Food and Agriculture Organization of the United Nations

Haiti

Green Coffee Value Chain Analysis in Haiti

EX-ACT VALUE CHAIN CASE STUDY – Preliminary assessment

Targeting climate change mitigation, climate resilience and income in a coffee value chain with EX-ACT VC

This report is a case study of a multi-impact appraisal of a green coffee value chain in Haiti. The value chain is analysed from production to the distribution of green coffee to retailers, comparing the performance of an upgrading scenario to the current situation. In the present case, the Haitian coffee production dropped from 150 000 ha in 1950 to less than 100 000 ha in 2004, from conversion to other types of cultivation or trees density reduction, tree's ages and diseases. The project "the revival of Haitian coffee sector" (" Haiti prend Racine") aims at reversing this trend in order to protect the environment (soil erosion) and improve the economic situation of the farmers. Impact on climate mitigation, climate change resilience and adaptation, income and employment created from the upgrading scenario are presented in this report.
Data from this report are issued in some part from interview realised Haiti during February 2017 and completed with literature. This is a draft of an ex-ante appraisal of the project, which should be complemented with missions & interviews with every actor of the value chain in Haiti by fall 2017.

KEY MESSAGES

- Climate change dimension: the upgrading project scenario allows to sequester up to **6 tCO_2-e per ha per year** as a result of increased bio-sequestration and improved agronomic management.
- The resulting carbon footprint is about -**9.68 tCO_2-e per tonne of green coffee** from production to retailers.
- Socio-economic performance: the revival of the coffee sector allows to increase the volume of employment creation from more compelling need of labor force at every stage of the chain. In total, about **13,160 jobs** are created.

EX-ANTE CARBON-BALANCE TOOL FOR VALUE CHAIN — EX-ACT VC

Background of the project – The coffee sector in Haiti

Of the many countries vulnerable to climate change, small islands developing states (SIDS) are widely considered to be among the most vulnerable. These countries are not only exposed to direct impacts of climate change, i.e. sea level rise, but SIDS are also highly sensitive to existing environmental stresses that will be exacerbated by climate change. Overlapping factors such as high population densities, fragile ecosystems, overstressed water resources, and limited institutional capacity mean that SIDS face serious challenges to their development in a changing climate. Haiti is one this striking example of how a combination of physical exposure and socioeconomic conditions could lead to extreme climate change vulnerability. The 7.0 magnitude earthquake in 2010 and Hurricane Mathew in 2016 worsened living conditions of 10 million citizens of the one of the poorest country in the world, with a gross domestic production (GDP) per capita of US$723[1]. Hurricane Mathew was estimated US$1.9 billion damage in its wake, or 22 percent of GDP. Loss in agriculture, fisheries and livestock were estimated at US$600 million, with a long term impact on the livelihoods of the rural population. Indeed, "according to the latest household survey more than 6 million out of 10.4 million Haitians live under the national poverty line of US$1.23 per day" World Bank 2017[2].

The agricultural sector has the potential to play an important role in reconstruction, by rapidly absorbing large amounts of labor and providing livelihoods for rural households. However, in Haiti, the agricultural sector is severely constrained by a lack of access to finance, poor infrastructure, and environmental degradation among many other constraints. Although agriculture alone accounts for 25 percent of GDP and 51 percent of employment in Haiti, the transportation and agriculture sectors combined account for less than one percent of total bank credit. Haiti's agricultural challenges are most evident in the coffee sector.

According to FAOSTAT, over the last decade, surface dedicated to coffee production was stable around 80 000ha from 2006 to 2013 when it increased up to 120 000 ha before collapsing back to 70 000 ha in 2014. Presently this surface is about 80 000 ha according to project information « Haïti prend racine » (HPR) presented at COP21. Yield of green coffee sharply decline following the earthquake in 2010, from 5187 hg per hectare to 5172 hg per hectare in 2014. Although green coffee production is reported to be constant in the FAOSTAT database (and not following the yield) other publications reported in a study from World Bank (2010) sustained a rapid fall in production attributed to multiple factors including deforestation, replacement of coffee by more profitable staple crops (beans, cabbage), aging trees and farmers, diseases and lack of investment. Nevertheless green coffee gross production value ranged from US$37,6 million up to US$60 million over the past decades (FAOSTAT), while the value of coffee exports fell from a peak of US$90 million (in the 1980's) to US$1.8 million in 2013 (FAOSTAT).

Therefore local production in Haiti is widely under-exploited and effort can be achieve to expand this production in terms of volume produced, area cultivated and quality of the coffee product. Despite the decline in production and exports, however, coffee remains a significant source of income for more than 200,000 Haitian families, or roughly 10 percent of the overall population. The type and quality of coffee play an important role in terms of economic valuation. It is thus an important source of income which can participate to the reduction of poverty where the agricultural sector is the first source of revenue in the Haitian economy, country which is one of the poorest of the planet with 60% of the population living behind the poverty level, World Bank 2010.

Highly impacted by climate change, rural Haitian population is very vulnerable and developing sustainable value chain can be a starting point for reducing ecological degradation (soil erosion, water management…), increase agricultural productivity, contribute to improving small holder income and acquire new asset to facing climate shocks.

To develop this value chain in Haiti it is require to pursue rehabilitation and plantation of coffee, to keep markets open, and to reduce barriers to entry in order to commercialize coffee with creation of value added on high-end market, to structure stakeholders and to value production by certification.

Within this case study, an ex-ante multi-impact appraisal is carried to estimate the economic analysis using the current situation data for every level of the VC and for an upgrading project scenario, a qualitative identification

[1] https://tradingeconomics.com/haiti/gdp-per-capita

[2] http://www.worldbank.org/en/country/haiti/overview

for climate resilience analysis. The climate resilience brought by an upgrading scenario and the socio economic performance induced by both situation. Thus, comparing both results will allow us to identify to what extent the upgrading scenario can bring solution for coffee producers in Haiti in terms of mitigation and adaptation to climate change.

Methodology and tools used

EX-ACT VC tool

EX-ACT VC is a tool derived from EX-ACT (EX-Ante Carbon-balance Tool), developed by FAO in 2009. EX-ACT VC is an AFOLU, processing and transportation framework of 8 Excel modules that provides co-benefits appraisal of crop-based value chain in developing countries on GHGs emissions, climate resilience and income.

The EX-ACT VC aims at helping designing performant and sustainable value chain. The methodology provides here both a quantified socio-economic appraisal of value chain both at micro and meso level (by agent, by group and for the whole chain) and an environmental carbon-balance appraisal of the value chain impact, in terms of climate mitigation, adaptation and value chain resilience:

- The impact on climate mitigation is reflected through quantitative indicators, derived directly from the EX-ACT tool. These indicators are used to obtain and analyse the mitigation impacts in terms of tCO_2-e of the project. The carbon footprint of the product is calculated for the whole value chain and at different needed stage, aiming at analysing the environmental performance of the chain. The equivalent economic return is also determined and could be an important aspect to be considered when attempting, for example, to access to payments for environmental services.
- Value chain resilience is assessed using simple quantitative but also qualitative indicators. Adaptation indicators measure the reduction of vulnerability of people, livelihoods and ecosystems to CC.
- Socio-economic impact of the value chain is assessed in terms of value added, income and job generated using a socio-economic appraisal of the value chain.

EX-ACT tool

The Ex-Ante Carbon-balance Tool (EX-ACT) is an appraisal system developed by FAO providing ex-ante estimates of the impact of agriculture and forestry development projects, programmes and policies on the carbon-balance. The carbon-balance is defined as the net balance from all GHGs expressed in carbon dioxide (CO_2) equivalents that were emitted or sequestered due to project implementation as compared to a business-as-usual scenario.

EX-ACT is a land-based accounting system, estimating carbon (C) stock changes (i.e. emissions or sinks of CO_2) as well as GHG emissions per unit of land, expressed in equivalent tonnes of CO_2 per hectare and year. The tool helps project designers to estimate and prioritize project activities with high benefits in economic and climate change mitigation terms. The amount of GHG mitigation may also be used as part of economic analysis as well as for the application for funding additional project components.

EX-ACT has been developed using mostly the Intergovernmental Panel on Climate Change 2006 Guidelines for National Greenhouse Gas Inventories (IPCC, 2006) that furnishes EX-ACT with recognized default values for emission factors and carbon values, the so called Tier 1 level of precision. Besides, EX-ACT is based upon chapter 8 of the Fourth Assessment Report from working group III of the IPCC (Smith, *et al*., 2007) for specific mitigation options not covered in the IPCC (2006). Other required coefficients are from published reviews or international databases. For instance embodied GHG emissions for farm operations, transportation of inputs, and irrigation systems implementation come from Lal (2004) and electricity emission factors are based on data from the International Energy Agency (IEA, 2013).

Revival of the coffee sector in Haiti

The project HPR aims at (1) promoting forest and biodiversity, (2) supporting sustainable agriculture and management of watershed management and (3) supporting environmental sustainable alternatives for charcoal. The project will target 90 000 ha, i.e. the total country's surface dedicated to coffee production as corresponding to the range of surface in FAOSTAT, and about 140 000 households.

This analysis focuses on the coffee value chain in Haiti, under tropical moist climate, where LAC soils represent the most common type of soil in the region. We assume that the implementation of the project will start in 2018 for a 10-year duration period.

The value chain boundaries, which include Carbon Footprint (CFP), socio-economic and climate resilience aspects of the value chain, enclose on-farm coffee production (without taking into account GHG emissions associated with the transportation of fertilizers and pesticides) to local retailers.

Modules Land use changes and agricultural practices and inputs

According to FAOSATAT the Haitian green coffee yield is 5173 hg/ha the past years. For sake of simplicity with the economic analysis, as farmers are selling cherry coffee to collectors or processors, green coffee yield was corrected multiplying it by a factor of 2 to take into account weight from the pulp in the cheery coffee[3].

Within the area, the conventional production of coffee currently concerns 80 000 ha of coffee plantations with a yield half of the average country. The project aims at doubling the yield by developing coffee agroforestry systems "jardin créole", substituting old coffee trees with new ones, and converting 10 000 ha of degraded area into one of this system. Over the 90 000 ha farmers will apply better agronomic practices, i.e. doubling consumption of organic fertilisers (compost and urea) and insecticides, figure 1.

Figure 1: EX-ACT VC Screenshot details of agricultural inputs in the current and upgrading scenario

List of specific fertilizers	Specify NPK parts (%)			Amount introduced and corresponding areas			
				Current		Upgrading	
	N	P	K	Qty (Kg/ha/yr)	Area (ha)	Qty (kg/ha/yr)	Area (ha)
Lime				0	0	0	0
Urea	47%			15	7500	45	15000
Other N-fertilizer	40%			0	0	0	0
N fertilizer in irrigated rice	38%			0	0	0	0
Sewage	5%			0	0	0	0
Compost	4%	1.5%	1.2%	300	37500	500	45000
Phosphorus synthetic fertilizer (P2O5)		10%		15	2500	30	5000
Potassium synthetic fertilizer (K2O)			10%	0	0	0	0
Please enter your specific NPK synthetic fertilizer (N other than urea and not for irrgated rice)							
TSP	0%	45%	0%	10	5000	20	10000
Description#2	0%	0%	0%	0	0	0	0
Description#3	0%	0%	0%	0	0	0	0
Description#4	0%	0%	0%	0	0	0	0
Description#5	0%	0%	0%	0	0	0	0

The coffee biomass growth for the coffee plantations developed on degraded areas is corrected, using the tier 2 approach of the tool, to 2.9 tC ha^{-1} yr^{-1} (the default value is 2.6 from the IPCC of 2006) according values encountered in the scientific literature for coffee agroforestry (Umulisa, pers. com.). For areas with progressive substitution of old coffee trees with new ones, we assumed the biomass growth to be half of the new plantations, i.e. 1.5 tC ha^{-1} yr^{-1}, representative of the trees ages diversity, figure 2. With improved management practices and new trees, the production loss is assumed to decrease from 8 to 4 percent (data not showed).

[3] http://www.thecoffeeguide.org/coffee-guide/world-coffee-trade/conversions-and-statistics/

Figure 2: EX-ACT VC screenshot with details on the coffee plantations between the two scenario in the agroforestry module.

Perennial systems from other LU	Residue/ biomass burning	Yield (t/ha/yr)	Area concerned (ha) Current	Upgrading	Tier 2 Biomass growth (tC/ha/yr)	Default value
Perennial after Deforestation	NO		0	0	2.9	2.6
Perennial after non-forest LU	NO	1.03	0	10,000		2.6
Perennials staying as perennials:						
Old coffee plantations	NO	0.52	80000	16000	1.5	0
Rehabilitated coffee plantations	NO	1.03	0	64000		0
Description#3	NO		0	0		0
Description#4	NO		0	0		0
		Total area	80000	80000		

Prod. loss

Processing module

Once coffee berries are collected they are transported to processing mill where they are processed, sorted, and graded by size, weight, and form, before being packed for international or national markets.

Processing of coffee is the method of converting the coffee cherry into the green coffee beans. There are two processing methods: wet and dry process. The wet process requires a lot of effort, time, water, and therefore money but results in a coffee of higher quality. The coffee cherries are sorted by immersion in water; bad or unripe cherries float and the good ripe cherries sink. It takes around 15 m^3 of water per tonne of coffee. The green beans are then dried by sun or machines, classified, graded, and exported to the consuming country for roasting and final packaging for consumers or retails. In the dry process cherries are sorted and cleaned by hand and then placed under the sun to dry naturally or suing a machine to speed up the process, before packaging/exportation.

Most international and therefore national coffee trade consists of green coffee beans which is prone to water absorption and desorption. Coffee beans are sensitive to moisture and they are usually shipped in jute bag (or hessian) which allow free circulation of air. They can contain from 60 to 100 kg of green coffee.

As the roasting phase, which relies on fuel consumption, usually occurs in the importing countries, and is not accounted for in the present study which limits its outer boundary to Haitian retailers.

In the present analysis, farmers keep 15% of the coffee cherry production for auto-consumption or home processing. In the current scenario only a small percentage of the coffee production is washed and wet processed, i.e. 10 percent, while it is assumed that the upgrading project will allow to wet process 50 percent of the production, which will ultimately generates CH_4 emissions. The quantity of water used for the wet processed is corrected (tier 2) to 20 m^3 per tonne of coffee according to on-field information, figure 3.

With a good processing management, production loss decreases from 3 to 2 percent, while the processing rate or transformation is 50 percent as this phase involved removal of the pulp and parchment which represent about 50 percent of the weight of a coffee cherry berry.

Figure 3: EX-ACT VC screenshot on details of methane emissions generated during the wet process of cherry coffee

5.2. Methane emissions from industrial wastewater

Industrial product and associated treatment

Industry product	Current	Upgrading	
Coffee	Untreated	Untreated	
	Untreated = wastewater is discharged into streams, rivers and lake		
% production involved in this process:	10%	50%	
Water consumption (m^3 per tonne)			H_2O use efficiency at processing level
Volume of water consumption	20	20	0.00
Are CH4 emissions from wastewater treatment plant used as biomethane ?	NO	0	tCO_2-e per year

Transportation

Once coffee berries are collected they are transported from the farm to the processing mills, by truck, distant about 20 km from the farms. Once processed and packed, green coffee is transported to wholesalers by truck, on an average distance of 75 km. A part of the production is then shipped by international water container to international market (United States, Europe) or even to the Dominican Republic. This not considered here in the present study. The remained production, about 50 percent, is assumed to the present knowledge to be sold to retailers within Haiti. From wholesalers to retailers transport is done by truck, with an average estimated distance of 20 km. The loss in transport is considered small, with a maximum of 2 percent from processing to wholesalers, and 1 percent between other actors of the value chain. Upgrading the value chain will result in no loss between the different phases of the value chain, except from processing to wholesalers. i.e. 2 percent.

Socio-economic analysis

Most of the information given in the previous EX-ACT VC modules are automatically taken-back in this module, where only costs information have to be addressed where needed. Every prices are entered in local currency and converted in US$ according to the currency exchange rate, US$1 corresponds to HTG 63 (june 2017 value exchange). Prices of agricultural and energy inputs, salary cost, value of the production in and out from the different stages, taxes and others have to be provided for the different stage of this analysis, i.e. production, processing, transport.

Most of the price information here are coming from a previous mission in Haiti and also from economic data gathered among publications and ad-hoc source of information. A mission on the field by next September should allow to refine the present section.

Selling prices are different between the current situation and the upgrading scenario as we assume the new yield is of better quality. They are based on data from Rodriguez et al 2011, i.e. US$2.3 for the current situation and US$3.1 for the upgrading scenario.

We assumed salary in man-day ranging from HTG250 (workers at production, seasonal workers and drivers assistants who also have other source of income) to HTG500 (drivers, full time workers at processing, wholesalers and retailers phases) which should be the minimum wage in Haiti.

The cost of tree seedlings and renewal of old coffee trees, on 74 000 ha, was estimated to US$164 per hectare per year, Rootcapital 2013.

As it was difficult to get enough and accurate information on prices and cost further downstream the value chain, results are presented only until processing.

EX-ACT VC screenshot 3: details of the socio-economic analysis for the production stage for the upgrading value chain

Agregate Value chain at farm/HH level	Upgraded value chain	
Coffee value chain revival Haiti Value chain		Unit
Area covered for crop	90,000	ha
Annual total food production	81,444	tonne
Gross production Value	251,374	000 US$
Value Added (VA)	232,223	000 US$
Labor costs	22,250	000 US$
Tax and Bank interest	0	US$
Gross Income (GI)	209,973	000 US$
Value Added / tonne of product	2,851	US$
Value added / ha	2,580	US$
Gross income / HH	1,500	US$
Total days of labour in man days	8010000	MD
Total employments equivalent	32040	Units
BALANCE:		
Additional employments generated	13,160	
Incremental value added	146,165	000 US$
Incremental Gross Income of beneficiaries	135,153	000 US$

Climate resilience analysis

The scope here is to specify an assessment between 0 and 4 for every questions asked in this module based on project experts' judgement. It is a qualitative appraisal of the extent of the upgrading scenario on the buffer capacity of the coffee value chain to natural shocks, of the households in relation to food security, the resilience and the self-organization of households and the market resilience and the adaptation capacity to the value chain. An assumption for every sub-index was done in this case, but is open to debate.

EX-Ante Value chain appraisal results

Climate mitigation dimension

Over the whole duration of the VC analysis, improvement of the Haitian coffee agroforestry system results in a high climate mitigation potential of about -245 000 tCO_2-e per year, or -2.7 tCO_2-e per hectare per year. In the current scenario, coffee production allows to sequester small amount of carbon in the soil, about 56 000 tCO_2-e per hectare per year (data not shown), with about 10 000 tCO_2-e emitted from use of agricultural inputs and energy consumption in the downstream phases of the production. New coffee plantations on degraded areas and renewal of old trees in the current production's areas lead to carbon bio-sequestration in the biomass and soil, about 313 000 tCO_2-e (data not shown), while about 23 000 tCO_2-e are emitted from use of agricultural inputs and energy consumption in the downstream phases of the production.

Figure 4: EX-ACT VC screenshot on details of the climate mitigation dimension of the value chain

Climate Mitigation dimension of the Value Chain	Current	Upgrading	Balance
GHG impact (tCO_2-e per year)	-45,680	-290,394	
GHG impact (tCO_2-e per year per hectare)	-0.5	-3.2	-2.7
Carbon footprint of production (tCO_2-e per tonne of product)	-1.3	-5.0	-3.7
Annual tCO_2-e [emitted (+) / reduced or avoided (-)]		-244,714	
Annual tCO_2-e from renewable energy		0	
Equivalent project cost per tonne of CO_{2-e} reduced or avoided (in US$ per tCO_2-e)		0	
Equivalent value of mitigation impact per year (US$ 30/tCO_2-e)		7,341,412	
Equivalent value of mitigation impact per year per ha (US$ 30/tCO_2-e per year per ha)		82	

Looking at the whole GHG emissions and carbon sequestration, the CFP of the revival coffee from production to processing, is about -5 tCO_2-e per tonne of cherry coffee, while at the processing level and transport level is respectively 0.23 and 0.21 tCO_2-e per tonne of green coffee, figure 5. Processing level emissions are a major source emissions from energy consumption and principally from the generation of wastewater from pulping, fermentation and washing of cherry coffee. Increase of the CFP at the processing level from the current situation to the upgrading value chain is attributed to a higher proportion of cherry coffee going through wet mill instead of dry processing, while the reduction at the transport level is due to the reduction of loss production.

Figure 5: EX-ACT VC screenshot on details of the carbon footprint for production, processing and transport of the value chain

Carbon footprint at the different levels of the Value Chain	tCO_2-e per tonne of product		Balance
	Current	Upgrading	
PRODUCTION	-1.32	-5.00	-3.69
PROCESSING	0.02	0.23	0.21
TRANSPORT	0.23	0.21	-0.02
TOTAL	-1.07	-4.57	-3.50

To the best of our knowledge, the CFP at farm level is the lowest one encountered in the literature, table 1. Although it is difficult to compare CFP of different coffee value chain because of the difference between the boundary limits of the studied system, inputs considered and related GHG emission factors, unit used for the final product (cherry coffee, green coffee or cup of coffee), inclusion or not of carbon sequestration from the coffee trees and/or the shaded biomass, table 1 presents a brief view of CFP for mainly shaded polyculture systems. Here, in all cases but Maina et al (2015), carbon sequestration from coffee trees and/or shade biomass is not accounted for, leading to a positive CFP which increases proportionally to inputs, fuel and water consumption. Values found by Noponen et al (2012) are representative of the CPF at farm level (output unit is cherry coffee) and similar to the one reported by Maina et al (2015), but still well above value in the present study.

Table 1: Carbon footprint of various coffee production systems from scientific literature

Country	Type of production	Fertilizers	Processing	Carbon Footprint	Reference
Costa Rica	Shaded polyculture systems	Chemical	wet	**1.93 tCO_2-e (green coffee)**	Killian et al 2013.
Mesoamerica	traditional polyculture	compost	dry	**7.3 tCO_2-e (green coffee)**	Rikxoort et al 2014
	commercial polyculture	compost + chemical	dry	**6.2 tCO_2-e (green coffee)**	
	shaded monoculture	compost + chemical	wet	**10.8 tCO_2-e (green coffee)**	
	unshaded monoculture	compost + chemical	wet	**9 tCO_2-e (green coffee)**	
Kenya	Shaded polyculture systems	urea, compost, manure	wet	**4 tCO_2-e (green coffee)**	Maina et al 2015
Nicaragua & Coast Rica	Shaded polyculture systems (organic and conventional)	chemical, organic	not included	**0.12-0.67 tCO_2-e (cherry coffee)**	Noponen et al 2012

Therefore the present case study highlights the strong impact on CFP that can have inclusion or not of bio-sequestration. While this impact can be minor for an agro-forestry system that reached an equilibrium (after +-20 years), this is not the case for newly developed agroforestry systems. This is also an added value for label certification, fairtrade markets, and for farmers.

Indeed these GHG emissions reduction can be assessed in terms of economic returns. Those indicators are only present for the value chain upgrading scenario. Implementing new coffee trees plantations allows to earn 82 US$ per hectare ha per year considering a carbon market value of 30 US$ (figure 1), that can be used, for instance, to seek access to payments for environmental services.

Socio-economic performances of the value chain.

Revival of the Haitian coffee sector increases the value added generated at every level of the value chain, gross production value and gross income available for farmers and operator among the green coffee value chain (figure 6). Looking at the production level, the value added per hectare of product increases from US$1 076 to US$2 721 at the production level between the two situations (+26 percent), while the one per tonne of cherry coffee increases from US$2 260 to US$3 007(+140 percent). The strongest impact is on gross income per households which is 181 percent higher between the current scenario and the upgrading value chain. Increased surface areas of coffee cultivation and renewal of old trees boost the production by +90 percent, owing to get coffee of better quality and increase price market. Additionally it also impact the work on field and allow to generate 13 160 employment equivalent.

At the processing level, the strongest impact is on the gross income per operator, from US$ 53 000 to US$118 000, i.e. 125 percent of variation, and creation of 298 additional employment equivalent. This holds in an increase of the production processed (from 150 tonnes to 323 tonnes per operator, as we assumed the number of operators remained constant) and of the selling price of green coffee. However this results need to be taken with caution as we assumed a higher selling price owing to an increase of the production being wet processed and thus of higher quality, but it was not possible to estimate investment needed to develop the wet processing. Intuitively using this method will require investment in new equipment and their maintenance, therefore decreasing the value added (+US$23 with the present result) and gross income per operator. More on field information (survey and interviews scheduled in September 2017) should help to refine the results. However improvement at farm level with higher yield and better cherry coffee quality also trigger positive impacts downstream the value chain as shown with these preliminary results.

Figure 6: EX-ACT VC screenshot on details of the socio-economic performances of the value chain at the production and processing & transportation levels for the current and upgrading scenario.

Socio-economic performances of the value chain		Current	Upgrading	Balance	
Production level					
	Nb of HH	0	140,000		
	Nb of employement-eq	18,880	32,040	13,160	jobs
Gross production Value (GPV)		88,134	251,374	163,240	000 US$
Value Added (VA)		86,058	232,223	146,165	000 US$
Gross Income (GI)		74,820	209,973	135,153	000 US$
VA / tonne of product		2,260	2,851	591	US$
VA / ha		1,076	2,580	1,505	US$
Gross income / HH		534	1,500	965	US$
Processing and upstream transportation level					
	Nb of operator-eq	214	214		
	Nb of employement-eq	256	554	298	Jobs
Gross processed production value (GPPV)		12,729	28,489	15,760	000 US$
Value added		12,196	27,390	15,194	000 US$
Gross income		11,253	25,353	14,100	000 US$
VA / tonne of product		785	807	23	US$
Gross income / operator		52,684	118,291	65,607	US$

Climate resilience dimension and index of the value chain

In terms of climate resilience and index (figure 7), 74 000 ha are managed under climate resilience as only 16 000 ha of the surface area remained unchanged in trees renewal.

The medium resilience index is explained by a medium buffer capacity households in relation to food security and their self-organization, see annex I for climate resilience appraisal for these components. Indeed the project strongly benefits farmers only in terms of income (as shown by the socio economic appraisal) and agricultural physical assets and connect them to cooperatives or other farmers organization.

On the contrary the project has strong impact on (1) the buffer capacity of the watershed, e.g. reducing erosion, improved land cover, better management of water, (2) the buffer capacity of crop production, e.g. reducing crop failure, increase resistance to disease and pest, increase inter-cropping promoting on-farm diversity and (3) the learning capacity of households, e.g. improve farmer knowledge of threats and opportunities to agricultural production, improve access to extension services, improve access to market information.

Figure 7: EX-ACT VC Screenshot on climate resilience dimension and index with implementation of the revival of the Haitian coffee sector

Climate Resilience dimension (s)	Upgrading	
Hectares of land managed under climate-resilient practices	74,000	ha
Hectares with improved tree and vegetal coverage (land slide, flood resilience)	74,000	ha
Number of hectares with increased soil carbon (drought and erosion resilience)	74,000	ha
Number of HH having become more climate resilient	140,000	HH

Resilience index of the value chain upgrading	Upgrading	
Buffer capacity of watershed and landscape and project area	high	Buffer capac
Buffer capacity of crop -livestock production	high	buffer capac
Buffer capacity of households in relation to food security	medium	Buffer capac
Self-organisation of households	medium	Self-organis
Learning capacity of households	high	Learning ca
Global climate resilience generated by Value chain	**high**	

Conclusion

Although this analysis is an ex-ante appraisal from little information collected on the field and supplemented by ad-hoc publications, the revival of the coffee sector through the HPR project from this ex-ante appraisal seems to provide multi benefits along the value chain in term of job creation, increase income for households and processors, climate resilience and mitigation. Coffee based agroforestry systems (jardin céole) provide multiple climate smart and environmental benefits, e.g. adaptation, increased resilience and mitigation to climate change, but also increased income for smallholders, improved soil fertility, reduced runoff, soil protection from erosion…. The increased organic matter inputs to soil through leaves and branches and shading from high temperatures and physical protection from wind are other externalities improving the resilience. Incremental carbon stored in growing plant biomass is also the main source carbon mitigation. Indeed results suggest opportunities to carbon markets and payments for environmental services through the carbon sequestration from renewed coffee trees.

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Annex I: Climate resilience appraisal

Buffer capacity of households in relation to food security	(0-4)	
To what extent does upgrading the value chain improve household food availability (e.g. through increased household food production or improved household access to food)?	3	3
To what extent does upgrading the value chain improve household food storage ?	1	2
To what extent does upgrading the value chain improve household income?	4	3
To what extent does upgrading the value chain increase agricultural production physical assets?	4	3
To what extent does upgrading the value chain improve access of households to agricultural inputs?	2	2
To what extent does upgrading the value chain support (existing or new) farmer groups and networks?	2	2
To what extent does upgrading the value chain increase agricultural skills?	2	3
To what extent does upgrading the value chain improve access of households to climate-related social safety nets (e.g. climate-index agriculture insurance, cash, vouchers, warehouse receipt systems etc.)?	2	3
Sub-Result	55	medium
Resilience and self-organisation of households	**(0-4)**	
To what extent does upgrading the value chain improve cooperation and networks of farmers (e.g. farmer groups, farmer field schools, farmer organisations etc.)?	3	2
To what extent does the value chain upgraded collaborate with national/sub-national farmer/pastoralist organisations (capacity of farmers/pastoralists to influence decisions)?	2	2
To what extent does upgrading the value chain support farmer-networks across scales (e.g. local farmer groups being connected to national farmer organisations; bridging/linking social capital)?	4	3
To what extent are farmers actively participating in the upgrading project?	2	2
To what extent does upgrading the value chain foster good governance (keeping of records; accounting for exclusion, elite capture and corruption) in farmer cooperation and networks?	2	2
To what extent does upgrading the value chain improve farmer skills to manage groups?	2	2
To what extent does upgrading the value chain link agriculture value chains?	2	3
On-farm reliance: To what extent does upgrading the value chain build on local knowledge?	2	3
Sub-Result	46	medium

EX-ANTE CARBON-BALANCE TOOL [EX-ACT]

The EX-Ante Carbon-balance Tool (EX-ACT) is an appraisal system developed by FAO providing estimates of the impact of agriculture and forestry development projects, programmes and policies on the carbon-balance. The tool helps project designers estimate and prioritize project activities with high benefits in terms of economic and climate change mitigation, and it helps decision-makers to decide on the right course to mitigate climate change in agriculture and forestry and to enhance environmental services.

EX-ANTE CARBON-BALANCE VALUE CHAIN TOOL [EX-ACT VC]

EX-ACT VC is a tool derived from EX-ACT developed by FAO in 2016. EX-ACT VC is an AFOLU, processing and transportation framework of 8 Excel modules that provides co-benefits appraisal of crop-based value chain in developing countries on GHGs emissions, climate resilience and income.

The EX-ACT VC aims at helping designing performant and sustainable value chain. The methodology provides here both a quantified socio-economic appraisal of value chain both at micro and meso level (by agent, by group and for the whole chain) and an environmental carbon-balance appraisal of the value chain impact, in terms of climate mitigation, adaptation and value chain resilience.

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EX- ACT VALUE CHAIN STUDIES

This report is part of a series of brief, presenting project appraisals for value chain studies using either the EX-ACT VC Tool, which provides the potential climate change mitigation impacts, climate resilience, income and creation of jobs from investment projects in the Agriculture, Forestry and Land Use (AFOLU) sector. Each brief provides a short description of the project analyzed, the main results obtained and the related materials (case study document, EX-ACT VC screenshot).