

Annex 10. Economic and Financial Analysis

Annex 10 follows the recommended guidelines for preparing the economic and financial analysis of SAP proposals. In line with the guidance for most public-sector SAP submissions, a formal economic or financial model is not strictly required. However, projects must still provide evidence of cost-effectiveness, financial adequacy, minimum concessionality, and long-term economic and financial viability, as outlined in the GCF Investment Criteria. analysis.

- **Cost-effectiveness**

Cost-effectiveness is demonstrated through an analysis of the costs of inaction, showing how investments in climate-resilient development will significantly reduce future economic and social costs. This includes references to current cost studies, preliminary findings from the assessment of blue-green infrastructure, and evidence supporting the financial viability of the selected commodities.

The costs of inaction on climate change in Indonesia are already significant and projected to escalate sharply. According to the Climate Resilience Development Policy (PBI), losses in water, health, agriculture, and coastal/marine sectors are expected to reach USD7.9 billion by 2024. Indonesia's NDC estimates GDP losses of 0.66–3.45% of GDP by 2030 (USD 7.6–39.8 billion) due to climate impacts (Gol, 2021¹). These findings mirror national and global studies. The World Bank (2021²) estimates climate change could reduce Indonesia's GDP by up to 3.5% annually by 2050, with coastal flooding a key driver. The UNEP *Adaptation Gap Report* (2022³) stresses that delayed adaptation compounds future costs exponentially.

Studies conducted in the Kupang watershed highlight this trend at the local level. The Climate Risk and Impact Assessment (CRIA, 2021⁴) of 42 flood-prone villages estimated annual losses of USD 134.7 million, covering infrastructure repairs, household damage, and losses of agricultural and aquaculture land. These costs already exceed municipal budgets, forcing the diversion of funds away from essential development priorities (MCI, 2023⁵). Future projections paint an alarming picture: inundated land in Kupang is expected to increase from 1,800 ha in 2020 to 5,700 ha by 2035. Annual damages are projected to surge from USD 134.7 million to USD 2.2 billion by 2035, a more than twentyfold increase, driven by sea-level rise, land subsidence, and more frequent flooding (CRIA, 2021). The impacts will fall disproportionately on poor households, who make up 12.5% of the watershed population, as they face recurrent damage to homes, productive land, and market disruptions. According to inundation models, the share of villages/kelurahans with a very high hazard index is projected to rise from 10% in 2020 to nearly 40% by 2035. By the end of 2035, over 90% of mangroves, bushes, and parkland are expected to be permanently inundated, along with more than half of settlements, fishponds, open land, and industrial areas.

Overall, annual damages in the Kupang watershed are forecast to reach USD 2.2 billion by 2035, more than twenty times the 2020 baseline. This dramatic increase reflects not only the higher frequency and intensity of floods but also the compounding effects of sea-level rise,

¹ Government of Indonesia. (2021). Indonesia's updated nationally determined contribution (NDC). Ministry of Environment and Forestry, Republic of Indonesia. <https://unfccc.int/NDCREG>

² World Bank Group, and Asian Development Bank. (2021). Climate Risk Country Profile: Indonesia. Climate Change Knowledge Portal. The World Bank Group & Asian Development Bank

³ United Nations Environment Programme. (2022). Adaptation Gap Report 2022: Too Little, Too Slow – Climate adaptation failure puts world at risk. United Nations Environment Programme.

⁴ Mercy Corps Indonesia, 2021. Climate Risk and Impact Assessment of Kupang Watershed and Coastal Area of Pekalongan City and Regency

⁵ Mercy Corps Indonesia, 2023. Regional Climate Budget Tagging for Pekalongan City

land subsidence, and permanent inundation, which together threaten large portions of settlements, aquaculture areas, industrial zones, and farmland (CRIA, 2021).

Supporting climate-resilient development will substantially reduce costs. The BRAVE project's strategy for reducing the costs of climate change in the Kupang and Sengkarang watersheds combines scientific risk assessment, on-the-ground resilience measures, and policy and market system reform into an integrated framework designed to be both effective locally and replicable elsewhere. The project builds a strong evidence base for climate-resilient planning through comprehensive climate risk and livelihood assessments to identify future hazards, quantify potential losses, and understand the links between climate impacts and economic activities. Sub-seasonal to seasonal forecasts will be combined with daily weather data to produce impact-based forecasts tailored to selected agriculture and aquaculture commodities. These forecasts can also support anticipatory actions in other sectors, including, to some extent, flood preparedness. This data will be translated into clear, actionable advice for farmers and fish farmers, such as optimized planting schedules, pond management techniques, and harvest timing, helping avoid income losses and reduce damage from floods or drought. By equipping local governments and communities with forward-looking, location-specific climate data, the project helps avoid unplanned losses and reduces the need for costly post-disaster repairs.

Climate resilient development will be achieved through runoff management via blue-green spaces through the creation of multi-use public spaces that act as flood detention areas during heavy rain, reducing inundation damage while in dry periods, these spaces function as recreational and ecological areas, improving urban liveability and biodiversity. These measures directly reduce the scale and frequency of flood damage to assets, productive land, and infrastructure, while also boosting incomes from agriculture and aquaculture. Evidence from the initial studies of the blue-green space shows that proactive adaptation is highly cost-effective: global meta-analysis indicates a benefit-cost ratio of 4:1 to 7:1 for adaptation measures (Global Commission on Adaptation, 2019⁶).

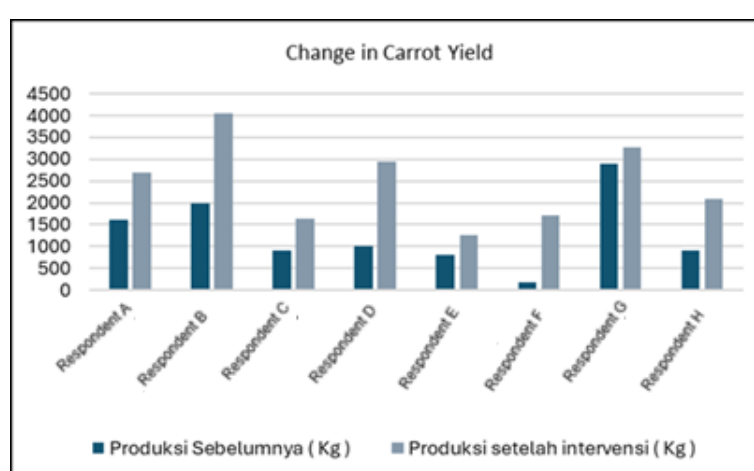
Climate smart agriculture models which are financially viable will be promoted. Based on the findings of the value chain assessment, the project will focus on agroforestry-based coffee production and climate-smart carrot cultivation in upstream areas. Interventions will promote improved land and forest management to reduce surface runoff, enhance soil health, and increase yields. Post-harvest processes will also be strengthened to improve income stability. In the lowland areas, the project will support adaptive aquaculture (milkfish and grouper) in high-risk coastal zones by facilitating a shift toward more resilient production systems, such as floating nets, improved feed and water management, and locally-sourced fingerlings. In addition, value-added processing, particularly women-led product diversification, will be supported to raise household incomes and strengthen adaptive capacity. Initial financial analyses demonstrate the benefits of these climate smart farming techniques:

- Carrot farming (upstream): Under the ZFRA project, climate-smart carrot cultivation achieved a 35% return on investment (ROI) per cycle (around 3-4 months), with yields increasing around 67% compared to conventional farming. A 1,700 m² production cycle, sold at a moderate price point, generated net profits of IDR 912,000 (~USD 55). An example of these yield gains is shown in the figure below.
- Coffee (Agroforestry): Climate-smart coffee practices have been shown to improve productivity by 30–50% and stabilize yields under increasingly erratic rainfall. Enhanced post-harvest processing further improves market access (World Coffee Research, 2021⁷).

⁶ Global Commission on Adaptation. (2019). Adapt Now: A global call for leadership on climate resilience. World Resources Institute. <https://gca.org/reports/adapt-now/>

⁷ World Coffee Research. (2021). Annual Report 2021. World Coffee Research. <https://worldcoffeeresearch.org/resources/annual-report-2021>

- Milkfish (downstream aquaculture): While the initial ROI of floating nets is negative due to upfront investment, transitioning from fixed-stake nets (KJT) to floating nets (KJA) has proven to give a higher profit after the first cycle, primarily due to KJA's lower maintenance costs. The profit gap can reach IDR 5,250,000, meaning that the KJA and KJT will have an equal economic value after 3.5 cycles (less than 2 years) under normal conditions. The actual benefit of KJA becomes evident during coastal flooding and high tides, which typically peak around 9 times per year. During these periods, KJT is vulnerable to losses of up to 35% of total revenue, as survival rates drop from the standard 60% to just 39%—impacting the entire annual cycle. Not to mention, these extreme events also incur additional maintenance costs for KJT. In contrast, KJA is designed to better adapt to fluctuations in sea surface levels, reducing its maintenance needs (this information is from MCI analysis under the ZFRA project).
- Grouper (high-value aquaculture): Current low-yield methods limit economic viability, but improved practices identified in the value chain assessment show potential to double yields and significantly expand market access.



These results confirm strong financial viability across commodities, particularly when combined with adaptive practices and market integration. Once broader socio-economic benefits, such as reduced flood damage, food security, and enhanced resilience, are included, overall economic viability is higher than business as usual.

● Financial adequacy

The proposed financial structure blends concessional public finance (grants) with confirmed co-financing of USD 688,922 (6.89% of total budget) from the Executing Entity (USD 165,158) and local governments (USD 523,764). Public finance is critical because:

- Local governments face severe fiscal constraints, and Central Java is projected to suffer among the highest climate-related GDP losses nationally.
- Adaptation costs, USD 2.2 billion in projected annual flood losses by 2035—far exceed local budget capacity (MCI, 2022).
- Benefits such as flood protection, water security, and ecosystem services are public goods with no monetized revenue streams.

The grant-based approach reflects the nature of interventions, climate-resilient infrastructure, ecosystem restoration, and community-based adaptation, and the limited fiscal space in the Kupang and Sengkarang watersheds. Under Indonesia's PBI policy, Central Java is expected

to experience the highest climate-related GDP losses in the coastal subsector and third highest in agriculture, while municipal budgets remain relatively stagnant (MCI, 2023⁸).

This public finance base is designed to unlock additional private investment. While commercial commitments are still in structuring and excluded from confirmed co-finance, there is strong interest from private companies and financial institutions to participate through equity and loans. GCF funding will help de-risk early adoption, demonstrate technical and economic viability, and create investable models for climate-resilient and biodiversity-positive livelihoods.

Grants are preferred over debt or equity because the measures do not generate predictable revenue streams. The main benefits, reduced flood damages, improved water security, and ecosystem services, are shared public goods. Over time, proven adaptation models are expected to attract bank financing and private investment, especially for climate-smart agriculture and aquaculture.

The terms and tenor of GCF support are aligned with the time needed for ecosystems to recover and community adaptive capacity to strengthen. Public finance is therefore essential to absorb early-stage risks, enable enabling-market conditions, and lay the foundation for long-term private sector engagement.

- **Minimum concessionality**

The proposed instrument, a concessional grant, addresses the absence of viable commercial financing for climate-resilient watershed management, climate-smart agriculture, adaptive aquaculture, and blue–green infrastructure in the Kupang and Sengkarang watersheds. These activities deliver significant public goods, including reduced flood risk, improved food and water security, biodiversity protection, and enhanced climate resilience; however, they do not generate direct cash flows that would appeal to private investors.

Current market conditions in Central Java do not provide adequate financial incentives for such investments due to high upfront costs, long payback horizons, and benefits that are widely shared across communities, ecosystems, and sectors. Without concessional support, local governments and communities cannot fund these long-term resilience measures, leading to continued and escalating losses. The project addresses this market failure by:

- Providing public goods such as climate risk information systems, and community-based adaptation planning that benefit all residents and sectors.
- Demonstrating viable models of climate-smart agriculture, adaptive aquaculture, and nature-based runoff management that reduce losses and generate co-benefits, enabling future private sector participation once risks are reduced.
- Building the enabling environment, policy frameworks, market linkages, and institutional capacity, necessary for replication and scale-up.

By absorbing early-stage climate and adoption risks, the concessional structure allows the project to progress from pilot to scale, proving technical, social, and economic feasibility. This foundation will enable future blended finance approaches that can incorporate private capital as models mature, and commercial opportunities emerge.

- **Leveraging and catalysation of finance**

The project has confirmed co-financing totalling USD 688,922, representing 6.89% of the total project budget, with contributions from the Executing Entity support fund (USD 165,158) and local government annual budget allocations (USD 523,764). GCF funding will act as a catalyst, helping to structure and operationalize these co-financing contributions. The project is

⁸ Mercy Corps Indonesia, 2023. Regional Climate Budget Tagging for Pekalongan City

expected to leverage additional public and private finance through policy reform, value chain strengthening, and risk reduction through the following mechanisms.

- *Integration into business strategies.* The project focuses on promoting resilient business models in two key sectors: climate-smart agriculture (coffee, carrot) and adaptive aquaculture (grouper, milkfish). These models can be co-developed with private sector partners using a shared-value approach, ensuring mutual benefits for businesses and communities. Expected outcomes include reinvestment in value chains, infrastructure, and logistics, with an estimated 20% average increase in community income, and increased private capital inflows through replication and scale-up of successful models.
- *Expansion of local government investment.* The project also strengthens local government engagement by embedding climate-resilient measures into development plans. This approach is expected to catalyze a growth in climate-resilient budget allocations and mobilize significant funds for flood-related projects, creating a sustainable financing pathway for long-term resilience and development.

The project provides multiple incentives for sustained investment by addressing key barriers and creating opportunities for both private and public stakeholders. Risk reduction through climate-smart measures helps stabilize production, making it more bankable and attractive to financiers. Improved market access, facilitated by strengthened supply chains and secured procurement contracts, further encourages private investment by reducing uncertainty and increasing profitability. Policy integration ensures that climate-resilient interventions are embedded into long-term public financing plans, providing a stable foundation for continued support. Additionally, the project leverages a demonstration effect, where successful models, such as those implemented in the Kupang watershed, can be replicated in other areas like the Sengkarang watershed, promoting wider adoption and scaling of effective practices.

- **Long-run economic and financial viability is achieved through various channels.**

Operation and maintenance (O&M). The project ensures sustainability through a comprehensive O&M plan covering routine upkeep of blue-green space and other nature-based measures; improvement of aquaculture ponds, and fingerling banks. Maintenance of the climate information system and its observation devices to ensure the continuation of climate data updates are integral components. Responsibilities are clearly allocated:

- Local governments manage infrastructure maintenance, including for climate information system operations, and integrate costs into budgets.
- Community-based organizations and villages maintain assets through business revenues and village budget.
- Provincial/national agencies oversee environmental monitoring and policy alignment.

Post-GCF sustainability incentives. The project creates strong incentives for continued investment through predictable financial returns, reliable market access, and institutional integration. Income stability motivates farmers and fishers to sustain climate-smart practices, while supply reliability attracts private investment. Embedding measures into local development plans ensures ongoing public financing, while capacity-building, through trained personnel, technical guidelines, and resilience assessments, supports expansion to other watersheds.

Market system development and bundled services. Long-term sustainability is reinforced through a bundled services approach that combines access to finance (commercial banks, microfinance, and crop insurance), technical advisory support (on-site training for adaptive agriculture and aquaculture), and closed-loop agriculture models integrating production, processing, and marketing. This integrated approach reduces post-harvest losses, improves product quality, ensures reliable market access, and enhances value capture, while

simultaneously strengthening producers' financial literacy and creditworthiness and reducing dependence on middlemen.

Experience and partnerships. Building on MCI's experience since 2009, including 10 microcredit schemes and four crop insurance-credit programs, the project applies proven approaches for resilient livelihood financing (e.g., MCI/ZFRA project). GCF funds serve as seed capital to support inputs, market development, and pilot business models, ensuring interventions are scalable and bankable.

Economic rationale. The costs of inaction in Central Java, USD2.2 billion annually by 2035, far exceed the proposed investment. Evidence from comparable initiatives (ZFRA model for carrots, milkfish floating nets etc) confirms that climate-smart practices generate strong returns, boost productivity, and enhance resilience.

Overall, the project meets the GCF Investment Criteria by demonstrating cost-effectiveness, financial adequacy, minimum concessionality, and long-term viability. Public concessional finance is essential to catalyze adaptation in high-risk watersheds while leveraging local and private resources to sustain and scale interventions.