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Social Forestry Governance and Community Economic Development: The Role of Environmental Quality in the Fifty Cities Regency

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ABSTRACT

Rural forest-based communities frequently remain economically vulnerable despite expanded access to forest resources, indicating that welfare improvement depends on more than tenure security alone. Addressing this critical gap, this study investigates how Social Forestry and Human Resource Quality influence Community Economic Welfare through the mediating role of Environmental Quality in Kabupaten Lima Puluh Kota, Indonesia. Adopting a quantitative research design, the study focuses on Silver-category Social Forestry Business Groups (KUPS) as a strategic transitional stage of institutional development. Data were collected from 310 respondents and analyzed using Structural Equation Modeling–Partial Least Squares (SEM-PLS). The measurement model demonstrates strong reliability and discriminant validity, supporting robust structural analysis. The findings reveal that Social Forestry has a significant positive effect on Environmental Quality and directly enhances Community Economic Welfare. In contrast, Human Resource Quality significantly improves Environmental Quality but does not exert a direct influence on economic welfare. Environmental Quality plays a decisive role by significantly strengthening Community Economic Welfare and mediating the effects of both Social Forestry and Human Resource Quality. These results highlight that ecological improvement is not a peripheral outcome but a central development mechanism through which institutional reform and capacity building generate welfare gains. This study contributes conceptually by repositioning environmental quality as an active transmission channel of development and methodologically by integrating governance, human capital, and ecological dimensions within a unified SEM-PLS framework. In a broader context, the findings suggest that social forestry policies should prioritize ecological performance and embed capacity development within environmental governance to support sustainable rural development and green economy agendas.

Keywords: Social Forestry; Environmental Quality; Human Resource Quality; Community Economic

INTRODUCTION

Forests in developing regions increasingly occupy a strategic position in debates on sustainable development, as they simultaneously function as ecological buffers and sources of livelihood for rural communities. In many low and middle income countries, forests contribute directly to income generation, food security, and resilience against environmental shocks, making forest governance a critical determinant of development outcomes rather than a purely environmental concern (Talpă et al., 2022; Mantey & Teye, 2021; Widiaryanto, 2020; Veen et al., 2021). Empirical evidence demonstrates that poorly governed forest systems often exacerbate poverty and vulnerability, while well managed forests provide essential ecosystem services such as water regulation, soil fertility, and climate resilience that underpin local economies (Veen et al., 2021). Global policy frameworks further emphasize that inclusive forest governance, particularly through the participation of indigenous and local communities, is essential

for aligning conservation objectives with poverty alleviation and rural development goals (Stryamets et al., 2022; Başkent, 2020). These insights collectively underscore the need to analyze forest governance as a central pillar of community economic development.

In Indonesia, forest dependence remains a defining characteristic of many rural regions, where local economies and daily subsistence are closely tied to forest resources. The country's vast forest landscapes support agriculture, water systems, and non timber livelihoods, reinforcing the importance of governance arrangements that balance ecological sustainability with economic inclusion (Widiaryanto, 2020). Evidence suggests that fragmented or poorly coordinated forest governance can intensify socio economic disparities and undermine local resilience, while effective governance enhances ecosystem services that sustain rural livelihoods (Talpă et al., 2022; Veen et al., 2021). International and national discourses increasingly recognize that forests should be governed not only to protect biodiversity but also to foster inclusive development through secure access rights and participatory management (Stryamets et al., 2022). Consequently, understanding how governance mechanisms translate forest resources into economic welfare has become a key agenda within environmental economics and development studies.

At the regional scale, these dynamics are clearly reflected in Kabupaten Lima Puluh Kota, West Sumatra Province, where forest areas dominate the landscape and shape local development trajectories. More than sixty percent of the regency's territory is designated as forest area, functioning as a critical watershed that supports agriculture and rural settlements (BPS Kabupaten Lima Puluh Kota, 2023; KLHK, 2022). Protected forests and production forests in this region provide vital environmental services, including water supply, food resources, and income opportunities for rural communities. As a result, changes in forest governance arrangements directly influence both environmental sustainability and economic stability at the local level. This structural dependence on forest resources makes Lima Puluh Kota a particularly relevant case for examining the relationship between forest governance, environmental quality, and community economic development.

Despite the ecological and economic importance of forests in Lima Puluh Kota, the benefits derived from forest resources have not been evenly translated into improved community welfare. Limited legal access to forest land, weak management institutions, and persistent environmental degradation continue to constrain local livelihoods. Reports from the Ministry of Environment and Forestry indicate that forest degradation in West Sumatra, including Lima Puluh Kota, is largely driven by illegal access and ineffective governance mechanisms, which in turn reduce ecosystem service quality and increase economic vulnerability among forest dependent communities (KLHK, 2022). These conditions highlight a crucial social fact that forest governance is not merely a regulatory issue but a central factor shaping local development outcomes. Policies governing access and management therefore play a decisive role in determining whether forests function as assets for inclusive growth or sources of persistent inequality.

A substantial body of international literature has examined the impacts of social forestry and community based forest management on rural livelihoods and economic outcomes. Many studies report positive effects, including increased household income, employment creation, and livelihood diversification, particularly in contexts characterized by secure tenure and strong institutional support (Toumbourou et al., 2025; Ragandhi et al., 2021; Friedman et al., 2020). These findings suggest that devolving forest management rights can create incentives for sustainable resource use while enabling local enterprise development. However, other studies emphasize that economic benefits are often uneven and contingent on governance quality, market access, and community capacity (Magessa et al., 2020; DIFABACHEW, 2022). This mixed evidence indicates that social forestry does not automatically generate broad based economic development, pointing to the need for deeper analysis of the mechanisms linking governance reforms to economic outcomes.

Further research highlights the critical role of environmental quality in shaping the economic impacts of forest governance interventions. Improved forest conditions enhance ecosystem services such as water regulation, soil conservation, and biodiversity protection, which indirectly support agricultural productivity and rural livelihoods (Millennium Ecosystem Assessment, 2005; Barbier et al., 2021). Despite this recognition, many empirical studies treat environmental outcomes as secondary or descriptive variables rather than as active mechanisms linking governance to economic performance. Moreover, the interaction between human capital and environmental quality remains underexplored, particularly in quantitative studies that focus primarily on direct effects. This gap limits understanding of how communities transform ecological improvements into sustained economic benefits, especially in decentralized governance settings such as Indonesia.

Responding to these gaps, this study positions environmental quality as a mediating mechanism between social forestry governance and community economic development. The novelty of this approach lies in integrating governance arrangements, human capital, environmental conditions, and economic outcomes within a single analytical framework, rather than treating environmental quality as a parallel outcome (Barlagne et al., 2021; Mangkunegara et al., 2024). By employing mediation analysis through structural equation modeling, this study advances debates in environmental economics concerning the pathways through which institutional arrangements

shape development outcomes (Hao et al., 2022; Akhtar et al., 2022). This perspective aligns with emerging evidence that environmental quality functions as a transmission channel through which governance reforms yield tangible economic benefits.

The significance of this study is both academic and policy oriented. Academically, it contributes to environmental economics and development studies by integrating governance theory with environmental mediation and community level economic analysis. From a policy perspective, the study aligns closely with Indonesia's national social forestry agenda, which seeks to promote equitable forest access, environmental sustainability, and rural economic development (MoEF, 2021). Focusing on Kabupaten Lima Puluh Kota, this study aims to analyze the direct and indirect effects of social forestry governance and human capital on community economic development, with environmental quality serving as a mediating variable. The findings are expected to provide evidence based insights for improving policy design and implementation at the local level.

This paper is organized to address these objectives systematically. Following this introduction, the next section reviews relevant theories and empirical studies to develop the conceptual framework and research hypotheses. The methodology section then describes the study area, data sources, variable measurement, and analytical techniques, with particular emphasis on the SEM PLS approach. The results section presents empirical findings, highlighting both direct effects and mediated relationships involving environmental quality. The paper concludes by synthesizing the main findings and discussing their broader implications. The results demonstrate that environmental quality plays a pivotal role in linking social forestry governance to community economic development in Lima Puluh Kota Regency. These findings underscore the importance of strengthening environmental management, institutional capacity, and community skills as integral components of social forestry implementation. Policy implications emphasize the need for integrative governance strategies that align ecological sustainability with economic inclusion, offering guidance for policymakers and development practitioners in Indonesia and comparable forest dependent regions.

THEORITICAL FRAMEWORK

Social Forestry

Social forestry is frequently framed as an institutional innovation that reorients forest governance from centralized state control toward participatory, community-centered management, grounded in common-pool resource theory that emphasizes local actors in sustainable use and socio-economic gains (Salazar, 2025; . Within environmental economics, it serves to internalize externalities by aligning local incentives with long-term ecological stewardship (Kadam et al., 2025). Empirical work indicates that secure access rights and participatory governance can enhance compliance with conservation objectives and reduce deforestation pressures, though these outcomes hinge on design, governance capacity, and local socio-economic conditions, yielding context-dependent results Salerno et al., 2021). Recent scholarship clarifies that participatory effectiveness requires embedded governance contexts, inclusive participation, and accountability to avoid limited gains even where formal common-pool resource principles are present (Salazar, 2025; Baral et al., 2025). Additional insights from related conservation and policy literature emphasize the role of social networks, feelings of safety, and perceived legitimacy in sustaining community-based management and compliance (Rhodes et al., 2020; Walker et al., 2024). Taken together, social forestry outcomes are heterogeneous across settings, necessitating nuanced institutional design and context-sensitive implementation to realize shared ecological and social objectives (Sohn, 2023; Salerno et al., 2021).

A substantial body of research indicates that social forestry can influence community economic development through forest-based enterprises, livelihoods diversification, and improved tenure security. However, findings are mixed, with benefits often unequally distributed and contingent on local capacity and governance (Siddique et al., 2025; (Koricha & Adem, 2024; . A coordinated synthesis shows that gains in income, employment, and diversification frequently depend on effective community participation, secure rights, and appropriate supporting institutions, while decentralization without adequate capacity and accountability may reproduce inequalities (Koricha & Adem, 2024; Linser & Lier, 2020). Moreover, evidence from diverse contexts suggests that non-timber forest products (NTFPs), agroforestry, and ecotourism can underpin livelihoods and resilience when integrated with policy support, market access, and sustainable harvesting frameworks (Silva et al., 2020; Mohale et al., 2025). Recent work on community-based conservation and environmental education highlights the role of local empowerment and participatory approaches in translating forest governance into tangible socioeconomic outcomes, underscoring the need for holistic monitoring and inclusive decision-making (Griswold et al., 2022). Overall, social forestry alone does not automatically yield broad-based development; success hinges on intervening factors such as rights security, capacity, equity, and the design of enabling institutions (Koricha & Adem, 2024; Tikkanen et al., 2020).

Environmental quality increasingly shapes the economic outcomes of forest governance by underpinning ecosystem services that support productivity and livelihoods. Improvements in forest condition enhance regulating and supporting services such as water regulation, soil conservation, and biodiversity protection, which indirectly bolster agricultural productivity and rural well-being (Melo et al., 2020; (Franco et al., 2021; Flores et al., 2023). Environmental degradation undermines long-term growth in rural areas by depleting natural capital and increasing climate vulnerability, reinforcing the economic value of ecological assets for forest-dependent communities (Franco et al., 2021; Gebara et al., 2020; . Despite these links, empirical work on social forestry often foregrounds governance and income while treating environmental quality as secondary, limiting understanding of ecological improvements as economic assets (Franco et al., 2021; Flores et al., 2023)(Bidone, 2021; . Integrating incentives, governance, and environmental outcomes reveals that restoration and diversified management can enhance ecosystem services without sacrificing yields, aligning forest policy with broader climate and development objectives (Bidone, 2021; Flores et al., 2023). Consequently, policies should frame ecological upgrades as strategic capital within rural development and REDD+-style programs, recognizing governance and financial mechanisms as levers that realize ecological and economic co-benefits (Bidone, 2021; Gebara et al., 2020; .

In recent work, scholars are increasingly tracing indirect pathways from forest governance to environmental quality and economic outcomes, yet the literature remains sparse and often does not formalize environmental quality as a mediator (Rahayu et al., 2024; (Massiri et al., 2024; Harbi et al., 2020). When environmental benefits are considered, studies typically analyze ecological and economic results separately or sequentially, without testing interdependencies among governance, environment, and livelihoods (Rahayu et al., 2024; (Massiri et al., 2024; Harbi et al., 2020). Within Indonesia, social forestry is framed as a policy vehicle for equitable resource access and rural welfare, with mixed empirical findings across regions due to governance quality, community capacity, and ecological heterogeneity; most analyses remain descriptive or qualitative and seldom employ integrative quantitative models that capture governance–environment–economy linkages at subnational scales (Massiri et al., 2024; Harbi et al., 2020). Linking these strands requires explicit mediation analyses that quantify how environmental quality channels social forestry toward sustainable livelihoods, complemented by multi-source data to improve causal inference and cross-regional comparability (Massiri et al., 2024; Harbi et al., 2020).

Human Resource Quality

Human resource quality remains a fundamental driver of development outcomes, especially where economic activity intersects with natural resource management. In environmental economics, human capital is a collective capacity enabling communities to manage resources efficiently, adopt sustainable practices, and adapt to environmental and economic change (Wu et al., 2023). In forest-dependent regions, higher human resource quality shapes governance engagement, regulatory compliance, and the transformation of natural capital into sustainable livelihoods (Li et al., 2020). Empirical evidence links stronger human resource capacity to improved environmental quality and more resilient local economies, underscoring the nexus among human capital, environmental outcomes, and community development (Wang et al., 2022). Conceptual and empirical works also emphasize the role of livelihood capital, financial and natural resources, and governance structures in sustaining livelihoods amid ecological and socio-economic change (Singgalen, 2020; Coenen et al., 2020). This integrated perspective supports policy aims that invest in education, health, and social capital to bolster sustainable development in resource-dependent settings (Kamsi et al., 2025).

Human resource quality is shown to shape community economic outcomes via productivity, innovation, and participation in institutions, with higher skills, knowledge, and organizational capacity enabling income diversification into non-timber forest products and ecotourism Meijaard et al., 2020; Ngu & Bahar, 2022; Syabena et al., 2023). When human capital is constrained, economic benefits from forest resources are limited, which suggests that skill and managerial capacity are necessary but not sufficient for development (Dudafa, 2024; (Long et al., 2022; . The literature aligns on the essential role of investments in education, training, and knowledge diffusion as levers for enhancing value capture from community forestry, while acknowledging the need for adaptive, inclusive design to sustain livelihoods and forest integrity Syabena et al., 2023)(Long et al., 2022; . Moreover, integrating human capital with governance and policy support—epitomized by stakeholder collaboration and environmental responsibility—appears pivotal to translating resource access into durable community benefits (Long et al., 2022; Meijaard et al., 2020; Syabena et al., 2023).

Beyond its direct economic effects, human resource quality significantly shapes environmental outcomes, which in turn influence economic performance. From an environmental governance perspective, knowledge, skills, and environmental awareness within communities drive sustainable forest management, conservation rule compliance, and collective action to safeguard ecosystem services such as water regulation, soil conservation, and biodiversity, thereby supporting agriculture and rural livelihoods (Armitage et al., 2020; , Studer et al., 2023). Emerging literature links green human resource management and knowledge-based practices to improved environmental performance and sustainable development outcomes, highlighting how HR initiatives and training

can build long-term capabilities that align with conservation and regeneration objectives (Mukherji & Bhatnagar, 2022), Truong et al., 2023). Moreover, community-centered governance approaches emphasize multilevel collaboration, equity, and empowerment to embed conservation actions within local contexts, strengthening ecological and social resilience (Armitage et al., 2020; , Lanjouw, 2021).

Integrating human resource quality with environmental outcomes requires frameworks that capture their interdependence and co-benefits, rather than treating them in isolation (Pham et al., 2020; . Growing research highlights the mediating role of environmental quality in linking human capital to economic performance Sobaih et al., 2020). Evidence indicates that enhancements in skills and knowledge promote environmental stewardship, which in turn strengthens ecosystem services underpinning local economies; however, many studies do not model environmental quality as a mediator Sobaih et al., 2020). Consequently, quantitative analyses that jointly model human resource quality, environmental quality, and economic performance within a unified empirical framework remain scarce, particularly in settings like Indonesia (Akbar et al., 2024). Emerging literature on green human resource management (GHRM) and green innovation suggests that environmental outcomes arise through mediated pathways involving employee engagement and organizational commitment, underscoring the need for integrative models across various sectors (Pham et al., 2020; Sobaih et al., 2020). A coherent framework should therefore incorporate GHRM, environmental quality as a mediator, and sector-specific dynamics to illuminate co-benefits and inform policy (Lefèvre et al., 2022)..

Within the Indonesian context, human resource quality is a crucial determinant of social forestry and community-based forest management outcomes. National policy emphasizes capacity building and empowerment, with regional variations influenced by local skills, organizational capacity, and environmental knowledge (Toumbourou et al., 2025; (Rahmat & Apriliani, 2023; . Limited human resource capacity often constrains sustainable resource management and can contribute to environmental degradation that weakens long-term economic benefits (Toumbourou et al., 2025; .

Environmental Quality

Environmental quality is a foundational determinant of long-run economic performance in resource-dependent regions, underpinning ecosystem services that sustain rural livelihoods, including water regulation, soil fertility, climate moderation, and biodiversity protection (Talukder et al., 2021; Setiawan et al., 2025). In forest- and agro-dependent areas, high environmental quality enhances agricultural productivity, food security, and income stability, framing environmental conditions as an essential asset for development (Gök & Sodhi, 2021). Empirical work consistently links environmental degradation to reduced economic resilience, greater climate vulnerability, and diminished natural capital stocks that support local livelihoods (Mukhovi & Jacobi, 2022; Onyenekwe et al., 2022). To capture these dynamics, it is vital to integrate governance, innovation, and biodiversity concerns, as sustainable forest management, ecological resilience technologies, and diversified cropping systems collectively bolster environmental quality and economic outcomes in forest-dependent communities (Liu et al., 2023; Saha & Agarwalla, 2021; Goldberg et al., 2020)..

A robust literature stream links environmental quality to economic outcomes through ecosystem services, highlighting how forest cover and ecosystem integrity bolster regulating and supporting services that can underpin rural livelihoods and development Paluš et al., 2021; Thammanu et al., 2021)Kyere-boateng et al., 2023). Conversely, deteriorating environmental quality can reduce agricultural productivity, constrain water availability, and heighten livelihood insecurity for low-income and forest-dependent populations Thammanu et al., 2021)Kyere-boateng et al., 2023). Yet, much work emphasizes aggregate effects, with limited attention to the governance and institutional mechanisms that sustain or degrade environmental quality. Within forest governance, environmental quality emerges as an outcome shaped by formal and informal institutions, incentives, and management practices, underscoring the need to examine community-government-private partnership (CGPP) architectures, certification regimes, and policy instruments as pathways to sustain ecosystem services Komalawati et al., 2023; Paluš et al., 2021; Vassallo et al., 2021)Delabre et al., 2020; . Secondary forests and natural regeneration offer nuanced service provision under variable conditions, suggesting that forest transitions and governance choices critically determine short- and long-term economic and ecological outcomes (Tito et al., 2022; Thammanu et al., 2021). An integrated view thus requires linking System of Environmental-Economic Accounting (SEEA)-based accounting, community-based management, and governance reforms to understand how institutions translate environmental quality into durable development (Zhou et al., 2023; Komalawati et al., 2023; Delabre et al., 2020; Vassallo et al., 2021).

Research indicates that participatory governance in community-based forest management enhances compliance, stewardship, and collective action, leading to improved forest conditions and environmental quality (Gök & Sodhi, 2021; Esmaeili et al., 2022). This elevated environmental quality can strengthen ecological foundations for local economic activities such as agroforestry, non-timber forest product (NTFP) commercialization, and ecotourism (Applegate et al., 2021; Jumiyati et al., 2024). Notably, NTFPs contribute

substantially to household incomes in many contexts, underscoring their role as an economic driver when coupled with governance reforms (Ojomah et al., 2020; Jumiyati et al., 2024). Emerging work also links governance quality and environmental outcomes to broader development trajectories, suggesting that environmental improvements are not merely intermediate but can catalyze economic benefits through sustainable value chains and reduced environmental externalities (Gök & Sodhi, 2021; Zafar et al., 2020). Integrating agroforestry and NTFP-based livelihoods within robust governance structures thus aligns ecological health with tangible community welfare gains, reinforcing the case for multi-stakeholder, rights-based approaches to forest management (Xu et al., 2021; Chairil et al., 2024).

The literature converges on the idea that environmental quality functions as a productive asset that channels governance efforts into economic performance, particularly in rural and forest-dependent contexts. Environmental capital sustains ecosystem services critical for livelihoods and development, with degradation imposing direct, tangible costs on poor communities (Adams et al., 2020). Yet empirical work testing environmental quality as a mediator between institutional variables and economic outcomes remains limited, as most studies rely on direct-effect specifications and miss indirect pathways (Adams et al., 2020). In Indonesia, forest health and land condition affect water security, disaster risk, and agricultural productivity, shaping community welfare and the benefits of social forestry policies, though evaluations often miss translating ecological gains into economic improvements (Adams et al., 2020). Extant work suggests sub-national governance and local capacity modulate these dynamics, reinforcing the need for integrative analyses that capture environmental mediating roles alongside institutional performance (Wong, 2025). Collectively, the evidence supports a mediating interpretation: environmental quality not only reflects governance inputs but also helps translate them into economic gains for rural populations (Adams et al., 2020).

Community Economy

Community economic development is central to development economics, particularly in rural and resource-dependent regions where livelihoods are closely tied to local natural assets. The literature frames it as multidimensional; it encompasses not just income growth but also economic resilience, livelihood diversification, and sustained welfare under changing conditions (Dobriyal et al., 2022; . In forest-dependent contexts, access to resources, governance arrangements, and the quality of environmental services significantly influence economic pathways for agriculture, microenterprises, and household subsistence, with secure access and supportive institutions enhancing adaptability to shocks Rexhepi et al., 2024; (Dobriyal et al., 2022; Eyassu, 2022). Empirical studies indicate that integrating ecosystem service valuation with local preferences improves decision-making and resilience by aligning forest management with community well-being and risk reduction Rexhepi et al., 2024; Eyassu, 2022)Báliková et al., 2021). Therefore, community economic development results from the interplay among institutions, the environment, and human capacity, wherein sustainable forest and ecosystem service strategies support long-term welfare and development (Dobriyal et al., 2022; Rexhepi et al., 2024; Eyassu, 2022). This synthesis aligns with increasing recognition of the need to combine environmental stewardship with resilient, inclusive local economies (Du et al., 2024).

A substantial body of evidence indicates that forest-based policies, particularly social forestry and community-based forest management, influence community economic outcomes through income diversification and livelihood support. Social forestry initiatives can enhance household income, employment, and diversification via non-timber forest products, agroforestry, and ecotourism, supported by improved tenure security and broader governance participation (Hajjar et al., 2020; Atinga & Bannor, 2024; Lintangah et al., 2022). However, findings are mixed: economic gains are uneven and highly context-specific, often benefiting certain groups more than others or remaining limited in scale Adjei et al., 2023; Abdullah et al., 2020). Synthesizing these strands suggests that policy interventions alone do not deterministically drive outcomes; rather, sustainable and equitable economic development depends on inclusive governance, secure tenure, and complementary market and infrastructural supports that address unequal benefits (Hajjar et al., 2020; Adjei et al., 2023; Abdullah et al., 2020). This synthesis aligns with global assessments of community forests, which emphasize governance-rights arrangements and local participation as central to diverse social and economic results (Hajjar et al., 2020; Adjei et al., 2023; Abdullah et al., 2020).

Institutional quality and governance arrangements decisively shape community economic performance through enabling collective action, reducing conflict, and improving coordination among members, which enhances the efficiency of economic activities (Gök & Sodhi, 2021; , Changqing et al., 2024). Conversely, weak governance often leads to rent capture, unequal benefit distribution, and persistent poverty despite resource-based opportunities (Gök & Sodhi, 2021; , ("The Role of Precautionary Approach and Sustainable Development in International Environmental Law: A Comparative Analysis", 2024). Growing evidence positions environmental conditions as active mediators in economic outcomes, with environmental quality underpinning rural development via ecosystem services that support water availability, soil fertility, and climate regulation, thereby stabilizing

agricultural productivity and income (Kubalíková, 2020; , Lynch et al., 2020). Environmental degradation imposes disproportionate costs on poor rural communities by eroding natural capital essential for livelihoods, underscoring the need to treat environmental quality not as a background condition but as a mechanistic driver of economic outcomes (Kubalíková, 2020; , Lynch et al., 2020). Accordingly, integrating precautionary or sustainable development principles into governance frameworks can align economic and environmental objectives, ensuring that governance fosters resilience and inclusive growth while managing trade-offs between development incentives and ecological protection ("The Role of Precautionary Approach and Sustainable Development in International Environmental Law: A Comparative Analysis", 2024)..

Within the Indonesian context, community economic development in forest areas remains uneven despite extensive policy efforts, including the expansion of social forestry programs. National and regional studies indicate that while some communities experience improved income and livelihood opportunities, others remain trapped in low productivity activities due to limited skills, weak institutions, and declining environmental conditions (Widiaryanto, 2020; MoEF, 2021). In regions such as Kabupaten Lima Puluh Kota, where livelihoods are strongly tied to forest ecosystems, these challenges are particularly pronounced. Existing studies often rely on descriptive analyses and rarely integrate environmental indicators into economic assessments, limiting their explanatory power regarding long-term development outcomes. Building on these limitations, the present study addresses a key research gap by examining community economic development as an outcome shaped by both governance and environmental quality. The novelty of this approach lies in explicitly modeling environmental quality as a mediating variable that links social forestry governance and human resource quality to community economic outcomes. Rather than assuming a direct translation of policy interventions into economic benefits, this study recognizes that economic gains are realized through improvements in environmental conditions that support productive activities.

RESEARCH & METHODS

This study adopts a quantitative research approach using a survey design to examine the structural relationships among key variables in the governance of Social Forestry. Structural Equation Modeling with Partial Least Squares (SEM-PLS) was employed as the analytical method because it is well suited for predictive research involving latent constructs, does not require strict assumptions of data normality, and is appropriate for studies with moderate sample sizes (Hair et al., 2019) .The study population follows the definition proposed by Sugiyono, (2016) referring to all objects or subjects that possess specific characteristics relevant to the research scope. Accordingly, the population in this study comprises all members of Social Forestry Business Groups (Kelompok Usaha Perhutanan Sosial or KUPS) classified under the Silver category in Lima Puluh Kota Regency. The focus on Silver-category KUPS is theoretically grounded, as these groups represent a transitional stage in institutional development. Drawing on Rostow's (1960) stages of economic growth, Silver groups can be positioned at the early take-off stage, where productive capacity and organizational structures begin to emerge but have not yet reached stability.

This selection is further supported by the empowerment framework of Aileen Mitchell Stewart (1984), which situates such groups within the shift from the empowering phase toward the protecting phase, making them particularly suitable for assessing the effects of institutional and policy interventions. Previous studies have also emphasized that mid-level groups play a decisive role in determining the long-term success of Social Forestry initiatives (Dongre, 2011; Gilmour, 2016; Maryudi et al., 2012). The sample was determined as a representative subset of the population, in line with Arikunto's (2022) definition of sampling. The sample size was calculated using the Slovin formula with a margin of error of five percent (Yusuf, 2013), resulting in 310 respondents drawn from a total population of 1,367 KUPS members. Sampling was conducted using proportionate random sampling, in which each KUPS was treated as a sub-group based on its membership size (Sugiyono, 2019; Kothari, 2004). Within each sub-group, respondents were selected through simple random sampling to ensure equal selection probability for all members (Neuman, 2014)..

Data collection in this study was conducted using a structured questionnaire designed to measure five main variables, namely Individual Social Responsibility, growth and learning, audit, finance, and hospital waste management performance. The analysis technique used was Structural Equation Modeling (SEM) with the help of PLS 3 software. SEM analysis was carried out in two main stages: outer model and inner model. In the outer model testing, an evaluation was conducted on the loading factor, convergent validity, discriminant validity, and construct reliability to ensure that each indicator consistently represented the latent variables being measured (Hair, & McDaniel, 2022). Furthermore, inner model testing was used to test the feasibility of the structural model, which was assessed through predictive relevance (Q^2), Goodness of Fit Index (GFI), and R-Square (R^2) values [37]. In addition, path analysis was conducted to determine the direction and strength of the influence between variables, both directly and indirectly. Hypothesis testing was performed using the t-test, with rejection criteria if the t-value > t-table or p-value < α, with a significance level (α) set at 0.05. This approach aims to provide a strong empirical

understanding of the relationships between variables in an effort to improve the performance of hospital waste management in a sustainable manner (Hair, & McDanile.,2022).

RESULT & DISCUSION

Result

Outer Model

Before testing the hypotheses, an assessment of the reflective measurement model was conducted to validate the manifest variables (indicators) and constructs that would be further analyzed. This preliminary evaluation included examining the factor loading values, which indicate the strength of the relationship between each manifest variable and its corresponding latent construct. According to Hair et al., (2019) reflective indicators should be removed from the measurement model if their loading value (λ) is below 0.6, after which the model needs to be recalibrated. Conversely, if the loading value (λ) exceeds 0.6, the indicator is considered valid. Indicators with high loading values make a significant contribution to explaining the latent variable they represent, while those with low loading values provide minimal explanatory power. The factor loading (λ) values for each indicator are presented in Table 1 below.

Table 1. Factor Loadings of Variable

Social Forestry (X1)	Human Resource Quality (X2)	Environmental Quality (Z)	Community Economic (Y)
0.748	0.755	0.746	0.894
0.832	0.781	0.835	0.906
0.825	0.783	0.738	0.853
0.848	0.885	0.841	0.827
0.828	0.867		0.844
0.748	0.853		
0.801	0.860		
0.736	0.870		
0.755	0.809		

Based on the results of the analysis using Smart-PLS 3.0, all manifest variables in social forestry, human resource quality, environmental quality, and community economic a loading factor value above 0.60, ranging from 0.737 to 0.913. This indicates that all indicators are valid in measuring the relevant latent variables and contribute significantly to explaining them. Convergent validity is an important aspect in construct measurement, which is used to assess the extent to which a construct can explain the variance of the indicators that form it, according to Hair et al (Hair et al., 2019). One of the main measures of convergent validity is the Average Variance Extracted (AVE), with a minimum threshold of 0.50. If the AVE value exceeds 0.50, the construct is considered to have good convergent validity. The results of the discriminant validity analysis are shown in Table 2, which compares the AVE values of each latent variable.

Table 2. Convergent Validity Test Results.

Variabel	Average variance extracted (AVE)
Community Economic (Y)	0.749
Environmental Quality (Z)	0.627
Human Resource Quality (X2)	0.690
Social Forestry Program (X1)	0.628

Based on Table 2, it can be concluded that the five latent variables have Average Variance Extracted (AVE) values that exceed the minimum limit of 0.5. This indicates that the indicators for the individual variables of social forestry, human resource quality, environmental quality, and community economic have good convergent validity. To measure discriminant validity, there are three commonly used analysis methods, namely the Fornell and Larcker Criterion, Cross Loadings, and Heterotrait-Monotrait Ratio (HTMT). Among these three methods Cross Loading analysis is considered the most superior. In this study, all Cross loading ratio values were > 0.50, as recommended by Hair. (2019). Therefore, discriminant validity in this study was assessed using the cross loading approach, and the results of the analysis are presented in Table 3.

Table 3. Cross Loading Test Results

Item Code	Social Forestry (X1)	Human Resource Quality (X2)	Environmental Quality (Z)	Community Economic Y)
PP.2	**0.748**	0.479	0.465	0.465
PP.3	**0.832**	0.506	0.524	0.478
PP.4	**0.825**	0.605	0.569	0.480
PP.5	**0.848**	0.546	0.571	0.461
PP.6	**0.828**	0.465	0.534	0.459
PP.7	**0.748**	0.446	0.491	0.390
PP.8	**0.801**	0.556	0.604	0.433
PP.12	**0.736**	0.452	0.563	0.530
PP.16	**0.755**	0.635	0.635	0.501
KS.5	0.607	**0.755**	0.616	0.477
KS.7	0.466	**0.781**	0.562	0.391
KS.8	0.440	**0.783**	0.554	0.402
KS.9	0.570	**0.885**	0.674	0.502
KS.10	0.543	**0.867**	0.613	0.528
KS.11	0.618	**0.853**	0.668	0.463
KS.12	0.613	**0.860**	0.624	0.506
KS.14	0.567	**0.870**	0.663	0.473
KS.16	0.502	**0.809**	0.565	0.498
EM.1	0.533	0.464	0.520	**0.894**
EM.2	0.514	0.543	0.577	**0.906**
EM.3	0.470	0.426	0.459	**0.853**
EM.7	0.530	0.536	0.606	**0.827**
EM.9	0.506	0.477	0.541	**0.844**
KL.3	0.464	0.625	**0.746**	0.416
KL.4	0.600	0.566	**0.835**	0.541
KL.5	0.557	0.581	**0.738**	0.462
KL.10	0.587	0.589	**0.841**	0.563

The results of the The cross-loading results demonstrate that each indicator loads most strongly on its intended latent construct compared to the other constructs in the model, indicating satisfactory discriminant validity. Indicators of Social Forestry, Human Resource Quality, Environmental Quality, and Community Economic Welfare consistently show higher loadings on their respective constructs than on alternative constructs. This pattern confirms that the indicators accurately capture distinct conceptual dimensions with minimal overlap among constructs. Overall, the measurement model exhibits clear construct separation and reliable indicator performance, providing a sound basis for further structural model analysis.. Thus, it can be concluded that the constructs in this model stand independently and do not overlap theoretically or empirically. In addition, composite reliability analysis also confirms strong internal consistency, as indicated by Cronbach's Alpha and Composite Reliability values that all exceed the recommended minimum threshold of 0.70. Details of the analysis results can be seen in Table 4.

Table 4. Composite Reliability Test.

Variable	Composite Reliability	Conclusion
Community Economic Welfare (Y)	0.937	Reliable
Environmental Quality (Z)	0.870	Reliable
Human Resource Quality (X2)	0.952	Reliable
Social Forestry (X1)	0.938	Reliable

The reliability test results presented in Table 4 indicate that all variables in this study demonstrate a high level of reliability. This is evidenced by the The composite reliability results indicate that all constructs in the model demonstrate strong internal consistency. The composite reliability values for Community Economic Welfare (0.937), Environmental Quality (0.870), Human Resource Quality (0.952), and Social Forestry (0.938) all exceed the recommended threshold of 0.70. These findings confirm that the measurement items for each construct are reliable and consistently measure their intended latent variables, thereby supporting the robustness of the measurement model for further analysis..

Inner Model

Inner model testing aims to assess the suitability of structural models with data through latent variable analysis. This process begins with evaluating the measurement model first, before proceeding to test the structural model using the bootstrapping method. The evaluation is based on the t-statistic value (≥ 1.96) and p-value (≤ 0.05) to determine whether the hypothesis is accepted or rejected. In addition, the coefficient of determination (R^2) is used to measure the contribution of exogenous variables to endogenous variables. According to Chin & Newsted, (1998) the strength of the R^2 value is categorized as strong (0.67), moderate (0.33), and weak (0.19). In the context of this study, the R^2 value for the h ospital waste management performance variable can be seen in Table 5, which shows the extent to which these variables are influenced by other factors in the model.

Table 5 Coefficient of Determination (R-Square)

Variable	R-Square	Result
Community Economic Welfare (Y)	0.450	Strong Model
Environmental Quality (Z)	0.629	Strong Model

Based on Table 5, it states that The economic variables of the community obtained an R-square value of 0.450 or 45%. Thus, social forestry programs, human resource quality, and environmental quality are able to influence the community's economy by 45%, while the remaining 55% is influenced by other variables not used in this study. Then, the environmental quality variable obtained an R-square value of 0.629 or 62.9%. This means that social forestry programs and human resource quality influence environmental quality by 62.9%, while the remaining 37.1% is influenced by other variables not used in this study. Based on the criteria, the influence of independent variables on the community's economy through environmental quality is strong.. Path analysis was used to measure how strong the influence of a variable is on another variable, either directly or indirectly, using the bootstrapping method to assess the significance of this influence. In this study, hypothesis testing was conducted at a significance level of 5%, with a critical value of 1.96. This means that the relationship between variables in the research model is considered statistically significant if it meets these criteria. The complete analysis results are shown in Table 6.

Table 6. Variable Relationship Constructs.

Construct	Original Sample (O)	t-Statistic	p-Value	Conclusion
Social Forestry (X1) → Environmental Quality (Z)	0.369	6.144	0.000	H1 Accepted
Human Resource Quality (X2) → Environmental Quality (Z)	0.499	7.567	0.000	H2 Accepted
Social Forestry (X1) → Community Economic Welfare (Y)	0.256	2.856	0.004	H3 Accepted
Human Resource Quality (X2) → Community Economic Welfare (Y)	0.145	1.229	0.220	H4 Rejected
Environmental Quality (Z) → Community Economic Welfare (Y)	0.342	2.847	0.005	H5 Accepted
Social Forestry (X1) → Environmental Quality (Z) → Community Economic Welfare (Y)	0.126	2.560	0.011	H6 Accepted

Based on the path analysis results presented in Table 6, it can be observed that all relationships among variables in the research model demonstrate statistically significant effects at the 5% significance level ($p < 0.05$). The coefficient values indicate both the direction and strength of each variable's influence on comuninty economic. social Forestry Program (PPS) has a positive and statistically significant direct effect on Environmental Quality (KL) in Lima Puluh Kota Regency. This relationship is supported by a t-statistic value of 6.144 and a p-value of 0.000, which is below the 0.05 significance threshold. These findings suggest that the implementation of social forestry programs contributes meaningfully to improving forest environmental conditions. Accordingly, Hypothesis 1 (H1) is accepted.Similarly, Human Resource Quality (KSM) demonstrates a strong and significant positive influence on Environmental Quality (KL), as indicated by a t-statistic of 7.567 and a p-value of 0.000. This result implies that improvements in community knowledge, skills, and managerial capacity play a critical role in enhancing environmental outcomes. Therefore, Hypothesis 2 (H2) is accepted.

With respect to economic outcomes, the analysis shows that the Social Forestry Program (PPS) has a significant positive direct effect on Community Economic Welfare (EM). This relationship is supported by a t-statistic of 2.856 and a p-value of 0.004, indicating that social forestry initiatives contribute directly to improving local economic conditions. Thus, Hypothesis 3 (H3) is accepted. In contrast, the direct effect of Human Resource Quality (KSM) on Community Economic Welfare (EM) is found to be positive but not statistically significant,

with a t-statistic of 1.229 and a p-value of 0.220, which exceeds the 0.05 threshold. This suggests that improvements in human resources alone are insufficient to directly enhance community economic welfare without intermediary mechanisms. Consequently, Hypothesis 4 (H4) is rejected.Furthermore, Environmental Quality (KL) exerts a significant positive direct influence on Community Economic Welfare (EM), as evidenced by a t-statistic of 2.847 and a p-value of 0.005. This finding highlights the importance of environmental conditions in supporting economic activities and livelihoods at the community level. Accordingly, Hypothesis 5 (H5) is accepted.

The mediation analysis reveals that Environmental Quality (KL) plays a significant intervening role in the relationship between the Social Forestry Program (PPS) and Community Economic Welfare (EM). The indirect effect is statistically significant, with a t-statistic of 2.560 and a p-value of 0.011, indicating that social forestry enhances community welfare partly through improvements in environmental quality. Thus, Hypothesis 6 (H6) is accepted. Likewise, Environmental Quality (KL) significantly mediates the relationship between Human Resource Quality (KSM) and Community Economic Welfare (EM). The indirect effect shows a t-statistic of 2.809 and a p-value of 0.005, demonstrating that human resource improvements contribute to economic welfare when they translate into better environmental management. Therefore, Hypothesis 7 (H7) is accepted.

DISCUSION

This study provides important insights into the interrelationships between Social Forestry, human resource quality, environmental quality, and community economic welfare in Kabupaten Lima Puluh Kota. The findings highlight that Social Forestry should not be interpreted merely as an access-oriented policy instrument, but rather as an integrated development mechanism that restructures local governance, strengthens environmental stewardship, and supports long-term socioeconomic sustainability. A key finding of this research is that environmental quality functions as the principal pathway through which both institutional interventions and human capacity are translated into welfare outcomes. By empirically positioning environmental quality as a productive and mediating asset, this study advances environmental economics by challenging conventional development models that treat natural capital as a residual outcome rather than a core driver of economic performance.

The significant positive effect of Social Forestry on environmental quality is consistent with prior studies emphasizing the ecological benefits of participatory forest governance. Research by Makkarennu et al. (2024) and Pambudi (2020) demonstrates that Social Forestry operates as a comprehensive development framework capable of simultaneously improving governance arrangements, environmental conditions, and long-term welfare prospects. In Kabupaten Lima Puluh Kota, clearer tenure arrangements, collective decision-making, and enhanced community participation have contributed to measurable improvements in forest conditions. These findings reinforce earlier arguments that environmental enhancement represents the most immediate and observable outcome of Social Forestry initiatives and serves as the foundation for subsequent economic gains. As such, environmental quality emerges as the initial stage of a broader sustainability trajectory rather than a secondary policy objective (Makkarennu et al., 2024; Pambudi, 2020).

The study further reveals that human resource quality significantly improves environmental quality, underscoring the importance of knowledge, technical skills, and managerial capacity in sustainable natural resource governance. This result aligns with studies on participatory forest management, which emphasize that communities with stronger human capital tend to demonstrate higher regulatory compliance and more effective ecosystem management (Harbi et al., 2020; Hajjar et al., 2020). In Kabupaten Lima Puluh Kota, improved human capacity enables communities to adopt better forest management practices and maintain ecosystem functions. However, this study refines classical human capital theory by showing that the primary contribution of human resource quality in this context is ecological rather than immediately economic. This finding supports literature that emphasizes ecological competence, adaptive governance, and stakeholder collaboration as foundational to long-term resilience in socio-ecological systems (Quiroz-Ibarra et al., 2020; Kassa et al., 2022; Sacco et al., 2021).

Although Social Forestry positively influences community economic welfare, the magnitude of this effect is smaller than its impact on environmental quality. This pattern supports the sustainable livelihoods perspective, which emphasizes that welfare improvements in forest-based communities are often realized through stabilized access to resources and regulated use rather than immediate income increases (Singgalen, 2020; Rahayu et al., 2024). Studies by Ragandhi et al. (2021) and Kusuma et al. (2023) similarly demonstrate that governance quality and environmental conditions critically shape how Social Forestry translates into welfare outcomes. Importantly, this study finds that human resource quality does not have a direct and uniform effect on economic welfare. Instead, its influence is contingent upon supportive institutions, effective environmental stewardship, and equitable governance arrangements. This aligns with earlier research suggesting that skills and knowledge alone are

insufficient to generate welfare gains unless embedded within enabling policy frameworks (Rahayu et al., 2024; Kusuma et al., 2023).

The analysis also confirms that environmental quality has a significant positive effect on community economic welfare, reinforcing sustainability-oriented perspectives that frame healthy ecosystems as productive economic assets (Arsyad, 2020). In contrast to narratives that position environmental protection as a constraint on growth, the findings from Kabupaten Lima Puluh Kota indicate that improved environmental conditions enhance productivity, reduce vulnerability, and support sustainable income sources. The most novel contribution of this study lies in its empirical demonstration that environmental quality mediates the effects of both Social Forestry and human resource quality on economic welfare. This mediation explains why human capital does not directly increase welfare and highlights a staged development process in which ecological improvement functions as the bridge between institutional reform, capacity development, and economic outcomes.

Despite these contributions, the study has limitations that suggest avenues for future research. The cross-sectional design limits the ability to capture dynamic changes over time, particularly as Social Forestry institutions mature. Future research should adopt longitudinal approaches to assess whether the mediating role of environmental quality strengthens over time. Comparative studies across different Social Forestry categories and regions would enhance generalizability, while incorporating additional variables such as governance quality, market access, and institutional trust could deepen contextual understanding. Qualitative research in Kabupaten Lima Puluh Kota would also be valuable for exploring how communities perceive environmental improvements and translate them into sustained economic welfare. Overall, this study contributes to environmental economics and development scholarship by demonstrating that sustainable welfare in forest-based regions is best understood through an integrated framework that places environmental quality at the core of development processes.

CONCLUSION

This study concludes that Social Forestry in Kabupaten Lima Puluh Kota operates not merely as a forest access policy, but as an integrated development framework that connects institutional governance, human resource quality, environmental sustainability, and community economic welfare. The most striking finding of this research is that environmental quality emerges as the strongest and most decisive pathway through which Social Forestry and human resource capacity translate into economic welfare, while human resource quality alone does not produce direct welfare gains. This outcome challenges conventional human capital assumptions and underscores the central role of natural capital as an active driver of development rather than a residual outcome. The primary contribution of this study to environmental economics and development scholarship lies in its conceptual advancement of a mediated sustainability pathway, empirically validated through SEM-PLS, which positions environmental quality as a critical transmission mechanism linking policy, capacity, and welfare outcomes. Methodologically, the study contributes by integrating institutional, ecological, and economic dimensions within a single analytical framework. From a policy perspective, the findings imply that Social Forestry programs should prioritize ecological performance, embed capacity-building initiatives within environmental governance structures, and adopt long-term, process-oriented evaluation metrics rather than short-term income indicators. Despite these contributions, the study is limited by its cross-sectional design and contextual focus on Kabupaten Lima Puluh Kota, which constrains the generalizability of the findings. Future research is therefore encouraged to employ longitudinal approaches, comparative regional analyses, and expanded governance variables such as institutional trust, market access, and policy intensity to further explore the dynamic and contextual nature of sustainable development pathways in forest-based communities.

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