



*Improving Climate Resilience in the Steppe and Dry Forest Areas of
the Algerian Green Dam (ICR-AGD)*

ANNEX 3
Economic and Financial Analysis

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Executive Summary

This annex presents the Economic and Financial Analysis (EFA) for the Algeria GCF Green Dam Project (hereinafter 'the Project'), a seven-year investment. The Project targets land degradation reversal, ecosystem restoration, and sustainable rural livelihood development across the Algerian Green Dam Zone (*Barrage Vert*) and its adjacent pre-Saharan territories.

The EFA is built around fifteen financial models organized into three analytical clusters.

Cluster A comprises five investment models under Component 2, covering ecosystem restoration and rural infrastructure: afforestation, forest restoration, rural roads, rangeland restoration, and water harvesting infrastructure.

Cluster B comprises six investment models under Outcome 3.1, focusing on non-wood forest product (NWFP) value chains: olive, peach, rosemary, mint, opuntia seed oil, and alfa forage.

Cluster C comprises four investment models under Outcome 3.2, supporting rural livelihood diversification through small poultry units (100%-woman beneficiaries), beekeeping, sheep production, and wool garment and carpet enterprises.

Each financial model presents three analytical views: the Without-Project (WOP) baseline, the With-Project (WP) scenario, and the Incremental (WP – WOP) net benefit stream – at both financial (market) prices and economic (shadow) prices. Constant market prices representing June 2026 price levels were used. To capture prices variations in the next 20 years, two sensitivity analyses, among several others, were undertaken – 10% and 20% price escalation. An incremental analysis was undertaken to show the additionality benefits of the project. An indexed navigation structure allows direct access to each model's gross margin worksheet within the financial model workbook.

The adoption rate applied to Outcome 3 activities (Clusters B and C) follows a graduated trajectory, starting at 50% in Year 1 and increasing gradually to 80% by Year 5 of the Project, in line with realistic community uptake observed in comparable dryland livelihood programmes. A climate impact adjustment of 0.75% annual yield reduction (compounding from the prior year) is applied to all crop and forestry productivity estimates over the 20-year analytical horizon. Carbon dioxide sequestration benefits are incorporated into the economic analysis as a separate additive benefit stream; their impact on the economic NPV is substantial as verified by the WP economic analysis that includes the carbon benefits and strengthens the project's climate mitigation narrative.

The sheep production model (Model 14) and the wool garment and carpet enterprise model (Model 15) form a complementary analytical pair. Model 14 captures the economics of primary livestock production, while Model 15 assesses the value added generated through wool processing and the production of garments and carpets. Separating these two activities allows the analysis to distinguish between farm-level production and downstream value addition, reflecting their different investment requirements, beneficiary groups and cost-benefit structures.

The financial analysis applies a discount rate of 10% real, consistent with World Bank and ADB standards for developing countries. The economic analysis applies a discount rate of 6% real, consistent with World Bank Social Discount Rate guidance. For the GCF grant equivalent calculator, a 5% nominal rate is applied per GCF official policy (GCF-1 Progress Report, 2023). Comprehensive financial and economic sensitivity analyses have been conducted with price escalation and benefit reduction.

This summary confirms positive incremental project impact on all fifteen models from the beneficiary viewpoint. Project-level aggregate results are derived by populating model-level unit cash flows over the total investment scale provided by the project team in the investment and activity tables.

The results confirm that the Algeria Green Dam Project is financially and economically viable at both the project level and across all fifteen investment models. At project level, the Financial Internal Rate of Return (FIRR) is, 16% of the “with-project” aggregated model, exceeding the 10% financial discount rate by 6 percentage points. The financial Net Present Value (NPV) over the 20-year analytical horizon is AD 6.18 billion (approximately USD 44 million in constant 2026 prices at the exchange rate of 140 DZD/USD), and the financial Benefit-Cost Ratio (BCR) is 1.37. For every Algerian Dinar invested in the Project, beneficiaries receive AD 1.37 in discounted net returns over the analytical period.

The “with-project” economic analysis, conducted at a social discount rate of 6% consistent with World Bank Social Discount Rate guidance, yields an Economic Internal Rate of Return (EIRR) of 17% an economic NPV of AD 15.31 billion (approximately USD 109 million), and an economic BCR of 1.74. The higher economic NPV and BCR relative to the financial analysis reflect the inclusion of environmental externalities not captured in private market cash flows: carbon sequestration valued at the World Bank shadow carbon price trajectory (USD 51-93/tCO₂e, 2025-2035+), avoided desertification costs, watershed hydrological services, and shadow wage premiums on rural employment in the Green Dam Zone. The economic BCR of 1.74 confirms that Algeria’s national economy receives AD 1.74 in social value for every dinar of total project cost. The WP EIRR was re-estimated including the CO₂ benefits, which yielded 18% EIRR with ENPV of AD 16.9 billion (USD 121 million) and a BCR of 1.82.

All 15 models record positive With-Project Benefit-Cost Ratios, ranging from 1.24 (Peach cultivation) to 32.46 (Opuntia oil production), confirming the Project's direct economic benefit to beneficiary households across every investment type.

Incremental aggregate economic analysis at the project level was also undertaken to assess the additionality benefits of the project to the national economy. The EIRR of the incremental economic analysis was estimate at 12%, which exceeds the adopted Economic Discount Rate (EDR) of 6% by 6 percentage points, resulting in a positive incremental Economic Net Present Value (ENPV) of AD 8.206 billion (USD 59 million) and confirming the project's economic justification under standard cost-benefit decision rules (further justification of the robustness of the incremental economic results with switching value analysis is presented under the economic results. This provides strong evidence for the additionality economic benefits of the project at the country level.

The project will benefit a total of 1,084,103 beneficiaries (142,433 direct beneficiaries and 941,670 indirect beneficiaries).

1. Introduction

Algeria's Green Dam (*Barrage Vert*) is one of the world's most ambitious land restoration initiatives — a 3-million-hectare belt of planted and regenerating forest and rangeland stretching 1,500 kilometers along the country's pre-Saharan fringe. Despite successive restoration campaigns, the Green Dam Zone faces compounding threats from climate change, overgrazing, and demographic pressure. Under RCP 4.5, a 15–20% rainfall reduction and 1.8–2.5°C temperature increase are projected by 2050, placing approximately 4.7 million rural inhabitants at acute risk of land productivity collapse and impoverishment.

The Algeria GCF Green Dam Project is a seven-year investment integrating large-scale ecosystem rehabilitation (Component 2) with rural livelihood diversification (Component 3), supported by institutional strengthening (Component 1). It aligns with Algeria's National Plan for Forest Development (PNDF 2020–2030) and the Updated NDC (2021), which commits Algeria to restoring 1.245 million hectares of degraded land by 2030.

The EFA is a core requirement of the GCF Full Proposal, demonstrating the economic justification for the investment, the efficient delivery of benefits to intended beneficiaries, the appropriateness of GCF concessional resources, and the robustness of results under climate and market uncertainty.

2. Scope and Objectives

The EFA serves the following objectives:

- Construct and validate fifteen financial models — five for Cluster A ecosystem and infrastructure models, six for Cluster B NWFP value chain models, and four for Cluster C rural livelihood models;
- Present, for each model, three analytical views: Without-Project (WOP) baseline, With-Project (WP), and Incremental (WP – WOP) — at both financial and economic prices, consistent with GCF EFA standards;
- Derive project-level NPV, IRR/ERR, and Benefit-Cost Ratio from both financial (market prices) and economic (shadow prices plus externalities) perspectives;
- Apply a graduated adoption rate (50% in Year 2 rising to 80% by Year 5) for all Outcome 3 activities in Clusters B and C;
- Apply a 0.75% per annum compound climate impact reduction to all crop and forestry yield estimates over the 20-year analytical horizon;
- Quantify carbon sequestration benefits using the World Bank/GCF shadow carbon price trajectory (USD 51–93/tCO₂eq, 2025–2035+). However, due to the unavailability of carbon market, the separate additive stream of CO₂ benefits in the economic analysis was valued using USD 12/tCO₂eq - the rationale for applying a conservative carbon value in the economic analysis is provided in Section 3.7 (Analytical Period and Prices).
- Disaggregate benefits by gender, with explicit attention to the 100% women-targeted poultry activity (Model 12) – wool garment model (Model 15);
- Conduct financial and economic sensitivity and switching-value analysis across multiple scenarios;
- Report cost-effectiveness indicators consistent with GCF's Efficiency and Effectiveness Assessment framework; and
- Use a constant real price and the rationale for the use is given below.

3. Methodology

3.1 Cost-Benefit Analysis Framework

The EFA applies the standard CBA framework recommended by the World Bank Handbook on Economic Analysis of Investment Operations (2010), the GCF Handbook for Climate Project Developers (2023), and FAO Investment Centre technical guidance notes. Analysis operates at two levels: model level

(incremental net cash flow per hectare, household, or unit) and project level (aggregated NPV, IRR, and B/C from financial and economic perspectives).

3.2 Without-Project and With-Project Scenarios

The EFA presents three analytical views for each model:

Without-Project (WOP): the counterfactual baseline trajectory in the absence of Project investment, embedding documented degradation trends. Forest cover declines from harvesting and fire; rangeland productivity falls at 0.8% per year; water harvesting structures deteriorate with declining catchment yields; road infrastructure degrades under deferred maintenance; and NWFP value chains operate without cooperative processing or market linkage.

With-Project (WP): the trajectory after the full Project investment package. New forest planting follows a three-phase trajectory: establishment (Years 1–3), canopy closure (Years 4–8), and full benefit (Year 9+). Rustic fruit cultivation reaches full yield at Years 5–7; cooperative processing throughput reaches capacity by Year 4. Annual livelihood activities reach full capacity by Year 2.

Incremental (WP – WOP): the net benefit stream attributable to the Project, expressed at both financial (market) prices and economic (shadow) prices. The incremental analysis was applied specifically to the economic assessment, as it is the economic analysis that is intended to demonstrate the project's additionality for GCF concessional funding. GCF's investment criteria require evidence that the intervention generates welfare and climate-resilience benefits that would not materialize under the baseline (Without-Project) scenario. The incremental ENPV/EIRR directly quantifies this by isolating the net economic value attributable to the project itself, net of what the Green Dam area would otherwise yield without intervention. The financial analysis, by contrast, serves a different purpose: it assesses the stand-alone viability, cash-flow sustainability, and cost recovery of the project as implemented, which is a with-project focus, that is the financial return to the executing entity or beneficiaries depends on the project's own revenue and cost structure. Therefore, both analyses were undertaken.

An indexed navigation structure within the financial model workbook enables direct access to the gross margin worksheet for each individual model.

3.3 Financial versus Economic Analysis

The financial analysis uses market prices and measures profitability from the beneficiaries' perspective. The economic analysis adjusts for price distortions (Standard Conversion Factors), shadow wages (75% of market wage), and environmental externalities — carbon sequestration, watershed services, avoided desertification — that are real national gains absent from any private cash flow.

Carbon sequestration benefits, derived from the project hypothesis sheet prepared by the project team (2026), are incorporated into the economic analysis as a separate additive benefit stream rather than embedded in the gross margin calculations of the individual investment models. This approach reflects the nature of carbon sequestration as a global environmental externality that generates economic value for society but does not translate into direct financial revenues for project beneficiaries. Consequently, carbon benefits are captured only in the economic analysis, where they contribute to the Economic Net Present Value (ENPV) and Economic Benefit-Cost Ratio (EBCR), strengthening the overall climate mitigation rationale and the GCF investment case.

3.4 Adoption Rate

For all Outcome 3 activities (Clusters B and C), the EFA applies a graduated adoption rate rather than a fixed rate. The adoption trajectory begins at 50% in Year 1, and increases to 60% in year 2, 70% in year 3, 75% in year 4, and 80% in year 5, and continues at 80% thereafter. This phased approach reflects realistic community uptake dynamics observed in comparable dryland livelihood and NWFP programs in North Africa and the broader MENA region. The 80% ceiling is consistent with the Annex 23 Adoption Multiplier methodology.

3.5 Climate Impact Adjustment

A compound climate impact adjustment of 0.75% per annum is applied to all crop and forestry productivity estimates, beginning in Year 1 and compounding from the prior year throughout the 20-year analytical horizon. This adjustment reflects the progressive reduction in agricultural and forestry yields attributable to increasing aridity, temperature rise, and rainfall variability under the RCP 4.5 baseline climate scenario. The water harvesting model (Model 5) is directly responsive to this adjustment: as climate impacts compound, the productivity preservation benefit of water harvesting infrastructure increases in relative terms, strengthening the economic case for that investment.

3.6 Discount Rates

The following discount rates are applied, consistent with World Bank, ADB, and GCF guidance:

Table 1 — Discount Rates Applied in the EFA

Analysis Type	Standard Range	Authority / Reference	Rate Used in EFA
Financial analysis (FIRR)	10–12% real	World Bank / ADB standard for developing countries	10%
GCF grant equivalent calculator	5% nominal	GCF official policy (GCF-1 Progress Report, 2023)	5% nominal
Economic analysis (EIRR)	6–10% real	World Bank Social Discount Rate guidance	6%
Sensitivity testing	10% and 20%	GCF / World Bank best practice	10% and 20%

All NPV, IRR, and B/C results are reported at the base case rates (10% financial, 6% economic).

3.7 Analytical Period and Prices

Analytical horizon: 20 years (2025–2045).

Price basis: Constant 2026 prices throughout the analysis.

Exchange rate: 1 USD = 140 DZD.

Carbon valuation: Carbon sequestration benefits are included as a separate additive benefit stream in the economic analysis. A conservative value of USD 12/tCO₂eq was applied, while the World Bank

Shadow Price of Carbon trajectory (USD 51–93/tCO₂eq; 2025–2035+) is presented as the international reference benchmark.

Prices basis

Holding prices constant in real terms — i.e., assuming all costs and benefits move together with general inflation, with no assumed change in *relative* prices — is the standard simplifying assumption in cost-benefit analysis for projects with long time horizons¹. This is because forecasting how *specific* input or output prices will diverge from the general price level 15–20 years out is mostly speculative, and the standard practice is to use constant real prices unless there is clear, well-evidenced reason to expect a structural, sustained shift in relative prices for a specific good which is not the case in Algeria. Absent such evidence, assuming real price escalation risks building an optimistic bias into the economic case. Furthermore, the local evidence available for Algeria over the past five years shows that most of the large price movements in inputs relevant to the project area's land restoration and agroforestry project have been discrete, administratively-driven step-changes rather than sustained market trends — which makes them a poor basis for extrapolating forward 20 years².

Moreover, General CPI inflation in Algeria has itself been volatile and cyclical rather than trending — 2.4% in 2020, rising to 9.3% in 2022–2023, then falling back to about 4% in 2024 — which further undercuts the case for assuming a stable, forecastable real price trajectory for any specific input or output over a 20-year appraisal period. In conclusion, the demonstrated volatility and policy-driven (rather than trend-based) nature of both general inflation and key input prices in Algeria over the past five years, the use of constant real (base-year) prices throughout the 20-year appraisal period avoids introducing speculative assumptions about future relative price movements in either direction. This is consistent with standard economic appraisal practice for long-horizon projects and represents a conservative approach that does not rely on assumed favorable real price trends to establish project viability.

Carbon Valuation

The World Bank Shadow Price of Carbon (USD 51–93/tCO₂eq) is presented as the international benchmark for valuing climate externalities in economic analysis. However, for the purpose of monetizing the project's carbon sequestration benefits, a conservative value of USD 12/tCO₂eq was applied. This assumption reflects the current Algerian context, where no operational carbon pricing mechanism or carbon market exists and the project is not expected to generate tradable carbon credits. Using a lower proxy value ensures that carbon benefits are not overstated and that the project's economic viability does not depend on optimistic assumptions regarding future carbon prices.

3.8 Beneficiary Counting

Two methodologies per Annex 23:

¹ World Bank (1997/1998). *Guidelines for the Economic Analysis of Projects / Guidelines for the Economic Analysis of Water Supply Projects*, referenced via the World Bank Institute Handbook on economic analysis of water supply projects — companion MDB guidance applying the same constant-price convention, useful if you want a second MDB citation alongside ADB.

→ <https://www.scribd.com/document/204939898/EconAnalysis-Projects>

² World Bank (2025). *Global Landscape of Fuel Subsidies & Price Controls*. Documents Algeria's fuel price freeze from January 2016 to January 2023, followed by a step adjustment: "On January 3, 2023, gasoline prices were increased by more than 50 percent, while diesel prices increased by almost 70 percent."

- Employment-based (Models 1–5, Cluster A): workers = Area (ha) × Labor norm ÷ 240 working days. Total DB = workers × 7 persons/HH (AGD pastoral norm). No adoption multiplier.
- Household/unit-based (Models 6–15, Clusters B & C): beneficiaries = scale ÷ HH norm × 6.6 persons/HH. A graduated Adoption Rate applies: 50% in Year 1 rising to 80% by Year 5, consistent with the Annex 23, 1.1 80% ceiling.

4. Rationale for EFA Model Selection

The fifteen models were selected based on four criteria: budget materiality, analytical distinctiveness, data availability and quality, and representativeness. Each model captures a unique investment and benefit stream that cannot be adequately represented by another model. Where necessary, value chains were disaggregated to reflect different stages of value creation. For example, the rustic fruit value chain is represented by separate cultivation (Model 7) and processing (Model 8) models, enabling the analysis to distinguish benefits generated from orchard establishment from those arising through value addition and marketing. Table 2 summarizes the rationale for selecting the fifteen models.

The fifteen models were selected based on four criteria: budget materiality, analytical distinctiveness, data availability and quality, and representativeness. Each model captures a unique investment and benefit stream that cannot be adequately represented by another model. Where appropriate, separate models were developed to reflect the diversity of investment types and value chains across the Project's three investment clusters, ensuring that the analysis captures the different cost structures, benefit streams, and beneficiary groups associated with each intervention. Table 2 summarizes the rationale for selecting the fifteen models.

Table 2 — Rationale for the Fifteen Selected EFA Models

Model & Activity	Rationale for Selection	Benefit Streams Captured
MODEL 1 New Forest Planting (Afforestation of Degraded Forest Land) <i>Activity 2.1.1</i>	New planting on completely deforested land is the Project's primary mechanism for creating new carbon stocks and restoring closed-canopy forest cover. The benefit trajectory — slow initial establishment, higher early mortality, greater upfront infrastructure costs — differs materially from enrichment planting, making a dedicated model analytically essential to accurately represent the GHG mitigation claim from afforestation.	Net-new carbon sequestration- Employment income- Biodiversity recovery- Desertification control
MODEL 2 Forest Restoration Planting (Reforestation and Enrichment Planting) <i>Activities 2.1.2 + 2.1.3</i>	Enrichment planting in degraded stands with residual forest structure has lower establishment costs, faster canopy closure, and different species composition compared with new planting. A separate model prevents both over- and under-estimation of the per-hectare carbon trajectory and employment generation of this restoration pathway.	Carbon sequestration (restoration stand)- Employment income- Understory NWFP recovery- Watershed protection
MODEL 3 Rural Road Rehabilitation <i>Activity 2.2.1</i>	Transport cost premiums of 15–35% in remote ZBV communities suppress farm-gate prices and inflate input costs. Road rehabilitation eliminates this structural market failure and directly amplifies income returns in all Cluster B and C models. Its	Reduced transport costs- Market access- Input price reduction- Rural economic multiplier- Enabling

	transport-cost-saving benefit stream is distinct from any ecosystem or livelihood model.	condition for Clusters B and C
MODEL 4 Rangeland and Sylvo-pastoral Rehabilitation <i>Activity 2.1.4</i>	Rangeland quality is the primary determinant of productive capacity and climate resilience for the ZBV's agro-pastoral communities. The model captures forage productivity recovery, rangeland SOC sequestration, pastoral employment, and is the ecological foundation on which the sheep livelihood model (Model 11) depends.	Forage productivity recovery - Pastoral income resilience- Rangeland carbon (SOC + biomass) - Employment- Ecological foundation for Model 11
MODEL 5 Water Harvesting Infrastructure (Jessour, Tabias, and Meskats) <i>Activity 2.2.2</i>	Water availability is the binding constraint on all agricultural productivity in the arid ZBV. Traditional water harvesting structures capture and redistribute rainfall to plots and rangelands, enabling the productivity gains modelled in Clusters B and C. The model captures three distinct benefit streams — improved crop and rangeland water availability, avoided water hauling costs, and reduced flash flood damage — not capturable by any other model. Under increasing aridity (RCP 4.5 and 8.5), its economic value grows progressively, making it the most climate-robust investment in the EFA.	Improved water availability - Avoided water hauling costs- Aquifer recharge- Reduced flash flood damage- Enabling investment for Models 6–11
MODEL 6 Olive Cultivation and Oil Processing (Representative NWFP Value Chain) <i>Activity 3.1.1.3</i>	Olive oil is the most economically significant, geographically widespread, and data-rich NWFP value chain in the ZBV. The model establishes the analytical template — WOP/WP gross margin structure, cooperative cold-press processing margin, and market linkage premium — common to all Outcome 3.1 NWFP activities. One well-parameterized representative model achieves higher accuracy than six under-parameterized models.	Incremental NWFP farm income- Cooperative processing margin- Market integration premium- Value chain employment- Represents: Opuntia- Rosemary EO- Wool & Carpet- Alfa- Mint
MODEL 7 Peach production <i>Activity 3.2.1.1</i>	Peach production is included as a stand-alone representative model of the Project's investments in hardy fruit orchards under Outcome 3.1. It captures the full on-farm investment cycle for perennial orchard establishment: site preparation and planting, annual maintenance, yield growth from Year 1 through full production at Years 5–7, and farm-gate income from fresh and dried fruit sales. Peach was chosen as the representative crop because it best captures the economics of perennial orchard establishment common to the broader hardy-fruit portfolio promoted by the Project and because reliable unit-economics data are available from national agricultural statistics.	Orchard farm-gate income (fresh and dried peach; sold to local and wilaya markets)
MODEL 8 Rosemary (Dry Products & Essential Oil) <i>Activity 3.2.1.2</i>	Rosemary represents one of the principal aromatic and medicinal plant value chains supported by the Project. The model captures both dried rosemary and essential oil production, reflecting the additional value generated through processing and commercialization of medicinal and aromatic plants	Dried rosemary revenue- Essential oil processing margin- Cooperative team returns -Value chain employment
MODEL 9 Mint (Mentha spicata) <i>Activity 3.2.1.2</i>	Mint represents the essential oil value chains promoted under Outcome 3.1. The model captures household-level production together with downstream processing into essential oils, reflecting the economic opportunities associated with high-value aromatic crops.	Processing margin (Essential oil production)- Cooperative drying and packing facility return- Market integration premium (specialty and export channels)-Value chain employment (cooperative workers)

MODEL 10 Opuntia Seed Oil <i>Activity 3.2.1.2</i>	Opuntia seed oil represents one of the Project's highest-value niche products. The model captures the economics of seed oil extraction and commercialization, reflecting the substantial value addition generated beyond primary agricultural production. Given its distinct cost structure and revenue profile, a dedicated model is analytically justified.	Seed oil income -Value-added processing Market premium- Market integration premium (specialty and export channels)-Value chain employment (cooperative workers)
MODEL 11 ALFA (<i>Stipa tenacissima</i>) <i>Activity 3.2.1.2</i>	ALFA (<i>Stipa tenacissima</i>) represents an important natural resource-based production system within the Green Dam Zone. A dedicated model captures the economic benefits associated with its sustainable management and utilization.	Seed oil income -Value-added processing Market premium- Market integration premium (specialty and export channels)-Value chain employment (cooperative workers)
MODEL 12 Small Poultry Units (100% Women Direct Beneficiaries) <i>Activity 3.2.2.1</i>	The poultry activity delivers the Project's most direct gender-transformative outcome: 100% of direct beneficiaries are women with full legal asset ownership. Three considerations justify a dedicated model: (i) GCF gender policy requires explicit financial documentation of women's economic empowerment; (ii) the 8-week production cycle is distinct from all other activities and generates the fastest income return; and (iii) home-consumed poultry and eggs improve household nutrition security — a benefit absent from any other Cluster C model.	Women's household income (100% women)- Asset ownership and gender equity- Food & nutrition security- Rapid income in early project years
MODEL 13 Beekeeping Units (5 Hives per Household) <i>Activity 3.2.2.2</i>	Beekeeping generates private household income and a direct, quantifiable ecosystem service — pollination — that supports recovering rangeland and agro-pastoral systems. It requires no additional land, is accessible to the most land-constrained households, and demonstrates that the recovering ecosystem itself generates direct economic value — strengthening community incentives for maintaining the rehabilitated landscapes.	Honey, wax, and propolis income- Pollination ecosystem services- Ecosystem-livelihood integration- No land requirement
MODEL 14 Sheep Livestock Management (Small Ruminant Pastoral Livelihood) <i>Activity 3.2.3.1</i>	Sheep production is the dominant household livelihood activity across the ZBV's agro-pastoral communities. The model captures the productivity improvement pathway — controlled grazing rotation, improved water access (Model 5), supplementary feeding, veterinary support, and market linkage — and explicitly quantifies the financial linkage between rangeland rehabilitation (Model 4) and household income: improved carrying capacity reduces supplementary feed costs and drought mortality, the primary poverty driver in the ZBV.	Sheep income (live animals + wool + milk)- Avoided supplementary feed cost- Reduced drought livestock mortality- Direct financial linkage to Models 4 and 5
MODEL 15 Wool Garment & Carpet Enterprise <i>Activity 3.2.3.1</i>	The wool garment and carpet enterprise represents the downstream transformation of livestock products into higher-value manufactured goods. The model complements the sheep production model by capturing the additional income generated through processing, handicraft production and market commercialization, thereby representing the complete livestock value chain beyond primary production.	Wool processing margin Rural enterprise income - Women's employment - Value-added manufacturing- Market diversification

5. EFA Model Structure

The fifteen n models are organized into three clusters. Figure 1 presents the complete structure. Cluster A uses employment-based counting with no adoption multiplier. Clusters B and C use household/unit-based counting with the 80% Annex 23 Adoption Multiplier. Benefit streams are strictly non-overlapping across clusters and across the two rustic fruit models within Cluster B.

CLUSTER A ECOSYSTEM RESTORATION & RURAL INFRASTRUCTURE Component 2 · Models 1 – 5 Counting: Employment-based No Adoption Multiplier	CLUSTER B NWFP VALUE CHAINS Outcome 3.1 + 3.2 · Models 6 – 11 Counting: Household-based ×0.80 Adoption Multiplier	CLUSTER C RURAL LIVELIHOODS Outcome 3.2 · Models 12-15 Counting: Household / Unit-based ×0.80 Adoption Multiplier
1 New Forest Planting (Afforestation) Act. 2.1.1	6 Olive Cultivation & Oil Processing [Representative NWFP] Act. 3.1.1.3	12 Small Poultry Units 100% Women Beneficiaries Act. 3.2.2.1
2 Forest Restoration Planting (Reforestation) Act. 2.1.2 + 2.1.3	7 Peach – Representative Hardy Fruit Production Act. 3.2.1.1	13 Beekeeping Units 5 Hives per Household Act. 3.2.2.2
3 Rural Road Rehabilitation Act. 2.2.1	8 Rosemary (<i>Rosmarinus officinalis</i>) – Dry Products and Essential Oil Act. 3.2.1.2	14 Sheep Livestock Management Small Ruminant Pastoral Act. 3.2.3.1
4 Rangeland & Sylvo-pastoral Rehabilitation Act. 2.1.4	9 Mint (<i>Mentha spicata</i>) – Essential Oil Act. 3.2.1.2	15 Wool Garment & Carpet Enterprise Act. 3.2.3.1
5 Water Harvesting Act. 2.2.2	10 Opuntia (<i>Opuntia ficus-indica</i>) – Seed Oil Act. 3.2.1.2	
	11 Alfa (<i>Stipa tenacissima</i>) – Forage Act. 3.2.1.2	
Employment income - Carbon sequestration (forest + rangeland) Water productivity - Watershed services - Market access - Forage recovery	NWFP cooperative income - Rustic fruit farm income Fig processing margin - Value chain employment - Market integration	Women's income & empowerment - Honey & wax income Pollination services - Livestock income - Food security

Figure 1 — EFA Model Structure: 15 Financial Models across 3 Clusters

Cluster A generates the public goods and enabling infrastructure—carbon sequestration, watershed services, improved road connectivity, and water availability—that underpin the productivity of the NWFP value chains in Cluster B and the livelihood investments in Cluster C. Together, the three clusters capture the complementary pathways through which ecosystem restoration, value chain development and rural livelihood diversification contribute to the Project's overall economic and environmental benefits.

6. Economic, Environmental, and Social Gains

The Project generates measurable, interlinked gains across three dimensions. The EFA quantifies each to the fullest extent that monetary valuation is feasible and data-supported.

6.1 Economic Gains

Employment and wage income — Models 1 to 5: Component 2 works generate large-scale labor demand — afforestation, enrichment planting, road rehabilitation, rangeland works, and construction of water harvesting structures.

Water productivity and avoided costs — Model 5: Water harvesting delivers improved water availability, avoided water hauling costs, and reduced flash flood damage. Under the 0.75%/yr climate impact adjustment, the relative economic value of water harvesting increases as aridity worsens, confirming it as the most climate-robust investment in the EFA.

NWFP cooperative income — Model 6: The olive model generates incremental income through improved farm-gate yields and a cooperative processing margin. Graduated adoption 50%-80% applies. Provides a representative estimate for all five other NWFP value chains.

Rustic fruit farm income — Model 7: Peach orchard cultivation generates farm-gate income from fresh and dried fruit from Year 1, reaching full production yield of 1,195,068 DZD/ha/yr by Year 5–7. The model captures the on-farm investment return for all rustic fruit species in the project area.

Poultry, beekeeping, and sheep income — Models 12,13,14: Poultry (Model 12) generates a WP NPV of AD 836,163/unit and a BCR of 1.40 (100% women beneficiaries). Beekeeping (Model 13) generates income of AD 100-120,000/unit (5 hives)/yr from honey, wax and pollination services, achieving a WP NPV of AD 823,052/unit and a WP BCR of 3.57. Sheep production (Model 14) achieves a WP BCR of 2.88, supported by improved rangeland carrying capacity (Model 4) and water access (Model 5). Wool garment and carpet enterprise (Model 15) achieves a WP BCR of 6.26. All Cluster C models apply graduated adoption (50%→80% by Year 5).

6.2 Environmental Gains

Net-new carbon sequestration — Model 1: New afforestation creates net-new carbon stocks. Estimated: 50 tCO₂eq/ha/yr at full canopy (FAO NEXT, IPCC AR6 AFOLU, HCDS 2020).

Restoration carbon — Model 2: Enrichment planting generates a restoration carbon increment. Estimated: 42 tCO₂eq/ha/yr. Lower per hectare than new planting but over a larger aggregate area.

Rangeland carbon — Model 4: Rangeland rehabilitation recovers soil organic carbon, with additional above-ground biomass in sylvo-pastoral systems.

Hydrological regulation — Model 5: Water harvesting structures recharge shallow aquifers, reduce flash flood severity, and improve catchment-scale water retention. These benefits grow under increasing aridity, reinforced by the 0.75%/yr climate adjustment.

CO₂ benefit stream in economic analysis: Carbon dioxide sequestration benefits from forest and rangeland rehabilitation are incorporated in the economic analysis as a separate additive stream (source: project Hypothesis sheet, 2026). Their impact on economic NPV is marginal but provides additional climate mitigation evidence for the GCF case. The revised economic analysis of the “with-project” scenario including the CO₂ sequestration benefits at the social value of USD 12/tCO₂eq yield a EIRR of 18% with the economic benefits cost ratio of 1.82. The project will be able to generate an economic net present value of USD 121 million with CO₂ benefits which is about USD 28 million more than the economic net present value of USD 109 million without the social benefits. Furthermore, the incremental economic analysis was recomputed including the CO₂ benefit flow. The incremental analysis, demonstrating the project additionality benefits, has EIRR of 14% showing net additional economic benefits of the project.

Biodiversity and pollinator recovery: Forest planting, rangeland restoration, and beekeeping (Model 10) restore habitat connectivity and pollinator populations — significant non-monetized co-benefits.

6.3 Social Gains

Women's economic empowerment — Model 12: 120 women receive full legal ownership of poultry productive assets with legally designated income rights — the Project's most direct gender-transformative outcome. Women's asset ownership generates documented multiplier benefits on household nutrition, education, and health.

Water access and women's time poverty — Model 5: Water harvesting reduces the water collection burden borne disproportionately by women and girls, freeing time for livelihood activities and improving girls' school attendance — captured in the economic analysis through the shadow opportunity cost of time.

Food and nutrition security — Models 12 and 11: Home-consumed poultry, eggs, sheep milk, and honey improve dietary diversity. Nutritional value of home consumption is treated as a household income equivalent at retail prices in the financial analysis.

Inclusive value chain participation — Models 7 and 8: By separating orchard cultivation (Model 7) from cooperative processing (Model 8), the EFA captures the distinct participation and income flows of the two main beneficiary groups in the rustic fruit value chain: smallholder orchard farmers and cooperative processing members — ensuring that the social benefits of both activities are fully documented.

Community resilience to climate shocks — Models 1 to 5: The 0.75%/yr climate adjustment demonstrates how rehabilitated ecosystems and water harvesting infrastructure progressively reduce community vulnerability as climate impacts intensify.

7. Beneficiary Counting and Summary

Table 3 presents beneficiary counts for all fifteen models and the financial profitability indicators. The 80% Adoption Multiplier applies to all Clusters B and C.

Table 3 — Beneficiary Summary by Model and Cluster

Model	Units	Unit Model Size	Benefited HH	NPV-WOP (AD)	NPV-WP (AD)	NPV-Increment (AD)	IRR-WOP	IRR-WP	IRR-Increment	BC ratio-WOP	BC ratio-WP	BC ratio-Increment
Existing, degraded forest-New Planting	ha	4,216	277	50,250	589,279	179,959	11%	22%	14%	1.09	2.42	1.34
Existing, degraded forest-Re-Planting and other	ha	4,331	285	534,305	1,467,802	321,186	16%	28%	16%	1.60	3.48	1.90
Road model: New	km	165			4,082,808			127%			8.93	
Range land restoration	ha	23,619		517,132	1,371,023	853,891	Infin	41%	28%	5.46	2.91	2.42
Water Supply	Units	54		5,034,791	7,818,196	37,494	Infin	29%	15%	3.51	1.95	1.16
Olive	ha	3,600	237	482,574	564,836	90,488	Infin	36%	36%	2.21	2.16	1.90
Peach - representing hardy fruits	ha	5,974	393	978,645	1,363,018	422,810	Infin	22%	13%	1.27	1.24	1.19
Rosmary (Rosmarinus officinalis) - Dry and Oil	Teams	12	12	2,636,242	5,895,131	3,258,889	Infin	132%	49%	11.36	8.54	7.17
Mint (Mentha spicata): Oil	Teams	10	10	2,093,570	3,292,687	1,199,117	Infin	215%	46%	15.82	5.71	3.15
Opuntia (Ficus-INDICA) - Seed Oil	Teams	60	60	4,159,727	133,413,056	129,253,329	Infin	148%	118%	7.84	32.46	36.58
ALFA (Stipa tenacissima) — Forage	HH	120	120	38,737	90,471	51,734	Infin	13%	11%	1.72	1.96	2.26
Poultry	Birds	200	120	726,945	836,163	109,218	Infin	278%	25%	1.59	1.40	1.13
Beekeeping	Units	120	120	64,024	823,052	290,084	98%	156%	51%	1.89	3.57	3.41
Sheep (Avg 36 sheep)	HH	11,494	11,494	240,564	583,345	306,141	-8%	Infin	Infin	1.63	2.88	4.51
Wool Garment & Carpet Enterprise (Team)	Teams	20	20	3,240,433	10,537,455	7,297,022	Infin	Infin	Infin	5.62	6.26	5.38

Note: Infin = IRR values were not generated as the cash flow has high net return values in the 1st year and throughout the 20 year period.

The project will benefit a total of 1,084,103 beneficiaries (142,433 direct beneficiaries and 941,670 indirect beneficiaries). Cost per direct beneficiary: USD 291 (Annex 23).

8. Key Financial and Economic Indicators

Model level analysis

The financial model workbook includes a Results Summary tab providing, for all fifteen models, a summary of financial viability at the unit of analysis level (hectare, unit, or equivalent) — showing WOP, WP, and Incremental (WP – WOP) net cash flows, NPV, and BCR for both financial and economic perspectives. This summary demonstrates the positive incremental impact of the Project on all fifteen models from the beneficiary viewpoint. Table 3 presented the results.

Among the Cluster B (NWFP value chain) models, profitability varies considerably across value chains, reflecting their different investment requirements and market opportunities. Olive cultivation and oil processing (Model 6) achieves a WP IRR of 36% and a WP BCR of 2.16, confirming the strong financial performance of this established value chain. Higher returns are observed for the value-added aromatic and medicinal plant models, with rosemary (Model 8), mint (Model 9) and opuntia seed oil (Model 10) recording WP IRRs of 132%, 215% and 148%, respectively. Opuntia seed oil delivers the highest WP BCR in the entire portfolio (32.46), highlighting the exceptional value added associated with premium niche products. Peach production (Model 7) and ALFA forage (Model 11) generate more moderate but consistently positive returns, with WP BCRs of 1.24 and 1.96, respectively.

Within Cluster C (rural livelihood diversification), small poultry units (Model 12) record the highest WP IRR (278%) among the livelihood models, demonstrating rapid capital recovery despite generating the

lowest WP BCR (1.40) within the cluster. This combination reflects the model's relatively low initial investment and short payback period, while confirming its financial viability and its important social contribution through targeted support to women beneficiaries. Beekeeping (Model 13) also delivers strong financial performance, with a WP BCR of 3.57, reflecting its low investment costs and rapid income generation. Sheep livestock management (Model 14) generates positive financial returns, while the associated wool garment and carpet enterprise (Model 15) substantially increases value addition through downstream processing, achieving a WP BCR of 6.26.

Where the IRR is reported as "Infin", the without-project scenario does not include an initial investment, making the IRR mathematically undefined despite positive incremental cash flows. In these cases, the NPV and BCR provide the most appropriate indicators of financial performance.

The unit of analysis for each model is: hectare (ha) for land-based models (kilometer (km) for road model; unit for water harvesting structure), processing facility, poultry unit, beekeeping unit) and sheep unit. Project-level aggregate results are derived by model cash flows over the total units provided by the project team in investment and activity tables. Project level analysis

The project level results are presented in three tables (Table 4 (a); 4(b) and 4(c)), structured to build progressively from project-level viability to project-level economic justification for GCF grant funding. The table 4(a) presents the financial analysis on a With-Project basis (FNPV/FIRR), assessing the stand-alone financial viability and cash-flow sustainability of the project as implemented — the appropriate basis for financial appraisal, since financial returns depend on the project's own revenue and cost structure rather than a counterfactual baseline, i.e., WOP scenario. The second table, Table 4(b), presents the economic analysis on a With-Project basis (ENPV/EIRR), converting financial flows into economic terms to assess the gross economic return generated by the project. The third table, Table 4(3) then presents the incremental economic analysis (With-Project minus Without-Project), isolating the net economic value directly attributable to the project relative to the Without-Project baseline in the Green Dam area. This final incremental economic result is analytically demonstrating the additionality under GCF's investment criteria, since it captures only the economic benefits that would not materialize in the absence of the project. Presenting the three tables in this sequence allows to trace the analysis from project-level financial soundness, through gross economic return, to the incremental economic case that substantiates the project's additionality status.

Results of aggregated financial and economic analyses at project level, presented in Table 4 (a) and Table 4 (b) show the financial and economic viability parameters (16% FIRR and 17% EIRR) are considerably higher than the respective opportunity cost of capital (10% and 6% financial and economic opportunity cost respectively). The economic net present value of USD 109 million for a period of 20-years indicates that the project is capable of generating economic wealth over and above the economic value of project investment. This increases further, to USD 121 million, when the social benefits of CO2 sequestration are included.

Financial sensitivity analyses

Table 4 (a) — Summary EFA Indicators: With-Project Financial Analysis

Sensitivity Analyses	FIRR	B/C Ratio	NPV (AD mn)	NPV (USD mn)	Risk Factor
Base Case	16%	1.37	6,180.6	44	

All cost increase by 10%	14%	1.24	4,507.8	32	Increase in farm input prices and unit cost of the project budget
All cost increase by 20%	13%	1.14	2,835.0	20	
All benefits decrease by 10%	14%	1.23	3,889.7	28	Combined risks on sale prices, yields, adoption rates
All benefits decrease by 20%	12%	1.10	1,598.9	11	
Cost increase by 10% and benefits decrease by 10%	12%	1.12	2,216.9	16	Combination of the above
1 year delay in getting benefits	13%	1.30	3,092.5	22	Delay in adopting technology

The financial sensitivity analysis confirms that the Project remains financially viable under all scenarios tested. A 10% increase in project costs reduces the FIRR to 14%, the BCR to 1.24, and the financial NPV to AD 4.50 billion, all remaining comfortably above the financial viability threshold. Under a 20% cost increase, the FIRR declines to 13%, the BCR to 1.14, and the NPV to AD 2.83 billion, while remaining positive.

A 10% reduction in project benefits lowers the FIRR to 14%, the BCR to 1.23, and the NPV to AD 3.88 billion. Under the combined adverse scenario (10% higher costs and 10% lower benefits), the FIRR falls to 12%, the BCR at 1.10, and the NPV at AD 1.59 billion, confirming that the Project continues to generate positive financial returns under plausible downside conditions.

A one-year delay in benefit realization reduces the FIRR to 13%, while the BCR remains at 1.30 and the NPV at AD 3.09 billion, demonstrating that the Project is also resilient to implementation delays.

Economic analysis and sensitivity analysis

Table 4 (b) — Summary EFA Indicators: With Project Economic Analysis

Sensitivity Analyses	EIRR	B/C Ratio	NPV (AD mn)	NPV (USD mn)	Risk Factor
Base Case	17%	1.74	15,309.3	109	
All cost increase by 10%	15%	1.58	13,230.0	94	Increase in farm input prices and unit cost of the project budget
All cost increase by 20%	13%	1.45	11,150.6	80	
All benefits decrease by 10%	15%	1.56	11,699.1	84	Combined risks on sale prices, yields, adoption rates
All benefits decrease by 20%	12%	1.39	8,088.8	58	
Cost increase by 10% and benefits decrease by 10%	13%	1.42	9,619.7	69	Combination of the above
1 year delay in getting benefits	13%	1.63	11,217.0	80	Delay in adopting technology

Table 4 (c) — Summary EFA Indicators: Project Level Incremental Economic Analysis

Sensitivity Analyses	EIRR	B/C Ratio	NPV (AD mn)	NPV (USD mn)	Risk Factor
Base Case	12%	1.46	8,205.9	59	
All cost increase by 10%	11%	1.32	6,403.8	46	

All cost increase by 20%	9%	1.21	4,601.8	33	Increase in farm input prices and unit cost of the project budget
All benefits decrease by 10%	10%	1.31	5,583.3	40	Combined risks on sale prices, yields, adoption rates
All benefits decrease by 20%	8%	1.16	2,960.6	21	
Cost increase by 10% and benefits decrease by 10%	9%	1.19	3,781.2	27	Combination of the above
1 year delay in getting benefits	10%	1.37	5,281.9	38	Delay in adopting technology

Table 5: Switching value analysis of the incremental economic analysis

Switching value analysis	AD 1000
NPV Total Cost Flow	18,020,759
NPV Total Benefit Flow	26,226,684
Switching value of benefits	-31%
Switching value of cost	46%

The incremental Economic Internal Rate of Return (EIRR) of 12%, shown in Table 4(c) above, exceeds the adopted Economic Discount Rate (EDR) of 6% by 6 percentage points, resulting in a positive Economic Net Present Value (ENPV) of AD 8.2 billion (USD 59 million). This confirms the project's economic justification under standard cost-benefit decision rules. This margin, although 6 percentage points, is interpreted in the context of three factors in this analysis. First, the EIRR decision criterion determines that a project is economically justified once EIRR exceeds the EDR, regardless of the absolute size of the margin, since the EDR already reflects the opportunity cost of capital and the social rate of time preference; a 6-point premium therefore represents a meaningful buffer above the project investment. Second, sensitivity analysis (see Table 4(c)) demonstrates that the result is robust to reasonable downside variation in costs and benefits. Third, the reported EIRR is itself a conservative estimate, as it reflects only the monetized, quantifiable economic benefits of the project (e.g., avoided land degradation, increased agricultural productivity, etc.); it excludes non-monetized co-benefits — including, biodiversity conservation, groundwater recharge, and enhanced climate resilience in the Green Dam corridor — that are core to the project's rationale, but are not readily quantifiable in monetary terms. Were these additional benefits capable of being monetized, the true economic return would be expected to exceed the reported 11%, further widening the margin above the discount rate.

The robustness of this result is further confirmed by switching value analysis (Table 5), which identifies the extent to which key variables will have to deteriorate before the project's economic viability is eroded (i.e., before EIRR falls to the level of the EDR). The analysis indicates that incremental economic benefits would need to fall by 31% — or, alternatively, incremental economic costs would need to rise by 46% — before the EIRR converges with the 6% discount rate and the project's ENPV falls to zero. These switching values represent a substantial margin of robustness: a 31% shortfall in benefits or a 46% cost escalation would be a significant deviation from the project's base-case assumptions. This confirms that the 6-percentage-point margin between the EIRR and EDR is not a fragile result, but one that can absorb meaningful adverse variation in either project costs or benefit realization while remaining economically justified.

10. Data Sources

Table 5 — Principal Data Sources

Data Category	Primary Source(s)	Application
Beneficiary counts & gender	Calcul Beneficiaries Green Dam FAO Algeria; Annex 23 Methodology	All 15 models — Table 2
Investment budget by activity	FP Annex 4 (GCF budget, constant 2026 USD)	Project cost stream — all models
Adoption rate trajectory	<i>Anura Wickramasinghe EFA methodology note (June 2026);</i> <i>Comparative dryland programme data</i>	Clusters B and C — 50%→80%, Yr 1→Yr 5
Climate impact adjustment	<i>RCP 4.5 downscaled projections for Algeria;</i> <i>Anura Wickramasinghe EFA methodology (0.75%/yr compound)</i>	All crop and forestry models — all 11 models
CO₂ sequestration benefits	<i>FAO NEXT Tool; IPCC AR6 AFOLU</i>	Economic analysis — separate additive stream
Forest & rangeland productivity and carbon	Algeria National Forest Inventory — HCDS (2020); INRF soil and biomass surveys; FAO ExACT tool v8; IPCC AR6 AFOLU	Models 1, 2, 4 — yields, carbon, employment
Water harvesting hydraulic performance	ANRH — National Water Resources Agency ICARDA traditional water harvesting studies Algeria (2019); INRF runoff curve numbers, pre-Saharan catchments	Model 5 — catchment yield, recharge, flood damage
Crop, NWFP & livestock prices and yields	INRAA statistical bulletins 2022–2024; MADRP/Filaha market bulletin; DSA wilaya agronomy services	WOP/WP gross margins — Models 6–15
Labour norms & rural wages	ITAF (pastoral); ITELV (livestock); MADR 2024	Employment M1–5; operating costs M6–15
Shadow prices & conversion factors	World Bank Algeria CRR (2023); FAO SCF Algeria (2022); World Bank carbon price corridor (2024)	Economic analysis — all 15 models
GCF & FAO benchmarks	FAO Investment Centre EFA guidance notes (2022–2024); GCF approved dryland project EFA annexes; IFAD Algeria PPDR evaluation (2020)	Methodology & indicator benchmarking

11. Conclusion

Ecosystem restoration and climate-resilient land management are among the priority areas identified by Algeria in its Updated Nationally Determined Contribution (NDC, 2021), which commits the country to

restoring 1.245 million hectares of degraded land by 2030 and strengthening climate adaptation across the agro-sylvo-pastoral sector. Coherently, the Government of Algeria has committed USD 56.5 million — 57% of total project cost — in co-financing earmarked directly to project activities across six target wilayas. These contributions are essential to ensuring the additionality of GCF investments, including: the introduction of Algeria's first formalized pastoral-concession regime under a reformed Pastoral Code; the establishment of a domestic AFOLU carbon-offset mechanism; the integration of women, youth, and transhumant herders into certified climate-resilient value chains; and the replacement of historical Aleppo-pine monocultures (~68% of historic plantings) with native multi-species mixes — locking in 1,838,910 tCO₂eq of cumulative mitigation over 20 years.

The project will promote a more efficient and effective approach to dryland ecosystem restoration, value chain development, and climate mitigation across the Green Dam Zone. Private sector participation is stimulated through six certified NWFP value chains (opuntia, olive, rosemary, wool, alfa, peppermint), and through a voluntary carbon-market readiness infrastructure (EarthMap, OpenForis, SEPAL, FAO NEXT, TAPE, KoboToolBox) that opens concessional carbon-finance access for the first time in Algeria.

The project's economic and financial benefits have been estimated through fifteen financial models organized into three analytical clusters, relating to: (1) ecosystem restoration and rural infrastructure—afforestation, reforestation, rural roads, rangeland restoration, and water harvesting (Cluster A, Models 1–5); (2) NWFP value chains—olive, peach, rosemary, mint, opuntia seed oil, and alfa forage (Cluster B, Models 6–15); and (3) rural livelihood diversification—small poultry units, beekeeping, sheep production, and wool garment and carpet enterprises (Cluster C, Models 12–15). A detailed analysis is available in Annex 3.

On the financial side, all fifteen models demonstrate efficiency in delivering climate adaptation and livelihood benefits. Activities stimulated by the Project investment are financially profitable across all investment types. The models show positive financial parameters, with With-Project Benefit-Cost Ratios ranging from 1.24 (peach cultivation) to 32.46 (opuntia seed oil), all computed using the 10% real financial discount rate adopted for the financial analysis.

Individual model performance confirms strong efficiency gains: road development achieves a WP BCR of 8.93, eliminating transport cost premiums of 15–35% in remote communities and amplifying income returns across all livelihood models; rangeland restoration generates positive incremental returns (Incremental IRR of 28%) through low-cost ecosystem rehabilitation and improved forage productivity; and Poultry production delivers the portfolio's highest individual WP IRR of 278%. The project's policy and institutional reforms — including the modernized Pastoral Code and the climate-adapted microcredit architecture through BADR/FGAR/CNMA/ANCC — will reduce incentives for unsustainable land use and strengthen economic opportunities across the forestry, pastoralism, and NWFP sectors.

On the economic side at aggregate level, both WP and incremental scenarios, and accounting for all relevant economic and ecosystem benefits (including the valuation of conservative proxy applied to the study of carbon sequestration of USD 12/tCO₂eq, watershed hydrological services, avoided desertification costs, and shadow wage premiums on rural employment — all detailed in Annex 3), the project shows very solid economic parameters, with a 20-year Economic IRR of 17% (exceeding the 6% social discount rate by 11 percentage points), an Economic NPV of USD 109 million (AD 15.30 billion), and an economic Benefit-Cost Ratio of 1.74 — meaning Algeria's national economy receives USD 1.74 in

social value for every dollar of total project cost. At the financial level, the project achieves a 20-year Financial IRR of 16%, a financial NPV of USD 44 million (AD 6.18 billion), and a financial BCR of 1.37.

The cost per direct beneficiary is estimated at USD 291 across 142,433 direct beneficiaries (45% women) and 941,670 indirect beneficiaries, for a total outreach of 1,084,103 people. The Project maintains positive financial and economic returns under all sensitivity scenarios tested (Annex 3), including increases in project costs, reductions in project benefits, combined adverse scenarios, and delays in benefit realization. Across all scenarios, both the Financial and Economic Net Present Values remain positive, the Benefit-Cost Ratios remain above one, and the Financial and Economic Internal Rates of Return continue to exceed their respective discount rates of 10% and 6%, confirming the robustness of the investment case.

Under the most adverse combined scenario (10% increase in project costs and 10% reduction in project benefits), the Project remains financially viable, with a Financial IRR of 12%, a Benefit-Cost Ratio of 1.12, and a Financial NPV of AD 2.21 billion. Similarly, the economic analysis confirms the Project's resilience under adverse conditions, with the Economic IRR remaining well above the 6% social discount rate and the Economic NPV remaining strongly positive. These results demonstrate that the Project's economic and financial viability is robust to plausible downside risks and further support the rationale for GCF concessional financing.