declining MP as variable labor increases beyond a particular operating condition with other inputs fixed	Potential reduction in additional output generated by successive labor increments	Repeated labor–output observations with information on fixed-input constraints
Labor productivity	Output per worker or working hour	Production performance relative to labor utilization	Output, employee numbers, or labor-hour records
Technical efficiency	Relative position of observed output against an estimated production frontier	Capacity to utilize a given input combination relative to a modeled production possibility	Firm-level input–output observations and an appropriate frontier estimation model

Source: Conceptual synthesis of short-run production theory and relevant production-efficiency literature; the table contains no newly measured firm-level data.

The relationships summarized in Table 1 establish that TP, AP, and MP address different questions concerning the behavior of production as labor utilization changes. An increase in TP does not establish that AP has improved, since aggregate output may rise while output per worker declines, and a positive MP does not necessarily indicate that marginal returns are increasing. The production-function framework examined by NingTyas et al. (2025) and Damayanti and Kurniati (2024) provides the conceptual basis for interpreting these relationships, while manufacturing-efficiency research emphasizes the need to account for differences in productive resources and operating conditions (Sugiharti et al., 2022). For Purbalingga's false-eyelash industry, a meaningful empirical application would consequently require consistent measures of production quantity, labor utilization, and relevant fixed inputs rather than isolated workforce or output figures.

Production organization introduces another dimension into the relationship between labor input and aggregate output, particularly where manufacturing activities involve sequential tasks and interdependent workstations. Research on garment production-line optimization shows how production information and operational coordination can be incorporated into manufacturing-system analysis, while assembly-line balancing research provides a basis for examining the distribution of workloads across production stages (Jung et al., 2024; Teshome et al., 2024). Such findings are relevant as comparative evidence because false-eyelash manufacturing may involve labor-dependent operations whose performance is constrained by the coordination of workers, materials, and equipment, although specific production configurations cannot be presumed to be identical across industries. The theoretical implication is that marginal labor contribution should be interpreted relative to the organization of existing productive resources, rather than attributed exclusively to the number or characteristics of employees.

Technological differences further complicate attempts to infer a stable relationship between workforce expansion and output performance across manufacturing enterprises. Dinlersoz and Wolf (2024) examined automation, labor share, and productivity at the manufacturing-plant level, while Zhu, M., et al. (2024) investigated intelligent manufacturing and labor productivity among Chinese manufacturing companies. These research directions suggest that production technology and capital–labor arrangements are relevant when interpreting productivity differences, although their findings do not establish the technological conditions currently prevailing in Purbalingga's false-eyelash enterprises. The short-run framework consequently requires a distinction between changes in labor utilization under an existing production configuration and productivity changes associated with alterations in technological capability or capital intensity.

The literature-based synthesis identifies a conditional rather than deterministic relationship between additional labor input and productive performance in Purbalingga's false-eyelash industry. Studies of industrial productivity in Indonesia and other manufacturing economies demonstrate that efficiency analysis involves multiple productive resources and institutional or technological characteristics, while the local false-eyelash literature supplies a narrower industrial basis for assessing labor-related production concerns (Yasin, 2023; Andita et al., 2025; Amaliyah et al., 2022). The principal analytical finding is that short-run production theory can explain the circumstances

under which workforce expansion may contribute to output growth, but the available secondary evidence cannot determine the actual marginal-product schedule or identify the stage of diminishing returns for a particular enterprise. Establishing those outcomes would require comparable firm-level labor and production observations alongside information on equipment availability, raw-material use, working hours, and production organization, permitting the conceptual relationships in Table 1 to be evaluated empirically.

Production Efficiency and Labor Productivity Determinants in Purbalingga's False-Eyelash Industry

Production efficiency in Purbalingga's false-eyelash industry depends on the relationship between labor utilization and the combination of resources required to sustain manufacturing activities. The literature indicates that workforce performance cannot be interpreted independently of raw-material availability, equipment utilization, employee capabilities, and organizational arrangements because these factors jointly influence the production process. Amaliyah et al. (2022) examined technical efficiency in Purbalingga's false-eyelash and hairpiece industries through Stochastic Frontier Analysis, while Asrizal (2018) investigated production efficiency and labor productivity among Indonesian micro and small enterprises. These analytical approaches establish that production performance should be examined through the interaction of productive inputs rather than through employee numbers or aggregate output alone.

Labor characteristics constitute a distinct dimension of productive performance because differences in knowledge, experience, and operational capabilities may influence how effectively available working time is converted into finished products. Aisyah and Oktavilia (2020) examined the productivity of women workers in the hairpiece industry, while Rakhmawati and Karsinah (2021) investigated labor-productivity determinants in Purbalingga's artificial-eyelash manufacturing sector. Their research provides a basis for distinguishing employee-related productivity factors from production constraints arising from equipment availability or other relatively fixed inputs. Within short-run production theory, differences in worker productivity may affect observed output per employee, but these differences do not independently establish the marginal contribution of additional workers under unchanged production conditions.

Workforce management introduces further variation in the relationship between labor availability and production performance because employment arrangements influence how employees undertake assigned manufacturing activities. Filani et al. (2024) investigated compensation and work discipline among false-eyelash factory employees in Wirasana, Purbalingga, whereas Fauziah et al. (2023) examined skills, work attitudes, discipline, and motivation among production employees at PT Rosa Sejahtera Eyelashes. Finissa et al. (2024) extended the examination of employee productivity at the same enterprise by considering workplace-related and organizational determinants. These studies collectively indicate that labor-productivity research in the local industry has concentrated substantially on workforce characteristics and employment management, leaving the connection between such determinants and the marginal-product relationships of short-run production theory less explicitly developed.

The distinction between labor-related determinants and structural production constraints is particularly relevant when assessing whether productivity differences originate from employee performance or from the organization of manufacturing resources. Research on lean manufacturing and physical work environments in the Indonesian apparel industry provides comparative evidence concerning the relationship between workplace organization and labor productivity, while studies of manufacturing technology indicate that production systems may shape the productivity associated with labor utilization (Sarnadi & Sulistyowati, 2024; Dinlersoz & Wolf, 2024). These findings support an analytical separation between worker attributes and production conditions because identical labor inputs may operate under different technological and organizational arrangements. For false-eyelash manufacturing, evaluating labor efficiency consequently requires consideration of workforce characteristics alongside material flows, equipment capacity, production sequences, and the distribution of tasks among employees.

The reviewed evidence can be classified into interconnected dimensions of labor efficiency without assuming that studies employing different populations, industrial settings, and measurement procedures produce directly comparable estimates. Table 2 organizes the principal determinants

addressed in the literature and identifies their relevance to short-run production analysis, particularly the distinction between labor-specific characteristics and constraints associated with other production inputs. This classification draws on local studies of employee productivity and technical efficiency, supplemented by comparative research on manufacturing operations and productivity determinants (Amaliyah et al., 2022; Fauziah et al., 2023; Jung et al., 2024). The table represents a qualitative synthesis of research concerns and analytical implications rather than a statistical ranking of determinants or an estimation of their effects within Purbalingga's false-eyelash industry.

Table 2. Literature-Based Classification of Labor Productivity Determinants and Production Efficiency Constraints

Analytical dimension	Factors examined or considered	Supporting literature	Relevance to short-run production theory	Interpretive limitation
Labor characteristics	Education, work experience, and employee productivity	Aisyah & Oktavilia (2020); Rakhmawati & Karsinah (2021)	Worker characteristics may influence output generated from available labor input	Does not directly establish marginal labor productivity
Workforce management	Compensation, discipline, motivation, skills, and work attitudes	Filani et al. (2024); Fauziah et al. (2023); Finissa et al. (2024)	Employment management may affect the productive utilization of labor	Relationships vary across organizational settings and study designs
Production inputs	Raw materials, labor, equipment, and electricity	Amaliyah et al. (2022); Asrizal (2018)	Input combinations influence the production possibilities available to enterprises	Technical efficiency cannot be equated directly with AP or MP
Workplace organization	Physical working conditions, lean manufacturing, and task coordination	Sarnadi & Sulistyowati (2024); Jung et al. (2024)	Operational arrangements may affect the use of available labor and fixed inputs	Evidence originates partly from other manufacturing industries
Production-line coordination	Workstation allocation, task sequencing, and assembly-line balancing	Teshome et al. (2024); Jung et al. (2024)	Production bottlenecks may constrain incremental output from additional labor	Production-stage characteristics may differ across enterprises
Technology and innovation	Production technology, automation, and innovation efficiency	Ningsih (2024); Chen & Chen (2024); Zhu, M., et al. (2024)	Technology influences the productive conditions under which labor operates	Cross-sectoral findings do not measure local factory conditions
Workers' social conditions	Family circumstances and employment precarity	Anistiarini et al. (2021); Satria (2025)	Provides the social setting within which labor utilization decisions occur	Social conditions are not direct technical-efficiency indicators
Industrial environment	Institutional coordination,	Syafiq & Haryanti (2022);	External conditions may influence	Does not establish firm-level input–

	market access, and business continuity	Hidayah et al. (2025)	employment and output production planning relationships

Source: Authors' thematic synthesis of the reviewed literature.

The classification presented in Table 2 indicates that labor efficiency involves analytically distinct influences arising from employee characteristics, production organization, technological capabilities, and the surrounding industrial environment. Local studies provide direct relevance for workforce management and technical efficiency, whereas evidence concerning assembly-line balancing and technology offers comparative explanations of how manufacturing arrangements may constrain or support labor productivity (Filani et al., 2024; Teshome et al., 2024; Chen & Chen, 2024). The relationships represented in the table should not be interpreted as estimated causal effects because the reviewed publications differ in research design, observation units, and operational definitions. Their principal contribution to the present synthesis is the identification of factors that must be considered before attributing changes in output exclusively to additional labor utilization.

Operational coordination deserves particular analytical attention because production processes may contain sequential activities whose completion rates depend on the interaction of several workstations or tasks. Teshome et al. (2024) examined assembly-line balancing through simulation in garment manufacturing, while Jung et al. (2024) investigated production-line optimization using operational monitoring information. Their methodological approaches demonstrate how production organization can be examined beyond employee-level characteristics, although the present literature review does not reproduce their simulations or establish equivalent process configurations in Purbalingga. Under short-run production constraints, insufficient coordination between labor allocation and available production facilities represents a plausible mechanism through which additional workers may contribute progressively smaller increments of output, subject to empirical verification within individual enterprises.

Technological capability introduces another distinction between improvements in labor productivity and changes in the production environment within which labor is employed. Ningsih (2024) addressed technology and labor productivity in Indonesia, while Zhu, M., et al. (2024) examined intelligent manufacturing and labor productivity among Chinese manufacturing enterprises, and Chen and Chen (2024) analyzed technological innovation efficiency in textile and apparel companies. These studies provide comparative grounds for considering technological conditions when interpreting industrial performance, but they do not establish the extent of automation, technological adoption, or innovation capacity among the false-eyelash enterprises examined in the local literature. From a short-run analytical standpoint, productivity improvements associated with changes in production technology must be distinguished from output changes attributable solely to increasing labor while other productive resources remain fixed.

The synthesis also reveals limitations in interpreting production efficiency without accounting for the social and institutional characteristics of the local workforce. Anistiarini et al. (2021) investigated family functioning among women workers in Purbalingga's false-eyelash industry, while Satria (2025) examined employment precarity and social risks affecting women working in the false-eyelash and hairpiece sectors. Research on industrial stakeholders and market development further indicates that business continuity and employment conditions extend beyond the internal allocation of productive resources (Syafiq & Haryanti, 2022; Hidayah et al., 2025). These publications contribute to understanding the conditions surrounding labor utilization, but their findings cannot be treated as direct measurements of production efficiency or evidence of a specific marginal-product relationship.

The analytical findings indicate that labor productivity in Purbalingga's false-eyelash industry should be interpreted as the outcome of potentially interacting worker-level, operational, and resource-related conditions rather than as a simple function of workforce size. Research on technical efficiency and firm productivity in Indonesian manufacturing supports the consideration of input combinations and enterprise characteristics, while local studies provide more specific evidence concerning labor management and production efficiency (Sugiharti et al., 2022; Yasin, 2024; Amaliyah et al., 2022). A meaningful empirical distinction between productive labor utilization and production constraints would require comparable observations of employee numbers, working hours, completed output, equipment availability, and material use across defined production periods. The present literature synthesis establishes the conceptual relevance of these dimensions but does not

determine their relative quantitative effects, identify an optimal workforce size, or estimate the technical-efficiency level of any individual false-eyelash enterprise.

Integrating Short-Run Production Theory with Industrial Efficiency and Sustainable Labor Allocation

The application of short-run production theory to Purbalingga's false-eyelash industry requires an analytical distinction between increasing production volume and improving the efficiency of existing productive resources. Labor-intensive manufacturing enterprises may adjust workforce utilization within a given operating period, but changes in output remain dependent on equipment capacity, material availability, production organization, and the productive capabilities of employees. Amaliyah et al. (2022) examined technical efficiency in Purbalingga's false-eyelash and hairpiece industries, while Yasin (2022) investigated technical efficiency and total factor productivity in Indonesian manufacturing, establishing complementary approaches to evaluating industrial performance. Their analytical orientations indicate that workforce expansion should not be interpreted as evidence of efficiency improvement unless the relationship between additional labor input and the resulting production output can be established through appropriate measurements.

The relationship between production theory and operational efficiency becomes more complex when manufacturing processes consist of interdependent activities with different processing requirements. A production stage with insufficient equipment capacity or inadequate material supply may restrict output even when additional workers are available, creating conditions under which labor expansion does not necessarily generate proportional increases in production. Jung et al. (2024) examined garment-production optimization using operational information, whereas Teshome et al. (2024) investigated productivity improvement through assembly-line balancing and simulation modeling. These studies provide comparative analytical support for examining workflow coordination in labor-intensive manufacturing, although their findings cannot establish the actual location or magnitude of production bottlenecks in Purbalingga's false-eyelash enterprises.

Short-run labor-allocation decisions also require differentiation between employee productivity and the marginal contribution of additional workers under relatively fixed production conditions. Average Product indicates output per unit of labor input, while Marginal Product captures the change in output associated with an incremental change in labor input when other relevant productive factors remain constant. Rakhmawati and Karsinah (2021) examined labor-productivity determinants in Purbalingga's artificial-eyelash industry, while Damayanti and Kurniati (2024) discussed production-function relationships relevant to short-run and long-run production analysis. Their combined relevance lies in demonstrating why employee-productivity indicators alone cannot determine whether additional labor will increase marginal output, particularly when variations in equipment utilization, materials, and production organization remain unobserved.

Technological capability further influences the interpretation of productive performance because improvements in production systems may alter the relationship between labor requirements and attainable output. Research on automation and manufacturing productivity suggests that technological arrangements are relevant to the distribution and productive contribution of labor, while studies of intelligent manufacturing examine productivity under increasingly technology-intensive operating conditions (Dinlersoz & Wolf, 2024; Zhu, M., et al., 2024). Similar considerations arise in research on innovation efficiency among textile and apparel enterprises, where technological capabilities are evaluated as part of broader industrial performance rather than as a direct measure of employee output (Chen & Chen, 2024). These findings indicate that labor-efficiency comparisons must distinguish changes arising from workforce utilization under existing technological conditions from productivity changes associated with modifications to the production system.

The preceding analytical relationships identify several dimensions that should be considered when interpreting short-run labor allocation in Purbalingga's false-eyelash industry. Table 3 translates the literature-based synthesis into an analytical framework linking production constraints, relevant indicators, potential operational responses, and the evidence required for empirical assessment. The framework draws on short-run production theory, local technical-efficiency research, and comparative manufacturing studies without assuming that particular production problems have been documented at individual enterprises (NingTyas et al., 2025; Amaliyah et al., 2022; Sarnadi & Sulistyowati, 2024). Its purpose is to distinguish theoretically plausible mechanisms from verified industrial conditions and

to identify the observations necessary for evaluating workforce utilization under actual production constraints.

Table 3. Literature-Based Framework for Evaluating Short-Run Labor Allocation and Production Efficiency in Purbalingga's False-Eyelash Industry

Analytical dimension	Short-run production consideration	Relevant indicators	Potential operational implication	Evidence required
Workforce allocation	Labor input changes while other production factors remain relatively fixed	TP, AP, MP, number of workers	Align workforce utilization with available productive capacity	Comparable labor and output observations
Equipment capacity	Machinery and installed equipment may constrain additional production	Equipment availability, operating time, production capacity	Evaluate labor allocation relative to equipment constraints	Equipment records and production-stage observations
Material availability	Inadequate variable-input supply may interrupt production activities	Raw-material use, availability, production interruptions	Coordinate labor utilization with material availability	Material-consumption and production records
Production coordination	Sequential activities may create uneven workloads	Processing time, task distribution, waiting time	Examine workflow coordination and task allocation	Process-level time observations
Workforce capabilities	Employee characteristics may influence productive performance	Skills, experience, work discipline, productivity	Assess workforce development and work organization	Workforce and productivity information
Technological conditions	Production technology influences output possibilities	Equipment characteristics, technological capabilities	Distinguish labor-allocation changes from technological improvements	Technology and equipment documentation
Technical efficiency	Productive performance depends on input combinations	Input–output observations and production-frontier indicators	Evaluate resource utilization through an appropriate efficiency model	Comparable firm-level data suitable for frontier analysis
Employment sustainability	Production decisions may interact with employment stability and labor conditions	Employment arrangements and working conditions	Consider the labor implications of production decisions	Relevant organizational and labor-condition evidence

Source: Authors' conceptual synthesis of the reviewed production-theory, industrial-efficiency, and labor-productivity literature. The

Table 3 differentiates the informational requirements of short-run production indicators from those needed to evaluate technical efficiency and wider employment conditions. Measurements of TP, AP, and MP require comparable production and labor observations, whereas technical-efficiency estimation requires a broader representation of production inputs and an explicitly specified analytical model. Studies of manufacturing efficiency and productivity in Indonesia demonstrate the importance of examining productive-resource combinations and technological heterogeneity rather than relying

on isolated indicators of labor output (Sugiharti et al., 2022; Yasin & Sari, 2022; Asrizal, 2018). The framework consequently provides a basis for identifying which relationships can be interpreted conceptually and which require additional quantitative evidence before claims about industrial performance become empirically defensible.

Labor-efficiency assessment must also account for organizational and human-resource conditions that may influence how employees utilize available production time. Studies conducted in Purbalingga's false-eyelash industry have examined compensation, discipline, skills, motivation, and working conditions as dimensions of employee productivity, while research on Indonesian apparel manufacturing has considered the relevance of lean production practices and physical workplace arrangements (Filani et al., 2024; Fauziah et al., 2023; Finissa et al., 2024; Sarnadi & Sulistyowati, 2024). These findings suggest that changes in workforce performance may reflect organizational factors without necessarily involving adjustments to equipment capacity or the number of employees. An interpretation consistent with short-run production theory must consequently distinguish improvements in labor utilization from changes in labor quantity and avoid assuming that productivity gains originate from a single employment-management variable.

The industrial relevance of efficient labor allocation extends beyond production performance because employment decisions also influence the economic circumstances of workers and the continuity of local manufacturing activity. Anistiarini et al. (2021) examined family functioning among women workers in Purbalingga's false-eyelash industry, while Satria (2025) addressed employment precarity and labor-related social risks in the false-eyelash and hairpiece sectors. Research on stakeholder coordination and digital-market development further indicates that industrial continuity involves institutional and commercial considerations that are analytically distinct from production efficiency (Syafiq & Haryanti, 2022; Hidayah et al., 2025). These findings support a cautious interpretation of labor-allocation recommendations, particularly where potential improvements in productive efficiency cannot be assumed to produce equivalent improvements in employment stability, remuneration, or working conditions.

The literature also identifies limitations in transferring productivity findings from larger manufacturing sectors or technologically advanced enterprises to Purbalingga's false-eyelash industry. Research concerning enterprise performance, innovation, industrial openness, and productivity growth provides comparative explanations of industrial heterogeneity, but differences in production scale, market conditions, technological capability, and research design restrict direct generalization to local labor-intensive manufacturing (Afin et al., 2025; Geylani, 2024; Yasin, 2023; Zhu, X., et al., 2022). Evidence from these studies is more appropriately employed to interpret potential mechanisms than to estimate local production responses or prescribe an optimal workforce configuration. The analytical implication is that production-efficiency evaluation must remain sensitive to enterprise characteristics and distinguish general theoretical relationships from findings demonstrated within the specific industrial setting.

The synthesis establishes that short-run production theory offers a coherent framework for interpreting labor efficiency in Purbalingga's false-eyelash industry, provided that theoretical propositions are not confused with empirically estimated production relationships. Local studies supply evidence concerning technical efficiency, worker productivity, and employment conditions, while comparative manufacturing research clarifies the potential relevance of workflow coordination, technological capability, and resource allocation (Amaliyah et al., 2022; Rakhmawati & Karsinah, 2021; Jung et al., 2024; Yasin, 2024). The principal contribution is the integration of TP, AP, MP, diminishing marginal returns, and technical efficiency into a structured interpretation of labor utilization under constrained production capacity, without claiming to identify actual marginal returns or optimal employment levels. Further firm-level examination would require observations of output, working hours, workforce size, raw-material utilization, equipment availability, and production processes to determine whether the conceptual relationships identified in this literature-based analysis are supported by measurable conditions in individual enterprises.

CONCLUSION

Short-run production theory provides a coherent analytical framework for examining labor efficiency and productivity in Purbalingga's false-eyelash industry under conditions of relatively fixed productive capacity. The literature synthesis establishes that Total Product (TP), Average Product

(AP), and Marginal Product (MP) represent distinct dimensions of production performance, while diminishing marginal returns explain why additional labor may generate progressively smaller increments of output when other productive inputs remain constrained. Evidence from previous studies identifies workforce characteristics, technical capabilities, raw-material availability, equipment utilization, compensation, work discipline, employee skills, and production organization as relevant dimensions of industrial productivity. Technical efficiency and labor productivity must nevertheless be distinguished because they represent different measurements of productive performance and cannot be interpreted interchangeably. The synthesis further indicates that workforce expansion alone cannot be regarded as sufficient evidence of improved production efficiency, particularly when material availability, equipment capacity, and operational coordination may constrain additional output. Since the study relies on secondary literature, these findings establish conceptual relationships rather than measured marginal-product values, actual efficiency levels, or optimal workforce sizes for individual enterprises.

The study contributes to microeconomic production analysis by integrating short-run production indicators with empirical literature on technical efficiency, labor productivity, and manufacturing organization in a specific labor-intensive industrial setting. Its methodological contribution lies in distinguishing evidence directly obtained from Purbalingga's false-eyelash industry from comparative findings in other manufacturing sectors, while preserving differences among theoretical explanations, productivity measures, and production-frontier approaches. Practically, the synthesis provides an analytical basis for considering workforce allocation alongside equipment availability, material supply, working hours, employee capabilities, and production sequencing rather than evaluating labor performance through employee numbers alone. These implications remain conditional because the reviewed literature does not provide comparable firm-level observations sufficient to establish causal relationships or quantify the effects of individual production constraints. Subsequent empirical investigation should incorporate consistent measurements of production output, labor input, equipment utilization, raw-material consumption, and operational working time to evaluate marginal productivity and technical efficiency within defined production periods. Such evidence would permit the conceptual relationships identified in this study to be tested against actual manufacturing conditions and support more precise assessments of labor allocation in Purbalingga's false-eyelash industry.

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