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CONTENTS

CONTENTS

EFFICIENT USE OF FINANCIAL RESOURCES IN UZBEKISTAN'S FORESTRY SECTOR

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Abstract: The paper proposes a four-pillar framework for efficient use of financial resources in Uzbekistan's forestry sector: standardizing project selection with NPV, IRR, and discounted payback; balancing CAPEX/OPEX via life-cycle costing (LCC); establishing an off-budget, stable revenue stream from ecosystem services (PES, carbon credits, water funds); and enforcing results-based contracting through MRV and digital transparency. Regional clustering and a package of PPP/leasing/interest-rate subsidies accelerate capital inflows, diversify revenues, and reduce risks. The proposed model aligns economic returns with ecological sustainability and social benefits.

Key words: financial efficiency; NPV; IRR; LCC; CAPEX/OPEX; PES; carbon credits; water funds; MRV; clustering; PPP; leasing.

Annotatsiya: Maqola O'zbekiston o'rmon xo'jaligida moliyaviy resurslardan samarali foydalanishning to'rt bo'g'inli yondashuvini taklif qiladi: loyiha tanlovini NPV, IRR va diskontlangan qaytish muddati orqali standartlashtirish; CAPEX/OPEXni umr sikli xarajatlari (LCC) asosida muvozanatlashtirish; ekotizim xizmatlari (PES, karbon kreditlari, suv fondlari) orqali budjetdan tashqari barqaror daromad konturini yaratish; MRV (monitoring–hisobot–verifikatsiya) va raqamli ochiqlik orqali natijaga bog'langan kontraktlashni joriy etish. Hududiy klasterlash va DXH/lizing/foiz-subsidiya paketlari kapital kirishini tezlashtiradi, daromad oqimlarini diversifikatsiya qiladi va risklarni pasaytiradi. Taklif etilgan model iqtisodiy qaytish, ekologik barqarorlik va ijtimoiy manfaatni uyg'unlashtiradi.

Kalit so'zlar: moliyaviy samaradorlik; NPV; IRR; LCC; CAPEX/OPEX; PES; karbon kreditlari; suv fondlari; MRV; klaster; DXH; lizing.

Аннотация: Статья предлагает четырёхзвенную модель эффективного использования финансовых ресурсов в лесном хозяйстве Узбекистана: стандартизация отбора проектов по NPV, IRR и дисконтированному сроку окупаемости; баланс CAPEX/OPEX на основе жизненного цикла затрат (LCC); формирование внебюджетного устойчивого доходного контура за счёт экосистемных услуг (PES, углеродные кредиты, водные фонды); внедрение контрактов, привязанных к результату, через MRV и цифровую открытость. Региональная кластеризация и пакет ДХЧ/лизинг/субсидии по ставкам ускоряют приток капитала, диверсифицируют доходы и снижают риски. Предложенная модель совмещает экономическую отдачу, экологическую устойчивость и социальную выгоду.

Ключевые слова: финансовая эффективность; NPV; IRR; LCC; CAPEX/OPEX; PES; углеродные кредиты; водные фонды; MRV; кластер; ГЧП; лизинг.

INTRODUCTION

The task of ensuring the efficient use of financial resources in Uzbekistan's forestry sector requires harmonizing two strategic directions: preserving and expanding natural capital, and sustainably increasing the sector's economic returns. Recent reforms have created an institutional foundation for this balance: "Transparent resource allocation through e-auction strengthens market discipline when accompanied by long-term investment commitments" (President of the Republic of Uzbekistan, 2020), and "a permanent 5-percent quota for science stabilizes the financing of R&D processes" (President of the Republic of Uzbekistan, 2021). These measures stimulate stricter project-selection discipline, optimization of expenditures across the full life cycle (CAPEX/OPEX), and the transition to result-based management (MRV), all of which are necessary to improve the efficiency of financial flows.

International literature highlights practical approaches to monetizing forest value: "PES, water funds, and carbon credits transform the non-market value of forests into real income streams" (Verweij Piter, 2002). At the same time, within the industrial value chain, "leasing, subsidized interest rates, and export support

reduce capital burdens and accelerate technological renewal" (Golovina Elena; Dykusova Anna, 2020), while "clustering balances the risk/return profile and increases investment efficiency" (Shanin Ivan, 2022).

Domestic indicators confirm that the country possesses the macroeconomic conditions to apply this approach: "the growth of investment in fixed capital and of the output of products/services indicates an expanding financial capacity of the sector" (Statistics Committee, 2022; Statistics Committee, 2025). Therefore, the concept of efficient use must be viewed together with standardized project selection based on NPV/IRR, CAPEX/OPEX design according to LCC, an additional revenue contour through PES–carbon–water funds, and transparent, accountable management through MRV.

REVIEW OF LITERATURE ON THE SUBJECT

The efficient use of financial resources in the forestry sector has become one of the central themes in international forest economics and sustainability research. Pearse provides a foundational analysis of long-term investment decision-making in forestry, emphasizing that the biological regeneration cycle of forests requires the application of discounted cash-flow indicators such as NPV, IRR and long-horizon cost–benefit criteria. His work highlights that forestry differs from other sectors precisely due to its extended investment cycle, which demands strict financial discipline and stable funding mechanisms. Hyde and Newman further develop these ideas by examining the balance between public, private and community-based financing models. Their research demonstrates that mixed financing arrangements, combined with transparent governance structures, can significantly enhance reforestation outcomes and economic stability across forest landscapes.

A separate branch of the literature focuses on ecosystem service financing mechanisms. Salzman, Bennett and Daily show that Payments for Ecosystem Services (PES) create additional market-based revenue streams for forestry institutions through carbon credits, watershed protection payments and biodiversity conservation funds. Their findings indicate that PES schemes can stabilize liquidity and reduce dependence on state budgets when institutional transparency and monitoring systems are well-established. The Stern Review also stresses the strategic importance of forest conservation within global climate policy and argues that effective financing tools can reduce emissions, strengthen ecological resilience and generate long-term economic benefits for developing countries.

In the context of Uzbekistan, academic contributions address both economic efficiency and institutional modernization of the forestry system. Jo'raqulov analyzes investment projects in afforestation, seedling production and water-efficient irrigation technologies, showing that financial returns are highly sensitive to discount rates, climatic risks and technological choices. His research underscores the need to adopt rigorous project appraisal standards and long-term cost accounting in forest expansion programs. Xolmurodov and Sayfullayev study the modernization of forestry infrastructure, including seed banks, nurseries and greenhouse systems, providing CAPEX–OPEX analyses that illustrate the importance of cost-saving technologies such as drip irrigation, greenhouse automation and remote monitoring.

Reports by FAO, the World Bank and UNDP offer comprehensive assessments of sustainable forest management in Uzbekistan, linking financial sustainability to improved governance, modern technologies and ecosystem-based financing. These publications highlight the potential of carbon markets, land restoration grants and geospatial monitoring tools—GIS platforms, remote sensing and drone-based inventories—to lower operational costs and increase transparency. World Bank analyses also emphasize that financial stability in the forestry sector depends on effective contract management, public procurement discipline and long-term budget planning aligned with national environmental goals.

Taken together, the international and local literature demonstrates that efficient financial resource allocation in forestry relies on integrating economic valuation techniques, ecosystem-service-based revenue mechanisms, technological modernization and strong institutional frameworks. These factors jointly determine the sector's capacity to maintain ecological sustainability while ensuring fiscal stability and investment attractiveness.

RESEARCH METHODOLOGY

The research methodology relies on collecting secondary data from government statistical reports, forestry agencies, international organizations, and academic publications. The collected information was analyzed using comparative assessment, financial indicator dynamics, investment efficiency criteria, and evaluations of CAPEX–OPEX structures to determine the effectiveness of financial resource use in the forestry sector.

ANALYSIS AND RESULTS

Efficient use of financial resources in forestry primarily depends on discipline in attracting and allocating capital for each project. This management consists of several key components.

First, criteria for selecting investment projects must be standardized. Projects should be compared on the basis of financial efficiency metrics. The main indicators include:

Net Present Value (NPV):

$$NPV = \sum_{t=1}^{T} \frac{CF_t}{(1+r)^t} - I_0$$

This indicator represents the result obtained by subtracting the initial investment (I_0) from the sum of discounted future cash flows generated by the project. Requirement: if NPV > 0, the project is financially acceptable.

The Internal Rate of Return (IRR) is the rate r at which NPV = 0. Requirement: IRR ≥ the sector's accepted cost of capital (WACC). This is especially important in environments with high interest rates, because a high IRR highlights projects that reach payback faster.

The discounted payback period determines the moment when $\sum_{t=1}^{\tau} \frac{CF_t}{(1+r)^t} \geq I_0$. It answers the question of how long it takes for capital to recover itself. Since forestry is typically a long-cycle sector, monitoring the payback period improves planning of cash flows.

Second, it is necessary to manage the balance between capital and operational expenditures. Here, CAPEX (investments in fixed assets — nursery modernization, drip irrigation, seed banks, drone monitoring systems) and OPEX (maintenance, fire prevention, inspection work) must be optimized. The Life Cycle Cost (LCC) approach demonstrates that in some cases higher initial CAPEX significantly reduces the OPEX burden later. For example, introducing drip irrigation and remote sensing technologies (drones, GIS) reduces OPEX costs related to manual inspection and loss detection. This approach not only cuts expenditures but also improves asset security by enabling early detection of losses (e.g., illegal logging, fire risk).

Third, the structure of financing sources must be diversified. Forestry financing is formed within three contours: state (budget and targeted funds), private (enterprises, processors, exporters), and mixed (public–private partnerships, leasing, interest subsidies, green bonds). Instruments such as leasing and interest-rate subsidies reduce entry barriers to technological modernization, especially in wood processing and pulp-and-paper sectors. Clustering—integrating raw material supply, processing, logistics, and export into a single chain—reduces investment risk and increases revenue sources. Thus, replacing excessive dependence on a single source (such as exclusive reliance on state funding) with a mixed financing model improves resource sustainability.

Fourth, the revenue contour itself must be redefined. Forestry is not limited to timber or wood products. Ecosystem services—carbon storage, watershed stabilization, pollination, recreation, and tourism—should also be a source of financial resources. Payments for Ecosystem Services (PES) contracts, water funds for watershed protection, and revenue from selling carbon credits create an additional off-budget income stream. If these revenues are shared with local users (forest management brigades, local communities) through clear rules, financial stability becomes interconnected with social stability.

Fifth, procurement and contract management are direct determinants of financial efficiency. Electronic auctions and open tenders reduce artificially inflated prices, lower corruption risks, and ensure greater output per unit of expenditure. Results-based contracting (for example, when a portion of maintenance payments is made only after environmental indicators are verified) links budget spending to "results, not activities." This mechanism connects the use of financial resources with quality and accountability.

Sixth, the MRV — Monitoring, Reporting, Verification — system safeguards the use of financial resources. Through MRV, each expenditure (for instance, 1 billion soums allocated to irrigation systems) is connected to a measurable outcome (such as sapling survival rate or reduced fire risk). This serves as a confidence mechanism for both investors and the state. Digital MRV (using GIS, drones, IoT sensors, and mobile apps providing photo/video reports from the field) reduces paperwork and ensures near-real-time oversight.

Seventh, risk management limits the loss of financial resources. It is necessary to apply reserve mechanisms and insurance for interest-rate risks, exchange-rate risks, climate risks (drought, fire), and institutional risks (delays in permits or licenses). Additionally, internal methods of risk reduction exist: instead of relying on a single project, it is necessary to maintain a diversified portfolio, meaning that along with industrial processing projects, ecosystem-service projects such as PES/carbon/water funds should also be developed. As a result, revenue streams do not become one-sided, and market fluctuations (such as declines in timber prices) do not destabilize the entire system.

At the end of this section, it should be emphasized that the efficient use of financial resources is not simply about "earning more money." It concerns how funds are allocated, how project priorities are justified, how costs are controlled, and who is accountable for results. These managerial decisions professionalize forestry both as an economic entity and as an environmental responsibility subject.

The sector's financial capacity and the pace of capital absorption are clearly reflected in three directions. First, in January–September 2021, investments directed to fixed capital in agriculture, forestry, and fisheries amounted to 12,199.1 billion soums; regionally, the figure reached 650.5 billion soums in Qashqadarya. This indicates that capital demand in the sector is forming across a wide geographic area and that regional implementation mechanisms need strengthening. Second, in January–June 2025, the volume of products and services in the sector reached 194,910.4 billion soums. This demonstrates that the sector is no longer limited to raw-material supply but includes services (recreation, ecotourism), processing and value-added segments, and monetization of ecosystem services. The third aspect is the emergence of a "capacity window" between investment inflows and production volume: capital investments are gradually transforming into production and service scale. This means that financial instruments (leasing, interest-rate subsidies, PPP) are supported by stable demand. At the portfolio level, the data enable the application of a diversification strategy: while revenue from industrial processing is cyclical, ecosystem services such as PES/carbon/water funds provide a relatively stable income contour. Consequently, when regional clusters are combined with national-level NPV/IRR discipline and MRV transparency standards, the cycle of "capital inflow–turnover–return" accelerates, and the overall efficiency of financial resource utilization increases.

The analysis results showed that improving the efficiency of financial resource use in forestry is formed at the intersection of three directions: standardizing investment selection based on NPV, IRR, and the discounted payback period; balancing CAPEX and OPEX according to Life Cycle Costing (LCC); and activating an additional revenue contour through ecosystem services (PES, carbon, water funds). In the first direction, when project selection criteria are clearly defined, cash-flow forecasting stabilizes even in a "long-cycle" sector, and prioritizing viable projects becomes easier. In the second direction, it was determined that CAPEX solutions such as drip irrigation, seed banks, and drone/RS monitoring systematically reduce maintenance and inspection costs (OPEX); this is particularly important for early detection of fire risks and illegal logging. In the third direction, PES contracts, voluntary/international carbon credits, and revenues from water funds can serve as stable off-budget sources, and when revenue-sharing mechanisms with local stakeholders are incorporated into contract design, they strengthen social legitimacy.

Statistical data confirm the capacity for these mechanisms: in January–September 2021, investments in fixed capital across the sector amounted to 12,199.1 billion soums, with 650.5 billion soums recorded in Qashqadarya; in January–June 2025, the volume of products/services reached 194,910.4 billion soums. These figures indicate that capital investments are gradually transforming into production and service outcomes and that real demand is emerging for leasing–interest-subsidy–PPP packages. Implementing MRV (monitoring–reporting–verification) based on GIS/IoT makes it possible to link every spent soum to performance indicators (forest-covered area, tCO_2e, watershed indicators) and increases confidence in the credit/bond market. Consequently, the integrated application of the "investment selection + LCC + ecosystem revenues + MRV" bundle, together with clusters and regional implementation, enhances the efficiency of financial resource use and reduces risks.

CONCLUSIONS AND SUGGESTIONS

In Uzbekistan's forestry sector, the efficient use of financial resources must be viewed through the chain of "project selection – cost architecture – revenue contour – oversight and transparency." Standardizing project selection using NPV > 0, IRR ≥ WACC, and the discounted payback period clearly identifies priority directions and stabilizes cash flows in a long-cycle sector. The balance of CAPEX/OPEX based on the LCC approach systematically reduces OPEX through technologies such as nurseries, drip irrigation, seed banks, and drone/RS monitoring. In the revenue contour, PES contracts, voluntary/international carbon credits, and water funds monetize the non-market value of forests and generate stable off-budget income; sharing revenues with local stakeholders strengthens social legitimacy.

When financing sources are diversified through leasing, interest-rate subsidies, PPPs, and (pilot) green bonds, multi-channel revenue streams emerge across industrial clusters (deep wood processing, pulp-and-paper, recreation). Results-based contracting and transparent reporting built on MRV (GIS/IoT) increase lender confidence and reduce risks. This alignment simultaneously ensures economic returns, ecological sustainability, and social benefit.

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