

Annex 3.b – Description and Summary Results of Economic Analysis

1.1 Overview and methodology

This analysis models the economic and financial impacts of the USD 706.9 million investments to be supported by the IDB-GCF Amazon Bioeconomy Fund Programme (the “Programme”). The model was developed based on assumed investments by financial intermediaries and their client businesses into the bioeconomy. Representative business models for a number of bioeconomy sub-sectors were constructed to estimate the costs, revenues, and other benefits generated by the project. Taking into account taxes and financing terms, simple financial statements were generated in order to calculate projected profitability of business models and the financial implications of financing them via GCF-enabled loans. Business models were based either on per hectare or per recipient business assumptions, and then scaled up to the sector and country level to calculate aggregate results on a value chain, country, and Programme level (Figure 1). Business As Usual models were also developed in order to estimate the impacts of the project compared to baseline conditions.

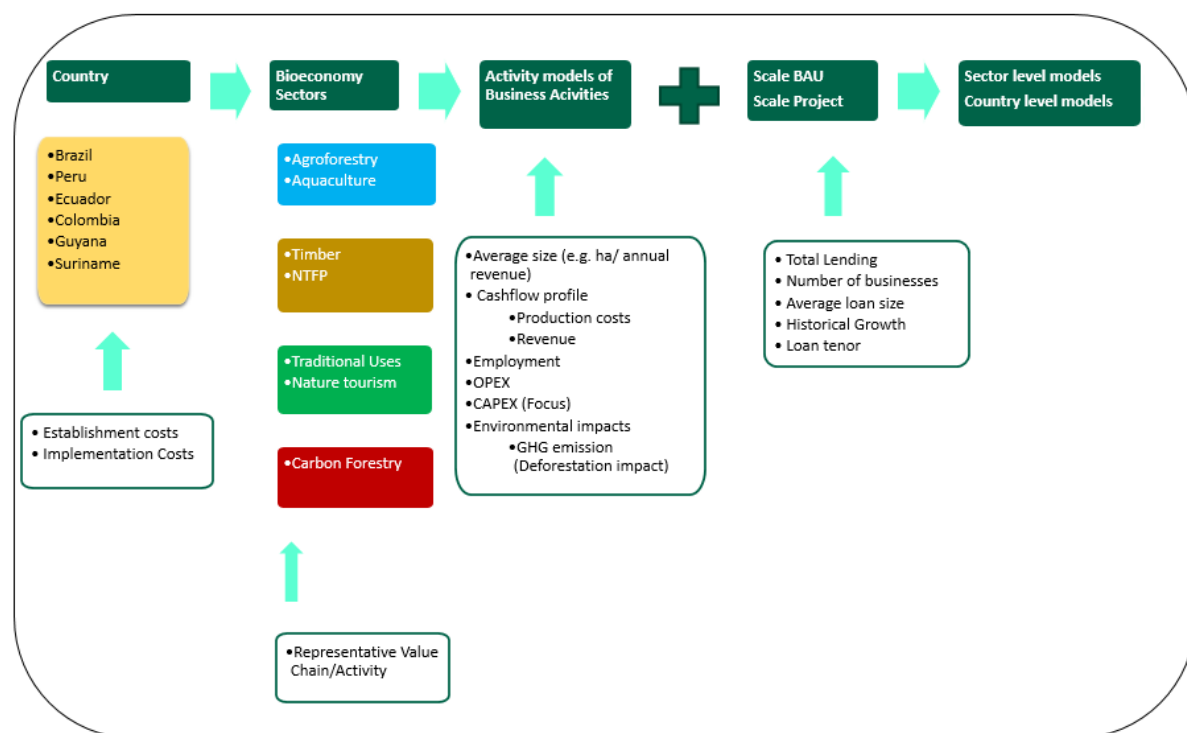


Figure 1: Overview of data flow and modeling

Input assumptions for the project were based on similar business models in the region, expert opinion, and desk research. Assumptions were developed on a per hectare or per business basis, and can be grouped into several categories: i) costs, such as capital expenditures, operating expenditures, working capital; ii) productivity, either in terms of yield per hectare or change in customers per business;

iii) market prices; iv) employee and job creation impacts; v) climate change mitigation impacts; and vi) financial assumptions, e.g. interest /and loan tenors. The model utilizes business assumptions described in the feasibility study and generally reflects the logic that investments made through the project result in productivity and expansion gains that improve the profitability of the business. The specific values of assumptions and their sources can be found in the “Model Inputs” tab of the Excel model.

In order to navigate the Excel, there are some categories of tabs that should be focused on:

- i. The Instructions and Workbook information tabs provide an overview and explanation of the model.
- ii. The Employment Hectares, Results tables landscapes, Results tables, and Sensitivity tabs present the results at value chain and country level, overall project level, and consider how different input assumptions impact project results.
- iii. The Financing split, Land use change, Project cost input, and Employment tabs provide scaling assumptions for the project.
- iv. The Project inputs tab provides all the input assumptions of the model.
- v. The Per hectare models (tabs labeled Br.1, B.3, etc.) provide the representative cash flows of each value chain and country.

The model calculated benefits of representative business models for seven distinct value chains: native palm, aquaculture, cacao, coffee, timber, non-timber forest products and wilderness tourism. Distinct models were generated for representative micro, small and medium/large businesses in order to incorporate the different financing terms for them, as well as to account for the differentiated social and environmental impacts of different sized businesses.

The total investment allocation made by value chain and country varies according to the estimated absorption capacity and demand of the particular value chains (Table 1), as per the market sizing assessment presented in the feasibility study.

Based on the financial demand market assessment presented in the feasibility study (Annex 2), and allocating Programme resources generally on a pro rata basis, companies in the NTFP sector, native palm, and timber production value chains receive the largest investment with 23%, 23%, and 22%, respectively. Aquaculture (5%) and tourism (3%) receive the smallest amounts of investment. The smaller size of these sub-sectors means they are less able to absorb larger amounts of investment. Country allocations also vary significantly, with Brazil receiving USD 412.2 million in investment (58% of overall Programme investment), while other countries range between USD 31.4 million to USD 127.9 million.

Table 1: Overall investment by value chain and country (USD)

Value chain/segment	Brazil	Colombia	Ecuador	Guyana	Peru	Suriname	Total	% of total
Native Palm - micro enterprise	43,861,256	8,386,367	5,845,245	3,730,670	1,040,447	3,510,974	66,374,959	9%
Native Palm - medium enterprise	65,791,884	12,579,550	8,767,868	5,596,005	1,560,671	5,266,461	99,562,439	14%
Aquaculture - micro enterprise	18,333,701	4,604,878	150,449	192,045	3,101,199	180,735	26,563,007	4%
Aquaculture - small enterprise	4,942,770	1,336,974	133,123	169,929	592,956	159,922	7,335,676	1%
Cacao Agroforestry - micro enterprise	34,680,264	11,775,371	9,006,991	-	10,392,147	-	65,854,772	9%
Cacao Agroforestry - medium enterprise	4,851,929	1,647,429	3,760,926		4,339,307		14,599,591	2%
Coffee Agroforestry - micro enterprise	34,443,765	36,835,614	3,896,830		5,062,525		80,238,734	11%
Coffee Agroforestry - medium enterprise	2,820,177	4,407,749	2,591,193		3,081,894		12,901,013	2%
Timber - micro enterprise	26,559,584	13,341,947	9,299,254	5,935,157	1,725,861	5,585,640	62,447,442	9%
Timber - medium enterprises	39,839,376	20,012,921	13,948,881	8,902,735	2,588,791	8,378,460	93,671,164	13%
Non-Timber Forest products - micro enterprise	18,173,117	1,174,303	818,482	1,044,776	489,983	983,250	22,683,912	3%
Non-Timber Forest products - small enterprise	112,781,269	6,677,560	4,654,217	3,976,762	3,040,802	5,591,154	136,721,765	19%
Wilderness Tourism - micro enterprise	392,070	393,905	274,549	87,614	50,954	82,455	1,281,547	0%
Wilderness Tourism - small enterprise	4,685,869	4,707,801	3,281,308	1,755,111	608,982	1,651,754	16,690,825	2%
Total	412,157,033	127,882,368	66,429,317	31,390,805	37,676,519	31,390,805	706,926,846	

1.2 Results

Overall, the project delivers strong economic and development benefits. Excluding benefits from climate change mitigation, and using an economic discount rate of 8%, the project is expected to have a Net Present Value (NPV) of USD 469.7 million. The Economic Rate of Return (ERR) is 14.4%. The weighted-average equity internal rate of return (IRR) for investments made by end beneficiaries is 11.1% with a payback period of 12 years. While these are positive returns, the long-term nature of the return on investment reflects why providing long-term financing at affordable costs (along with risk mitigation instruments) to partner financial institutions that can enhance final conditions to, and access for, borrowers is a critical aspect of the value add this IDB-GCF Programme can deliver. Without the longer maturities that banks can provide to businesses and producers, the bioeconomy business models will likely not scale-up at the rate targeted by the Programme.

In addition to direct financial flows from the Programme, the model estimates and values its climate change mitigation benefits, by estimating its GHG abatement outcomes. Values at a social cost of carbon of USD 40 per ton of CO₂ equivalent (tCO₂e), the estimated 123.4 million tCO₂e sequestered or avoided emissions of the Programme result in a significant increase of the ERR (from 14.4% to 49.3%) and the NPV (from USD 469.7 million to USD 2,452.5 million). Further, the economic payback period would reduce from 9 years to 4 years. These outstanding improvements in economic performance metrics when mitigation contributions are considered shows the disadvantage that the lack of internalization of carbon benefits (a key externality of bioeconomy projects) generates for these activities.

The climate change mitigation benefits vary by country and value chain, as some activities are more effective than others at generating GHG emissions reductions (Table 2). Non-Timber Forest products creates over half (56%) of the climate mitigation benefits, reducing more than 68.7 million tCO₂e. Brazil accounts for 64% of emission reductions, as a result of its larger investment absorption capacity.

It is important to note that the model does not currently fully capture the economic value of the Programme. Many goods and services without market values (e.g. improved water provision, biodiversity habitat, etc.) are very complex to quantify with reasonable confidence and therefore their economic benefits have not been estimated and valued in the model.

Other results and co-benefits quantified with the model include:

1. 49,200 new jobs created (as a result of the increased production enabled by the Programme investments).
2. 57,300 businesses obtaining enhanced financing from the Programme.
3. 144,900 direct beneficiaries (people employed by supported businesses, which improve their revenue and profitability and thus reduce their economic vulnerability) and 333,000 indirect beneficiaries (household members associated to direct beneficiaries).
4. 3.8 million hectares supported through sustainable, increased productivity and/or forest protection.

Even without counting externalities, the project generates significant economic benefits (Table 3), as measured in terms of NPV. The native palm sub-sector derives the largest value, with USD 118 million, followed by wilderness tourism and cacao agroforestry SMEs, with USD 91 and 85

million, respectively. In the case of native palm and cacao, this results from their superior combination of larger investment allocations to these chains and their ERRs. In the case of wilderness tourism, which only captures 3% of investment resources, its relatively large NPV results from its significant ERR, at 60% and 49% for the micro and SME segments, respectively. These large ERRs are explained by the current context of the tourism sector, dramatically hit by the COVID pandemic. Relatively small recovery investments (e.g. working capital) on existing infrastructure, but with significant investment and credit risk levels (as the length of the restrictions and effects associated to the pandemic are still hard to assess), would help -once tourism demand recovers- bring these businesses back to normal and increase revenue significantly, back to historic values from their current very depressed levels. On the opposite end, medium-sized aquaculture investments are the worst performing, but break even in terms of NPV. Brazil and Colombia have the highest direct NPV benefits, which is consistent with the fact that the modelling assigns to them the highest investment allocations based on their relatively larger markets.

Table 2: Tons of CO₂e reductions per country and value chain

Value chain/segment	Brazil	Colombia	Ecuador	Guyana	Peru	Suriname	Total
Native Palm - micro enterprise	2,241,560	428,591	298,725	190,658	53,173	179,431	3,392,138
Native Palm - medium enterprise	3,362,340	642,887	448,088	285,988	79,759	269,146	5,088,208
Aquaculture - micro enterprise	-	-	-	-	-	-	-
Aquaculture - small enterprise	-	-	-	-	-	-	-
Cacao Agroforestry - micro enterprise	4,314,278	1,464,874	1,120,483	-	1,292,799	-	8,192,434
Cacao Agroforestry - medium enterprise*	-	-	-	-	-	-	-
Coffee Agroforestry - micro enterprise	5,148,588	5,506,117	582,491	-	756,737	-	11,993,933
Coffee Agroforestry - medium enterprise*	-	-	-	-	-	-	-
Timber - micro enterprise	988,341	496,484	346,046	220,860	64,223	207,854	2,323,809
Timber - medium enterprises	1,853,140	930,907	648,836	414,113	120,418	389,727	4,357,142
Non-Timber Forest products - micro enterprise	55,060,121	3,557,853	2,479,802	3,165,418	1,484,528	2,979,009	68,726,730
Non-Timber Forest products - small enterprise*	-	-	-	-	-	-	-
Wilderness Tourism - micro enterprise	5,912,669	5,940,343	4,140,382	1,321,279	768,419	1,243,470	19,326,562
Wilderness Tourism - small enterprise*	-	-	-	-	-	-	-
Total	78,881,037	18,968,056	10,064,853	5,598,317	4,620,056	5,268,636	123,400,955

*These investments are made on aggregation, distribution, manufacturing or commercialization assets and activities that do not produce per se any mitigation, but are however required to increase the operational capacity and level of activity of each respective integrated value chain (and which thus enable the continued development of the part/level of the chain that directly generates the mitigation benefits).

Table 3: NPV generated per country and value chain (USD millions)

Value chain/segment	Brazil	Colombia	Ecuador	Guyana	Peru	Suriname	Total
Native Palm - micro enterprise	31	6	4	3	1	3	47
Native Palm - medium enterprise	47	9	6	4	1	4	71
Aquaculture - micro enterprise	4	1	0	0	1	0	5

Aquaculture - small enterprise	0	0	0	0	0	0	0
Cacao Agroforestry - micro enterprise	43	15	11	-	13	-	81
Cacao Agroforestry - medium enterprise	1	0	1		1		4
Coffee Agroforestry - micro enterprise	27	29	3		4		64
Coffee Agroforestry - medium enterprise	0	1	0		0		2
Timber - micro enterprise	9	5	3	2	1	2	22
Timber - medium enterprises	25	12	9	6	2	5	58
Non-Timber Forest products - micro enterprise	19	1	1	1	1	1	23
Non-Timber Forest products - small enterprise	1	0	0	0	0	0	2
Wilderness Tourism - micro enterprise	3	3	2	1	0	1	9
Wilderness Tourism - small enterprise	24	24	17	9	-	8	82
Total	234	106	57	25	24	23	470

Table 4: Economic payback period for proposed business models (years)

Value chain/segment	Economic Pay-back (years)
Native Palm - micro enterprise	8
Native Palm - medium enterprise	8
Aquaculture - micro enterprise	10
Aquaculture - small enterprise	11
Cacao Agroforestry - micro enterprise	10
Cacao Agroforestry - medium enterprise	9
Coffee Agroforestry - micro enterprise	19
Coffee Agroforestry - medium enterprise	10
Timber - micro enterprise	12
Timber - medium enterprises	12
Non-Timber Forest products - micro enterprise	7

Non-Timber Forest products - small enterprise	11
Wilderness Tourism - micro enterprise	4
Wilderness Tourism - small enterprise	4

1.3 Sensitivity analysis of Economic Results

Sensitivity analysis was conducted to assess how results would be affected by changes in the input assumptions. Although base values for input data were selected based on field evidence, there is always a degree of uncertainty in modeling complex projects and system. Sensitivities were run for the following factors, with results presented in Table 5: i) sales prices of products, ii) operative costs (OPEX), iii) investment costs, iv) productivity improvements, v) the social cost of carbon, and vi) economic discount rates. In all cases (except for the discount rate), scenarios modeled represent down side sensitivities. In all cases, Programme economic results remained strong.

Table 5: Sensitivity analysis for main Programme economic results

	Base case	Sale prices decrease by 30%	OPEX increase by 20%	CAPEX/ investment costs increase by 20%	Productivity improvements decrease by 30%	Discount rate 3.5%	Social cost of CO2 reduces to \$5/tCO2e
NPV – excluding carbon	470	196	176	287	313	1,221	470
NPV - including carbon	2,452	2,205	2,193	1,949	2,308	4,164	668
Project IRR – excluding CO2	14%	11%	10%	12%	12%	14%	14%
Project IRR – including CO2	49%	47%	46%	41%	47%	49%	18%
Total GHG emissions abated - Annual	6,170,048	6,170,048	6,170,048	5,141,706	6,170,048	6,170,048	6,170,048
Total GHG emissions abated - Lifetime	123,400,955	123,400,955	123,400,955	102,834,129	123,400,955	123,400,955	123,400,955
Abatement Cost (GCF investment \$ per tCO2)	2.43	2.43	2.43	2.92	2.43	2.43	2.43

1.4 Business investment returns and the need for enhanced financing terms

While ERRs for most value chains range between 11% and 18%, as shown in table 6 below equity IRRs are generally lower, with moderate single digit or low double digit levels. This reduction from ERRs is the combined result of taxation and generally unsupportive financing terms available in the Amazon region for this type of investments. These returns are not sufficient to attract the levels of investment that can significantly upscale bio-businesses in the Amazon.

The exception in the table is wilderness tourism, with very high IRRs (between 70% and 92% depending the market segment); as previously explained, this is an outlier however, based on the expected significant rebound effect that should follow the pandemic-induced downturn of the sector.

Table 6: Average Equity IRR by value chain and segment

Value chain/segment	Equity IRR (average)
Native Palm - micro enterprise	10.5%
Native Palm - medium enterprise	14.7%
Aquaculture - micro enterprise	5.7%
Aquaculture - small enterprise	4.9%
Cacao Agroforestry - micro enterprise	11.8%
Cacao Agroforestry - medium enterprise	9.0%
Coffee Agroforestry - micro enterprise	9.6%
Coffee Agroforestry - medium enterprise	7.2%
Timber - micro enterprise	7.9%
Timber - medium enterprises	10.7%
Non-Timber Forest products - micro enterprise	13.3%
Non-Timber Forest products - small enterprise	5.4%
Wilderness Tourism - micro enterprise	92.1%
Wilderness Tourism - small enterprise	70.5%

To validate the relevance of GCF's support, the model assesses the impact of improved financing terms (in terms of interest rate and tenor) on equity IRR, for the various value chains and segments.

For investment modeled for SMEs in the native palm, cacao, coffee, aquaculture, native timber and NTFP sectors, a reduction of 300 bps in interest rates and a tenor of 10 years (matching the economic payback period of these investments) results in an average improvement of equity IRR of 2.3%, from 8.6% in the base case to 11.0% with GCF-enabled improved financing terms. This would achieve not only a meaningful improvement in IRR, but also an alignment between payback periods and loan tenors, which will reduce the need for further (generally scarcely available) equity injections to pay back debt before projects start paying off.

In the case of microenterprises, along with longer tenors, the decreases required in interest rates to significantly improve IRRs are more much significant, given the much higher interest rate baseline levels. In these cases a combination of financial instruments will likely be required to sufficiently enhance financial terms for borrowers. This -as proposed in the Programme- would include: i. low cost, longer term funding for FIs that allow them to increase loan tenors and reduce interest rates extended to clients; ii. risk mitigation instruments that can help reduce the expected higher portfolio losses in this segment, thus helping expand offer of credit in this segment while reducing the required spread of FIs.

As discussed in previous sections when comparing ERR with and without carbon value, access to carbon revenue (or similarly-oriented tax incentives) that compensate for the positive externalities of these projects could significantly further enhance financial performance of these projects

to drive additional investment towards them. If projects were to incorporate carbon revenue at USD 10/ton CO₂eq, weighted-average equity IRR would more than double, to about 24.6%.