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Report

Operationalizing Payment for Ecosystem Services in the Ghibe III Hydroelectric Dam Catchment, Omo-Ghibe Living Landscape, Ethiopia: Barriers, Opportunities, and an Implementation Roadmap

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Front cover photo: Gibe III hydroelectric dam (photo by Wolde Mekuria).
Back cover photo: Erosion-induced landslide affected area in the Omo-Ghibe living landscape (photo by Wolde Mekuria).

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Contents

Acronyms and abbreviations

CALM	Climate Action through Landscape Management
CDRM	Complaint and Dispute Resolution Mechanism
DA	Development Agent
EBI	Ethiopian Biodiversity Institute
EFCCC	Environment Forest and Climate Change Commission
EPA	Environment Protection Authority
EWA	Ethiopian Wildlife Authority
FGD	Focus Group Discussion
FMNR	Farmer Managed Natural Regeneration
GCF	Green Climate Fund
GIS	Geographic Information System
GO	Governmental Organization
GPS	Geographic Positioning System
IWMI	International Water Management
KII	Key Informant Interview
MEE	Ministry of Water and Energy
MEL	Monitoring, Evaluation, and Learning
MRV	Monitoring, Reporting, and Verification
NGO	Non-Governmental Organization
PD	Persons Day
PES	Payment Ecosystem Service
RCBIA	Rural Community Based Development Initiatives Association
RLLP	Resilient Landscapes and Livelihoods Project
SLM	Sustainable Land Management
SWC	Soil and Water Conservations
WSM	Watershed Management

Summary

The Gibe III hydroelectric dam catchment is a critical landscape that supports hydropower generation, agriculture, biodiversity conservation, water resources, and rural livelihoods. However, increasing soil erosion, land degradation, vegetation loss, sedimentation and climate-related pressures threaten both upstream livelihoods and downstream investments. This study assessed the feasibility of operationalizing a Payment for Ecosystem Services (PES) mechanism as a sustainable financing approach for the catchment. In this study, a PES scheme is understood as an incentive-based arrangement in which downstream users of watershed ecosystem services (the ecosystem service beneficiaries and potential buyers) make conditional payments, in cash and/or in-kind, to upstream land managers (the ecosystem service providers) in return for verified conservation actions or measurable improvements in agreed ecosystem services such as reduced sediment delivery to the Gibe III reservoir, more regulated water flows, and carbon sequestration. The assessment was based on a review of relevant policy and institutional frameworks, complemented by 11 key informant interviews and 5 focus group discussions involving 53 purposively selected participants from upstream, middle, and downstream sections of the catchment. Participants were drawn from ecosystem service provider communities (upstream farming households, watershed committee members, forest cooperative members), from government and civil-society actors supporting watershed management, and from experts familiar with downstream ecosystem service uses (irrigation, hydropower, and agricultural investment).

The findings indicate that upstream communities in the upper sub-catchments are the primary ecosystem service providers through their investments in soil and water conservation, agroforestry, exclosures, and landscape restoration, and are therefore the intended recipients of PES compensation. Downstream stakeholders, including the Gibe III hydropower facility, irrigation users, agricultural investors, and national energy consumers, are the main ecosystem service users/beneficiaries, and hence the potential PES buyers or co-financiers, who benefit from improved watershed regulation, reduced sedimentation, and enhanced water availability. The study identified sediment retention and soil erosion control, hydrological regulation, and carbon sequestration as the priority ecosystem services for PES investment. Results further show strong stated willingness among upstream communities to participate in the proposed PES scheme, provided that benefit-sharing arrangements are transparent, equitable, and linked to livelihood improvements. At the same time, significant barriers remain, including fragmented institutional coordination, limited technical and financial capacity, weak monitoring systems, and continued dependence on government- and donor-funded restoration programs.

To address these challenges, the study proposes a strategic framework for PES operationalization built around five key pillars: (i) recognition of upstream communities as ecosystem service providers through a proposed formal Watershed PES Charter and Ecosystem Stewardship Credits; (ii) a phased hybrid payment model that combines input-based incentives with performance-based payments linked to verified environmental outcomes; (iii) a diversified co-financing mechanism supported by hydropower operators, irrigation users, government institutions, development partners, and other beneficiaries through a proposed dedicated Watershed PES Fund; (iv) a robust Monitoring, Reporting, and Verification (MRV) system integrating scientific and community-based monitoring; and (v) transparent grievance, accountability, and safeguard mechanisms to ensure fairness and trust. The proposed Charter, Stewardship Credits, and Watershed PES Fund are put forward as design options that will require legal, institutional, and economic validation before adoption.

Building on this framework, the report presents a three-phase implementation roadmap. Phase I focuses on institutional readiness, stakeholder engagement, legal arrangements, financing

mechanisms, baseline assessments, and establishment of MRV systems. Phase II pilots PES implementation in priority upper catchments through conservation investments, livelihood support packages, and initial payment mechanisms. Phase III focuses on scaling up successful approaches, institutionalizing PES within watershed governance structures, diversifying long-term financing sources, and exploring opportunities for carbon finance integration. The roadmap is supported by a stakeholder responsibility matrix, monitoring and learning framework, and risk mitigation strategy to guide implementation and adaptive management.

Overall, the study demonstrates that a well-designed PES mechanism offers a practical pathway for linking watershed conservation with sustainable financing while improving livelihoods, enhancing climate resilience, and protecting downstream infrastructure. If supported by strong institutions, transparent governance, and diversified financing, PES can help transform watershed restoration from a largely project-driven activity into a self-sustaining investment that generates environmental, social, and economic benefits for both upstream and downstream stakeholders.

1. Introduction

The Omo-Gibe River Basin is one of Ethiopia's most important river basins, providing critical ecosystem services (Aneseyee et al., 2022; Gebre et al., 2023) and contributing to the national economic development, including hydropower generation, irrigated agriculture, livestock production, fisheries, and domestic water supply (Hodbod et al., 2019). The basin contributes nearly 45% of Ethiopia's hydropower generation through a cascade of dams, including the Gibe III Dam, making it a strategic basin for the country's energy security and economic transformation (Awulachew et al., 2007; Water, Peace and Security Partnership, 2023).

Despite its significant contribution and development potential, the basin faces several environmental and socio-economic challenges (Dagne et al., 2024; Orkodjo et al., 2022). In particular, accelerated land degradation in upstream catchments increasingly threatens the long-term performance and sustainability of downstream hydroelectric dams and medium- to long-term irrigation schemes (Dagne et al., 2024; Werede et al., 2024). Deforestation, cultivation on steep slopes, soil erosion, and unsustainable land-use practices have increased sediment loads in the rivers entering these reservoirs, reducing storage capacity, raising maintenance costs, shortening infrastructure lifespan, and undermining the reliability of hydropower generation and irrigation water supply (FAO, 2015; IPCC, 2022).

Beyond environmental degradation, the Omo-Gibe Basin continues to face persistent socio-economic challenges characterized by widespread rural poverty (World Bank, 2024; MoWE, 2024), high dependence on rain-fed agriculture and natural resources (FAO, 2024; MoWE, 2024), limited livelihood diversification (World Bank, 2024; FAO, 2024), weak market access and institutional capacity for sustainable natural resource management (MoWE, 2024; UNEP, 2021), and increasing vulnerability to climate variability and recurrent droughts (IPCC, 2022; World Bank, 2024). These interrelated challenges constrain household resilience, accelerate pressure on land and water resources, and reduce the long-term effectiveness and sustainability of watershed management and landscape restoration initiatives (FAO, 2022; MoWE, 2024; World Bank, 2024; Dagne et al., 2024).

In response to these environmental and socio-economic challenges, communities in the upstream and downstream catchments of the basin, in collaboration with government restoration programs and other development partners, have implemented a wide range of landscape restoration interventions (Solomon et al., 2024; MoWE, 2024). These include tree-based restoration options such as agroforestry, afforestation, and reforestation; ecological management practices such as exclosures and

grazing land management; and physical and biological soil and water conservation measures. These landscape management efforts generate multiple ecosystem services that extend well beyond local communities, including reduced sediment transport (Solomon et al., 2024; Tilahun, 2024; Dagnachew et al., 2024), improved water regulation (Aragawa & Kurab, 2024), enhanced groundwater recharge (Aragawa & Kurab, 2024), biodiversity conservation (Hirpa et al., 2024), carbon sequestration (Hirpa et al., 2024; Solomon et al., 2024), and protection of downstream hydropower and irrigation infrastructure (Tilahun, 2024).

Despite the substantial public benefits generated by the community-based landscape management efforts, ecosystem service providers receive little direct compensation for their investments and stewardship. Downstream beneficiaries, including hydropower operators, irrigation users, public institutions, water utilities, and emerging carbon markets, currently contribute very little to financing upstream conservation activities. This disconnect limits the long-term sustainability of restoration investments and weakens incentives for communities to maintain ecosystem services (Wunder et al., 2018; FAO, 2022).

Recognizing this disconnection between upstream communities investing in restoration activities and downstream beneficiaries, and to incentivize local communities, carbon financing has emerged recently. In line with this, Payment for Ecosystem Services (PES) has emerged globally as an effective market-based and incentive-driven approach for aligning the interests of ecosystem service providers and beneficiaries through voluntary or policy-supported financing mechanisms that reward environmental stewardship (Jack et al., 2008; Brownson et al., 2019; The World Bank, 2020; FAO, 2022).

Ethiopia has established a favorable policy environment for landscape restoration through initiatives such as the national Green Legacy Initiative, climate-resilient green economy strategies, and an integrated watershed management program (FDRE, 2011). Furthermore, practical experiences in the basin, such as the Humbo Assisted Natural Regeneration Project, implemented with support from World Vision International and the World Bank BioCarbon Fund, have demonstrated the potential for restoration-based financing mechanisms to generate environmental, social, and economic benefits while improving local livelihoods.

Despite the growing recognition of the importance of watershed services for hydropower and irrigation sustainability, operational PES mechanisms that link downstream beneficiaries with upstream ecosystem service providers remain largely undeveloped in Ethiopia. This institutional and financial gap limits opportunities for sustainable financing of watershed restoration and reduces incentives for communities to maintain ecosystem services that support downstream infrastructure and economic activities (World Bank, 2022; World Vision Australia, 2023). Against this background, this study assesses the feasibility of establishing an operational Payment for Ecosystem Services (PES) mechanism in the Gibe III hydroelectric dam catchment and develops a practical roadmap for its implementation. Specifically, it aims to (i) identify ecosystem service providers, beneficiaries, and key stakeholders, (ii) Assess institutional, governance, and capacity-related barriers and enabling conditions, including opportunities to align PES with existing initiatives, (iii) Evaluate viable financing mechanisms, including hydropower and irrigation-related payments, carbon finance, public-private partnerships, and stakeholder willingness to pay or accept compensation, (iv) Examine equity, benefit-sharing, and safeguard considerations, to ensure fair participation and alignment with community needs, and (v) Develop an implementation roadmap outlining phased actions, institutional arrangements, stakeholder roles, capacity requirements, and risk mitigation measures.

2. Methodology

2.1. Study area

The study was conducted in the Gibe III hydroelectric dam catchment, which is one of the living labs selected within the larger Omo-Ghibe River basin (Figure 1). The catchment represents diverse biophysical, socio-economic, and watershed management conditions along the catchment continuum, providing an opportunity to examine ecosystem service generation, environmental pressures, and interactions among upstream communities (ecosystem service providers through restoration of degraded ecosystems) and downstream communities (potential buyers of ecosystem services).

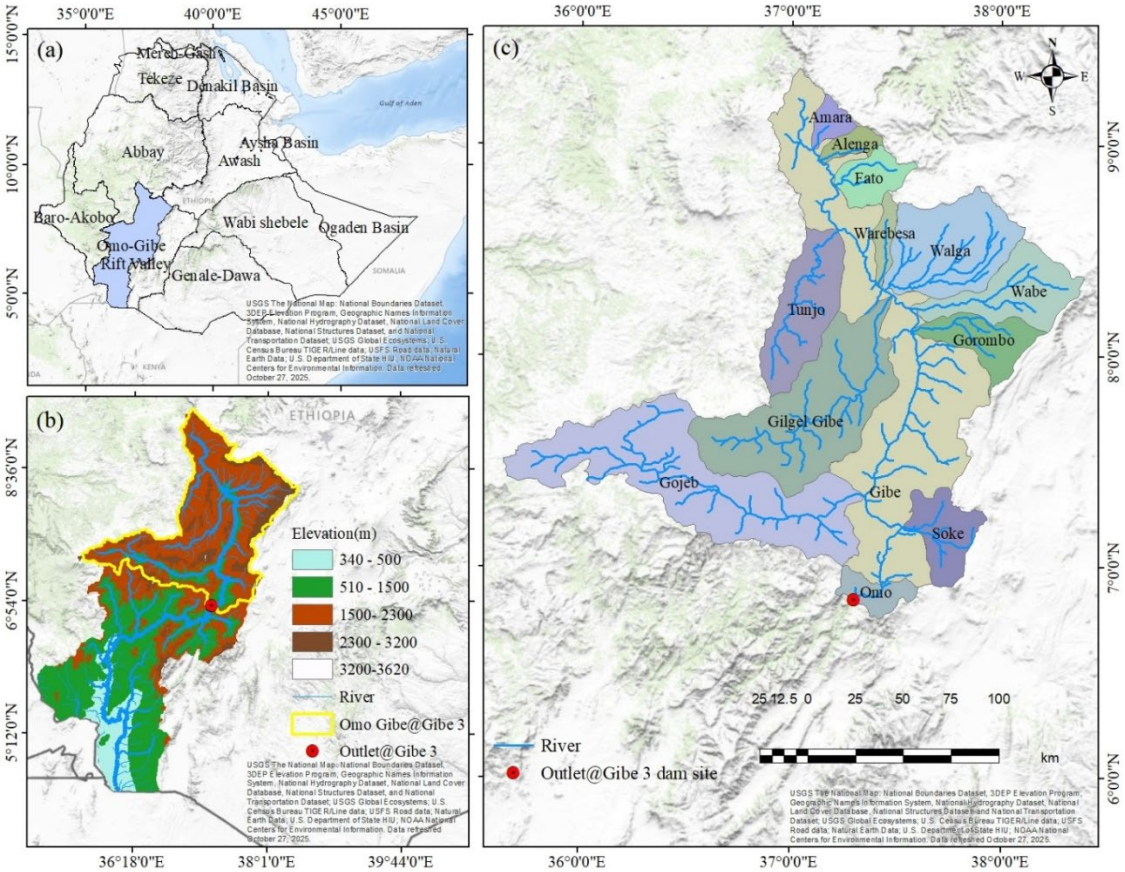

Figure 1: Location and topographical map of the Gibe III Hydropower Dam catchment: (a) major river basins of Ethiopia, (b) elevation gradient, and (c) delineated sub-watersheds and hydrological network contributing to the Gibe III dam site. Source: Authors.

The upstream areas of the catchment are characterized by relatively high rainfall, rugged topography, and intensive agricultural land use. The area serves as an important source of runoff and sediment flowing into the Gibe River system. Farming is dominated by mixed crop-livestock production, while increasing population pressure has contributed to deforestation, cultivation on steep slopes, soil erosion, and land degradation (Duguma and Janssens, 2021). In response, extensive watershed management interventions, including soil and water conservation, agroforestry, exclosures, and community-based watershed management practices, have been implemented by local communities in collaboration with government development organizations and development partners.

The middle catchment represents a transition zone between the upstream and downstream communities. The areas in the middle catchment exhibit moderate slopes and diverse land-use systems, with agriculture remaining the primary livelihood. Ecosystem services generated from

upstream conservation efforts continue to influence water regulation and sediment transport in this section (Gashaw et al., 2018). At the same time, land degradation and increasing pressure on natural resources remain important environmental challenges, making the sub-catchment a critical area for assessing interactions between ecosystem service providers and beneficiaries.

The lower sub-catchment benefits directly from upstream watershed management through improved water availability, reduced sedimentation, and enhanced ecosystem stability (World Bank, 2019; Anteneh et al., 2023). The lower catchment is particularly important because it contains communities and infrastructure that depend on the sustained flow and quality of water originating from upstream landscapes. Reduced sediment inflow contributes to protecting downstream irrigation schemes and maintaining the operational efficiency and longevity of the Gibe III hydropower system (Anteneh et al., 2023).

The study catchment has accumulated notable documented experience with carbon finance, PES, and related incentive-based restoration mechanisms, making it a particularly informative setting for this study. The flagship initiative is the Humbo Assisted Natural Regeneration Project in the Wolaita Zone, implemented by World Vision Ethiopia/Australia with support from the World Bank BioCarbon Fund, registered under the Clean Development Mechanism and later certified to the Gold Standard, widely recognized as Africa's first forestry carbon-credit project, restoring approximately 2,700 hectares of degraded native forest through Farmer Managed Natural Regeneration with seven community cooperatives and channeling carbon revenues into community infrastructure and livelihood investments (Shames et al., 2012). The closely related Sodo Community Managed Reforestation Project on Mount Damota extended the same community-based carbon finance model to adjacent landscapes. In parallel, the basin's highland and midland sub-catchments have hosted a series of donor-funded, incentive-linked landscape restoration programs — including the World Bank-supported Sustainable Land Management Programme (SLMP), the Climate Action through Landscape Management (CALM) programme, the Green Climate Fund-financed Resilient Landscapes and Livelihoods Project (RLLP II), and the national Green Legacy Initiative — that combine community labor with input-based incentives to sustain soil and water conservation, agroforestry, and exclosure works.

These existing mechanisms, however, are not functional substitutes for a hydropower-linked PES: forest carbon-credit projects such as Humbo reward verified biomass carbon sequestration, and the donor-funded landscape programmes are time-bound and largely externally financed, so neither explicitly compensates upstream land managers for the specific watershed services — reduced hillslope erosion and reservoir sedimentation, and more regulated dry-season and peak flows — on which the basin's downstream hydropower generation directly depends (Salzman et al., 2018; Aneseyee et al., 2021). A user-financed PES in which hydropower operators and reservoir beneficiaries pay upstream stewards for measurable improvements in these services would therefore complement, rather than duplicate, the existing carbon and donor initiatives by adding a domestic, service-targeted, and potentially more durable financing stream that can sustain soil and water conservation once carbon-project and donor-programme cycles conclude (Senbeta et al., 2024)

2.2. Study design and data collection

The study employed a qualitative, participatory research design to comprehensively assess the feasibility of establishing an operational PES mechanism within the Gibe III hydropower dam catchment. A qualitative approach was selected because the assessment of barriers and opportunities to develop a road map for operational PES sought to generate an in-depth understanding of ecosystem service provision and use, stakeholder perceptions and interests, institutional arrangements, policy and governance frameworks, financing opportunities, and the social, economic, and environmental factors

influencing the implementation of PES. In addition, a qualitative study approach enables the inclusion of diverse perspectives from upstream ecosystem service providers, downstream beneficiaries, government institutions, development partners, and other key stakeholders involved in community-based watershed management.

Data were generated through multiple qualitative data collection methods, such as desk review, Key Informant Interviews (KIIs), and Focus Group Discussions (FGDs). Key discussion points during KIIs and FGDs were ecosystem service flows, stakeholder roles and responsibilities in restoration and benefit-sharing, incentive structures, financing mechanisms, governance arrangements, and opportunities and barriers for operationalizing a sustainable, equitable, and financially viable PES scheme. Box 1 summarizes the key design considerations and thematic areas explored during the study. Table 1 summarizes the composition of key informants involved in the study, while Figure 2 summarizes the composition of participants in the FGDs.

Box 1: Summary of study design and thematic area covered during data collection

Qualitative Data Collection: Desk review, KII, and FGD

Focus Group Discussion

5 FGDs (Total)

53 individuals (Total)

How is it organized?

- 1 FGD per district bordering the Gibe III hydroelectric dam catchment; 9 – 12 individuals per FGD

Who participated?

- Community leader,
- Watershed Committee members,
- Forest cooperative members,
- Woreda level NGO's focal person,
- Experts from Government offices (NRs, Env't protection and Forest development experts)

What was the discussion point?

- Experience and Practice in Watershed Management
- Benefits and Drawbacks of community-based watershed Management
- Incentive Mechanisms (Including Payment for Ecosystem Services)
- Barriers, Opportunities, Road-map for and of Implementing PES

Key Informant Interviews

11 Interviews (Total)

Who was interviewed (Purposive Selection)?

- Technical experts from higher education and Research centers
- Focal persons of different relevant NGOs
- Experts from relevant Government offices

What were the main interview themes?

- Experience in watershed management
- Benefits and drawbacks of watershed management
- Incentive mechanisms (including PES),
- Barriers and opportunities for implementing PES
- Roadmap for implementing PES

Why multiple methods?
Validate and complement findings with the community perspective, explore governance arrangement, & stakeholder roles.

Desk-Review

What was the focus?

- National policies, strategies, legal frameworks, watershed management guidelines, climate and environmental programs, and relevant sectoral documents related to natural resource management, water resources, hydropower, land restoration, and environmental financing in Ethiopia.

Table 1: Composition and characteristics of key informant interview participants

Respondent name	Gender	Education status	Age	Institution	Category	Responsibility	Experience (In years)
Key informant 1	Male	MSc	38	Wolayita Zone's Office of Agriculture and Natural Resources	GO	Expert/Coordinator	18
Key informant 2	Male	MSc	35	Wolayita Zone Agricultural Office	GO	Forest Development and management Coordinator	8
Key informant 3	Male	MSc	36	Wolayita Rural Land Administration and Utilization	GO	Land Administration Team leader	21
Key informant 4	Male	MSc	45	Wolayita Zone Water and Energy Office	GO	Expert/ Team leader	7
Key informant 5	Female	Msc	37	Wolayita Zone Environment Protection and Forest Development	GO	Environmental Protection Team leader	6
Key informant 6	Male	MSc	45	Wolayita Zone Finance Office	GO	Office Head	7
Key informant 7	Male	PhD	51	Wolayita Sodo University	GO	Researcher	25
Key informant 8	Male	MSc	38	Rural Community-Based Development Initiatives Association (RCBDIA) Project	NGO	Zonal Coordinator	9
Key informant 9	Male	MSc	39	World Vision	NGO	Carbon Financing Expert	5
Key informant 10	Male	MSc	35	World Vision	NGO	Livelihood Expert	4
Key informant 11	Male	MSc	37	World Vision	NGO	Zonal project lead	6

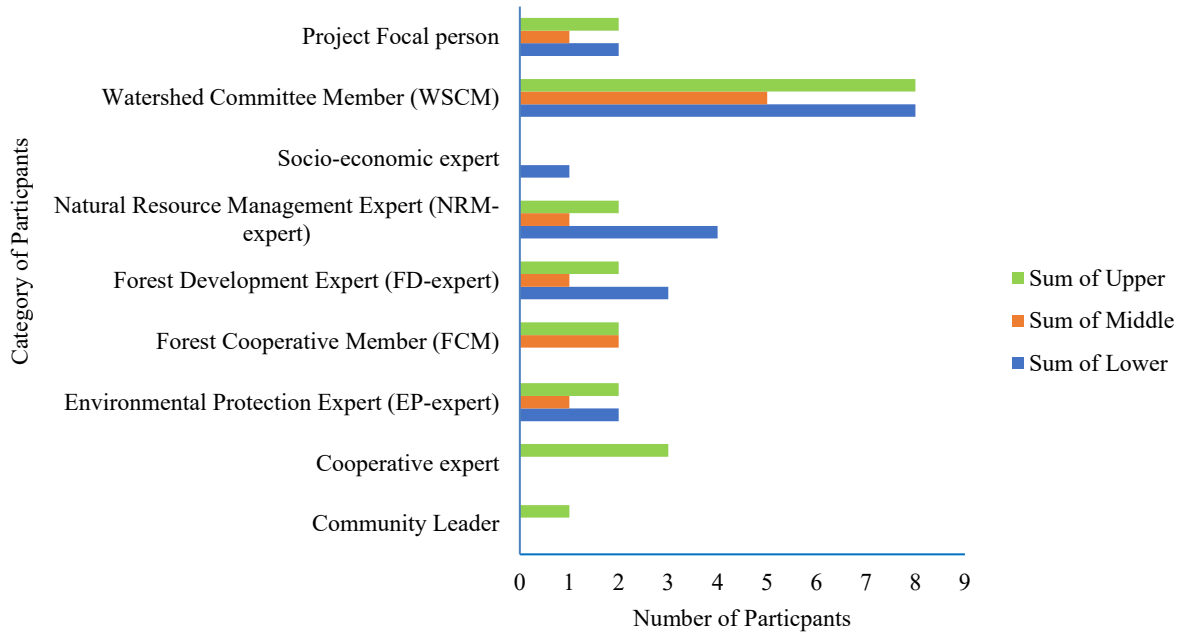

Figure 2: Composition of participants in the focus group discussions. Source: Authors.

2.3. Data analysis

Qualitative data generated through the desk review, KIIs, and FGDs were systematically organized and analyzed using thematic analysis. Information obtained from the three data sources was reviewed, coded (KII-ID 1-11, FGD 1-5) and categorized into major themes (experience in community-based watershed management, benefits and drawback as well as incentive mechanisms for watershed management, barrier and opportunity for operationalizing PES, and roadmap for PES and sub-themes aligned with the study objectives and the conceptual framework for assessing the feasibility of operationalizing a PES mechanism in the Gibe III hydroelectric dam catchment. Similarly, data from the desk review were first coded to establish the national policy and institutional context and to identify lessons from international PES experiences.

A PES analytical framework was used to analyze data (Wegner, 2016). The framework focused on key components including the policy and institutional environment, ecosystem service providers and beneficiaries, financing mechanisms, governance arrangements, stakeholder roles, implementation challenges, and opportunities for scaling PES. Emerging themes from the qualitative data were compared with the findings from the desk review to validate, complement, and refine the analysis, providing an integrated understanding of the conditions for operationalizing PES in the Gibe III hydroelectric dam catchment.

It is important to note the boundaries of this qualitative study. The present assessment did not include a formal downstream willingness-to-pay (WTP) survey of potential PES buyers, an upstream willingness-to-accept (WTA) and opportunity-cost survey of provider households, or a full economic feasibility and biophysical/economic valuation of the ecosystem services generated by upstream conservation in the Gibe III catchment. As a result, this report cannot definitively answer four interrelated economic-feasibility questions: (i) how large the effective demand from downstream users (hydropower operators, irrigation and agricultural investors, and other beneficiaries) is for the watershed services generated upstream; (ii) at what payment levels these downstream users would be willing and able to contribute; (iii) whether the quantity and value of watershed services generated by upstream stewardship are sufficient to motivate downstream contributions at levels that make PES financially viable; and (iv)

whether such payment levels would cover providers' opportunity costs together with transaction, administration, and monitoring, reporting, and verification (MRV) costs. These questions are treated in this report as key uncertainties and priorities for a subsequent, dedicated economic feasibility study (see section 4.2), rather than as established findings. This limitation is a material risk to the economic viability of any future PES scheme in the catchment and should be resolved before a final PES financing model is adopted.

3. Results and Discussion

3.1. The Drivers, Pressures, State, Impact, Response Framework for the Catchment

The Gibe III hydroelectric dam catchment faces severe and interconnected environmental and livelihood challenges. The Drivers, Pressures, State, Impact, Response (DPSIR) framework for the Gibe III hydropower catchment (Figure 3) shows how demographic, environmental, and institutional factors interact to influence watershed conditions. Population growth, land fragmentation, climate variability, and weak institutional support act as key drivers. These create pressures through agricultural expansion into marginal lands, unsustainable land-use practices, fuelwood extraction, charcoal production, uncontrolled grazing, and inadequate maintenance of conservation measures. As a result, the watershed is characterized by land degradation, reduced vegetation cover, increased runoff, soil erosion, sedimentation, flooding, and increased landslide risk. These conditions have significant impacts, including declining crop productivity, reduced food security, loss of soil fertility, damage to infrastructure and settlements, and sediment accumulation in the Gibe III reservoir, which threatens hydropower performance. Anticipating this sediment risk, the Gibe III scheme design explicitly reserves approximately 2.95 km³ (≈2,950 Mm³) of inactive ("dead") storage below the 800 m a.s.l. minimum operating level — about 20 % of the reservoir's 14.7 km³ total capacity — to accommodate long-term sediment accumulation; nevertheless, observed catchment sediment yields may still shorten its effective service life. However, restored areas demonstrate positive outcomes such as improved soil moisture, restored springs, enhanced crop yields, and reduced flood and landslide risks. In response, integrated watershed management interventions have been implemented, including soil and water conservation structures, afforestation, agroforestry, exclosures, fodder development, community mobilization, and support from government and development partners. Strengthening maintenance, monitoring, farmer incentives, institutional coordination, and sustainable financing is essential to ensure long-term watershed restoration and resilience.

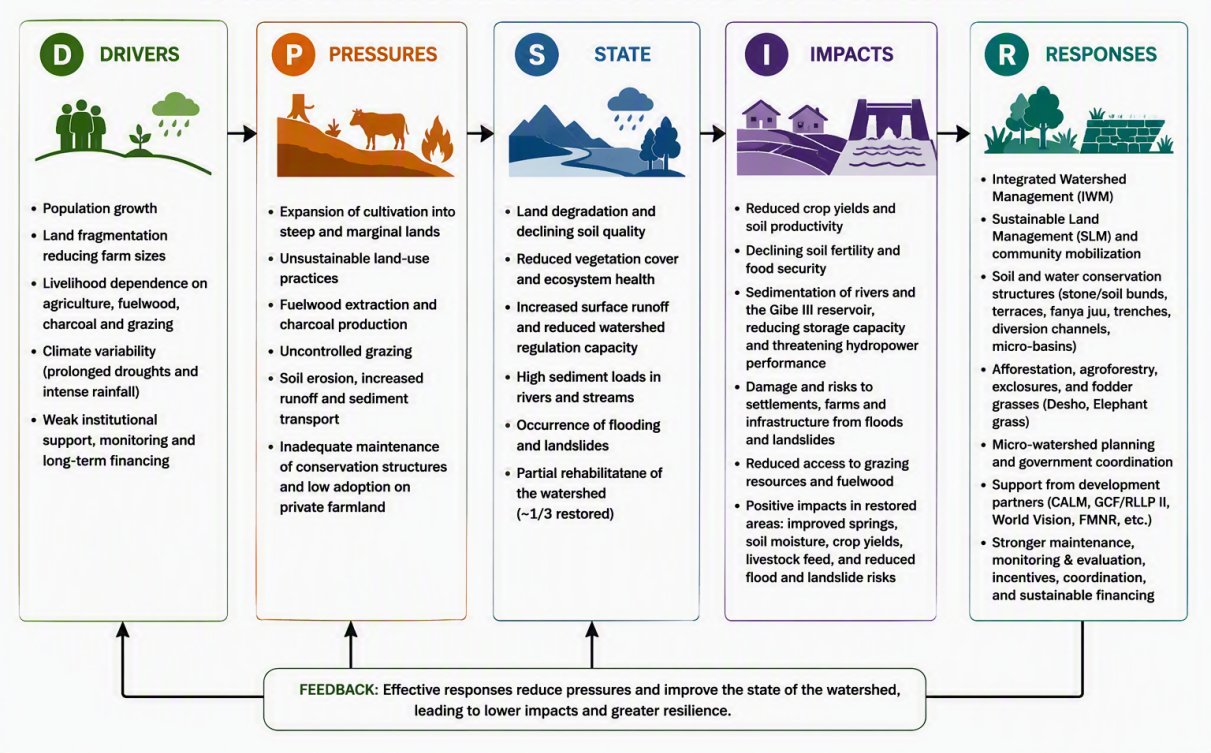

Figure 3. The Drivers, Pressures, State, Impact, Response framework for the Gibe III hydroelectric dam (Autor's formulation using AI assistance).

3.2. Perceived benefit and disbenefit (Trade-off)

Both key informants and participants in FGDs indicated that watershed management has generated important environmental and livelihood benefits. These respondents reported improvements in vegetation cover, restoration of degraded landscapes and springs, enhanced soil fertility, soil moisture, and water retention, reduced surface runoff, soil erosion, and flash flooding, and increased availability of livestock feed. These improvements have strengthened watershed functions and contributed to more sustainable natural resource management within the catchment. In addition, participants reported livelihood benefits through increased fodder production and additional income from activities such as honey production. Although the present study did not include biophysical monitoring at the selected sites, complementary quantitative evidence from elsewhere in the Omo–Gibe Basin also supports these community-reported benefits. Plot-scale monitoring on cultivated hillslopes in the southwestern basin documented that soil bunds reduced surface runoff by 80–92% and soil losses by about 96%, with strong controls on soil organic carbon and nutrient losses (Wolka et al., 2021). Complementary quantitative analysis in the upper Gibe (Rebu watershed) further reported statistically significant improvements in ecological outcomes and livelihood assets among watershed-programme participants compared with non-participants (Mengistu & Assefa, 2020).

However, these benefits are accompanied by important trade-offs. Communities face substantial labour requirements, including annual participation in watershed rehabilitation campaigns, temporary or prolonged restrictions on grazing and fuelwood collection, and reduced access to communal land, which can create short-term resource shortages and increase pressure on household livelihoods. While key informants generally viewed these challenges as temporary and manageable through measures such as cut-and-carry fodder systems, FGD participants described them as continuing livelihood constraints, particularly where land is fragmented and households depend heavily on communal resources.

Participants in FGDs also identified an additional challenge that was not raised during the KIIs: the recovery of wildlife in rehabilitated exclosures has increased crop damage and livestock predation by animals such as porcupines, hyenas, warthogs, and foxes, resulting in significant economic losses for nearby households. From an economic perspective, these costs reduce households' incentives to sustain conservation efforts. Therefore, future community-based watershed management practices should combine ecological restoration with livelihood support, fair compensation, or alternative income-generating opportunities to offset the opportunity costs of conservation and strengthen long-term community participation.

3.3. Ecosystem services and service flows

Both key informants and participants of FGDs indicated that the diverse ecosystems and watershed management practices in the study catchment provide different kinds of ecosystem services and functions that can be categorized as provisioning, regulating, and supporting ecosystem services (Table 2). Table 2 also summarizes how ecosystem services and functions are generated, flows, and major beneficiaries. Furthermore, participants in one of the FGDs indicated that communities benefited from increased grass production due to exclosures for livestock feed and sale, while improved watershed conditions supported irrigation-based production of ginger, cassava, and maize via the Chena River. Additional benefits included enhanced fish production, expanded beekeeping enterprises, livestock fattening opportunities, and improved dry-season water availability as direct benefits of upstream rehabilitation.

These downstream benefits, as reported here, are stakeholder-perceived and community-observed rather than the outcome of a dedicated biophysical monitoring programme in the study sites, and no site-specific pre-/post-rehabilitation impact evaluation has yet been undertaken in the Gibe III catchment. However, complementary evidence from the wider Omo-Gibe basin supports the plausibility of an upstream–downstream service linkage. Basin-scale SWAT modelling in the Gojeb tributary that feeds Gibe III indicates that combined SWC/BMP interventions can retain up to ~9.7 Mt yr^{-1} of sediment and cut surface runoff by ≈26 % (Anteneh et al., 2023), while sediment-budget work using SWAT and reservoir data reports a mean sediment yield of 62.5 t ha^{-1} yr^{-1} and a ~5.7 % loss of storage capacity in the neighbouring Gibe One reservoir over 13 years of operation (Kuma et al., 2024). Taken together, our qualitative findings and this quantitative basin-wide evidence are consistent with a clear upstream–downstream linkage in which upstream conservation efforts sustain ecosystem services that support local livelihoods and downstream users – irrigation users, fisheries, agricultural investors, hydropower services (Gibe III) and the wider electricity consumer base.

Downstream acknowledgment of these benefits is, at present, institutional rather than utility-metered: the 2024 Omo-Gibe River Basin Integrated River Basin Management Plan explicitly identifies erosion and reservoir siltation as basin-wide priorities requiring integrated watershed management (MoWE, 2024), and both Ethiopian Electric Power (Gibe III) experts and Zone Irrigation and Lowlands experts consulted for this study confirmed reduced sedimentation, more reliable water availability and protection of downstream infrastructure as key benefits of continued upstream watershed management.

The qualitative and complementary quantitative evidence summarized in Table 2 provides an overview of the ecosystem services likely to be generated by upstream watershed management in the Gibe III catchment and of the general direction of upstream-to-downstream service flows. However, this evidence is not sufficient, on its own, to (i) fully quantify each ecosystem service flow at the sub-catchment scale, (ii) attribute specific quantities of services to individual providers or provider groups, (iii) quantify service uptake and monetary value for each downstream beneficiary class (Gibe III hydropower, irrigation and agricultural investors, fisheries, downstream communities, and national

energy consumers), or (iv) determine appropriate payment levels for a PES scheme. A full ecosystem-service accounting and biophysical/economic valuation exercise, coupled with a formal downstream willingness-to-pay assessment and an upstream willingness-to-accept and opportunity-cost analysis, is therefore required as part of the more detailed economic feasibility analysis recommended in section 4.2, before PES payment levels and buyer contributions in the Gibe III catchment can be finalized.

Table 2: Summary of major ecosystem services and service flows

Category	Ecosystem Service Generated	How the Service is Generated (Watershed Process/Intervention)	Service Flow (From Source to Beneficiary)
Supporting Ecosystem Services	Regeneration of native plant species and biodiversity improvement	Biological conservation measures together with land management practices (e.g., exclosures) allow vegetation recovery and improve biodiversity.	Degraded landscapes → vegetation restoration → improved ecosystem functioning → enhanced ecological stability
	Improved soil structure and nutrient cycling	Increased vegetation cover and reduced land disturbance improve soil organic matter accumulation, nutrient recycling, and soil biological processes.	Conserved farmland and rehabilitated communal areas → improved soil quality → higher land productivity
Regulating Ecosystem Services	Soil erosion control	Physical and biological conservation measures reduce runoff and soil loss.	Catchment management in the Upper Slopes → reduced runoff and erosion → improved agricultural productivity
	Water quality regulation	Landscape management and restoration increase water infiltration, maintain soil moisture, and improve groundwater recharge.	Conserved landscapes → improved infiltration → restored springs and more reliable water availability
	Flood regulation	Landscape management and restoration reduce surface runoff and increase infiltration.	Upper watershed management → reduced peak runoff → reduced flooding and landslide risks downstream
	Sediment regulation and reservoir protection	Improved upstream land management reduces soil erosion and sediment transportation into rivers and reservoirs.	Upper catchment conservation → reduced sediment movement → reduced reservoir sedimentation
	Climate regulation and carbon storage	Vegetation restoration and enclosures increase biomass accumulation and carbon storage capacity.	Rehabilitated vegetation areas → increased carbon storage → improved environmental sustainability
Provisioning Ecosystem Services	Agricultural production improvement	Improved soil fertility, moisture conservation, and reduced erosion from conservation measures and the expansion of irrigated agriculture increase agricultural production.	Watershed conservation → improved soil and water conditions → increased crop production → household food and income benefits
	Livestock feed production	Communal exclosures and restored vegetation areas provide increased grass resources for livestock feeding and grass sales.	Rehabilitated communal areas → increased grass availability → livestock production and income generation
	Improved water supply	Restoration and protection of freshwater ecosystems improve the reliability of water resources for multiple uses.	Watershed restoration → spring recovery → improved water availability
	Natural resource-based livelihood products	Restored vegetation areas provide opportunities for implementing nature-friendly enterprises.	Rehabilitated ecosystems → increased resource availability → household livelihood improvement

Note: Biological conservation measures here refer to either planting Desho grass, Elephant grass, fruit trees, or other multipurpose species. Physical conservation measures include stone bunds, soil bunds, terraces, trenches, micro-basins, diversion channels, and fanya juu structures.

3.4. Key ecosystem service providers and beneficiaries

Building on the findings from KII and FGDs, Table 3 presents the main ecosystem service providers and beneficiaries associated with landscape restoration in the Gibe III hydroelectric dam catchment. It shows that upstream farming communities are the primary service providers through their investments in soil and water conservation, agroforestry, tree planting, and landscape restoration, while community watershed management groups, government institutions, and development partners play complementary roles in coordination, technical support, financing, materials, and capacity building. The table also highlights the key beneficiaries of improved watershed conditions, including the GIBE III Hydroelectric Power Facility, national energy consumers, downstream communities, agricultural investors and irrigation users, fisheries and aquatic ecosystems, and upstream communities that receive local restoration benefits

Table 1: Summary of ecosystem service providers and beneficiaries and their role

Category	Ecosystem Service Providers / Beneficiaries	Main Roles or Benefits
Ecosystem Service Providers	Local communities (Upstream farming communities & community watershed team)	Implement conservation measures and restore degraded landscapes
	Government institutions	Provide technical, institutional, and logistical support
	Development partners	Support restoration programs through financial and technical assistance
Ecosystem Service Beneficiaries	Gibe III Hydroelectric Power Facility	Benefit from improved watershed conditions and reduced sediment inflow
	National energy consumers	Benefit from reliable and sustainable electricity generation
	Downstream communities	Benefit from improved watershed regulation
	Agricultural investors and irrigation users	Benefit from improved water availability and reduced production risks
	Fisheries and aquatic ecosystems	Benefit from improved water quality and ecosystem health
	Upstream communities	Receive local benefits from restored landscapes

3.5. Rationale for payment for ecosystem services

The triangulated evidence provides a compelling justification for introducing a PES mechanism. Current watershed management depends heavily on government budgets, donor-funded projects and voluntary community labor, creating uncertainty regarding long-term financing. Both key informants and participants of FGDs consistently show that upstream communities incur substantial opportunity costs through labor investments, land allocated to conservation, restricted grazing and reduced access to natural resources, while downstream stakeholders receive benefits from improved water regulation, sediment reduction and sustained hydropower generation.

A PES mechanism would create a fairer distribution of costs and benefits by compensating ecosystem service providers for maintaining conservation structures, protecting communal exclosures, adopting agroforestry, restoring degraded land, and implementing sustainable grazing practices. In line with this, stakeholders identified several interrelated reasons for considering a PES mechanism in the watershed.

As illustrated in Figure 4, these range from recognizing upstream conservation efforts and addressing financing gaps to strengthening ecosystem protection, monitoring, and climate resilience.

It is important to clarify that the PES mechanism proposed here is envisaged as a complementary financing mechanism rather than a replacement for existing sources of watershed finance. Public budgets and integrated watershed management programmes, government development programmes, development-partner and donor projects, and other environmental and climate finance instruments (including forest carbon finance where applicable) are expected to remain central to upstream conservation in the Gibe III catchment. PES is proposed as an additional, service-targeted and demand-driven financing stream that would add durability and sharpen accountability as project-based and donor-programme cycles conclude. In practice, this means that any operational PES arrangement in the catchment should be designed to sit within, and blend with, a broader portfolio of public, donor, private-sector, and climate-finance instruments, with PES contributions increasing gradually over time as trust, MRV capacity, and buyer participation are established.

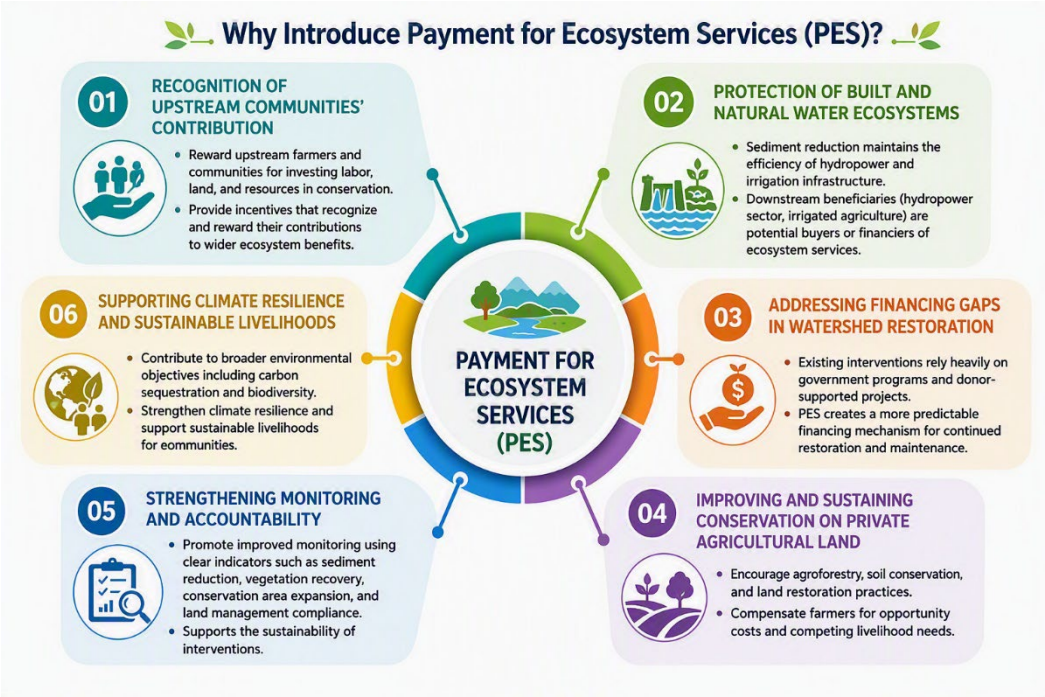

Figure 4. Rationale for introducing payment for ecosystem services in the study catchment (AI-assisted infographic).

3.6. Awareness and willingness to participate in PES

Both key informants and participants of FGDs show that although most community members are not familiar with the term PES, they clearly understand the idea of receiving compensation for conserving natural resources and participating in watershed management. Communities expressed a strong willingness to participate in a PES scheme if it provides fair and reliable benefits. Rather than relying only on cash payments, FGD participants preferred a combination of performance-based cash payments, such as the Person-Day (PD) system for conservation work, together with productive assets such as beehives, small ruminants, improved seeds, and forage planting materials. They were also cautious about depending on promises of cash payments from downstream users because previous experiences had reduced their trust in such arrangements. Key informants similarly emphasized that long-term watershed management cannot depend on short-term donor projects and should instead be

supported by clear benefit-sharing mechanisms and legally binding financing agreements, where downstream beneficiaries, such as hydropower and irrigation users, contribute to upstream conservation. Both key informants and FGDs, therefore, support the establishment of a formal PES system based on transparent performance, equitable benefit sharing, and sustainable financing that encourages long-term participation in watershed management.

3.7. Barriers and opportunities to operationalize payment for ecosystem services

Stakeholder-related barriers and opportunities

The findings from KII, FGDs, and literature reviews indicate that watershed management in the study catchment involves multiple government offices, development projects, and community-based organizations, and local leaders, but weak coordination among these actors remains a central barrier to effective implementation. Government offices responsible for agriculture, forestry, water, and environmental protection provide important technical guidance and oversight, yet their effectiveness is constrained by staff turnover, budget shortages, and weak coordination. At the same time, participants of FGDs indicate that communities often place greater trust in local institutions such as watershed committees, agricultural cooperatives, Iddir[1], and religious leaders because they are perceived as more transparent, accountable, and effective in mobilizing community participation and encouraging compliance. Key informants emphasized the need for strong technical oversight, financial accountability, and enforcement through formal institutions, while participants of FGDs highlighted the importance of developing more decision-making authority for trusted local structures and addressing concerns over transparency and elite influence. The main opportunity is therefore to combine the strengths of both systems: strengthen cross-sector coordination and technical accountability while formally integrating trusted community institutions into watershed governance and PES implementation arrangements.

Institutional and policy-related barriers and opportunities

Based on the desk review of relevant legal and policy documents (Table 4 and Annex 1), Ethiopia appears to have established a relatively strong legal and policy framework that provides a solid foundation for sustainable watershed management, the conservation and restoration of ecosystem services, and the implementation of PES. The reviewed proclamations indicate that, over the past decade, the country has strengthened land governance, watershed management, forest conservation, community participation, landscape restoration, and sustainable financing mechanisms. Table 4 summarizes the key gaps in the policies, constraining the effective implementation of PES.

The institutional structure for watershed management is relatively well established, with federal and regional bodies providing policy direction, zonal and woreda administrations supporting coordination and enforcement, technical extension offices contributing expertise, and community-level bodies implementing activities on the ground. However, the literature review, KIIs, and FGDs all point to persistent gaps in horizontal coordination, especially where agriculture, forestry, environment, water, and public works offices pursue sector-specific priorities without a unified watershed management framework. This creates inconsistent guidance for communities and can reduce the efficiency and sustainability of investments. The key opportunity is to establish a stronger watershed- or sub-catchment-level coordination platform that brings together relevant government offices, community

[1] Idir is a traditional Ethiopian community-based mutual support association whose members contribute money regularly and help one another, especially during bereavement and other major social needs.

representatives, cooperatives, and development partners, while clarifying institutional mandates, staffing, budget responsibilities, and implementation procedures for PES-related activities.

The gaps and practical implications summarized in Table 4 are preliminary, desk-based interpretations by the study team and should be treated as working assumptions rather than definitive legal conclusions. In particular, the exact scope of Proclamation No. 1401/2026, its interaction with existing land, water, forestry, environmental, and public financial management legislation, and the status and content of any implementing Council of Ministers regulations and EPA/EFCCC-successor directives, will need to be confirmed by a qualified Ethiopian legal expert who is conversant with the Proclamation and its subsidiary instruments before the identified gaps are used as a basis for PES design. This legal review is included as a specific component of the recommended economic and institutional feasibility study (see section 4.2).

Table 4: Gaps in the existing and newly released payment for ecosystem services proclamation

PES Component	What the Proclamation Provides	Identified Gap	Practical Implication
Rights & Obligations of Providers and/or Buyers	Establishes PES as a national policy instrument; names ecosystem service providers and users/buyers as parties; assigns EPA/EFCCC-linked bodies a coordinating role.	Provider tenure and use-rights are not clearly reconciled with existing land-holding law (federal land is state-owned); the proclamation does not specify minimum contract content, default remedies, or dispute-resolution forum for provider-buyer agreements.	Communities without registered land-use certificates may be excluded or under-compensated; buyers face legal uncertainty on enforceability of PES contracts.
Payment Mechanisms	Recognizes PES as a domestic financing mechanism and references a national/possibly sub-national PES fund and voluntary and compliance-based schemes.	No detailed secondary legislation (regulation/directive) yet defines payment calculation methods, pricing/valuation standards, currency and disbursement channels, or tax treatment of PES payments.	Absent a costed valuation methodology, buyers and providers cannot predict payment levels, discourage market uptake and create room for inconsistent, ad hoc pricing.
Benefit-Sharing Arrangements	States an intent that benefits reach federal, regional and local actors, including community and vulnerable groups.	No statutory benefit-sharing formula (e.g., percentage splits between federal/regional/local/community levels), no guidance on gender-responsive or Indigenous/customary rights-holder allocation, and no safeguard against elite capture at woreda/kebele level.	Risk that intermediary institutions retain disproportionate shares, undermining the incentive effect for front-line resource managers.
Monitoring, Reporting & Verification (MRV)	Implies EPA/EFCCC and sector agencies (EBI, EWA, Ministry of Water & Energy) will oversee compliance.	No independent, third-party verification standard; no defined baseline-setting methodology, additionality test, permanence/leakage safeguards, or grievance-redress mechanism for disputed measurements.	Without credible MRV, payments cannot be reliably linked to verified ecosystem outcomes, exposing the scheme to fraud risk and donor/investor distrust.
Institutional Responsibilities & Coordination	Assigns a lead role to EPA (policy/regulatory) with EBI and EWA as technical partners, and references federal-regional coordination.	Overlapping mandates among EPA, EFCCC-successor bodies, Ministry of Water & Energy, Ministry of Agriculture, and regional environment bureaus are not clearly delineated; no single implementing or coordinating secretariat or fund-management entity is designated with operational authority.	Coordination gaps typically slow implementation, duplicate oversight, and leave capacity-constrained regional bureaus without clear budget or staffing mandates.
Implementing Regulations & Directives	The Proclamation is framework legislation; it anticipates subsequent regulations/directives (typical of Ethiopian legislative practice).	As of the effective date, no published Council of Ministers regulation or EPA directive operationalizes valuation, MRV, or fund administration; the framework law alone is not self-executing.	PES implementation remains limited until supporting regulations are developed, leaving pilot buyers and sellers, such as watershed-based PES initiatives, without clear legal guidance.
Private Sector & Market Participation	Signals openness to private, NGO and multi-actor participation in PES.	No prudential or registration framework for private PES intermediaries/aggregators, no rules on cross-border or carbon-market-linked PES transactions, and no consumer/buyer protection provisions.	Limits the ability to attract private and international climate finance into domestic PES markets, and creates risk of unregulated intermediaries.
Enforcement & Compliance	Presumably includes general administrative penalty provisions consistent with other EPA-administered proclamations.	Specific, PES-tailored sanctions for breach of payment obligations, non-delivery of contracted ecosystem services, or MRV fraud are not detailed in the public record.	Weak, generic enforcement reduces deterrence against both non-paying buyers and non-performing providers.

Governance-related barriers and opportunities

The main governance barriers are weak inter-sectoral coordination, frequent institutional changes, uneven enforcement of environmental regulations, and limited accountability across land users. Key informants highlighted reduced institutional capacity and loss of technical experience, especially where regulatory bodies such as the Environmental Protection Authority (EPA) have undergone changes. Participants in FGDs also expressed community concern that smallholder farmers may face penalties for minor conservation violations, whereas larger investors are perceived to avoid similar accountability for activities that damage natural resources. These perceived inequalities reduce community trust and weaken compliance with watershed management rules.

Additional governance concerns include unclear rights for providers and buyers, PES contracts that lack detailed minimum requirements and dispute-resolution mechanisms, MRV standards that are not yet sufficiently defined, and underdeveloped PES-specific enforcement provisions. These gaps create uncertainty for communities, buyers, and implementing agencies. The opportunity is to strengthen governance by clarifying contractual rights and obligations, applying regulations consistently across all land users, establishing credible MRV and grievance mechanisms, and ensuring that PES payments are tied to verified ecosystem outcomes and enforceable agreements.

Whether the existing Ethiopian regulatory framework, in combination with Proclamation No. 1401/2026 and Ethiopian public financial management legislation, provides an adequate and specific enabling environment for a dedicated Watershed PES Fund could not be definitively established through this desk review and stakeholder consultation. The following issues therefore require targeted legal and institutional verification: (i) the legal basis on which such a fund can be established and operated; (ii) its permissible legal form (for example, a public trust fund, a special account within an existing public treasury structure, or an autonomous fund managed by a mandated federal or regional entity); (iii) the competent approving authority and the level of federal versus regional endorsement required; (iv) the fund's fiduciary arrangements, including audit, reporting, and accountability obligations; and (v) its relationship with existing public-finance, environmental-finance, and climate-finance mechanisms so that it complements, rather than duplicates or conflicts with, them. This verification should form part of the detailed economic and legal feasibility work recommended in section 4.2.

Capacity-related barriers and opportunities

Capacity constraints affect both institutions and communities. For example, regional, zonal, and district-level agricultural offices face shortages of transport, field equipment, nursery materials, operational budgets, and skilled personnel, limiting their ability to provide regular extension support, monitoring, and enforcement. At the community level, watershed management committees and cooperatives often lack financial management systems, data recording tools, and skills needed for environmental monitoring, verification and transparent benefit administration. As a result, monitoring can remain focused on simple activity indicators, such as the number of seedlings planted, rather than tracking actual outcomes like tree survival and landscape improvement. Similarly, weak record-keeping systems at the community level make benefit-sharing processes less transparent and increase the risk of errors or unequal distribution. The information summarized in Table 4 reinforces this capacity gap by showing that the PES proclamation does not yet provide detailed guidance on valuation methods, payment calculation, MRV standards, baseline setting, additionality, permanence, leakage, or fund administration. The opportunity is to invest in practical capacity-building for both government and community institutions, including financial management, record-keeping, participatory monitoring, outcome-based reporting, MRV, and transparent payment administration so that watershed and PES interventions are technically credible and locally accountable.

Safeguards-related barriers and opportunities

The main safeguards-related risks for a future PES mechanism in the study catchment include unequal access to benefits, possible capture of resources by influential individuals, exclusion of vulnerable groups such as landless youth and widows, and loss of community trust due to poor transparency in fund management. These risks are reinforced by the absence of clear benefit-sharing mechanisms, limited guidance on gender-responsive allocation, and no explicit safeguards against elite capture at Woreda or kebele levels. Key informants emphasize the importance of transparent financial management, regular independent audits, performance monitoring, and fair allocation of resources among cooperatives. Participants of FGDs highlight the need for inclusive benefit-sharing approaches that recognize differences in household conditions. They recommend using locally agreed wealth-ranking systems to identify vulnerable households and ensure that poor and disadvantaged groups receive fair access to PES-related livelihood support, assets, and employment opportunities. The opportunity is to design safeguards before PES implementation begins, including clear benefit-sharing rules, community-approved eligibility criteria, grievance-redress mechanisms, independent audits, and targeted support for poorer and disadvantaged households through livelihood assistance, assets, or employment opportunities. These measures would help ensure that PES incentives reach front-line resource managers and maintain community confidence in the system.

3.8. Strategic framework for operationalizing PES

Vision, Guiding Principles, and Institutional Foundations

The long-term vision for PES in the Gibe III hydroelectric dam catchment is a future in which the catchment is a resilient, climate-adapted, and sustainably managed watershed, where a durable and equitable partnership between upstream stewards and downstream beneficiaries of watershed services underpins long-term ecosystem service delivery, safeguards downstream investments such as hydropower generation and agricultural development, and sustains climate-resilient livelihoods and prosperity for upstream smallholder communities. Achieving this vision requires transforming upstream land managers, over time, from passive participants in externally driven conservation programmes into recognized ecosystem service providers and active partners in watershed protection, supported through a mix of public, private, and PES-based financing.

This vision is guided by five core principles: equity, transparency, performance conditionality, social inclusivity, and long-term institutional sustainability. Equity ensures fair recognition and compensation of upstream communities that contribute to watershed protection. Transparency promotes trust through clear rules for monitoring, verification, payment determination, and benefit sharing. Performance conditionality links payments to verified ecosystem services, particularly reduced erosion and sediment delivery. Social inclusivity ensures meaningful participation of local communities, including vulnerable groups, in decision-making and benefit-sharing processes. Institutional sustainability emphasizes the need for strong governance structures, reliable financing mechanisms, and lasting partnerships among upstream communities, government institutions, and downstream beneficiaries.

To institutionalize these principles, this study proposes two complementary instruments, a Watershed PES Charter and a system of Ecosystem Stewardship Credits, as options for further consideration rather than as legally established arrangements. The proposed Watershed Charter would define shared commitments, roles, responsibilities, benefit-sharing arrangements, and accountability mechanisms among national and regional governments, watershed cooperatives, upstream provider communities, downstream corporate beneficiaries, and other relevant actors, as the formal foundation for PES implementation. The proposed Ecosystem Stewardship Credits, established through local Bylaws,

would represent the verified contributions of upstream smallholders and communities to maintaining or improving ecosystem services and would provide visible economic recognition of their stewardship role. Before either instrument is formally adopted, the following must be determined through a dedicated legal review: (i) the appropriate approving authority, including whether regional endorsement alone is sufficient or whether federal-level endorsement (for example, by the responsible federal ministry, the environmental protection body, or another mandated federal institution) is required; (ii) the legal status of the Charter and Credits (voluntary compact, binding contract, subsidiary legal instrument, or administrative guideline); (iii) their enforceability and remedies for non-compliance; and (iv) their consistency with Proclamation No. 1401/2026 and its subsidiary regulations and directives, as well as with existing land, environment, water, and public financial management legislation.

Proposed PES Model and Priority Ecosystem Service

The proposed PES model is a phased, polycentric[2] hybrid payment model that combines input-based and performance-based payment mechanisms. It should be coordinated locally through watershed cooperatives and supported by a multi-sector watershed management platform involving government institutions, ecosystem service beneficiaries, and community representatives.

The hybrid model recognizes that watershed conservation requires both immediate support for community participation and long-term incentives for ecosystem service delivery. Input-based payments would compensate upstream households for verified conservation inputs, such as labor contributions for soil and water conservation structures, tree planting, and other watershed restoration activities. These payments would help address the immediate costs and opportunity costs faced by smallholder farmers while encouraging active participation in conservation activities. This also aligns with a broader finding in the Ethiopian SWC adoption literature that tenure security, social capital, and perceived profitability, not merely labor compensation, are significant determinants of the final, sustained adoption phase of conservation practice (Teshome et al., 2016). However, sustained adoption of conservation practices also depends on factors such as tenure security, social capital, and perceived profitability, not labor compensation alone.

In parallel, performance-based payments would reward verified environmental outcomes, such as tree survival, improved land management practices, reduced erosion, and sustained watershed protection. Rather than relying only on direct cash transfers, the model would combine cash payments with targeted in-kind livelihood support, such as improved livestock breeds, beekeeping equipment, and climate-resilient agricultural inputs, to strengthen household assets and long-term economic resilience. This approach responds to community concerns that cash-only payments may generate short-term benefits but limited long-term livelihood impacts, particularly for vulnerable households. Productive assets are therefore preferred because they can strengthen household resilience and generate continuing income.

To operationalize this model, PES agreements should include two complementary payment tiers: (i) input-based contracts that provide timely payments for approved conservation activities and labor contributions, and (ii) performance-based contracts that provide additional rewards after independent verification of agreed ecosystem service improvements. This approach ensures that upstream communities are fairly compensated for their efforts while maintaining accountability for the environmental benefits generated through PES implementation.

[2] *It means that PES governance is not controlled by a single institution. Instead, multiple actors (communities, local, zonal, Woreda and Regional authorities, development partners, Research institutions and technical organizations) share responsibilities, decision-making authority, and accountability. This makes local communities to have a voice, and thereby the PES mechanism becomes more accountable and sustainable.*

The PES framework should prioritize three ecosystem services that link local conservation efforts with downstream economic and environmental benefits. First, sediment retention and soil erosion control, aimed at reducing soil loss and sediment accumulation in the Gibe III reservoir, thereby supporting hydropower efficiency and infrastructure longevity. Second, hydrological regulation, focusing on dry-season water availability, groundwater recharge, and sustainable water resources for ecosystems and livelihoods. Third, carbon sequestration, which creates opportunities for additional incentives through forest restoration and potential carbon credit mechanisms.

To support payment design, a standardized Ecosystem Services Matrix[3] should be developed to identify, measure, and assign appropriate values to conservation activities based on their contribution to ecosystem service improvement, particularly sediment reduction. Successful forest restoration and exclosures establishment should also be assessed for possible integration into carbon credit programs, creating complementary financing opportunities alongside watershed PES payments.

Sustainable Financing and Fund Management

The financing framework for PES in the study catchment should be based on a multi-stakeholder co-financing mechanism, in which beneficiary sectors contribute according to the ecosystem services and economic benefits they receive. Evidence from KIIs and FGDs indicates that relying on a single financing source, particularly downstream water users alone, would be insufficient for sustaining PES implementation. Instead, shared financing responsibility is needed among government institutions, hydropower operators, agricultural investors, private companies, and other watershed beneficiaries.

Under this mechanism, each beneficiary sector would contribute based on its dependence on improved watershed conditions. The hydropower sector would contribute in recognition of reduced sedimentation, longer reservoir lifespan, and lower maintenance costs. Commercial agricultural investors would contribute because improved water availability, soil conservation, and stable production conditions directly support their activities. Other businesses, including bottled water companies, tourism enterprises, and watershed-dependent private actors, such as upstream and downstream agro-industries could contribute through negotiated environmental service fees or voluntary corporate commitments.

The financing system should be developed gradually. Initial investments from government budgets and development partners would support PES institution-building, baseline assessments, monitoring systems, and community capacity development. As the system becomes operational, regular contributions from ecosystem service beneficiaries should become the main source of funding for conservation payments and watershed restoration activities.

To ensure transparency and sustainability, all contributions should be managed through a dedicated Watershed PES Fund. The Fund would receive, administer, and distribute resources to verified ecosystem service providers based on agreed payment arrangements, verified performance, and approved benefit-sharing rules.

Monitoring, Reporting and Verification

A credible Monitoring, Reporting, and Verification (MRV) system is essential for PES implementation in the Gibe III hydroelectric dam catchment. KIIs indicate that the absence of reliable and verifiable environmental data is a major constraint to attracting and sustaining downstream financing.

[3] *It a structured tool used to show link between conservation activities → ecosystem improvements (along the indicators) → payment values.*

Beneficiaries and corporate contributors require evidence that their investments generate measurable environmental outcomes before they commit to continued payments.

Delivering credible MRV data will require deliberate investment in several complementary elements, sized to the scale of the scheme. (i) Robust baseline data (biophysical and socio-economic) should be established at the sub-catchment scale before payments begin, using clearly documented sampling designs and, where feasible, georeferenced monitoring points and plots so that future measurements are directly comparable. (ii) Transparent, well-documented, and consistently applied measurement methods and indicators should be adopted for each priority ecosystem service, so that reported outcomes such as reduced erosion, improved land cover, and reduced sediment delivery can be replicated and audited. (iii) Data-quality protocols — including standardized data-collection forms, quality-control checks, secure record-keeping, and versioned datasets — should be introduced so that MRV outputs can withstand scrutiny by downstream buyers, regulators, and auditors. (iv) Wherever it is technically and financially feasible, periodic independent or third-party verification should be built in, particularly to underpin performance-based payments, reduce conflicts of interest, and increase donor and buyer confidence. (v) Community-based monitoring, delivered through trained watershed committees, cooperatives, and youth groups, should be systematically combined with scientific and technical measurements from research institutions and government agencies, so that MRV is both technically credible and socially legitimate at the local level. The cost of establishing and running this MRV system should be included in the initial PES budget and in the economic feasibility analysis recommended in section 4.2.

The PES system should therefore move beyond activity counting, such as the number of trees planted or structures constructed, and adopt a results-based MRV framework that measures actual ecosystem service improvements. Key indicators should include reduced erosion, improved vegetation cover, tree survival, improved land management, and sediment reduction. The MRV system should combine scientific monitoring tools, including satellite-based land monitoring, with community-based field observations to ensure accuracy, transparency, and local legitimacy.

Community participation in MRV is particularly important. FGD participants emphasized that monitoring and verification should involve watershed cooperatives, local representatives, and customary leaders so that results reflect local realities and communities are not unfairly penalized for factors beyond their control, such as climate-related seedling failure. Local youth groups and community institutions can be trained and equipped with GPS-based tools to map conservation areas, document implementation progress, and monitor vegetation survival.

In addition, regional universities or independent research institutions should conduct periodic ecological assessments to verify outcomes such as reduced erosion, improved land cover, and sediment reduction. Verified results would then serve as the basis for releasing performance-based payments and maintaining trust among upstream communities, downstream beneficiaries, and implementing institutions.

Grievance, Accountability and Safeguards

Effective PES implementation requires a transparent, accessible, and trusted grievance and accountability system. FGD participants noted that formal court systems are often costly, time-consuming, and difficult for smallholder communities to access, especially when disputes involve powerful actors or resource-related conflicts. For this reason, locally trusted customary institutions, including elders' councils within Iddir networks, should serve as the first platform for handling community grievances.

At the same time, customary mechanisms should be linked with formal administrative procedures. KIIs emphasized that combining local conflict-resolution systems with formal documentation and oversight can strengthen accountability while maintaining community trust. This arrangement would allow local disputes to be resolved through trusted institutions while ensuring that decisions are recorded, monitored, and connected to official PES governance structures.

The PES framework should therefore establish an independent, multi-level Complaint and Dispute Resolution Mechanism (CDRM) that provides simple, affordable, and accessible channels for communities to raise concerns. The mechanism should address disputes related to beneficiary selection, delayed payments, conservation performance assessments, land boundaries, and benefit sharing. Complaints should be handled fairly, transparently, and without discrimination or retaliation.

To operate the CDRM, grievance committees should be established at the kebele level and include agricultural experts, watershed cooperative representatives, and elected customary leaders. In addition, information on beneficiary selection, performance verification, PES payments, and benefit-sharing decisions should be publicly disclosed through village information boards and other locally appropriate communication channels. These measures would strengthen transparency, reduce the risk of elite capture, improve accountability, and build long-term trust in the PES system.

3.9. Implementation roadmap for payment for ecosystem services operationalization

Roadmap Logic and Strategic Orientation

The PES roadmap will be implemented through a phased upstream-to-downstream approach, beginning in the most degraded and steep upper sub-catchments before expanding to lower catchments and basin-wide implementation. This sequencing responds to the need to address severe soil erosion and landslide risks, and downstream flooding early, while avoiding overstretching financial and technical resources across the whole basin at once. PES good practice also emphasizes that schemes require clear ecosystem services, defined providers and buyers, governance arrangements, baseline data, MRV, and benefit-sharing rules before full implementation.

The implementation of the PES Roadmap aims to establish a transparent, fair, and sustainable system that encourages ecosystem conservation, improves local livelihoods, and supports Ethiopia's sustainable development goals. The roadmap is based on voluntary participation between ecosystem service providers and beneficiaries, with payments linked to agreed conservation results. It also promotes transparency, equitable benefit sharing, community participation, accountability, and adaptive management to ensure that PES interventions achieve lasting environmental and socio-economic benefits, in line with the Ethiopian Payment for Ecosystem Services Proclamation No. 1401/2026. Table 5 and Table 6 summarize the Guiding Framework for PES Operationalization and Phased PES Implementation Roadmap, respectively.

Table 2: Guiding framework for PES operationalization

Guiding principle	Operational meaning for the study catchment	Practical implication
Upstream-to-downstream prioritization	Start in degraded upper catchments, steep slopes, erosion-prone areas, and landslide-risk zones before expanding downstream.	Targets urgent degradation hotspots first and improves downstream benefits from early investments.
Voluntary and contractual PES arrangement	PES should be based on agreed arrangements between ecosystem service providers and beneficiaries, with payments linked to conservation actions or verified outcomes.	Requires clear PES agreements, eligibility rules, payment conditions, and responsibilities before disbursement.
Legal alignment	Implementation should align with Ethiopia's Payment for Ecosystem Services Proclamation No. 1401/2026, which provides the legal basis for PES arrangements, payment mechanisms, verification, and benefit sharing as reflected in your draft roadmap summary	Local bylaws, PES contracts, fund rules, MRV procedures, and grievance systems should be designed consistently with the proclamation.
Equity and fair benefit sharing	Benefits should reach upstream households, community groups, cooperatives, watershed committees, and vulnerable groups that contribute to conservation.	Requires transparent beneficiary selection, community-approved criteria, public disclosure, and safeguards against elite capture.
Transparency and accountability	PES fund management, payment decisions, monitoring results, and benefit-sharing rules should be publicly disclosed.	Strengthens trust among providers, beneficiaries, government institutions, and funders.
Community ownership and participation	Cooperatives, watershed committees, Iddir, and local institutions should participate in decision-making, fund oversight, resource regulation, and grievance handling.	Builds local legitimacy and strengthens long-term maintenance of conservation investments.
Results-based and adaptive management	Combine input-based payments during early implementation with performance-based payments as MRV capacity improves.	Allows learning during piloting while gradually linking payments to verified ecosystem service outcomes.
Scientific and community-based evidence	Combine technical indicators such as vegetation cover, erosion reduction, and financial audits with community indicators such as livestock survival, dry-season spring water, food security, and fair benefit distribution	Makes MEL both technically credible and socially meaningful.

Table 6: Phased PES Implementation Roadmap

Phase	Timeline	Strategic focus	Key activities	Key outputs/deliverables
Phase 1: Preparation and Institutional Readiness	Year 1	Build the legal, institutional, financial, technical, and social foundation before payments begin.	Establish the foundation for PES implementation by engaging stakeholders, developing legal and benefit-sharing frameworks, strengthening institutions and monitoring systems, identifying priority areas and beneficiaries, and aligning conservation activities with local farming calendars.	Operational PES implementation framework established, including stakeholder engagement mechanisms, legal and contractual arrangements, benefit-sharing guidelines, strengthened implementing institutions, a PES financing mechanism, priority watershed and beneficiary identification, baseline data, and functional MEL/MRV systems ready for implementation.
Phase 2: Pilot Implementation and Expansion	Years 2–3	Test and refine PES implementation in priority upper micro-watersheds.	Schedule conservation works according to the local farming calendar (dry season); sign PES agreements; implement conservation and restoration measures, livelihood support, and input-based payments while preparing for performance-based payments; mobilize co-financing from government (including MoWE) and partners and continuously review and refine procedures.	Aligned conservation work plan with the farming calendar, signed PES agreements; functioning payment mechanism; pilot conservation packages; livelihood-support packages; verified activity records; first monitoring reports; and revised operational procedures.
Phase 3: Scaling, Institutionalization, and Sustainability	Years 4–5	Expand successful PES arrangements and embed them in regular watershed governance and financing systems.	Expand to additional micro-watersheds and downstream areas; evaluate environmental, livelihood, and governance outcomes; strengthen and diversify the Watershed PES Trust Fund and long-term financing (including carbon finance); institutionalize PES in planning and programs, and refine benefit-sharing, payments, and indicators based on MEL findings.	Basin-wide PES scale-up plan; independent evaluation report; strengthened PES Trust Fund; financing diversification strategy; carbon finance opportunity assessment; revised benefit-sharing and payment rules; institutionalized PES governance arrangement.

Stakeholders Roles and Responsibilities Matrix

The roadmap should present roles as a division of functions, not only a list of actors. This improves clarity and avoids overlap. Federal and regional government institutions will provide policy direction, technical support, and overall coordination, while local governments will oversee implementation and monitoring at the community level. The private sector, research institutions, development partners, and independent verifiers will support financing, technical assistance, research, and verification of ecosystem service outcomes. Table 7 Summarizes the key stakeholders, roles, and the specific functions in PES operationalization.

Table 3: Stakeholders' roles and responsibility matrix

Stakeholder group	Key roles	Specific functions in PES operationalization
Federal government institutions	Policy direction, legal alignment, national coordination, and resource mobilization.	Provide policy guidance; align PES with Proclamation No. 1401/2026; support national PES standards; mobilize public finance; coordinate with national restoration, water, energy, and climate-finance programs.
Regional government institutions	Technical oversight, regional coordination, and capacity support.	Translate national guidance into regional implementation support; coordinate regional Agriculture, Water, Energy, Environment, Forestry, Finance, and Cooperative offices; support regional monitoring and verification.
Zonal, woreda, and kebele administrations	Local implementation coordination and accountability.	Coordinate field implementation; support community mobilization; enforce local bylaws; integrate PES into woreda watershed and development plans; support local grievance management.
Agriculture, Natural Resource, Forestry, Water, and Environment offices	Technical design, extension, compliance, and monitoring support.	Provide technical designs for soil and water conservation, restoration, nursery development, riparian protection, slope stabilization, and environmental safeguards; support field monitoring.
Upstream communities and smallholder households	Ecosystem service providers and conservation implementers.	Implement agreed conservation measures; protect rehabilitated areas; participate in monitoring; maintain soil and water conservation structures; comply with PES agreements and local bylaws.
Watershed committees	Community coordination and local implementation oversight.	Coordinate collective labor and conservation activities; support beneficiary identification; track activity implementation; report local progress and challenges.
Cooperatives	Payment management, benefit-sharing, and local accountability.	Support local fund administration; manage payment records; distribute benefits according to agreed rules; maintain transparent records; support livelihood packages.
Community-based organization	Trust-building, grievance handling, and local legitimacy.	Support conflict resolution; strengthen compliance with community-agreed rules; assist in grievance handling; promote transparency and social accountability.
Downstream beneficiaries and private sector	PES buyers/co-financiers.	Contribute financing based on benefits received from watershed protection, including reduced sedimentation, improved water regulation, and infrastructure protection; participate in PES agreements.
Hydropower and irrigation actors	Major ecosystem service beneficiaries.	Support financing for upstream conservation where watershed services protect infrastructure, water regulation, and reservoir function; participate in performance review and verification processes.
Research institutions and universities	Evidence generation, monitoring design, and learning.	Conduct baseline studies; design indicators; support GIS/remote sensing, erosion, vegetation, sediment, and livelihood monitoring; support independent analysis and learning.
Development partners and NGOs	Facilitation, capacity building, livelihood support, and early-stage financing.	Provide technical assistance; support community training; co-finance pilot activities; facilitate stakeholder dialogue; support livelihood packages.
Banks and other regulated financial institutions	Fund custody, payment services, and financial controls — subject to the final legal architecture of the PES fund.	Provide custody of the proposed Watershed PES Fund; execute and record disbursements to verified providers; support transparent transaction and audit trails; and, where appropriate, help design tailored financial products such as dedicated PES accounts, mobile disbursement channels, or livelihood-linked financial services.
Independent verifiers/evaluators	Credibility and assurance.	Verify conservation outcomes; review financial and performance reports; support transition from input-based to performance-based payments.

Monitoring, Evaluation, and Learning (MEL) Result Framework

PES literature emphasizes that credible PES requires baseline data, monitoring, reporting, verification, and equitable benefit-sharing mechanisms (Bartelet et al., 2026). The MEL framework should regularly measure the progress and impact of the PES Roadmap. It should focus on three main areas: environmental improvement, livelihood improvement, and good governance. Monitoring should help determine whether conservation activities are improving ecosystem health, increasing household well-being, and ensuring that the program is implemented fairly and transparently. Both key informants and participants of FGDs highlighted the importance of using different types of indicators. Technical experts recommended measurable indicators such as vegetation cover, reduced soil erosion, and financial audit reports. Community members, however, suggested practical indicators that reflect their daily lives, including livestock survival, improved household food security, reliable spring water during the dry season, and fair distribution of benefits. Combining scientific measurements with community experience will provide a more complete understanding of the program's performance and support better decision-making. Finally, it is worth mentioning that baseline and MRV costs should be incorporated into the initial PES budget and supported through government and development-partner co-financing. To keep costs manageable, community-based monitoring can be combined with targeted technical measurements. Table 8 Summarizes the key MEL components.

Table 4: Monitoring, Evaluation, and Learning Results Framework

Objective area	Key results question	Indicators: scientific/technical	Indicators: community-based	Means of verification	Frequency
Environmental improvement	Are PES-supported conservation actions improving watershed conditions and ecosystem service delivery?	Vegetation cover; tree survival rate; area under soil and water conservation; erosion reduction; gully stabilization; sediment movement; spring flow/dry-season water availability; riparian buffer condition.	Visible reduction in erosion; reliable spring water during dry season; improved grazing/fodder availability; perceived reduction in flooding or landslide risk.	Field surveys; GIS/remote sensing; vegetation assessments; erosion and sediment monitoring; community monitoring forms; photo documentation; independent verification.	Baseline; semi-annual field monitoring; annual synthesis; independent verification at agreed milestones.
Livelihood improvement	Are PES benefits improving household resilience and reducing pressure on natural resources?	Number of participating households; livelihood assets provided; income from supported activities; adoption of improved land management practices; household food-security proxy indicators.	Livestock survival; household food security; reduced distress sale of livestock/assets; perceived fairness of support; reduced pressure to cultivate steep or degraded land.	Household monitoring; cooperative records; livelihood-support records; FGD feedback; sample household surveys.	Baseline, annual household monitoring; mid-term and final evaluation.
Governance and equity	Is the PES system fair, transparent, accountable, and trusted?	Timeliness of payments; number of signed PES agreements; financial audit reports; grievance cases received/resolved; public disclosure of beneficiary lists and payment decisions; participation of women, youth, and vulnerable groups.	Perceived fairness of benefit-sharing; trust in cooperatives/Iddir/watershed committees; community satisfaction with grievance handling; perceived transparency of fund management.	Cooperative financial records; public notice boards; audit reports; grievance logs; meeting minutes; community scorecards.	Quarterly administrative review; annual audit; annual participatory review.
Learning and adaptation	Are lessons being used to improve implementation?	Number of review meetings; changes made to payment rules, targeting, or indicators; documentation of lessons from pilot sites.	Community feedback incorporated into decisions; local perception that programme rules improve over time.	Annual learning workshop reports; revised guidelines; stakeholder meeting records; updated MEL framework.	Annual learning review; mid-term review; final evaluation.

Risk Matrix and Mitigation Measures

Both key informants and participants of FGDs identified important risks but from different perspectives. Key informants focused mainly on institutional and financial risks, such as changes in government structures and shortages of funding, and recommended strong policies and legal agreements to reduce these risks. Participants of FGDs, however, were more concerned about practical challenges such as drought, climate change, and human-wildlife conflict, which directly affect their livelihoods. They explained that PES programs should be flexible enough to support households during difficult times so that conservation activities do not increase food insecurity or reduce their ability to cope with unexpected shocks. Table 9 summarizes the key identified risks and suggested mitigation measures.

Table 5: Risks and mitigation measures

Risk	Category	Likelihood/impact	Mitigation measures
Weak coordination among sectoral offices	Institutional	Medium likelihood / High impact	Establish a PES coordination platform; define roles in MoUs/bylaws; hold joint planning and review meetings; align PES with watershed and local development plans.
Changing government structures and unclear mandates	Institutional/legal	Medium likelihood / High impact	Anchor PES roles in formal agreements; align with Proclamation No. 1401/2026; clarify coordination, fund management, MRV, and grievance responsibilities.
Limited monitoring and verification capacity	Technical/MRV	High likelihood / High impact	Develop simple MEL/MRV protocols; train local monitors and cooperatives; combine community monitoring with GIS/technical assessments; use independent verification for performance-based payments.
Limited or delayed financing	Financial	Medium likelihood / High impact	Establish a transparent PES Trust Fund; diversify financing from government, downstream beneficiaries, development partners, private sector, and carbon finance; use phased disbursement rules.
Delayed payments to providers	Financial/social	Medium likelihood / High impact	Set clear payment schedules; disclose payment rules publicly; maintain contingency reserves; use cooperative-level records and grievance channels.
Land tenure or boundary disputes	Social/legal	Medium likelihood / High impact	Verify land-use rights before agreements; use participatory mapping; involve kebele/woreda land offices; provide dispute-resolution procedures before payments begin.
Elite capture or unfair benefit distribution	Social/governance	Medium likelihood / High impact	Use transparent eligibility criteria; publicly disclose beneficiary lists; involve cooperatives, Iddir, women, youth, and vulnerable-group representatives; conduct independent audits.
Low community participation	Social	Medium likelihood / Medium impact	Align activities with farming calendar; provide clear incentives; use trusted community institutions; integrate livelihood support; conduct regular awareness and feedback sessions.
Drought and climate variability	Environmental/climate	High likelihood / High impact	Use climate-resilient restoration options; allow adaptive payment rules during shocks; distinguish non-performance from climate-related failure; support livelihood resilience.
Landslides, erosion, and severe runoff in upper catchments	Environmental	High likelihood / High impact	Prioritize steep and degraded upper catchments; implement slope stabilization, gully rehabilitation, SWC structures, vegetation restoration, and riparian protection.
Human-wildlife conflict	Environmental/social	Medium likelihood / Medium impact	Integrate local risk mapping; include community response mechanisms; coordinate with relevant environment/wildlife offices where applicable.
Weak record-keeping by local institutions	Governance/capacity	High likelihood / Medium impact	Train cooperatives and watershed committees in financial records, beneficiary registers, activity tracking, and reporting; introduce simple templates and periodic audits.

4. Conclusion and Recommendations

4.1. Conclusion

This study demonstrates that establishing a Payment for Ecosystem Services (PES) mechanism in the Gibe III hydroelectric dam catchment is both feasible and strategically important for sustaining watershed ecosystem services and supporting long-term rural development. The findings indicate that the watershed already possesses several enabling conditions, including extensive experience in watershed restoration, strong community participation, supportive institutional arrangements, and an evolving policy framework that recognizes PES as a viable environmental management instrument. These strengths provide a solid foundation for transitioning from project-based conservation approaches to a more sustainable, incentive-based financing mechanism. Nevertheless, successful implementation will depend on addressing key institutional, financial, and technical constraints, particularly by strengthening cross-sectoral coordination, developing clear operational guidelines, improving technical capacity, and establishing reliable long-term financing mechanisms. A key limitation of this study is that it did not assess the willingness of downstream ecosystem service beneficiaries to financially contribute to a PES scheme. Consequently, the actual demand for and economic viability of downstream financing remains uncertain and warrants further investigation through willingness-to-pay and stakeholder engagement studies.

The study further highlights that the long-term sustainability of PES depends not only on mobilizing financial resources but also on ensuring that governance arrangements are transparent, accountable, and socially inclusive. Our findings consistently show that local communities are willing to participate in PES when benefit-sharing mechanisms are perceived as fair, transparent, and responsive to local livelihood needs. A financing model that combines contributions from downstream ecosystem service beneficiaries, public investment, development partners, and emerging financing opportunities offers the most practical pathway for sustaining conservation efforts while protecting downstream economic investments, enhancing climate resilience, and improving rural livelihoods. Future research should therefore prioritize assessing downstream beneficiaries' willingness to pay and identifying appropriate payment levels and institutional arrangements to support effective PES implementation.

4.2. Recommendations

- Strengthen the institutional and legal framework by establishing clear governance structures, defined stakeholder roles, and effective coordination mechanisms to operationalize PES.
- Undertake a dedicated economic and legal feasibility study, combining quantification and attribution of the priority ecosystem services, biophysical and economic valuation of these services, comparison of alternative payment levels and financing scenarios, analysis of financing risks and sensitivity, and legal and institutional feasibility.
- Conduct a participatory feasibility and options study before selecting the preferred PES financing model, comparing alternative financing mechanisms and assessing stakeholder willingness and ability to pay, negotiation and agreement arrangements, financing risks, and institutional and legal feasibility to identify a viable, equitable, and sustainable financing pathway.
- Develop a sustainable financing mechanism that combines contributions from downstream beneficiaries, public investment, development partners, and innovative financing sources such as carbon markets and public-private partnerships.
- Enhance technical capacity and monitoring systems by investing in training, performance monitoring, verification systems, and institutional accountability to support effective implementation.
- Ensure transparent and equitable benefit sharing through inclusive governance, strong financial oversight, protection of vulnerable groups, and livelihood-oriented incentives that build community trust and participation.
- Implement the proposed phased roadmap by prioritizing institutional preparation, capacity development, pilot implementation, and gradual scaling to establish a resilient and sustainable PES system that delivers environmental, economic, and social benefits.

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