Promoting zero-deforestation cocoa production for reducing emissions in Côte d'Ivoire

(PROMIRE project)

Annex 10

Economic and Financial analysis

Introduction

An economic and financial analysis (EFA) of the project was undertaken in order to assess the economic soundness of the project and the likely impact of project interventions. More specifically, the economic and financial analysis intends to quantify the net incremental financial and economic benefits generated by the investments.

The financial analysis takes into account the estimated benefits from the point of view of individual farmers and beneficiaries, while the economic analysis takes into account the estimated incremental benefits and costs of the project investment to a society as a whole.

Project areas, project beneficiaries and benefits

The project will contribute to reducing greenhouse gas (GHG) emissions by implementing the REDD+ mechanisms to access to future results-based payments in Cote D'Ivoire.

The project has two components. Under the first component the project intends to operationalize the REDD+ architecture by strengthening institutional capacities so that the REDD+ mechanisms can be effectively implemented at national level. The first component is essential for the finalization of the Warsaw framework tools, but it has no direct quantifiable benefits that are relevant for this EFA.

The second component includes the core GHG mitigation activities. The component targets 30 villages in three regions: Agnéby-Tiassa, La Mé et Sud-Comoé. Grant funding is justifying vis a vis the need to create incentives for the private sector to invest in climate resilient resource management and land use practices. As these practices are not yet mainstream in Cote d'Ivoire it is needed to provide support to upscaling these innovative practices that will then be maintained and further implemented by the private sector.

The main quantifiable benefits of the second components are reported below.

Reduction of greenhouse gases from land use changes (LUC) caused by agricultural activities. According to recent deforestation estimations, every year 250,000 hectares had been lost between 1990 and 2015[1]. Agriculture caused 62% of the deforestation, of which 38% was caused by cacao expansion[2]. The project intends to establish a zero-deforestation commodity production approach and to support livelihoods diversification. The increase in income per unit of land is expected to reduce agricultural expansion into forest areas. Also, the livelihood diversification strategy will be based on the introduction of valuable forest trees in agro-forestry parcels.

Increase in carbon stock. The project will promote forest restoration in private land and in gazetted forests, which are managed by SODEFOR (a state-owned company). More specifically, the project will promote planting

[1] BNEDT, Ecterra, 2016. Étude qualitative des facteurs de la déforestation et de la dégradation des forêts désagrégés par zone agro-écologique.
[2] Ibid

of valuable timber trees in areas managed by SODEFOR. Annual crops are also expected to be planted by smallholders (on private land) along with forest trees during the first two or three years of a timber plantation.

Overall, the increase in carbon stock and the reduction in forest deforestation are expected to reduce GHG emissions for 270 thousand Tons of CO2eq per year.

Increase in farmers' income. Farmers' incomes are expected to increase as a consequence of the renovation of old cocoa and coffee plantations. The project will promote replanting of old cocoa and coffee plants and the introduction of other crops in the same parcel, with the final purpose increasing incomes per unit of land and reducing agricultural expansion in forests areas.

Overall, the project will promote agro-forestry interventions in old cocoa and coffee parcels in 3,650 hectares. Also, the project will promote forest restorations in 1,500 hectares, of which 1,000 hectares in gazetted forests managed by SODEFOR and the rest on smallholders' land or on larger private areas.

Methodology and assumptions

Incremental analysis. Incremental costs and benefits analysis was performed by comparing "with" and "without" project scenario performances. The without project scenario (WOP) was formulated based on the existing cocoa and coffee yields observed in the project areas with current production costs and output prices. The with-project situation (WIP) reflects likely changes in the planned cropping patterns and yields following the project interventions.

A cash flow model was used to conduct an ex-ante analysis of the project investment. Annual cash flows were estimated as the difference between without-project and with-project net benefits for direct beneficiaries.

For agro-forestry interventions the opportunity costs per hectare consist in the net benefit yielded by one hectare of old coffee and cocoa plantations. Forest restoration interventions are assumed to occur on land that is not used for productive purposes. Consequently, for forest restoration models, no foregone agricultural production was accounted for.

Parameters. The cost-benefit analysis is based on crop-level assumptions on yields, input requirements, prices and costs in constant 2019 currency amounts for the WIP and WOP scenarios. The parameters for the models are based on information gathered during the project design, including interviews with farmers and entrepreneurs, information provided by the feasibility studies, by ANADER and some project design team's estimates and literature[3]. Price information gathered includes in particular costs of labor, capital costs (equipment, tools), inputs, and outputs. Conservative assumptions were made both for inputs and outputs, taking account possible risks. For forest restoration models all labor costs were accounted for (including family

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[3] For cocoa-based agro-forestry systems the main source was « Production durable de cacao en Côte d'Ivoire: Besoins et Solutions de Financement pour le Petits Producteurs », REDD+ Cote d'Ivoire, EU-REDD facility, EFI.
For teck-based model the main source was Dupuy, B and Verhaegen, D. (1993) Le Teck de Plantation en Côte d'Ivoire. Bois et Forêts des Tropiques, 235.
For coffee-based models and rubber-based modes and parameters were derived by interviewing experts and by using the technical flyers of the Center National de Recherche Agronomique.

labor), while for agro-forestry interventions no allowance was made for family labor. This is because in agro-forestry interventions a large part of operations are supposed to be conducted by unpaid family work and also because a farm budget approach was used[4], while in forest restoration all operations are assumed to be paid.

Quantified benefits. Quantified benefits captured in the economic and financial analysis are the incremental net benefits of three main categories of interventions:

1) The renewal of old cocoa and coffee plantation and the introduction of agro-forestry systems over 3,650 hectares.
2) Forest restoration on 1,500 hectares

Models were developed for each of the envisaged categories of benefits, including variants of the different agro-forestry systems proposed by the project to renew old cocoa and coffee plantations and variants of forest restoration approaches.

Discount rate. For the calculation of the net present value (NPV) of the financial analysis a discount rate of 11.5% was used. The interest rate for a 10 -year government bond is 5.75%. This figure was doubled to reflect the inherent risk of the agricultural activity. The economic analysis was conducted using a social discount rate of 7.5%. This was obtained by multiplying the long-term per-capita real GDP growth (estimated by the IMF) by an elasticity of marginal utility of consumption of two[5].

Time-horizon. The financial analysis of the agro-forestry models is based on a 20-year time horizon, while the financial analysis of the forest restoration models is based on a 24-year time horizon. The reason for the longer period for forest restoration models is due to the fact that trees are planned to be cut and sold in Year 24. The economic analysis is based on a 20-year period, during which the project will generate benefits, and includes a five-year project implementation period. There are no further investment costs after five years of project implementation. However, annual operation costs were included in the economic analysis until Year 20, as these costs will have to be incurred if the future benefits of the project are to be sustained. The sensitivity analysis also includes the results of a 28-year time horizon (including the project implementation period). This is because the sensitivity analysis also includes scenarios whereby the accrual of benefits is delayed. Taking into account possible delays in the accrual of benefits (as reflected in the sensitivity analysis), after 28 years the last parcel of timber trees planted by the project is expected to be cut and sold

Prices. A financial analysis was conducted at farm level by using the market prices collected during the field missions occurred in the first semester of 2019, when the exchange rate was 590 FCFA per US$. For the economic analysis market prices were converted to shadow prices. A world price numeraire approach was used[6]. The economic analysis ignores all transfer payments such as taxes and subsidies paid to or received from farmers. In order to convert market prices to the shadow prices used in the economic analysis, conversion factors (CF) were calculated by using border parity prices. A list of prices and conversion factors used in the economic and financial

[4] Family farm is the recipient of the incremental net benefit. Thus, the family remuneration is the net income stream. Including family labor as a cost would constitute double counting (see Gittinger, 1982).

[5] Economists typically assume that if a beneficiary is x% richer, the marginal value of an additional dollar of benefits is lower by between x% and 2x% (so the elasticity of marginal utility of consumption is estimated to be between 1 and 2).

[6] See Curry, S and Weiss, J (1993) *Project analysis in Developing Countries*, Palgrave for a description of a word price and domestic price approach.

analysis is available in the “Prices & assumps” spreadsheet of the EFA document (attached in the Appendix of this annex).

Valuation of GHG emissions avoided. Coherently with the suggestions of the GCF for pilot programs for REDD+ Results-based Payment, the economic analysis assumed a price of USD 5 per tCO_2eq. No other valuation of ecosystem services or externalities (e.g. biodiversity improvement, reduction of soil erosion) was accounted for.

Financial analysis

The main purpose of the financial analysis is to examine the viability of the main crops and agro-forestry systems that will be supported by the project from a private point of view and to assess their potential increase in profitability as a result of project interventions. In the financial analysis all costs and benefits are valued at market prices.

Agro-forestry systems

The interventions are demand-driven, meaning that the project will support the planting of the species that are requested by beneficiaries. However, for modelling purposes the renovation of old cocoa and coffee parcels was based on four possible models. Their main characteristics are reported below.

A. Organic and fair trade cocoa-based agro-forestry systems. This consists in replanting part of old cocoa plants and in planting new forest and fruit trees. More specifically, it is assumed that each year ¼ of the typical cocoa plantation density (1330 plants/hectare) will be replanted. The first year timber seedlings (35 tress per hectare) will also be planted, along with one firewood spices (20 trees per hectare) and one forest fruit species (35 trees per hectare). The model assumes that the timber species is teak and the forest fruit tree is akpi (*Ricinodendron heudelotii*). Following the pilot project in La Mé, supported cocoa parcel will be certified as organic and fair trade. In addition, no inorganic fertilizers and chemical pesticides are used in organic certified cocoa parcels.

B. Conventional cocoa-based agro-forestry systems. This is the same agro-forest system described at the previous point. The man difference is that supported parcels are not certified and cocoa is sold at regular market price. Also, this model envisage use of plant protection chemicals and fertilizers.

C. Coffee-plantain agro-forestry system. In this model it is assumed that each year ¼ of old coffee plants are replanted. It is also assumed that plantain is planted in the same parcel with a density of 600 plants per hectare. Plantain suckers will be planted each year in a different location to avoid yield reduction caused by nematodes. Each plantain plant will be replanted in the same location after a rotation of four years. Following experiments conducted in Cote D'Ivoire the project will support the introduction of *Glyricidia sepium*, which is a leguminous shrub species that fixes nitrogen and reduce needs for weeding operations[7].

D. Coffee-rubber agro-forestry system. In this model part of old coffee plantations is substituted by rubber trees. More specifically, seven-meter width strips of rubber are planted between 33-meter widths of coffee strips[8].

The profitability of each agro forestry models from the farmer' point of view is include in Table 1.

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[7] Koné, S. and Kotschi, J. (2006) Agriculture Durable au Département d'Abengourou Cote d'Ivoire : une Collection des Fiches Technico Economiques. PROSTAB. GTZ, ANADER

[8] Boko et al (Analyse technico-économique de la rentabilité de l'association hévéa-caféier) report tests in Cote d'Ivoire, thus showing that the 33-meter distance maximise profits.

Table 1: Financial performance (in USD) of agro-forestry models for 1 Ha

	Yr 1 total costs	Incremental net benefit			Net present value	
		Yr 1 without project support	Yr 1 with project support	Yr 10	Without project support	With project support
Organic and fair trade cocoa-based system	246	-221	-16	271	381	759
Conventional cocoa-based system	326	-341	-80	165	-384	130
Coffee-plantain based system	852	-755	-464	155	-615	90
Coffee-rubber based system	289	-177	-67	124	-38	143

Organic and fair trade cocoa based system presents the best outlook, which is due to the relatively high sale price of certified cocoa. The coffee-plantain system presents the highest investment cost. This is because of the high costs of plantain cultivation. With the exclusion of organic and fair-trade cocoa based agro-forestry system, all models present a negative NPV without project support. Project support is needed to provide technical assistance to farmers and to distribute seedlings for free. Project support is also needed in the organic and fair-trade system to certify farmer cooperatives. The table also shows that all models involve significant costs per hectare and important losses (i.e. negative incremental net benefits) during the first year without project support. With project support, losses during the first year are strongly reduced.

Forest restoration will occur on gazetted forest and on smallholders' land. The models envisaged for forest restoration consist in teak plantations for gazetted land and in food crops planted during the first two years of teak plantation for interventions on smallholders' land. In both cases tree cutting operations will be borne by the timber buyers. The timber plantation density in gazetted forests is 1,100 trees per hectare and on smallholders' land is 833 trees per hectare. For modelling purposes it is assumed that the food crop planted on smallholder land is maize during Year 1 and cassava in Year 2. In principle food crop production could also occur in Year 3 (with lower yields and on a smaller area, which is due to the shadow created by growing trees), but production after Year 2 was not modelled.

The performance of the two models is reported in Table 2.

Table 2: Financial performance (in USD) of forest restoration models for 1 Ha

	Yr 1 total costs	Incremental net benefit			NPV
		Yr 1 without project support	Yr 1 with project support	Yr 16	
Gazetted forests	706	-706	0	4,551	1,054
Smallholders' land	1,089	-411	-119	4,551	2,388

Both models present a positive NPV, which is higher for forest restorations on smallholders' land. This is because during the first two years farmers gain an additional income by planting food crops. The initial costs are high in both models. The net benefit in Year 1 (when only costs are borne and no revenues are earned) is zero in the first of the two models when project support is included because all costs are expected to be borne by the project in gazetted forests.

Changes in costs and revenues that make the NPV negative are included in Table 3. The table shows that the coffee-plantain agro-forestry system has very low switching values, while the other considered system have much higher switching values.

Table 3: Switching values

	Revenues reduced by	Costs increased by
Organic and fair trade cocoa-based system	75%	290%
Conventional cocoa-based system	26%	30%
Coffee-plantain based system	2%	2%
Coffee- rubber based system	44%	77%
Gazetted forests	39%	64%
Smallholders' land	36%	56%

Economic analysis

The purpose of the economic analysis is to assess a project's worthiness from a society's perspective. Costs and benefits are valued at shadow prices. The incremental net benefits of each activity are aggregated by the number of hectares that a project targets.

For agro-forestry systems it is assumed that 55% of the total target area (3,650 hectares) will be conventional cocoa-based systems, 10% will be organic and fair-trade based systems, 20% will be coffee-plantain systems and 15% will be coffee-rubber systems (the description of each system is reported above in the financial analysis section).

All project management implementation costs were included in the project cash flow as an outflow along costs with the project costs of Component 2. Project costs for Component 1 were not included. This is because Component 1 has no direct quantifiable benefits.

Table 4 presents the aggregated results of economic analysis for the internal rate of return and the net present value. The results are presented with and without accounting for GHG emissions avoided. With a 20-year time-horizon and with GHG accounting, the economic NPV (ENPV) is positive (US$ 13.06 million) and the internal rate of return of the project (EIRR) is 27.7%, which is higher than the social discount rate.

Table 4: Results of the economic analysis

	With GHG emissions accounting		Without GHG emissions accounting	
	20-yr horizon	28-yr horizon	20-yr horizon	28-yr horizon
ENPV (million USD)	13.06	19.29	-0.98	3.36
EIRR	27.7%	28.4%	6.5%	9.7%

With a 20-year time horizon, the ENPV is negative without accounting for GHG emissions (and it turns positive if the time horizon has 28-year duration).

The sensitivity analysis (reported in Table 5) shows that major changes in costs and benefits do not affect the project worthiness when GHG emission reductions are accounted for.

Table 5: Sensitivity analysis over a 20-year time horizon (with GHG emissions accounting)

Scenario	ENPV (million)	EIRR
Baseline	13.06	27.7%
Benefits reduced by 10%	11.09	24.6%
Benefits reduced by 20%	7.54	19.4%
Benefits reduced by 30%	3.29	13.1%
Benefits delayed by 1 year	10.86	22.0%
Benefits delayed by 2 years	8.46	18.3%
Benefits delayed by 3 years	6.23	15.4%
Increase in purchase price of agr. inputs by 10%	12.39	25.8%
Increase in purchase price of agr. inputs by 20%	11.73	23.7%
Increase in purchase price of agr. inputs by 30%	11.06	22.0%
Reduction in agroforestry area uniformly by 10%	10.40	20.5%
Reduction in agroforestry area uniformly by 20%	12.32	26.5%
Reduction in agroforestry area uniformly by 30%	11.82	25.4%
Reduction in forest restoration area by 10%	11.32	24.3%
Reduction in forest restoration area by 20%	12.58	28.5%
Reduction in forest restoration area by 30%	12.33	29.3%

Conclusions

A detailed description of proposed models was provided in this economic and financial analysis. While on the financial side, the analysis shows a relatively lower outlook for the renovation of old cocoa and coffee plantations and a solid prospect for forest restoration interventions (due to the high value of tropical timber), overall the returns of planned interventions are sufficiently high to justify the project from an economic point of view.

The analysis of the proposed agroforestry models take into consideration the large initial investment costs that are needed to implement these models as well as additional one-time costs (or costs that would be reduced once scale is achieved) such as the cost of fair-trade certification. Therefore, once these models become mainstream and farmers see their economic benefit they will be interested in replicating on their own, having increased returns due to initial costs covered by the project.

The financial analysis shows that providing technical support along with seedlings to farmers is essential to improve the incremental net benefit the first year and to make the NPV positive. The financial analysis also shows that from a farmer's perspective the renovation of old cocoa and coffee plantation would not be worthwhile without project support since the NPV would be negative. Even though project interventions are demand driven, the low switching value for the coffee-plantain agro-forestry systems suggest that the project management should promote less this agro-forestry system and more the other agro-forestry systems.

Project support is also needed for forest restorations since it require substantial investment during the first year, which not would probably occur without project support. This is because both smallholders and SODEFOR (i.e. the beneficiaries of forest restorations) are resources constrained.

The economic analysis takes into account the project worthiness from a society's perspective. The ENPV is negative when the GHG emissions reductions are not valued, while it is positive if the GHG emissions reduction is factored in the economic analysis. This shows the public good nature of the forest restorations and agro-forestry interventions proposed.

Appendix: Spreadsheet EFA

EFA_V4.xlsx