

Gender-Inclusive Governance for Environmental Sustainability in Smallholder Coffee Systems: Evidence from the Gayo Highlands, Indonesia

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Abstract

Smallholder coffee systems require effective governance to balance rural livelihoods and environmental sustainability. This study examines how gender exclusion shapes governance effectiveness and sustainability outcomes in the Gayo Highlands, Indonesia. Using qualitative interviews and policy analysis, it explores how institutional arrangements influence land management, climate resilience, and value chain dynamics. The findings reveal that fragmented regulations, weak coordination, and limited participation of women in land ownership, cooperative leadership, and decision-making processes undermine governance effectiveness and agroecosystem resilience. These conditions encourage short-term land-use strategies, reduce investment in soil conservation and agroforestry, and increase vulnerability to climate change. Women's participation remains largely symbolic, limiting the integration of local ecological knowledge into governance processes. The study concludes that gender exclusion constitutes a key structural barrier to sustainable coffee systems. Improving sustainability therefore requires strengthening institutional coordination, expanding women's access to resources and leadership, and embedding gender-responsive mechanisms within governance structures. It further recommends adopting gender-inclusive polycentric governance to enhance accountability, support adaptive decision-making, and improve environmental outcomes in smallholder coffee systems.

Keywords

Gender-Inclusive Governance, Gender Exclusion, Polycentric Governance, Environmental Sustainability, Smallholder Coffee

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1. INTRODUCTION

Coffee production landscapes embody complex socio-ecological systems (SES) that intricately intertwine agricultural productivity, rural livelihoods, and vital ecosystem services, including biodiversity conservation, soil fertility maintenance, carbon sequestration, and hydrological regulation (Salmayenti et al., 2022; Shattuck et al., 2023; Tenriawaru et al., 2020). In Indonesia's Gayo Highlands of Aceh, specialty Arabica coffee, renowned for its superior flavor derived from traditional shade-grown agroforestry practices, serves as an economic cornerstone, supporting over 100,000 smallholders while also functioning as a critical ecological buffer that stabilizes fragile volcanic soils and moderates local microclimates under increasing temperature pressures (Ikhsan et al., 2024; Rahmaddiansyah et al., 2022).

These systems not only sustain local livelihoods through premium coffee exports but also play a critical role in preserving upland forests, regulating hydrological cycles, and

enhancing landscape resilience. However, smallholders are increasingly confronted with interconnected socio-ecological pressures, including land-use intensification, progressive soil nutrient depletion, and escalating climate variability such as prolonged droughts. These challenges are not merely biophysical but are deeply embedded in governance structures that shape resource access, decision-making authority, and incentive systems. In this context, governance plays a pivotal role in determining environmental sustainability outcomes in smallholder agricultural systems. Weak and fragmented institutional arrangements often fail to align short-term economic incentives with long-term sustainability objectives, thereby accelerating ecological degradation while reinforcing existing structural inequalities (Brondizio, 2025; Grohmann et al., 2023; Wright, 2024).

Within this governance context, gender dynamics play a pivotal role in shaping environmental sustainability outcomes, as structural exclusion constrains both participation

and adaptive capacity. In the Gayo Highlands, women contribute extensively across the entire coffee production chain, from land preparation and pruning to harvesting, wet milling, sorting, and informal marketing, often comprising 60–70% of the workforce. Despite this substantial contribution, patriarchal norms and customary institutions systematically restrict women's access to secure land tenure, cooperative leadership positions, price-negotiation authority, and equitable shares of value-chain benefits (Calo et al., 2024; Hajad et al., 2025a; Martial et al., 2023). This disconnect between labor contribution and decision-making power reflects a deeper institutional imbalance that limits inclusive governance, a pattern widely observed in socio-ecological governance systems characterized by entrenched inequalities (Brondizio, 2025).

This structural marginalization has direct implications for environmental sustainability. The exclusion of women from governance processes undermines the integration of localized ecological knowledge, which is critical for sustainable land management practices and the co-production of ecosystem services (Zoumides et al., 2025; Hirono and Nurdin, 2024). At the same time, restricted access to resources, information, and adaptive technologies, such as drought-resistant varieties and climate-smart practices, constrains farmers' capacity to respond effectively to environmental stressors (De Leijster et al., 2021). As a result, smallholders are often pushed toward short-term, extractive strategies, including excessive chemical input use and simplified monocropping systems, which accelerate soil degradation and reduce agroecosystem resilience, particularly in contexts characterized by weak regulatory enforcement and limited institutional accountability (Hajad et al., 2025b).

Policy frameworks in Indonesia provide partial responses but remain insufficient to address these structural challenges. Regional instruments, such as Aceh Governor Regulation No. 32/2022 on Gayo Arabica coffee and Qanun No. 3/2020 on farmer protection and empowerment, demonstrate a formal commitment to strengthening the sector. However, these policies lack explicit gender-inclusive provisions and are undermined by fragmented implementation, limited inter-agency coordination, and opaque decision-making processes that tend to favor local elites. Weak enforcement capacity further constrains their effectiveness, reducing institutional credibility and limiting the adoption of sustainable practices (Damayanti and Setiadi, 2019; Vicol et al., 2018). Consequently, smallholders face increasing pressure to comply with global sustainability standards, such as Organic, Fairtrade, UTZ, Rainforest Alliance, and 4C certifications, without adequate institutional support, exposing them to market exclusion, economic penalties, and heightened environmental risks when compliance cannot be met (Effiong et al., 2024; Ibrahim, 2026).

Recent studies have increasingly examined gender inequality in agricultural systems and governance challenges within coffee value chains.

(Croppenstedt et al., 2013; Grohmann et al., 2023; Kangile et al., 2021; Samoggia and Fantini, 2023; Vicol et al., 2018). However, much of this literature tends to frame gender primarily as a social or developmental concern, rather than as a structural dimension embedded within governance systems. As a result, limited attention has been given to how institutional arrangements, particularly fragmentation, weak coordination, and unequal power distribution, interact with gender exclusion to shape environmental outcomes in smallholder agroecosystems (FAO, 2023; UN Women, 2023). This gap is especially evident in Southeast Asian contexts, where socio-cultural norms and governance structures jointly influence resource access and decision-making processes (Huyer et al., 2024). Addressing this limitation, the present study positions gender-inclusive governance as a critical pathway for advancing environmental sustainability in smallholder coffee systems.

To analyze this relationship, this study draws on Ostrom's polycentric governance framework (Ostrom, 2010), which conceptualizes socio-ecological system (SES) resilience as emerging from multiple, interconnected centers of decision-making authority, including households, cooperatives, local governments, and state institutions. These actors are linked through nested and context-specific rules that enable adaptive governance across scales. In the context of Common-Pool Resources (CPRs) such as Gayo's coffee agroecosystems, sustainability depends on key design principles, including clearly defined boundaries, participatory rule-making, effective monitoring, and multi-level coordination. While these principles provide a robust foundation for understanding institutional performance, they have rarely been examined through a gender lens. This study extends the polycentric governance framework by explicitly integrating gender inclusion as a core mechanism for strengthening participation, enhancing knowledge integration, and improving environmental sustainability outcomes in smallholder coffee systems.

However, institutional realities in the Gayo Highlands reveal substantial deviations from the ideal principles of polycentric governance. Legal uncertainty, stemming from the absence of a finalized Coffee Qanun, combined with entrenched power asymmetries between smallholders and dominant market actors, and the systematic exclusion of women from collective decision-making processes, collectively undermines governance effectiveness and weakens socio-ecological resilience (Hartono et al., 2023; Martial et al., 2023). These overlapping constraints not only fragment institutional coordination but also disrupt the alignment between short-term economic incentives and long-term environmental sustainability. In this context, gender exclusion emerges not merely as a social inequity, but as a fundamental governance failure with direct and measurable environmental consequences.

Building on this premise, this study makes three key contributions to the literature. First, it reconceptualizes gender exclusion as a structural governance failure rather

than a peripheral social issue. Second, it provides empirical evidence linking institutional fragmentation and gender inequality to environmental degradation and climate vulnerability in smallholder coffee systems. Third, it advances polycentric governance theory by integrating gender inclusion as a core institutional variable shaping socio-ecological outcomes. To address these contributions, the study examines three central questions: (1) how regulatory gaps produce gender exclusion and broader governance failures; (2) how institutional barriers influence sustainable land management, climate resilience, and agroecosystem health; and (3) how polycentric governance can inform inclusive and sustainable pathways.

Drawing on qualitative interviews with 35 stakeholders, including farmers, cooperative leaders, and government officials, combined with in-depth policy analysis, the study identifies key mechanisms underlying governance fragmentation and proposes gender-inclusive polycentric strategies that strengthen transparency, institutional coordination, and the integration of local knowledge. These findings contribute to advancing socio-ecological systems governance and provide policy-relevant insights for equitable and climate-resilient agricultural development.

2. EXPERIMENTAL SECTION

2.1 Study Design and Study Area

This study employs a qualitative single-case study design (Gerring and McDermott, 2007; Yin, 2018) to examine how governance dynamics shape gender inclusion and environmental sustainability within the Gayo coffee sector. A single-case approach is particularly appropriate for investigating complex socio-ecological systems (SES), as it enables an in-depth exploration of the interactions among institutions, social actors, and ecological processes operating across multiple governance levels (Flyvbjerg, 2006). The design facilitates the identification of governance mechanisms through which regulatory arrangements, institutional practices, and participation patterns influence environmental and social outcomes.

The Gayo Highlands constitute an information-rich and analytically significant case for examining these relationships. As one of Indonesia's most prominent specialty coffee-producing regions, the area combines strong agroecological potential with persistent governance challenges, including fragmented institutional arrangements, unequal access to resources, and varying levels of stakeholder participation. These characteristics make the region particularly relevant for understanding how governance structures shape sustainability outcomes in smallholder coffee systems and provide broader insights into polycentric governance in agricultural landscapes.

The study was conducted in the Gayo Highlands of Central Aceh Regency, Aceh Province, Indonesia, one of the country's most important Arabica coffee-producing regions. Coffee cultivation occupies approximately 120,000 hectares

at elevations ranging from 1,200 to 2,000 meters above sea level. Production is predominantly managed by smallholder farmers operating agroforestry-based systems that integrate coffee plants with shade trees. These agroforestry systems contribute to soil conservation, biodiversity maintenance, and microclimate regulation while simultaneously supporting rural livelihoods. However, their sustainability is closely linked to the effectiveness of governance arrangements that regulate resource management, market access, and stakeholder participation.

To examine these dynamics, the analysis focuses on three interrelated governance dimensions: (1) regulatory frameworks, including government policies and sustainability certification schemes; (2) institutional practices, such as cooperative governance, coordination mechanisms, and power relations among actors; and (3) participation patterns, particularly the inclusion of women in decision-making processes. Together, these dimensions influence land management practices, adaptive capacity, and environmental sustainability within the broader socio-ecological system.

Figure 1 illustrates the geographical location of the study area in the Gayo Highlands, Central Aceh Regency, Aceh Province, Indonesia. The map provides spatial context for the research and highlights the region as a key Arabica coffee production landscape where governance, environmental sustainability, and rural livelihoods are closely interconnected.

2.2 Data Collection

Primary data were collected through 35 semi-structured interviews conducted between January and April 2025. A combination of purposive and snowball sampling was employed to capture diverse and theoretically relevant perspectives across the coffee value chain, ranging from upstream production activities to downstream market and governance actors. Participants were selected based on three criteria: (1) direct involvement in the coffee sector, (2) experience in governance or decision-making processes, and (3) representation of key stakeholder groups relevant to coffee governance and sustainability.

The sample size is consistent with qualitative saturation principles for single-case research, ensuring analytical depth without redundancy (Guest et al., 2006). Data collection continued until thematic saturation was reached, at which point no substantially new themes emerged from the interviews. The final sample comprised 14 smallholder coffee farmers, 5 cooperative leaders, 4 local government officials, 3 NGO representatives, 3 traditional and community leaders, 4 coffee traders and exporters, and 2 academic experts and journalists (see Table 1).

Interview protocols were pilot-tested through two preliminary interviews and designed to explore key dimensions of governance, gender inclusion, and environmental sustainability. Core topics included regulatory arrangements (e.g., the Coffee Qanun), participation in decision-making processes (e.g., women's roles in cooperatives), gender-based

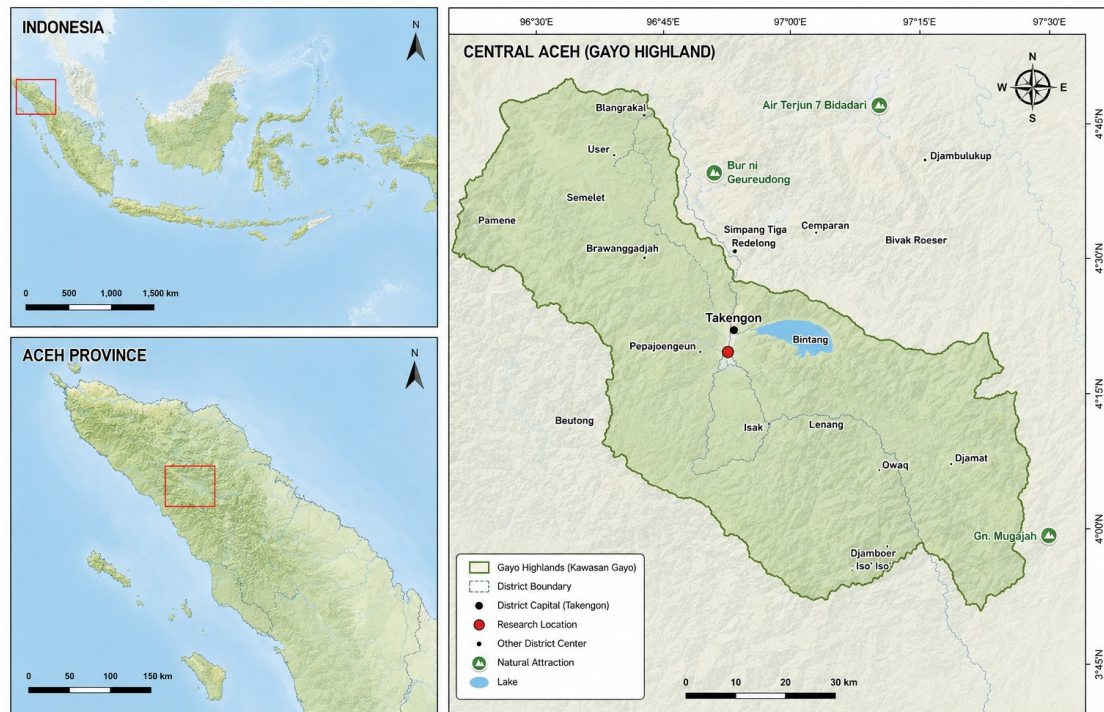


Figure 1. Study Area and Research Sites in the Gayo Highlands, Aceh Province, Indonesia Source: Authors' Elaboration Based on Google Maps and Field Observations (2025)

Table 1. Participant Categories and Analytical Contributions

Participant Category	Number of Participants	Analytical Contribution
Smallholder Coffee Farmers	14	Gendered experiences, livelihood strategies, land management practices, and climate adaptation challenges
Cooperative Leaders	5	Cooperative governance, certification systems, institutional arrangements, and decision-making processes
Local Government Officials	4	Policy implementation, regulatory frameworks, and governance challenges
NGO Representatives	3	Gender advocacy, community empowerment, and sustainability initiatives
Traditional and Community Leaders	3	Customary institutions, socio-cultural norms, and local governance practices
Coffee Traders and Exporters	4	Market dynamics, certification requirements, and value chain governance
Academic Experts and Journalists	2	Contextual interpretation, historical developments, and sectoral trends
Total	35	

Source: Authors' Fieldwork and Participant Classification (2025)

constraints (e.g., access to land and resources), land management practices (e.g., shade-tree systems), and sustainability challenges such as soil degradation and climate variability. The semi-structured format ensured consistency across in-

terviews while allowing participants to elaborate on their experiences and context-specific perspectives (Horton et al., 2004).

Interviews lasted between 45 and 120 minutes, with an

average duration of approximately 75 minutes. They were conducted in locations preferred by participants, including farms, homes, cooperative offices, and informal community meeting spaces. All interviews were audio-recorded with informed consent, transcribed verbatim in Bahasa Indonesia, and translated into English by bilingual researchers. Back-translation procedures were employed to ensure translation accuracy. In addition, field notes were used to document contextual observations, interactions, and non-verbal expressions that supported data interpretation.

To complement and triangulate the interview findings, a range of secondary sources was systematically reviewed. These included policy and regulatory documents, such as Aceh Governor Regulation No. 32/2022 and draft Coffee Qanun regulations, cooperative reports published between 2018 and 2025, regional development planning documents (Rencana Pembangunan Jangka Menengah Daerah, RPJMD Aceh), peer-reviewed academic literature, NGO reports, and relevant media coverage. These materials provided institutional, regulatory, and historical context for understanding governance dynamics within the Gayo coffee sector. Document and archival analysis further supported the validation of primary data by enabling cross-verification across multiple sources and reconstructing key governance processes over time. The integration of primary and secondary evidence enhanced the credibility, contextual depth, and analytical rigor of the study.

2.3 Data Analysis

Data analysis followed the interactive model of Miles and Huberman (1994), as extended by Miles et al. (2014), involving iterative and non-linear processes of data reduction, data display, and conclusion drawing/verification. Data reduction was conducted through a three-stage coding process: open coding to generate initial descriptive labels, axial coding to identify relationships between themes, and selective coding to develop core analytical categories linking governance, gender, and environmental sustainability.

NVivo 14 software was used to facilitate data organization, coding, and visualization of thematic relationships. During the open coding stage, interview transcripts, field notes, and documentary materials were examined line-by-line to identify recurring concepts related to governance arrangements, participation, gender inclusion, resource access, and environmental sustainability. In the axial coding stage, conceptually related codes were grouped into broader categories reflecting institutional dynamics and socio-ecological processes. Finally, selective coding was used to integrate these categories into overarching themes that structured the findings and discussion (see Table 2).

Table 2 illustrates how the coding process progressed from initial descriptive categories (open codes) to broader analytical categories (axial codes) and ultimately to the core themes developed in the findings. The coding structure enhanced analytical transparency by demonstrating

how empirical observations and participant narratives were systematically translated into the principal themes that underpin the study's interpretation of governance, gender inclusion, and environmental sustainability. Data display techniques included thematic matrices, actor comparison tables, and process tracing to enable systematic comparison across stakeholder groups (e.g., farmers versus government officials).

The analysis was structured around three interrelated domains aligned with the study's polycentric governance framework: (1) regulatory and institutional influences on participation and accountability, (2) gender inclusion and exclusion dynamics in resource access and decision-making processes, and (3) governance impacts on environmental outcomes, including land management practices, climate resilience, and agroecosystem sustainability. This approach enabled the identification of analytical linkages between governance fragmentation, gender exclusion, and environmental degradation.

To ensure rigor, the study applied multiple validation strategies, including member-checking with eight key informants, triangulation across data sources, researcher reflexivity through field journals, and peer debriefing. Data analysis was conducted iteratively alongside data collection to ensure depth and consistency (see Figure 2).

2.4 Ethical Considerations

This study adhered to ethical standards outlined in the Declaration of Helsinki and Indonesian research guidelines (Kemdiktisaintek). All participants were informed about the study's objectives, voluntary nature, potential risks, and data use through information sheets provided in Bahasa Indonesia. Informed consent was obtained prior to participation, with respondents retaining the right to withdraw at any stage.

Confidentiality and anonymity were strictly maintained through the use of pseudonyms and the removal of identifiable information. Audio recordings and transcripts were securely stored in encrypted files accessible only to the research team. Sensitive topics, particularly those related to gender inequality, were approached with care to ensure participants' comfort and safety. Fieldwork permissions were obtained from relevant local authorities and institutions. To ensure ethical reciprocity, key findings were shared with local stakeholders through community-based dissemination activities.

3. RESULTS AND DISCUSSION

3.1 Governance Failures and Environmental Sustainability Risks

Effective agricultural governance, defined as the institutional arrangements that regulate access to resources, decision-making processes, and distribution of benefits, plays a critical role in shaping sustainability outcomes in smallholder agroecosystems. In agrarian contexts such as Indonesia

Table 2. Coding Structure and Theme Development

Representative Open Codes	Axial Categories	Core Themes
Regulatory gaps; weak enforcement	Governance fragmentation	Governance failures and sustainability risks
Women's exclusion; male leadership dominance	Gendered participation barriers	Gender exclusion and socio-ecological implications
Land tenure insecurity; financial exclusion	Institutional constraints	Institutional barriers and participatory deficits
Multi-level coordination; stakeholder collaboration	Polycentric governance mechanisms	Polycentric reform pathways toward sustainability

Source: Authors' Coding and Thematic Analysis Based on Interview and Documentary Data (2025)

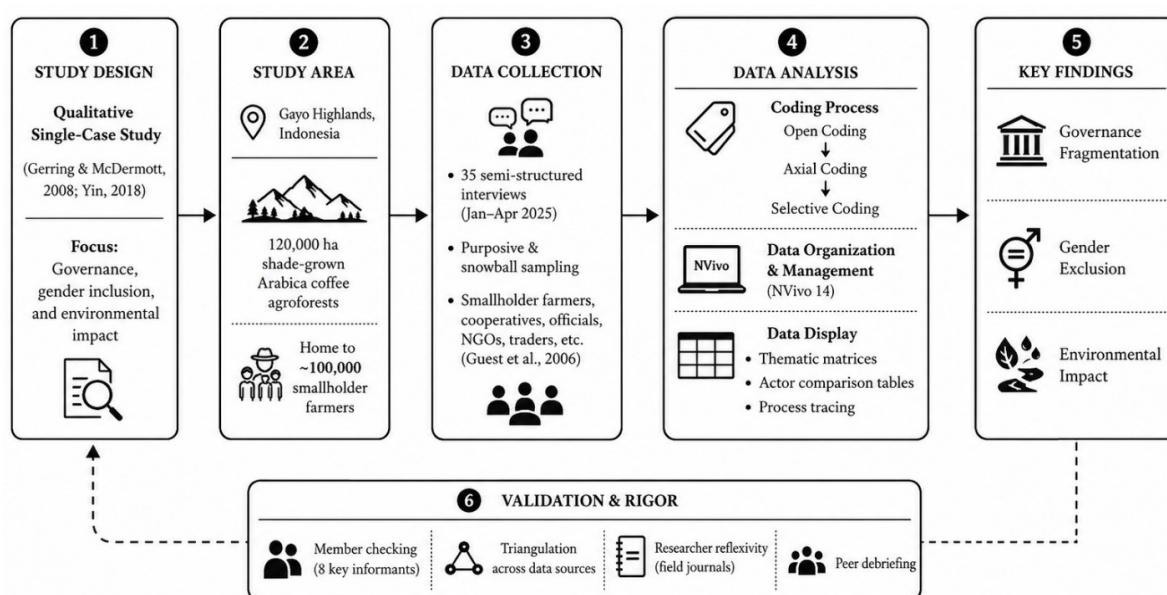


Figure 2. Research Design and Analytical Framework of the Study. Source: Adapted from Miles et al. (2014); Developed by the Authors (2025)

and other developing regions, weak governance structures are consistently associated with institutional fragmentation, limited accountability, and declining environmental performance (Bernstein, 2016; Razavi, 2009). These conditions often result in policy environments that prioritize short-term economic gains over long-term ecological sustainability. Consequently, smallholder farmers depend on agroecosystems that require strong institutional support for soil conservation, climate adaptation, and ecosystem-based management (FAO, 2023; International Coffee Organization, 2021b).

In the Gayo Highlands of Aceh, globally recognized for specialty Arabica coffee production, governance fragmentation represents a central vulnerability that threatens both environmental sustainability and farmer livelihoods. Despite the presence of sustainability-oriented discourse, institu-

tional arrangements remain weak, characterized by overlapping mandates among cooperatives and government agencies, limited enforcement capacity, and opaque decision-making processes. Field interviews with 35 stakeholders revealed three major governance gaps: the absence of an enforceable Coffee Qanun, weak price protection mechanisms, and inadequate labor standards that disproportionately affect women and informal workers.

These governance gaps amplify asymmetric power relations within the coffee value chain, where smallholders are structurally positioned against dominant actors such as exporters, intermediaries, and large cooperatives. These actors often leverage informal networks and market control to dictate prices, quality standards, and transaction terms, thereby limiting smallholders' bargaining power and reinforcing

ing unequal exchange relations. Such dynamics are widely documented in global agrifood systems, where unequal power structures constrain smallholder agency and reduce their capacity to engage in sustainable practices (Dzingai, 2026; Pyburn and Newton, 2025; Ramirez-Santos et al., 2023).

As a consequence, farmers are compelled to prioritize short-term economic survival over long-term environmental stewardship. This manifests in reduced investment in soil fertility management, limited maintenance of shade-tree systems, and declining adoption of agroforestry diversification. These practices are essential for maintaining soil health, biodiversity, and microclimate stability, yet are often neglected under conditions of economic pressure and institutional uncertainty. Similar patterns have been observed in other coffee-producing regions, where weak governance and market volatility drive environmentally unsustainable land-use decisions (Jemal et al., 2021; Volsi et al., 2019).

The ecological consequences of these governance dynamics are substantial. Weak coordination, limited stakeholder participation, and inadequate institutional support reduce incentives for sustainable land management and constrain collective responses to environmental challenges. As a result, land degradation processes, including soil erosion, declining soil organic matter, and reduced water retention capacity, have become increasingly evident in parts of the Gayo Highlands. The decline of shade-tree systems further contributes to biodiversity loss and heightens vulnerability to climate-related risks, including drought and pest outbreaks. These findings are supported by field interviews, in which farmers reported yield reductions of approximately 20–30% in unmanaged plots affected by soil erosion.

Similar relationships between governance quality, environmental management, and coffee productivity have been documented across major coffee-producing regions, including Colombia, Ethiopia, Brazil, and Rwanda (Barjolle et al., 2017; Rutayisire et al., 2017). Comparative analysis indicates that the Gayo Highlands perform relatively poorly in terms of regulatory effectiveness, state support, and participatory governance. In contrast, several coffee-producing countries have strengthened institutional coordination, accountability mechanisms, and stakeholder engagement, creating more favorable conditions for sustainable production and environmental stewardship. Governance arrangements in the Gayo Highlands, however, continue to be shaped by institutional fragmentation and limited participation, which constrain both sustainability transitions and climate resilience (Table 3).

The comparative assessment presented in Table 3 was based on three governance dimensions: regulatory framework, state support and market protection, and participation and accountability. Regulatory framework refers to the effectiveness of institutional arrangements, policy implementation, and enforcement capacity; state support and market protection refer to government assistance, producer support mechanisms, and market regulation; while participation and

accountability refer to stakeholder inclusion, transparency, and oversight in decision-making processes. Drawing on evidence from international reports and comparative literature, the assessment indicates that governance arrangements in the Gayo Highlands perform relatively weakly across all three dimensions, particularly in terms of institutional coordination and stakeholder participation. These findings suggest the presence of structural governance constraints that limit the capacity of local institutions to effectively support both environmental sustainability and producer resilience.

From an Ostromian perspective (Ostrom, 1990, 2010), these conditions reflect shortcomings in several core principles of effective common-pool resource governance, including clearly defined rules, inclusive participation, and effective monitoring systems (Day and Cramer, 2022; Eriksson et al., 2022). Institutional fragmentation reduces trust and coordination among actors, weakening the collective capacity needed to manage environmental risks and adapt to changing ecological conditions. In turn, these governance failures contribute to the persistence of socio-ecological vulnerability by limiting both sustainability transitions and climate resilience (Hajad, 2024).

The findings suggest that governance weaknesses should be understood not merely as institutional deficiencies but as fundamental drivers of environmental degradation and long-term vulnerability within coffee agroecosystems. Strengthening polycentric governance arrangements, expanding stakeholder participation, and aligning economic incentives with environmental objectives are therefore critical for enhancing both sustainability and resilience in the Gayo coffee sector.

3.2 Gender Exclusion and Socio-Ecological Implications

Gender exclusion constitutes a structural constraint that undermines both environmental sustainability and governance effectiveness in the Gayo coffee agroecosystem. Despite their extensive involvement across the entire production chain, from cultivation and harvesting to post-harvest processing, women remain systematically marginalized in decision-making structures. Their limited participation in key domains such as price negotiation, resource allocation, and cooperative governance restricts their capacity to influence strategic outcomes within the value chain. As a result, women's contributions are largely confined to peripheral roles, reflecting a persistent disconnect between labor contribution and decision-making power (Putra et al., 2024).

Empirical evidence from the Gayo Highlands reveals a substantial disparity between women's contribution to coffee production and their representation in cooperative leadership. Women are estimated to contribute approximately 75% of labor across cultivation, harvesting, and post-harvest processing activities, yet their presence in formal governance structures remains limited. Among the 16 export-oriented coffee cooperatives that play a central role in market access,

Table 3. Comparative Position of the Gayo Highlands within Selected Coffee Governance Systems

Country/Region	Regulatory Framework	State Support & Market Protection	Participation & Accountability
Colombia	Moderate	Moderate	Low–moderate
Ethiopia	Moderate	Strong	Moderate
Brazil	Low	Weak	Moderate
Rwanda	Moderate	Moderate	Strong
Gayo Highlands, Indonesia	Weak	Weak	Low

Source: Adapted from ICO (2021); Fairtrade International (2024); Authors’ Comparative Assessment and Analysis (2026)

certification, and collective decision-making, only four co-operatives (25%) are led by women. Leadership positions continue to be concentrated in male-dominated organizations, despite the significant role women play throughout the coffee value chain. This imbalance highlights a persistent institutional gap between labor contribution and decision-making authority within the Gayo coffee sector (see Figure 3).

The pattern observed in the Gayo Highlands reflects broader trends documented across global coffee-producing regions. Previous studies indicate that women contribute approximately 70% of labor in coffee production while occupying less than 20% of leadership positions within producer organizations and governance institutions positions (Baquero-Melo, 2023; Lyon et al., 2017; Palacios et al., 2023). The consistency of these findings suggests that the under-representation of women in leadership is not an isolated phenomenon but a structural characteristic of many agri-food systems. Recent research attributes these disparities to institutional barriers, including unequal access to land ownership, limited participation in policy and governance processes, restricted access to training and financial resources, and persistent gender norms that shape opportunities for leadership and decision-making (Acosta et al., 2025; Elias et al., 2024; Najjar et al., 2025).

In this context, the Gayo Highlands exemplify how gendered power relations continue to shape access to resources, influence, and governance outcomes within coffee production systems. These inequalities are reinforced through the interaction between customary norms (adat) and formal institutional arrangements, which collectively limit women’s participation in governance processes (Wijaya et al., 2024). Male-dominated inheritance practices, gender-biased representation in policy forums, and informal cooperative norms systematically restrict women’s access to leadership positions and decision-making arenas. As a result, power asymmetries are reproduced across the coffee value chain, weakening collective coordination and reducing the inclusiveness of environmental governance processes (OECD, 2022; Shisler

and Sbicca, 2019). The consequences of this exclusion extend beyond issues of representation and have important implications for environmental sustainability. Inclusive governance systems are widely recognized for enhancing knowledge diversity, improving risk assessment, and strengthening adaptive capacity in climate-sensitive agroecosystems. In contrast, exclusionary governance arrangements often prioritize short-term economic objectives while limiting the incorporation of locally grounded ecological knowledge into institutional decision-making processes (Huyer et al., 2024; Umezulike, 2026). In the Gayo Highlands, women possess valuable knowledge related to soil conservation, shade-tree management, and water regulation; however, their limited participation in governance structures constrains the integration of this expertise into collective environmental management.

These challenges are further compounded by unequal access to training, extension services, financial resources, and land tenure security (Hajad et al., 2025a; Olthoff et al., 2026). Women are frequently underrepresented in formal capacity-building programs and often depend on informal knowledge networks that provide limited opportunities for meaningful engagement in governance processes (Agarwal, 2001). Previous studies have shown that gender disparities in access to extension services, climate information, and productive assets reduce the adoption of sustainable agricultural practices and weaken adaptive capacity (FAO, 2023; World Bank, 2023). Similarly, insecure land tenure and restricted access to finance reduce incentives for long-term environmental investments, including agroforestry diversification, soil rehabilitation, and climate-resilient farming systems (Croppenstedt et al., 2013; Wienhold and Goulao, 2023; van Noordwijk et al., 2020).

Gender exclusion generates cascading effects that extend from individual households to the broader coffee agroecosystem. Limited access to land, financial resources, training opportunities, and decision-making processes constrains women’s capacity to adopt sustainable land management practices and contribute to environmental governance. As a

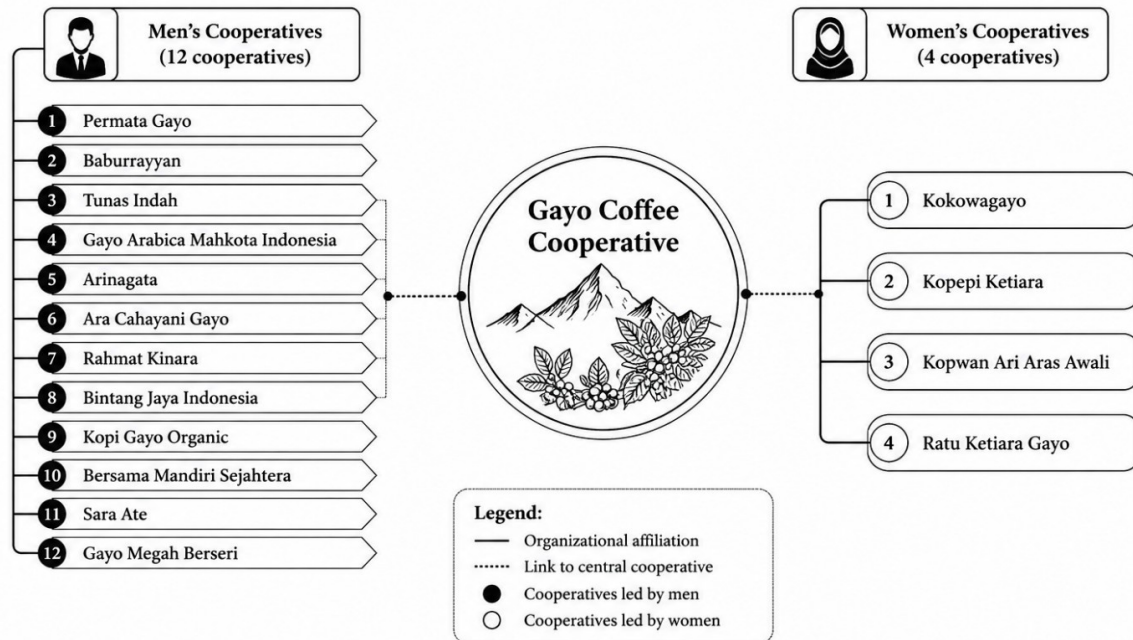


Figure 3. Gender Distribution of Leadership Among Export-Oriented Coffee Cooperatives in the Gayo Highlands Source: Adapted from [Nazaruddin et al. \(2022\)](#); Authors' Analysis (2026)

result, short-term production strategies often prevail over long-term investments in conservation, increasing risks of soil degradation, biodiversity loss, and reduced ecosystem resilience. These interconnected relationships illustrate how institutional inequalities shape both farmer behavior and environmental outcomes within the Gayo coffee sector (Table 4).

As shown in Table 4, gender exclusion operates through multiple and mutually reinforcing mechanisms. Insecure land tenure discourages long-term environmental investments, financial constraints limit the adoption of conservation practices, and exclusion from decision-making processes reduces the incorporation of local ecological knowledge into resource management. Similarly, restricted access to training and extension services weakens adaptive capacity and increases vulnerability to climate-related risks.

From a polycentric governance perspective ([Carlisle and Gruby, 2019](#); [Ostrom, 2010](#)), these dynamics represent not only a social inequality issue but also an institutional failure that undermines learning, coordination, and adaptive management across governance levels ([Agustin, 2018](#); [Jena et al., 2012](#)). By weakening the connections between local knowledge and institutional decision-making, gender exclusion reduces the effectiveness of environmental governance and limits the capacity of coffee-producing communities to respond to ecological change.

These findings demonstrate that gender inequality is both a governance and sustainability challenge. Strengthening women's participation in leadership, improving access

to productive resources, and integrating gender-responsive governance mechanisms are therefore essential for enhancing environmental stewardship, climate resilience, and the long-term sustainability of smallholder coffee systems.

3.3 Institutional Barriers and Participatory Deficits

Institutional barriers in the Gayo coffee sector, particularly land tenure insecurity, limited access to finance, and persistent participatory deficits, constitute interrelated constraints that undermine both environmental sustainability and social equity. Rather than operating independently, these barriers interact through reinforcing feedback loops that intensify gender-based exclusion and weaken the institutional conditions necessary for sustainable land management and climate adaptation ([Läderach et al., 2017](#); [Parsons et al., 2025](#); [Patnaik, 2021](#)).

Land tenure insecurity represents a foundational constraint. In the Gayo Highlands, only a small proportion of women hold formal land certificates due to entrenched customary (adat) inheritance systems that privilege male ownership (Central Aceh Bappeda data; [International Food Policy Research Institute, 2025](#)). Extensive research demonstrates that secure land tenure is a critical prerequisite for long-term environmental investment, as it provides both legal certainty and access to credit for conservation practices ([Doss et al., 2018](#); [Quisumbing et al., 2023](#)). In the absence of secure tenure, farmers are more likely to adopt short-term extractive strategies, contributing to soil degradation, declining organic matter, and reduced ecosystem resilience

Table 4. Pathways Linking Gender Exclusion to Environmental Degradation

Exclusion Mechanism	Governance Impact	Environmental Consequence
Limited land tenure security	Discourages long-term resource management	Accelerated soil erosion
Barriers to financial capital	Reduces investment in conservation practices	Declining soil fertility
Exclusion from decision-making	Limits integration of local ecological knowledge	Simplified agroforestry systems
Limited access to training and extension services	Weakens adaptive capacity	Increased drought and pest vulnerability

Source: Authors’ Synthesis based on Interview Findings and Supporting Literature (2026)

(Angula et al., 2021; Manero and Mach, 2023; Melesse et al., 2018).

Financial exclusion further compounds these constraints. Empirical evidence indicates that only a limited proportion of women in Gayo are able to access formal credit, often requiring approval from male household members. Restricted access to finance constrains investment in critical sustainability inputs and infrastructure, including organic soil amendments, erosion-control systems, water management facilities, and climate-resilient planting materials. Studies consistently show that gender gaps in financial inclusion reduce the adoption of sustainable agricultural practices and limit adaptive capacity in smallholder systems (Lambrecht et al., 2023; Nchanji et al., 2020; Quaye et al., 2019). As a result, land-use strategies tend to prioritize short-term productivity over long-term ecological sustainability.

Participatory deficits represent a third critical barrier. Despite formal recognition of inclusive governance principles, women’s involvement in policy processes, cooperative leadership, and local decision-making forums remains limited. This reflects a broader pattern of “tokenistic participation,” where inclusion is symbolic rather than substantive, and women’s voices have minimal influence on institutional outcomes (Andersson Djurfeldt and Hillbom, 2016; Cornwall, 2016; Kopnina et al., 2024). In the Gayo context, limited consultation in policy processes, such as the development of the Coffee Qanun, demonstrates how formal participation mechanisms fail to translate into meaningful engagement.

These overlapping inequalities are reflected clearly in the distribution of roles, access, and authority within the coffee system. Gender disparities are evident across three critical dimensions: income and labor roles, access and institutional recognition, and participation in decision-making processes. Women are concentrated in labor-intensive, lower-paid activities and receive a disproportionately small share of income, while men dominate higher-value functions such as marketing and export negotiation. Similarly, women face severe limitations in accessing land certificates, extension services,

and cooperative membership, which restricts their ability to benefit from institutional support mechanisms. These inequalities are further reinforced in governance structures, where men hold dominant leadership positions and control key decisions related to pricing, production planning, and resource allocation (see Table 5).

Table 5 illustrates that gender inequalities in the Gayo coffee sector are systemic and mutually reinforcing across economic, institutional, and political dimensions. Women contribute substantially to coffee production, particularly in labor-intensive cultivation and post-harvest activities, yet receive lower economic returns and exercise limited control over the benefits generated along the value chain. Restricted access to land ownership, cooperative membership, agricultural extension services, and government support programs further constrains their ability to accumulate productive assets and strengthen their bargaining position within the sector. These disparities extend beyond resource access and are reflected in governance processes, where leadership positions and strategic functions remain predominantly controlled by men. Women’s knowledge, experiences, and priorities are often underrepresented in decisions related to production strategies, resource management, and cooperative governance.

Such patterns indicate that gender exclusion is not confined to a single domain but is structurally embedded throughout the coffee value chain. The unequal distribution of resources, opportunities, and decision-making authority creates a disconnect between those who contribute substantially to production and those who shape governance outcomes. As a result, the inclusiveness and adaptive capacity of coffee governance systems are weakened, limiting opportunities to integrate diverse local knowledge and collective perspectives into environmental decision-making.

These challenges are compounded by broader institutional weaknesses within the governance system. Organizations such as the Gayo Coffee Protection Society (Masyarakat Perlindungan Kopi Arabika Gayo, MPKG), while estab-

Table 5. Gendered Inequalities Across Critical Dimensions in Gayo Coffee Systems

Aspect	Women	Men
Income & work roles	Lower daily wages (Rp 80,000–100,000); concentrated in labor-intensive post-harvest tasks (cherry sorting, wet milling, drying) with limited income share	Control household coffee income; higher wages (Rp 150,000+); strategic roles (marketing, export negotiation)
Access & recognition	Rarely registered as formal farmers; severely limited access to land certificates, extension training, government subsidies, cooperative membership	Majority hold land certificates; dominant in cooperative membership; priority access to training/subsidies
Decision-making	Low participation in farmer groups/forums; constrained by patriarchal norms and time poverty	Dominant leadership roles; control pricing, production planning, resource allocation decisions

Source: Processed by Authors (2026)

lished to support sectoral development, continue to face challenges related to unclear mandates, weak coordination, and limited accountability mechanisms. Such institutional fragmentation reduces policy coherence and constrains the implementation of sustainability initiatives across governance levels, reflecting broader governance challenges frequently observed in smallholder agricultural systems (Hackfort, 2021; Hajad et al., 2025b; Pernet and Ribi Forclaz, 2019). Similar limitations are evident within local participatory forums, where decision-making processes are often dominated by a narrow group of actors. This concentration of influence restricts the participation of women farmers and other marginalized stakeholders, thereby reducing the effectiveness of collective action and collaborative governance.

Comparative evidence from Ethiopia and Rwanda suggests that more inclusive governance arrangements, including gender-responsive participation mechanisms, formal accountability systems, and structured stakeholder engagement, can improve both governance effectiveness and environmental outcomes (Clay and Zimmerer, 2020; Dawson, 2018; Tesfaye et al., 2020; Woldesenbet, 2021). In contrast, limited access to land, finance, training, and decision-making authority in the Gayo Highlands constrains investment in sustainable land management practices and reduces the adoption of climate-resilient production strategies.

From a polycentric governance perspective, these dynamics represent a significant institutional failure. Effective agroecosystem governance depends on inclusive and multi-level participation that facilitates coordination, knowledge exchange, and adaptive learning among diverse actors (Carlisle and Gruby, 2019; Ostrom, 2010). The systematic exclusion of women weakens these processes by limiting the incorporation of local ecological knowledge into governance systems and reducing the capacity of institutions to respond to environmental challenges. Consequently, governance ar-

rangements tend to prioritize short-term economic objectives over long-term ecological resilience, contributing to persistent challenges such as soil degradation, biodiversity loss, and increasing climate vulnerability.

These findings demonstrate that institutional barriers and participatory deficits are not merely administrative shortcomings but structural drivers of socio-ecological vulnerability. Addressing these challenges requires governance reforms that strengthen land tenure security, expand access to financial and technical resources, and promote meaningful participation of women farmers as a central component of sustainable, inclusive, and resilient coffee governance systems.

3.4 Polycentric Reform Pathways Toward Sustainability

Building on the empirical findings, this study highlights the need for polycentric institutional reforms that integrate gender inclusion as a central component of environmental sustainability in smallholder coffee systems. The analysis shows that fragmented arrangements, persistent power asymmetries, and gender exclusion undermine institutional effectiveness and constrain adaptive capacity. In response, a polycentric approach, characterized by multiple, interconnected decision-making centers coordinated through context-specific and nested rules, Ostrom (2010) offers a robust framework for addressing these challenges. Within this framework, four interrelated reform pathways are proposed to strengthen institutional coordination, enhance inclusive participation, and improve sustainability outcomes in the Gayo coffee sector.

3.4.1 Strengthening Institutional Mandates and Accountability Mechanisms

Strengthening institutional mandates and accountability mechanisms constitutes a fundamental pathway for improving governance effectiveness in the Gayo coffee sector. This pathway emphasizes the need to establish coherent institutional arrangements that support sustainable land management and inclusive decision-making processes.

1. **Institutional Role Clarification.** Institutional role clarification is essential to address overlapping authority and fragmented governance structures. Clear legal mandates, time-bound responsibilities, and measurable performance indicators should be defined for all key governance actors, including MPKG, cooperatives, and relevant government agencies. Formal coordination frameworks can reduce institutional duplication and enhance governance coherence.
2. **Institutional Diagnostics and Monitoring Systems.** Strengthening monitoring and evaluation systems is necessary to ensure effective policy implementation. Current governance arrangements lack robust monitoring mechanisms, limiting the enforcement of sustainability standards. Improved systems can facilitate agroforestry adoption and soil conservation practices while ensuring regulatory compliance.
3. **Evidence-Based Institutional Strengthening.** Evidence-based institutional design plays a critical role in improving governance performance. Comparative studies demonstrate that institutions with clear mandates and accountability frameworks are more effective in supporting sustainability initiatives and certification compliance (Fairtrade International, 2024; International Coffee Organization, 2021a).
4. **Gender-inclusive Governance Integration.** Integrating gender-inclusive governance mechanisms is essential for achieving both social equity and environmental sustainability. Ensuring women's representation (minimum 40%) improves decision-making quality and enables the integration of diverse ecological knowledge into sustainability strategies. This pathway focuses on strengthening institutional coordination across governance levels within a polycentric system.

3.4.2 Combating Elite Concentration through Collaborative Governance

Within a polycentric governance framework, this pathway targets power imbalances across actors and governance levels that constrain inclusive participation and environmental sustainability. In the Gayo coffee sector, concentrated power structures often marginalize smallholders and women, weakening collective action and limiting equitable access to resources and decision-making processes. Addressing these challenges requires institutional reforms that enhance transparency, broaden participation, and strengthen accountability across governance levels.

1. **Representation and Quota Mechanisms.** Institutional reforms should prioritize dismantling entrenched elite dominance through proportional farmer representation quotas (minimum 30%) and gender-balanced leadership structures. Such arrangements improve participation, strengthen legitimacy, and enhance collective action in smallholder-based systems.
2. **Power Asymmetry Diagnostics.** Systematic assessment of power asymmetries is essential to identify inequalities in key governance domains, including price determination, certification access, and benefit-sharing mechanisms. Addressing these imbalances is critical for ensuring equitable resource distribution and strengthening institutional trust. Recent studies confirm that unequal power relations remain a major barrier to inclusive agrifood governance and climate resilience (FAO, 2023; OECD, 2022).
3. **Adoption of Comparative Governance Models.** Comparative evidence from countries such as Colombia and Rwanda demonstrates that polycentric governance systems with multi-level participation and gender-inclusive mechanisms improve environmental outcomes and institutional performance. Participatory governance structures enhance adaptive capacity and support climate-resilient agricultural systems (Clay and Zimmerer, 2020; De Leijster et al., 2021).
4. **Transparency and Accountability Tools.** The use of digital monitoring tools, including transparency dashboards and certification audit systems, can strengthen accountability and reduce governance opacity. Improved transparency ensures that sustainability benefits are distributed more equitably among smallholders, including women farmers, thereby enhancing both governance effectiveness and environmental outcomes.

3.4.3 Women's Empowerment for Environmental Sustainability

Within polycentric governance systems, strengthening women's agency and representation is essential for enhancing inclusive decision-making and improving environmental sustainability outcomes in smallholder coffee systems. In this context, women's empowerment should be understood not merely as a social objective but as a structural governance mechanism that enhances adaptive capacity, facilitates the integration of local ecological knowledge, and supports long-term agroecosystem resilience. This pathway therefore emphasizes institutional and socio-economic reforms that expand women's access to resources, participation, and decision-making authority across governance levels.

1. **Securing Land Tenure Rights.** Strengthening women's land tenure security is a foundational step in enabling long-term environmental investments. Joint land certification schemes and targeted support for women-headed households provide the legal certainty necessary for adopting sustainable land management

practices, including soil conservation and agroforestry systems (Hunsberger et al., 2017; Park, 2019).

2. Expanding Financial Access. Improving women's access to financial resources is critical for enabling the adoption of sustainable agricultural technologies. Gender-responsive financial instruments, such as collateral-free microfinance schemes, facilitate investments in climate-resilient practices and sustainable inputs (OECD, 2022; Saghir, 2014).
3. Legal Empowerment Initiatives. Strengthening legal empowerment enhances women's ability to navigate both customary and formal institutional systems. Community-based legal literacy programs support women in asserting land and resource rights while increasing their participation in governance processes (Gupta et al., 2024; Melesse et al., 2018; Quisumbing et al., 2023).
4. Leadership Development Programs. Enhancing women's leadership capacity is essential for strengthening inclusive governance structures. Structured mentorship and training programs increase women's representation in cooperative leadership and decision-making institutions, contributing to improved governance transparency and sustainability outcomes.
5. Gender-Responsive Agricultural Extension Reorienting agricultural extension systems to recognize and prioritize women's agroecological knowledge is critical for improving sustainability outcomes. Strengthening gender-responsive extension services enhances knowledge diffusion, increases adoption of sustainable practices, and improves overall agroecosystem performance (Hidrobo et al., 2024; Huyer et al., 2024; Stoian et al., 2018).

3.4.4 Contextualizing Global Sustainability Standards

Within polycentric governance systems, this pathway connects global sustainability frameworks with local institutional realities to ensure more inclusive and context-sensitive implementation. Aligning global standards with local socio-ecological conditions is critical for improving both effectiveness and equity in smallholder contexts. Standardized certification frameworks often overlook local inequalities in resource access, institutional capacity, and gender dynamics, thereby reinforcing exclusion and limiting meaningful participation. This pathway therefore emphasizes adaptive, locally embedded approaches that integrate global requirements with context-specific governance arrangements.

1. Localization of Certification Systems. Adapting global sustainability standards, such as Fairtrade, Organic, and Rainforest Alliance, through tiered compliance mechanisms enables alignment with variations in farm size, resource access, and socio-economic conditions. Context-sensitive certification pathways reduce entry barriers and facilitate broader participation among

smallholders.

2. Inclusive Implementation Strategies. Strengthening inclusive implementation requires the provision of subsidized technical assistance, input support, and community-based verification systems. These mechanisms reduce dependency on external actors while improving accessibility for marginalized groups, particularly women farmers. Evidence indicates that gender-responsive climate-smart agriculture approaches enhance both resilience and productivity in smallholder systems (FAO, 2023; Pyburn and Newton, 2025).
3. Learning from Hybrid Certification Models. Adopting hybrid certification models that combine global standards with locally embedded institutional arrangements can improve both participation and sustainability outcomes. Experiences from Ethiopia and Colombia demonstrate that such models enhance adaptive capacity and increase inclusion. Recent research further confirms that context-sensitive and gender-inclusive policies are more effective in supporting climate adaptation and sustainable land management (Adhikari and Ghimire, 2025; Raman et al., 2025).

The four reform pathways proposed in this study demonstrate how polycentric governance can address institutional fragmentation, power asymmetries, gender exclusion, and the disconnect between global sustainability standards and local realities. Rather than operating as separate interventions, these pathways are mutually reinforcing and collectively contribute to more inclusive and environmentally sustainable governance outcomes. Figure 4 synthesizes these relationships into a gender-inclusive polycentric governance framework derived from the empirical findings.

Figure 4 presents the gender-inclusive polycentric governance framework developed from the empirical findings of this study. The framework illustrates how multiple and interconnected governance centers, including national government agencies, provincial and district governments, coffee cooperatives, community and customary institutions, and smallholder farmers, collectively shape environmental sustainability outcomes within the Gayo coffee sector. Consistent with polycentric governance theory, sustainability is understood as the product of coordination, learning, and decision-making across multiple levels rather than the result of a single governing authority.

A central contribution of the framework is the positioning of gender inclusion as a cross-cutting governance mechanism linking actors and institutions across governance levels. The findings indicate that women's participation in leadership, decision-making, training programs, and resource governance enhances knowledge integration, strengthens institutional accountability, and improves collective adaptive capacity. Conversely, persistent gender exclusion weakens institutional effectiveness, limits the utilization of local ecological knowledge, and constrains sustainability initiatives.

The framework further suggests that effective environ-

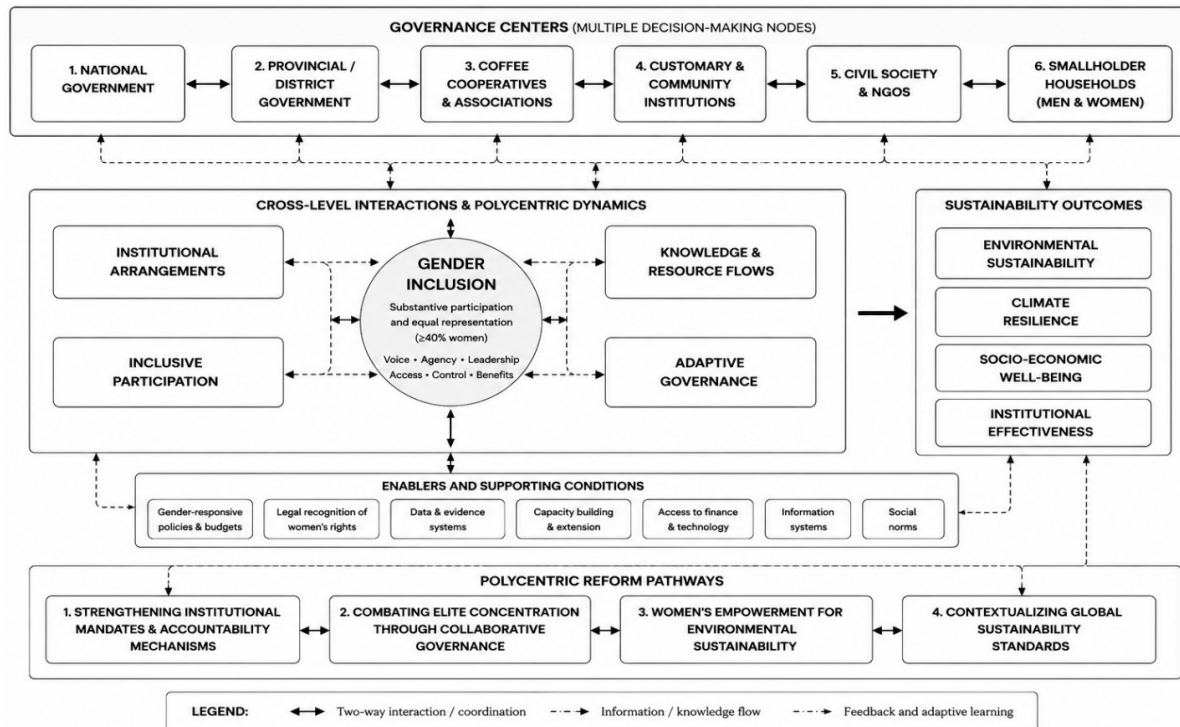


Figure 4. Gender-Inclusive Polycentric Governance Framework for Environmental Sustainability in Smallholder Coffee Systems. Source: Developed by the Authors Based on Interview Findings, Documentary Analysis (2025)

mental governance emerges when institutional coordination, collaborative participation, women's empowerment, and context-sensitive sustainability standards operate simultaneously. These interactions contribute to improved climate resilience, soil conservation, agroforestry sustainability, and broader environmental sustainability outcomes. By integrating gender inclusion into the core architecture of polycentric governance, the framework extends existing applications of Ostrom's polycentric perspective and demonstrates how social inclusion can function as a critical determinant of socio-ecological sustainability in smallholder coffee systems.

4. CONCLUSIONS

This study examines how gender exclusion constrains the role of governance in advancing environmental sustainability in smallholder coffee systems in the Gayo Highlands. The findings reveal that fragmented institutional arrangements, weak coordination, and limited participation of women in land ownership, cooperative leadership, and decision-making processes undermine agroecosystem resilience and encourage short-term land-use strategies, contributing to soil degradation, biodiversity loss, and increased climate vulnerability. While governance frameworks increasingly recognize inclusion, women's participation often remains symbolic, limiting the integration of local ecological knowledge into decision-making processes. These findings demonstrate that gender exclusion is not only a social issue but also a critical

structural barrier that limits the effectiveness of governance for environmental sustainability. From a policy perspective, improving sustainability outcomes requires strengthening institutional coordination, expanding women's access to resources and leadership roles, and embedding gender-responsive mechanisms within governance systems. By advancing a gender-inclusive polycentric governance approach, this study contributes to understanding how inclusive institutional arrangements can enhance accountability, support adaptive decision-making, and ultimately promote more sustainable and resilient smallholder coffee systems.

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