Practical guidance for using EX-ACT tool for Value Chain

(EX-ACT VC)

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Abbreviation list

CSA	:	Climate Smart Agriculture
CC	:	Climate Change
UNFCCC	:	United Nations Framework Convention on Climate Change
CH_4	:	Methane
CmiA	:	Cotton made in Africa
CO_2	:	Carbon Dioxide
EU	:	European Union
EX-ACT	:	Ex-Ante Carbon balance Tool
FAO	:	Food and Agricultural Organization from United Nation
WBF	:	World Banana Forum
IPCC	:	Intergovernmental Panel on Climate Change
ha	:	Hectare
GDP	:	Gross Domestic Product
GI	:	Gross Income
GPV	:	Gross Production Value
IAM WARM	:	Irrigated Agriculture Modernization and Water-bodies Restoration and Management
LED	:	Low Emission Development
MD	:	Man-Day
N_2O	:	Dioxide.
NGO	:	Non-Governmental Organization
ONU	:	Organization of United Nations
PV	:	Production Value
Q	:	Quantity
SFVC	:	Sustainable Food Value Chain
SO	:	Strategic Objective
SRI	:	System of rice intensification
t	:	Ton
tCO2-eq	:	Ton of CO_2 equivalent
VA	:	Value added
VC	:	Value Chain

Glossary:

Adaptation[1]: Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploit beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation (IPCC, 2001).

Emission Factors: Emissions factors are coefficient which measure emissions or sequestration of one gas per unit of activity. They are based on samples of data, on average at different levels of details according to the methodology and the level used in order to develop a significant rate of emissions for a level of a given activity. (FAO, 2015).

Mitigation (of climate change): A human intervention to reduce the sources or enhance the sinks of greenhouse gases.

Resilience: The ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions.

Value added: It is defined by the difference between the gross value of the product, incorporating the value of all the factors which go to make up the production, and the wealth which has been consumed in the production process.

[1] Every definition is adapted from « Annex I: Glossary, Acronyms, Chemical Symbols and Prefixes». In "IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation". All the others are quoted.

Table of contents

Table of figures:

This manual presents how to use the EX-Ante Carbon-balance Tool for Value Chain, known as "EX-ACT VC", to provide a multi-impact appraisal in terms of socio-economic and environmental assessment for value chain analysis. It also introduces its goals and particularity, as well as the justification of developing such a tool.

Chapter 1: Introduction

1.1. Background:

World poverty is primarily a rural phenomenon, where 75% of the world poor live in rural areas and 80% of their revenue comes from the agricultural sector (Rural Poverty Report, 2011). Indeed, the agriculture and food sectors represent a large, if not the largest part of the economy of most developing countries, especially in terms of people deriving an income from it (FAO, 2014). Growth in agriculture is on average at least twice as effective in reducing poverty as growth in the non-agriculture sector. For instance, an increase in GDP contributes four times more effectively in reducing poverty when such increase comes from agriculture, than another sector (World Bank, 2008).

As poor people in the less-favoured areas are the most vulnerable to climate change (CC), the improvement of climate mitigation* dimension as well as climate resilience* and adaptation* can be important pathways out of poverty for them. If climate effects are highly visible on agricultural production (decrease of productivity, variability in yields…) they also impact rural infrastructure, market access and the different sectors present in a *value chain** (FAO, 2013).

It is widely acknowledged that making significant progress on mitigating the impact of CC depends on reducing the impacts of supply chains. The full supply chain, from fertilizer manufacture, agriculture processing, transport retail, household food management to waste disposal, could contribute to 19-29% of all anthropogenic greenhouse gas (GHG) emissions, i.e. 9,800 – 16,900 million tons of carbon dioxide equivalent per year (tCO_2-e yr^{-1}), at 2008 levels (Vermeulen et al 2012). As energy prices will increase and a global price on carbon will emerge in the near future, it appears that sustainably managed agricultural value chains should be an opportunity to help countries to contribute to the Paris Agreement of the United Nations Framework Convention on Climate Change (UNFCCC) by supporting Low Emissions development (LED).

Several options concerning the production of food in a different way can be highlighted through the adoption of conservation and climate smart agriculture (CSA) approaches and decreasing food waste. As one third of all food produced is lost along the value chain from harvest to consumption (Wollenberg, 2014) and highly contributes to GHG emission (Vermeulen et al, 2012), in terms of increasing farmer's productivity, adaptation to CC will also provide mitigation benefits.

It is vital for global nations that aim for sustainable economic emancipation to establish a low-carbon economy that realizes the change towards economic growth. Many academic fronts have idealized a low-carbon economy as an advancement approach characterized by energy efficiency, minimized pollution, less carbon emission as well as high energy performance

(Ganda and Ngwake, 2013). The distributed nature of food value chains presents both a challenge and an opportunity to make meaningful progress in de-carbonizing our global economy.

Since several key societal trends, including population growth, resource constraints, and social and market pressures, have direct implications for supply chains, a tool for sustainable food value chain and climate resilience analysis that takes into account the consecutive and interlinked stages of a product, from the extraction of natural resources to the final disposal, must cover a whole range of performance indicators such as social performance (employment) economic performance (income growth value added), environment and GHG performance and climate resilience. In this perspective, it could bridge with different strategic objectives (SO) of FAO, in particular the SO 2, 3, 4 and 5[2], targeting the end of hunger and poverty in the world, by dealing with different dimensions that affect value chain performances. The multi-benefit appraisal related to the value chain may tackle simultaneously the multiple challenges faced by rural population, breaking their underperformance and poverty cycles.

1.2. What is a sustainable food value chain?

1.2.1. Development of the Value chain concept

Value chain concept has been derived for decades from several other related concepts which have been used for decades in the literature. From the "*Filière*" to the value chain, changes occurred over time to address the new stakes into the different notions. For instance, the "supply chain concept" is mostly concerned with the optimization of the flow of products and services through the chain, while Porter's value chain concept introduces the "value chain" as a new term, considering the value addition in competitive markets as the core element in the production-to-consumption chain of activities (FAO, 2014).

Derived from this last idea, a **value chain** is defined as "*the full range of activities that is required to bring a product or service from conception, through the different phases of production, delivery to final customers, and final disposal after use*". In the context of food production, these activities include farm production, trade and support to get food commodities to the end-consumer (Kaplinsky and Morris, 2002). The value chain analysis allows to identify the values added*, created at each stage of the chain.

Value chain can play a vital role in improving linkages between farmers and buyers, ensuring that farmers tailor their production to meet the demands of the market instead of simply looking for a market (Anonym 2012). Thus farmers can become more actively engaged in adding value to products by improving quality, packaging and presentation at every stage of the chain. The value chain concept is increasingly supported in the international discussion. For instance, an international conference was held in Addis Ababa in 2012 about "Making the Connection: Value Chain for small-holder agriculture", that was attended by more than 500 delegates, discussing about the importance of creating policy support and infrastructure to enable farmers to be well-placed in the national and intra-regional market.

[2] http://www.fao.org/docrep/018/mi317e/mi317e.pdf

With the need to cope with strategic objectives of FAO, the sustainable food value chain concept has been recently developed and derived from those different notions, targeting the three pillars of sustainable development. This guidance is inspired by the sustainable food value chain concept, but it has been adapted with the climate resilience, adaptation and mitigation aspect, in order to go further in the analysis to meet the different dimensions that affect the value chain performance. In particular, there are many benefits in associating the "value chain approach" to the climate resilience because climate change affects food production as well as food industry and it presents important opportunities for lifecycle thinking and creative collaboration.

1.2.2. Sustainable food value chain and CSA

A sustainable food value chain takes into consideration the different dimensions of sustainability throughout the value chain concept and it applies them to the specific nature of food production, processing and distribution. The guiding principles on developing sustainable food value chains, elaborated in 2014 by FAO, define these last ones as: *"The full range of farms and firms and their successive coordinated value-adding activities that produce particular raw agricultural materials and transform them into particular food products that are sold to final consumers and disposed of after use, in a manner that is profitable throughout, has broad-based benefits for society, and does not permanently deplete natural resources."*

Unlike related concepts, such as the *Filière* / commodity chain and the supply chain, the sustainable food value chain concept simultaneously stresses the importance of three elements: (1) it recognizes that value chains are dynamic, market-driven systems in which vertical coordination (governance) is the central dimension; (2) the concept is applied in a broad way, typically covering a country's entire product subsector (e.g. beef, maize or salmon), and (3) value added and sustainability are explicit, multidimensional performance measures, assessed at the aggregated level (FAO, 2014).

However, we consider besides the sustainable food value chain concept the introduction of additional dimensions concerning adaptation, resilience and mitigation induced at a value chain level, in order to better manage climate change risks at different levels, giving importance to CSA in the analysis of a food value chain.

The CSA concept was launched by FAO in 2010 and it defines a type of agriculture that sustainably increases productivity, resilience (adaptation), reduces/removes GHGs (mitigation), and enhances the achievement of national food security and development goals. CSA is an important framework for developing sustainable food value chains since it considers mitigation as well as adaptation options by managing ecosystems for conserving existing carbon stocks, decreasing carbon sources in the atmosphere, and adapting small-holders livelihood to be less vulnerable to climate change impacts.

Indeed, to achieve food security and agricultural development goals, adaptation to CC and lower emissions intensity is necessary and it requires changes in agricultural production systems. CSA is composed on three pillars coping with adaptation and mitigation plans by increasing sustainably agricultural production and incomes, adapting and building resilience to climate change for local and vulnerable populations and reducing GHG emissions where and when possible (FAO, 2013). Transformation of agricultural practices, that are better managed and adapted to this CC context will thus allow food producers to contribute significantly to the rural development, also by giving them the opportunity to have a better access to local and national markets (more productive, less variable in their production, more resilient…). CSA is not a new agricultural system nor a set of practices. It is a new approach, a way to guide the needed changes of the agricultural systems, given the necessity to jointly address food security and climate change. Several agriculture strategic options can be scrutinized: conservation agriculture, irrigation and water management, adapted crop and farming practices, crop and income loss risk management…. CSA is a win-win strategy since it allows to improve resilience of a value chain, sustainably increase productivity, insure food security and reduce GHG emissions.

CSA requires the transition to agricultural production systems that are more productive, use inputs more efficiently, have less variability and greater stability in their outputs, and are more resilient to risks, shocks and long-term climate variability.

A more productive and more resilient agriculture requires a major shift in the way land, water, soil nutrients and genetic resources are managed to ensure that these resources are used more efficiently. Making this shift requires considerable changes in national and local governance, legislation, policies and financial mechanisms. This transformation will also involve improving producers' access to markets, and developing a sustainable system for the entire value chain. It needs a growing interactions between sectors with involvement of every stakeholders. CSA brings together practices, policies and institutions that are not necessarily new but are used in the context of climatic changes, which are unfamiliar to farmers, herders and fishers.

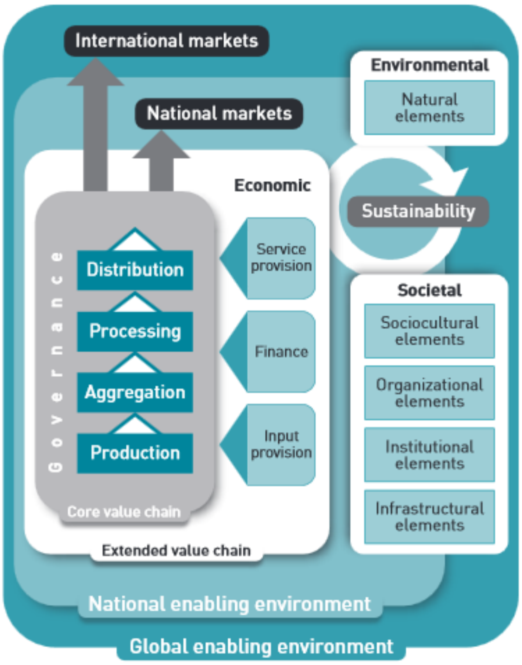
1.3. Mapping a food value chain :

Value chains are a complex framework analytical tool. Mapping the boarder is indispensable, both as a construct for ensuring analytical clarity and as a useful presentation tool to avoid any misunderstanding. A value chain starts from the product cultivated (rice, banana, cotton…) and can be separated in different sub-value chains according to the practices applied, the type of processing and the final product. For instance the rice value chain in Madagascar can be divided into 2 segments: (1) The rainfed rice value chain and (2) the irrigated rice. To clearly identify the boarder of the value chain it is important to first consider the different flow and operations taking part in the whole food process. Even though the product cultivated is often used to name the value chain (cocoa value chain, rice value chain…), it seems more relevant to start from the primary agricultural production and follow the product from the upstream level through the different marketing channels and the different stages of transformation up to the markets of realization. Then it is important to downstream identifying the major inputs and services providers present at the different stages of the production (Duruflé et al, 1998). However, the upstream level can put some more difficulties in appreciating the degree of participation from agro-furniture providers in the value chain (fertilizer, pesticides, agricultural machinery…)

whether it is relevant or not to consider them in the value chain analysis. Therefore we only consider agents, by whom the product actually transits, included in the value chain boundaries. Following the product may also highlight other difficulties in terms of defining the sub-value chain or segment. The logic leads to go on till the identification of the final consumer, or exportation since the limit of the chain stops at a market stage, without penalizing the socio-economic analysis.

For this purpose, we consider the sustainable food value framework as a guidance for defining the boarder for analysing food chain performance. It is based and related to the value chain actors, i.e. those who produce or procure from the upstream level, add value to the product and then sell it on the next level. In this framework, four core functions are distinguished in the chain: production, aggregation processing and distribution (wholesale and retail), in a national and global environment considering natural and societal elements as well as local, national and international markets. (See figure 1 below) (FAO, 2014).

Figure 1: The sustainable food value chain framework



This framework allows to work out most of criteria used to identify a growth engine sector and to analyse the potential of poverty reduction of an activity. It fits well to assess an engine growth sector in term of actual situation, potential impact on poverty reduction and to define an agricultural strategy with appropriate policy options.

Chapter 2: EX-ACT VC Background

2.1. Objectives:

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 agricultural-forestry, land use, processing and transportation framework of 8 Excel modules that provides co-benefits appraisals of crop-based value chains in developing countries, concerning GHGs emissions, climate resilience and income.

Recent initiatives and projects which focus on a value chain approach for policy making with a mix of environment and income distribution oriented objectives are multiplying in less industrialized countries. Different objectives converge towards common targets, and the socio-economic performance of the value chain appears to be an essential demand from developing countries, especially for increasing profitability of the value chain for small farmers, raising farmer's income and creating new jobs in processing activities.

In terms of environmental performances, there is an increasing demand concerning the access of knowledge about carbon footprint and strengthening knowledge about emissions from the various activities in the value chain. The aim is to reduce the impact of climate variability on yields, the amount of chemical inputs and energy per hectare, minimizing the value chain negative environment externalities and use carbon footprint labeling to value sustainable management efforts.

Therefore, there is an essential need of common methodologies and improved methods and tools to enhance sustainability, resilience and competitiveness for value chains in developing countries through the analysis of the food chain network to address these issues.

The EX-ACT VC aims at helping designing value chains that are performant and sustainable, within the different concepts described below. The methodology provides here both a quantified socio-economic appraisal of value chain both at micro and meso level (by agent, by stage and for the whole chain) and an environmental carbon-balance appraisal of the value chain impact, in term of climate mitigation, climate adaptation or resilience while analysing socio-economic impact at a value chain level. Thus:

- 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 of the value chain and of an upgrading project scenario. The carbon footprint of the product is calculated for the whole value chain and at different needed stages, 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, ecosystems and market 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.

Therefore, EX-ACT VC tool is of high interest for local and national initiatives in developing countries to:

- Pre-assess what impact they may reach (ex-ante appraisal) in a given time framework at a value chain level
- Monitoring their progress in achieving selected objectives at different points in time and at different scales of the chain;
- To evaluate (ex-post assessment) the achievement of stated objectives.

2.2. EX-ACT VC boundaries:

EX-ACT VC allows to develop the analysis from production to retailers, comparing two scenarios: the current situation of the value chain and an upgrading project scenario based on the analysis of agricultural production, land use change, processing, packaging and transportation of agricultural products. At the moment, this tool only concerns crop production, although fisheries and livestock value chain might be developed soon.

The current situation of the value chain corresponds to the current production, type of processing and transportation, characterising the analysed value chain.

The upgrading scenario denotes the development path of the value chain and aims at improving it in terms of climate mitigation, adaptation, value chain resilience and socio-economic performance. It could cover three different aspects: (1) "Product upgrading", that is the innovation, diversification or improvement of the final product (2) "process upgrading", which is the improvement of production and distribution technology and logistics, and (3) "Functional upgrading" which means the shifting of value chain functions from one VC operator to another (Bockel, 2009). Upgrading implies activities in different fields of action that can be summarized as "improving business linkages, associations and partnerships, strengthening service supply and demand, introducing standards, improving policies and the business environment of the banana chain, expansion or productive capacity which enhances the volume sold. To build a value chain strategy, a sequence of steps described in the following figure are needed:

Figure 2: Steps for building a value chain upgrading strategy

The multi-impact appraisal provided by EX-ACT VC compares both situations, while the current situation is used as the baseline scenario. The improvement of the value chain can be present at any level of the chain.

EX-ACT VC has been adapted and retargeted in order to analyze value chains in developing countries. It fits for analyzing either a simple value chain, or a segment of more complex value chains (regional or area specific sub-value chain). Therefore, it is possible to analyze a complex value chain, by fragmenting it in segments, providing an impact appraisal for each of the segment and finally aggregate the results. For instance, the rice value chain in Madagascar can be segmented in rainfed and irrigated rice chain, facilitating the analysis.

2.3. Methodology

The performance of a sustainable food value chain is generated at different dimensions that are tackled simultaneously in the tool. A value chain presents challenges and opportunities to make progress in de-carbonizing the food production/industry and reducing carbon emission at the different stages of the chain but also in terms of increasing resilience of local populations directly dependent on the food sector. Adaptation and mitigation options are two strategies, at a value chain level, against CC and vulnerability of the population in terms of risks, shocks and long-term climate variability, and have a real impact in terms of food value chain performances. This environmental performance is complementary to the socio-economic performance of the value chain. It is mostly generated by wealth accumulation, number and nature of direct and indirect jobs related and the improvement of food supply aiming at meeting food demand in rural as well as urban areas. Defining a food value chain sustainably means taking into account all these dimensions and being able to quantify and analyse its performance.

This proposed methodology is a first analytical framework on possible mitigation, adaptation and resilience indicators to include in a monitoring system for analysing a food value chain. It is based on the need for simple mitigation, adaptation and resilience indicators, easy to collect and to aggregate, which develop a measurable and concrete tracking system, in order to create an accurate assessment of the impact of the value chain.

2.3.1. Methodological background for climate mitigation dimension analysis

Climate mitigation consists on reducing rhythm and magnitude of environmental changes, here considered at the whole value chain level. It aims at reducing GHG emissions and increasing carbon sequestration, by improving practices at the different stages of food production (improving agricultural practices, reduction of production wasted…).

Several methodologies are used for the calculation of GHG emissions at the value chain level.

Climate mitigation is calculated using the framework of EX-ACT version 7 for the agricultural production part. Emissions factors and default values come from IPCC (2006), which developed a methodological guidance to estimate CO2 emissions for the different steps of the crop production. It has been completed with other existing methodologies, such as embodied GHG emissions for farm operations, inputs transportation, and irrigation systems

implementation from Lal (2004). For more details about the computation of GHG emission, please refer to the technical guideline of EX-ACT[3].

Concerning processing and transportation, GHGs emissions are mainly associated with energy use, such as fuel consumption, electricity and conditioning. Therefore, the straightforward approach is to estimate CO_2 emissions for those different steps and consists by multiplying the quantity of input per tonne of production by an ad-hoc emissions factor.

- For energy use at processing level, the emission factor remains the same as for crop production. Fuel and electricity default data are taken from IPCC (2006).
- For the packaging we currently consider the present values provided by Berneers-Lee and Hoolohan (2012). To simplify the tool, we consider the most widespread types of packaging. A Tier 2 option allows users to enter other types and emission factors associated.
- For refrigeration both in processing and transportation we consider data from Luske (2010), especially computed for banana production. Context-dependent and specific for the different types of food production users can enter other emission factors more adapted in a Tier 2 option.
- For transportation we consider emission factors from Weber & Mathews (2008) based on the carbon emission per kilometres.

We currently consider those emission factors but some improvement can be done at this level, considering the region and context of the banana value chain. These default data are globally values with high degree of uncertainties and therefore using them might lead to over or under-estimate carbon emissions.

The following tab gives the default data used for the two sections:

Table 1: Emission factors adapted for value chain analysis

		Emission factors used	Source
Processing	**Type of packaging** tCO2/t of packaging		
	Wood	0.4	Berneers-Lee and Hoolohan (2012)
	Paper and card	2.1	
	Aluminium	8.5	
	Plastic (mixed)	3.6	
	Conditioning (refrigeration) tCO2 / ton of product	0.00834	Lukse (2010)
Transport module	**Type of transport** tCO2-eq/t-km		
	Truck	0.0018	Weber & Mathews (2008)
	Air	0.0068	
	Rail	0.0018	
	Inland water	0.0021	
	International ship	0.0014	
	Conditioning refrigeration tCO2 / ton of product	0.00122	Lukse (2010)

Results in terms of climate mitigation are derived at a value chain level thanks to a carbon footprint indicator (tCO_2-e/ton of product), giving an environmental quantitative performance

[3] http://www.fao.org/fileadmin/templates/ex_act/pdf/Technical_guidelines/EX-ACT-tech-guidelines_V4.pdf

of the food production for the whole value chain and for the different stages of the food chain. A decrease of the carbon footprint means an improvement of environmental capacity, raising the performance of the whole value chain in terms of climate mitigation impact and can be an incentive for food sectors for reducing carbon emissions, reducing environmental negative impact generated at a value chain level and making food chain more performant (innovations…).

These indicators allow to obtain and analyse mitigating impacts in terms of the project and also tCO2 equivalent economic return, which could be an important aspect to consider when seeking, for example, the access to payments for environmental services. In order to assess an equivalent value of the impact of mitigation per year and per ha, users can enter in the "VC results module" the carbon price (US$): how much money does the upgrading of the value chain allow to gain or to lose?

The impact on the mitigation of climate change is reflected through the following quantitative indicators, derived directly from the EX-ACT tool:

- Tons of carbon dioxide equivalent (t CO2 equivalent) reduced or avoided (including increased removals) over 20 years;
- Mitigation impact in tCO2 per year;
- Mitigation impact per year per ha;
- Project cost per ton of CO2 equivalent reduced;
- Equivalent value of the impact of mitigation per year (10 US $ / tCO2);
- Equivalent value of the impact of mitigation per year per ha (10 US $ / tCO2);
- Carbon footprint

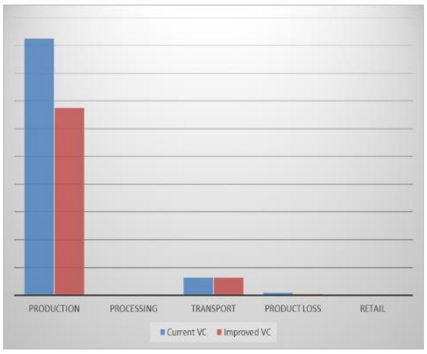
In EX-ACT VC, these mitigation impact indicators appear as follows:

Figure 3: Climate mitigation appraisal of the value chain

Price tCO_2-e	10	US$	
Climate Mitigation dimension of the value chain (s)	Current situation	Value chain upgrading project	Balance
GHG impact in tCO_2-e per year	1,671,006	1,585,660	-85,346
GHG impact in tCO2-e per year per hectare	11	10.63	-0.6
Carbon footprint per tonne of production, in tCO_2-e per tonne of product	3.7	3.11	-0.6
Incremental in tCO_2-e [emitted (+) / reduced or avoided (-)]		- 85,346	
Equivalent project cost per tonne of CO_2 reduced or avoided, in US$ per tCO_2-e		0	
Equivalent value of mitigation impact per year , in US$ /tCO_2-e		853,464	
Equivalent value of mitigation impact per year per ha, in US$ /tCO2-e per year per hectare		6	

Figure 4: Detailed carbon footprint

Carbon footprint at the different levels of the Value Chain	Emissions (tCO2/t product) Current VC	Improved VC	Balance
PRODUCTION	4.623	3.374	-1.249
PROCESSING	0.014	0.014	0.000
TRANSPORT	0.315	0.315	0.000
PRODUCT LOSS	0.048	0.024	-0.025
RETAIL	0.000	0.000	0.000
TOTAL	5.001	3.727	-1.274



2.3.2. Food value chain resilience methodological background

The EX-ACT VC appraisal of climate adaptation impact should target the incremental resilience generated by upgrading a value chain. Existing methods combine very global quantitative indicators as number of beneficiaries with improved value chain resilience capacity or number of ha with improved resilience to climate shocks. It also uses a set of qualitative indicators to estimate the potential of an upgrading scenario to build resilience, through contributing to the various dimensions of resilience.

Resilience does not derive from one indicator. As such the relative strengths of the resilience dimensions depend on the social-ecological (including political) framing conditions. While buffer capacity largely captures farmers' endowments and access to various capitals, self-organisation and learning include more process-like and practice-like indicators, capturing the ability of the farmers in building resilience. The aim of such resilience appraisal is to judge if and in what dimensions a project might contribute to increase climate resilience of beneficiaries.

(i) Quantitative resilience indicators:

EX-ACT VC quantitative resilience appraisals allow also to derive some quantitative indicators for resilience generated either in terms of areas or households benefiting from increased resilience:

- Increase of hectares of land managed through resilient practices to climate change;
- Hectares with improved coverage of trees and vegetation (reduction of landslides and erosion, flood resistance);
- Hectares with enhanced carbon content in the soil (resilience to drought and erosion reduction);
- Number of households benefiting from improved resilience of watersheds and land to climate shocks;
- Number of households benefiting from improved resilience of farming systems;
- Number of households benefiting from improved physical, social, financial capital;
- Number of households benefiting from improved self-organization and learning abilities

In EX-ACT VC, these qualitative resilience indicators appear as follows:

Figure 5: Quantitative appraisal of value chain resilience

Climate Resilience dimension (s)	Current situation	Improved VC	
Hectares of land managed under climate-resilient practices	149100	149100	ha
Hectares with improved tree and vegetal coverage (land slide, flood resilience)	0	0	ha
Number of hectares with increased soil carbon (drought and erosion resilience)		0	ha
Number of HH having become more climate resilient		0	HH

(ii) Qualitative resilience appraisal:

A more thorough assessment of the adaptation aspect is based on a multi-criteria analysis of different dimensions of resilience issued and derived from a FAO methodical study work (Chinwe Ifejika Speranza). The three identified resilience dimensions are: buffer capacity; self-organization of farmers in the value chain; market resilience and adaptation capacity. These three dimensions of resilience are based on a series of indicators deducted from the project profile. The buffer capacity differs in the three levels of analysis in which an agricultural system can be identified: value chain/area level, households parcel level and production systems. Consequently, the resilience index is based on five resilience factors:

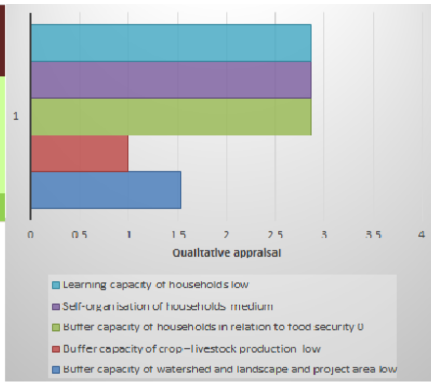
- Buffer capacity of the value chain to natural shocks
- The absorption capacity of climatic shocks of production systems;
- The absorption capacity of climatic shocks on household food security;
- Strengthening the self-organizing ability of households in the value chain;
- Market resilience and adaptation capacity of the value chain.

A general index, derived from these factors, gives a first estimate of the value chain resilience generated by an upgrading scenario, which is measured as very high, high, medium, low, very low. To assess the impact of the project on each of these resilience factors, different criteria are used. Every factor is measured through a set of specific qualitative criteria to be answered. For instance, to assess the buffer capacity of the value chain to natural shocks, a series of seven questions are proposed: (i) To what extent does the upgrading of the value chain improve land cover? (e.g. agroforestry, cover crops etc.); (ii) To what extent does the upgrading of the value chain reduce soil erosion?; (iii) To what extent does the upgrading of the value chain improve soil conditions (e.g. soil moisture, soil structure etc.)?; (iv) To what extent does the upgrading of the value chain improve efficient use of water?; (v) To what extent does the upgrading of the value chain save water?; (vi) To what extent is the value chain area protected from climate shocks; (vii) To what extent are the value chain infrastructure - building investments climate-proof ?

The complete list of questions is provided in the tables of data entry that can be found in chapter 3.2.8. Results are aggregated in the “VC results” module as follows:

Figure 6 : Qualitative appraisal of value chain resilience

Resilience index of the value chain upgrading	Current situation	Value chain upgrading project
Buffer capacity of the value chain to natural shocks		low
Buffer capacity of crop production		low
Buffer capacity of households in relation to food security		0
Resilience and self organization of households		medium
Resilience and self organization of households		low
Global climate resilience generated by Value chain		medium



2.3.3. Socio-economic methodological background

Four main indicators are used for appraising the socio-economic performance of the value chain linked with the concept of pro-poor growth. Growth is pro-poor, it is argued, if it uses the assets that the poor people own, if it favours the sectors where the poor people work and if it occurs in areas where the poor people live. This type of growth has to take into account both relative and absolute poor conditions to insure a rapid and equitable growth in the wealth distribution (Bockel & Chand, 2004).

(i) Value added

Associated with the concept of value chain and sustainable food value chain, value added is one of the main concepts used by Porter and FAO (2014). Value added measures the creation of wealth, the contribution of the production process to the growth of the economy.

It is defined by the difference between the gross value of the product, incorporating the value of all the factors which contribute to make up the production, and the wealth which has been consumed in the production process (Bockel & Tallec, 2005). In other words, the value added is the value that the agents have added to the value of the inputs in the process of food production, during the accounting period, at a stage of the value chain. It is calculated as the difference between the intermediate inputs used and the value of the output after the process.

Figure 7: The concept of value added

If,

II = value of intermediate inputs used
Y = value of the output

Then,

Value added (VA) is defined by the equation:

$$VA = Y - II$$

The value can be added to an intermediate agri-food product not only by processing it, but also by storing it or transporting it and can increase (decrease) over space and time (FAO, 2014) allowing to analyze the redistribution throughout the whole chain.

The value added generated throughout the production of food production, from producers to retailers plays a major role in terms of food value chain performance. Indeed, the value created, present at every stage of the value chain, may influence the three pillars of a sustainable development: economic, social and environmental sustainability, and directly impact poverty and hunger. The value added has five major components: salaries of workers, tax revenues to the government, return of assets, food supply to consumers and impacts on environment (FAO, 2014). Redistribution is thus measured amongst the different agents in the economy: households (the recipients of the return to labour), financial institutions (interest charges), the government administration (taxes) and non-financial enterprises (gross income).

Therefore, it is possible to analyse the impact of an upgrading value chain at a socio-economic level by measuring the increase or decrease of the value added at every stage of the banana value chain. An increase of the value added involves an increase of its different components converging towards reduction of poverty by increasing food security.

(ii) Gross production value (GPV)

The gross production value is computed at every stage of the value chain by multiplying the production value (PV) in US$ with the tonnage of the production (Q) or the area covered (ha) by the value chain. It is taking into account the amount of production lost during the different phases of the food production process.

$$\textbf{GPV (US\$) = PV (US\$/t) x Q (t)}$$

Therefore it is possible to estimate to what extent upgrading a banana value chain at every stage allows to increase the value of the production. An increase of the GPV can be explained by an increase of the value added. Thus it is possible to identify the impact in terms of poverty reduction, especially thanks to the two following indicators.

(iii) Gross income

As previously seen, an increase of the value added has an impact on the wealth redistribution for the different agents of the economy. The income allows to draw a wealth level at a meso as well as at a micro-economic level. It is directly measurable for every agent of every stage of the chain. In order to better understand how this redistribution is done across the chain, we decided to provide the gross income as results because it allows to explain the socio-economic performance.

The gross income or gross profit is the difference between the value added generated at a stage of the value chain and the expenditure on labour, interest charges and taxes. In other words, the gross income represents the return of cultivation, once the costs of production, intermediate inputs, labour costs, interest charges and taxes have been deducted.

The comparison between both the current situation and an upgrading scenario allows to assess to what extent the upgrading scenario increases the available income for every beneficiary. The gross income expresses the economic gain, or loss, of the agent once all current production costs are met.

(iv) Volume of employment generated

Indirectly associated with the value added, the volume of employment generated is however deeply connected.

Applied to agriculture value chains, the volume of employment generated is an important "pro-poor" growth engine such as there is a significant part of rural employment/labor in this sector in developing countries where they operate at a local or national level (World Bank, 2008). Therefore, agriculture's contribution to economic growth and poverty reduction is greater in low-income countries where agriculture represents an important activity for poor people. The key challenge is to create an environment that enables poor people, particularly those working in small and medium sized farm enterprises, to respond to opportunities presented by growing markets. Moreover, agricultural growth has a multiplier effect on the rest of the economy. The labor intensity of those multipliers has been emphasized. Empirical evidence is now accumulating that, for every job made directly in agriculture from agricultural growth, two to three jobs are made in the non-farm sector (Mellor 2002).

In order to significantly analyze the employment generated, we developed different methodologies for the each stage of the chain. Two steps allow to compute an equivalent number of employments. A number of man-day per unit is measured according to how many people are required or consumed to perform a task for a stage of the food value chain per day. An equivalent return of employment is then calculated, assuming that employees work on average 250 days a year. Therefore it is possible to identify the equivalent amount of employment generated at a value chain level, and the increase (decrease) of employment equivalent compared with an upgrading scenario.

Table 2: Methodology used for analysing the volume of employment at the different stages of the chain

Stage of value chain	Ùnit	Methodology
Agricultural production	Number of man-day	Every steps of the agricultural production is differentiated: from soil preparation to harvest
Downstream transportation	Nb of truck drivers equivalent + Number of truck assistants	We assume 1 collector = 1 truck x n truckloads / year, estimating the quantity transported by truck (n depends on the distance travelled)
Processing	Number of man-day/ton of production	The type of workers is differentiated: Full time practical workers and managers / Seasonal employees / Family workers
Upstream transportation	Nb of truck drivers equivalent + Number of truck assistants	Same computation than downstream transport
Wholesaler	Number of man-day / ton + Number of truck drivers and assistants	It takes only into account number of employees / ton of production Truck drivers : Same computation than downstream transport
Retailers	Number of man-day	It takes only into account number of employees / ton of production

The following tab gives a summary of the different socio-economic indicators that are used in EX-ACT VC:

Table 3: Summary of the economic indicators used in EX-ACT VC

	Gross production value
-	*intermediate inputs*
	= Value added
-	*labour cost, credit cost and taxes*
	= Gross income
	Total jobs generated
	Number of add. Man –days divided by 250

The “Economic analysis” module (details Chapter 3.2.7.) allows to calculate the costs of every intermediate input at the different stages of the value chain, essential steps to compute all these indicators. Results are then grouped in the “VC results” module for each stage of the value chain, as shown in the following figure:

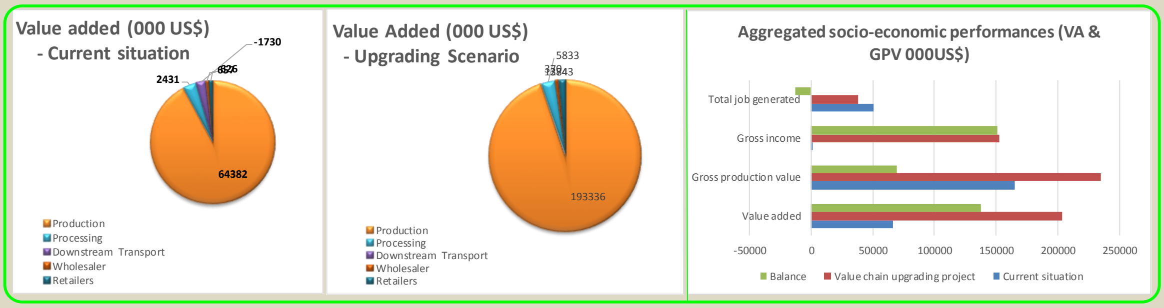
Figure 8: Detailed socio-economic results - example at production and packaging level

Socio-economic performances of the value chain	Current situation	Value chain upgrading project	Balance	
Production level				
Nb of operator eq	48308	34591	-13717	jobs
Gross production Value (GPV)	**161369**	**212958**	51589	000 US$
Value Added (VA)	**64382**	**184104**	119722	000 US$
Gross Income (GI)	**2079**	**136587**	134509	000 US$
VA / tonnes of product	**138**	**299**	161	US$
VA / ha	**432**	**1235**	803	US$
Gross income / farmer - beneficiaries	**28**	**1833**	1805	US$
Processing and upstream transportation level				
Nb of operator eq	1179	1556	377	jobs
Gross processed value	**3832**	**7682**	3851	000 US$
Value added	**2431**	**5833**	3403	000 US$
Gross income	**687**	**3854**	3167	000 US$
VA / ton of product	**7**	**18**	11	US$
Gross income / operator	**3734**	**15862**	12128	US$

In order to draw the entire value chain performances, aggregated results are given following the detailed socio-economic results. To better understand from which stage the value is created, EX-ACT B-VC also gives a detailed value added for both situations, as shown below:

Figure 9: Aggregated results and detailed value added

Aggregated Socio-economic performances	Current situation	Value chain upgrading project	Balance	
Value added	66365	203757	137391	000 US$
Gross production value	165048	234858	69810	000 US$
Gross income	1121	152471	151350	000 US$
Total job generated	50804	37949	-12855	Jobs created



Chapter 3: Structure of EX-ACT VC:

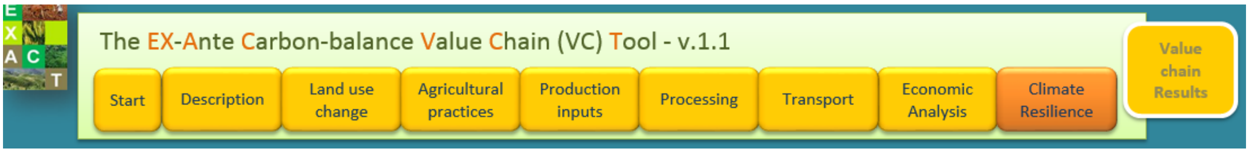
3.1. Basic structure of EX-ACT VC:

The proposed analysis is associated with methods of collection and it is structured in an Excel file that constitutes the EX-ACT VC tool. The file includes different modules which allow to enter data on the value chain: a module on climate resilience analysis, a module on socio-economic analysis and a module gathering value chain performance results. This proposed methodology is a first analytical framework on possible mitigation, adaptation and resilience indicators to appraise the value chain performance. It is based on the need for simple mitigation, adaptation and resilience indicators, easy to collect and to aggregate, which create a measurable and concrete tracking system, in order to develop an accurate assessment of every type of food value chain.

EX-ACT VC consists of a set of eight interconnected Microsoft Excel sheets, in which users insert basic data on agricultural management practices, processing and transportation. Users can specify geographical and agro-ecological information concerning the production level, but also data on agricultural practices, processing and transportation of food products.

A navigation bar allows users to move easily from one module to another. It is presented as follows:

Figure 10: EX-ACT VC navigation bar



This navigation bar refers to 8 modules briefly explained in the following tab:

Figure 11: Short description of the 8 modules present in the tool

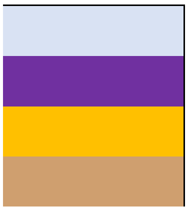
1	**General description**	Of the production zone considered and/or upgrading project: Type of Value Chain and/or project, climate, soil, type of vegetation, additional information
2	**Land use change**	Deforestation, non-forest land use change, new irrigated area
3	**Agricultural practices**	Annual and perennial crop, flooded rice system, production loss
4	**Production inputs**	Fertilizer and pesticides, energy consumption, infrastructure
5	**Processing**	Energy consumption, production loss
6	**Transport**	Type of transport and conditioning
7	**Socio-economic analysis**	Price and input cost, labour
8	**Climate resilience**	Qualitative evaluation of value chain resilience
	Value Chain results	Climate mitigation dimension, climate resilience, socio-economic performance

Those eight modules allow to analyse the current situation of the food industry and a wide panel of project activities such as developing agricultural production, land use change, rural development project and reduction of production loss at the different levels of the value chain.

Data collection and insertion in EX-ACT VC only depends on the type of analysis and thus it is not necessary to complete all the modules within EX-ACT VC. At some levels, the action plan for an upgrading scenario can also be low, but in order to compare the benefits or not of the upgrading project, it is necessary for users to specify every data for the current situation (which is the baseline scenario) in correspondence of the ones of the upgrading project.

Each EX-ACT B-VC module is sub-divided into its different components using boxes. It is clearly delimited by an outside frame from other sub-module components. A specific color code is used throughout the tool to help users:

Color code



It shows where users have to enter data

Tier 2 option

Help – additional information: map, definition…

Unit, variables, background

To better understand how the tool is functioning, we base the following module description on an example on rice production in India.

3.2. Entry data methodology in the different modules:

This part focuses on the analysis of a simple value chain, or a segment of more complex value chains (regional or area specific sub-value chains). For analyzing a more complex value chain, users have to divide them into different sub-value chains and follow the instruction below.

3.2.1 Description module:

This module is the first one that has to be compulsory filled. It has to be filled with central descriptive information on regional agro-ecological conditions. Every user has to start with filling the description module since the rest of the EX-ACT VC otherwise does not contain the necessary input information to proceed. In particular, users should fill in the following information depicted in figure 2, mainly by selecting from drop-down lists.

(i) General value chain information

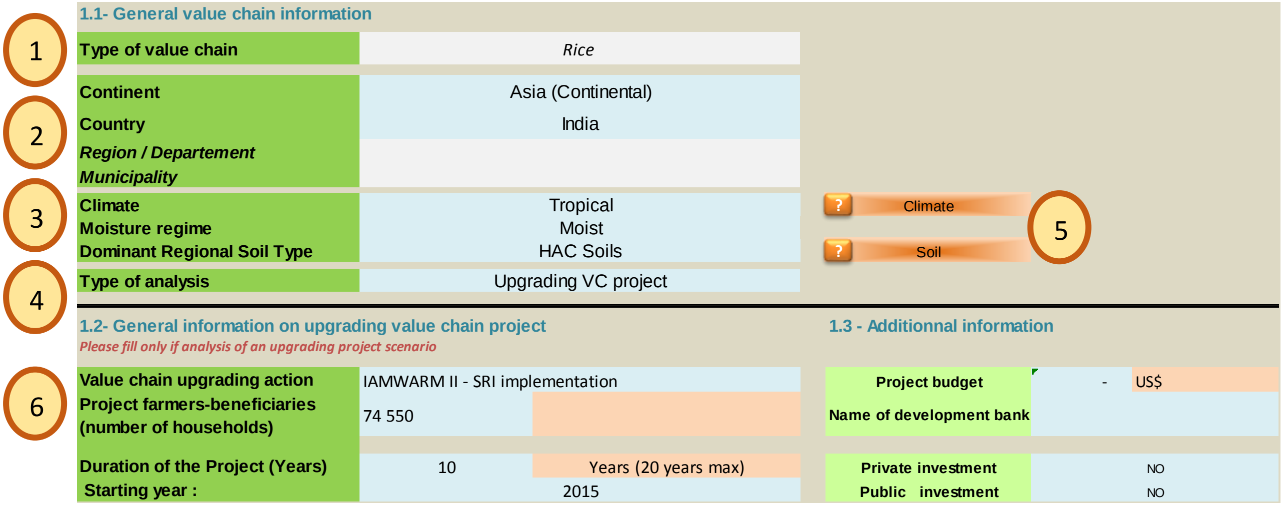
1 **Name of the Value chain**: it provides the name of the analysed value chain

2 **Location**: It select the continental region in which the analysis will take place from the drop-down list, which will preselect a set of default values for the later emissions calculations.

The eleven continental regions are: *Africa/ Asia (continental) / Asia (India subcontinent) / Asia (insular) / Middle East / Western Europe / Eastern Europe / Oceania / North America/ Central America/ South America*
Users can complement with the country (drop down list) and specify eventually with the region or department as well as the municipality.

3 **Climate***:* The climate is strongly influencing GHG emissions and sequestration in agriculture. A careful choice of the correct climate information is thus essential. The default options are thereby: *Boreal / Cool Temperate / Warm Temperate / Tropical / Tropical Montane.* The default options of the **moisture regime** are: *Dry / Wet / Moist.*

Figure 12: Description module



DominanDominant soil type*:* users should indicate the main dominant soil type using the simplified IPCC classification. IPCC retains only 6 soil categories: *High Activity Clay soils (HAC) / Low Activity Clay soils (LAC) / Sandy soils / Spodic soils / Volcanic soil / Wetlands soils.*

4 **Type of analysis**: Users have to specify the type of analysis: analysis of the current situation or upgrading scenario.

5 By clicking on the orange boxes, with the support of global maps this section provides guidance on which IPCC soils and climate category to be used.

The rice value chain analysis takes place in India within a Tropical Moist climate where HAC soils are the dominant regional soil type.

(ii) General information on upgrading value chain project

6 Information can be filled up such as the name of the value chain upgrading action, the number of beneficiaries, the duration of the project, the starting year of the upgrading

In the present example we analyse the improvement of the traditional rice grown in 66 basins in India. The project seeks implementing SRI ("System of Rice Intensification") in order to increase farmer's income and increase water productivity. The project started in 2015 on a 10 years duration

scenario, the project budget, the name of the development bank and if the project involves public and/or private investments or not.

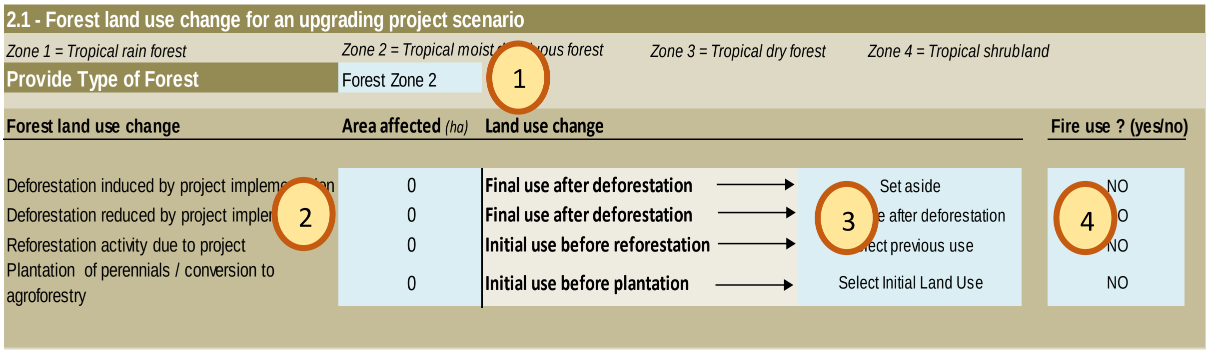
3.2.2 Land use change module:

This module only concerns the upgrading scenario analysis and informs on every land use change induced. It takes into account forest land use change (deforestation/reforestation), non-forest land use change and new irrigated area.

(i) Forest land use change:

This section concerns every deforested area induced or reduced by the upgrading project scenario as well as reforested or agroforestry converted area.

Figure 13: Forest land use change section



1 **Vegetation type**: Users have to specify the type of vegetation defined as follows, for the relative type of climate: *Forest zone 1: Tropical rain Forest, Forest zone 2: Tropical Deciduous forest, Forest zone 3: Tropical Dry Forest and Forest zone 4: Tropical shrubland.*

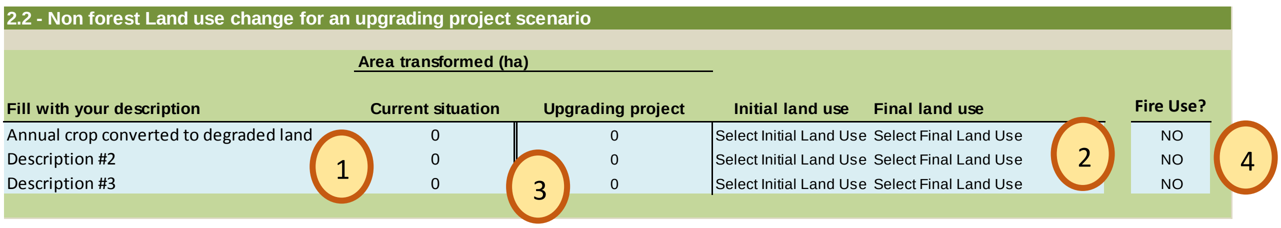
2 **Surface area**: Users have to specify the surface area concerned by the change in deforestation (induced or reduced deforestation by the upgrading value chain project), or reforestation or conversion to agro-forestry.

3 **Final land use**: Users have to specify the final state of the land from a drop-down list. It will determine default carbon stocks per year following the conversion.

4 **Fire use**: Users have to specify whether fire is used or not as a land use change tool

(ii) Non forest land use change:

Figure 14: Non-forest land use change section – Land use change module



1 **Description**: Users have to set up the description of the annual systems in order to avoid any misunderstanding in the data entry.

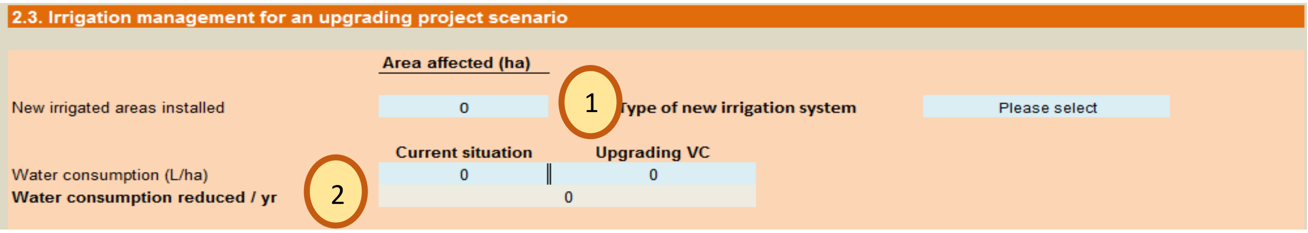
2 **Land use change**: Users have to identify the state of initial and final land use, before and after the upgrading scenario implementation from a drop-down list. This will determine default carbon stocks per year following the conversion.

3 **Surface**: Users have to specify the surface area of the current situation and with the upgrading value chain project.

4 **Fire use**: Users have to specify if fire is used as a land use tool for the conversion.

(iii)Irrigation:

Figure 15: Irrigation section - Land use change module



1 **Surface and irrigation type: Users can find the surface area under new irrigation practices** and the type of new irrigation systems from a drop-down list with implementation of the project.

2 **Water consumption**: Users have to specify the water consumption for both situations. The amount of water consumption reduced within an upgrading scenario will be computed in order to assess the irrigation efficiency.

3.2.3 Agricultural practices module:

This module presents agricultural practices applied from different types of systems: annual, perennial and flooded rice divided into three different sections. Users have to complete this module according to the different practices present for the production. Agricultural practices that are induced by a land use change (automatically integrated) or systems remaining the same (i.e. annual remaining annual during the period of analysis) are differentiated.

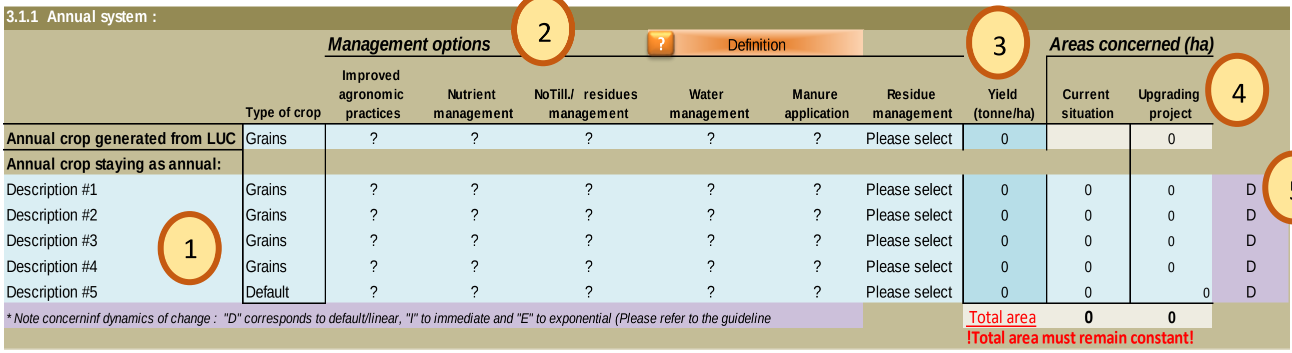
(i) Annual system:

Land management practices are important determinant of soil carbon, especially for annual systems. Annual crops in particular are generally characterized by more intensive forms of land preparation. It is thus essential to differentiate between the following improved practices:

- **Improved agronomic practices** comprise all practices that may increase yields and thus generate higher quantities of crop residues. Examples of such practices reported by Smith et al. (2007) are the use of improved crop varieties, extending crop rotations, and rotations with legume crops.

- **Improved nutrient management** includes the application of fertilizer, manure or bio solids in a way that improves either the efficiency (adjusting application rate, improving timing and location) or diminishes the potential losses (forms of fertilizer with slow release rate or nitrification inhibitors).
- **Improved tillage and residue management** comprises the adoption of tillage practices of less intensity ranging from minimum tillage to no-tillage. It may include or not include mulching of crop residues and thus also comprises a key element of conservation agriculture.
- **Enhanced water management** consists of enhanced irrigation measures that can lead to an increase in productivity and hence augment the quantity of residues.

Figure 16: Annual system section



3.1.1 Annual system :

		Management options							Areas concerned (ha)		
	Type of crop	Improved agronomic practices	Nutrient management	NoTill./ residues management	Water management	Manure application	Residue management	Yield (tonne/ha)	Current situation	Upgrading project	
Annual crop generated from LUC	Grains	?	?	?	?	?	Please select	0		0	
Annual crop staying as annual:											
Description #1	Grains	?	?	?	?	?	Please select	0	0	0	D
Description #2	Grains	?	?	?	?	?	Please select	0	0	0	D
Description #3	Grains	?	?	?	?	?	Please select	0	0	0	D
Description #4	Grains	?	?	?	?	?	Please select	0	0	0	D
Description #5	Default	?	?	?	?	?	Please select	0	0	0	D
								Total area	**0**	**0**	

Definition

* Note concerninf dynamics of change : "D" corresponds to default/linear, "I" to immediate and "E" to exponential (Please refer to the guideline

!Total area must remain constant!

1 **Description**: Users have to set up the description of the annual systems in order to avoid any misunderstandings in data entry. Then users have to select the type of annual crop from the following drop-down list: grain / beans and pulse / root crops / tubers / barley / maize / oats / potato / soybean / wheat. A default value is used for every other crop that is not in the top down list.

2 **Management options**: Users have to select the type of management practices non-mutually exclusive, that are applied for the system described below:

Management options: The drop-down list informs on whether one type of management option is realised for one type of crop. A question mark is a default value, corresponding to "NO".

Residues management: Users have to define which type of residues management is realised for this type of practice (burnt, exported or maintained)

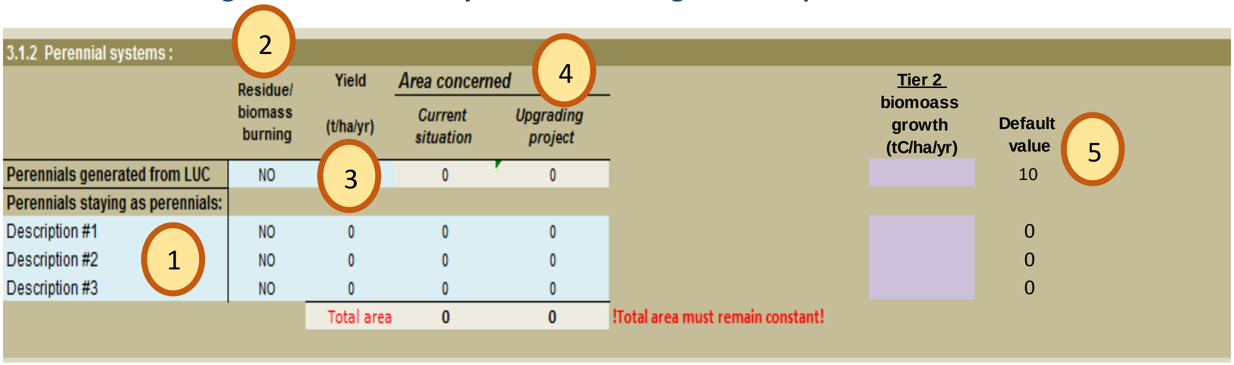
3 **Yield**: Users have to enter the average yield for this crop practice (which will be integrated into the economic analysis)

4 **Area concerned**: Users have to specify the surface area for the current situation and with the upgrading value chain scenario.

5 **Dynamic of change**: In the small violet boxes users can specify whether the changes in management practices materialize linearly (default) over time, occur immediately or exponentially.

(ii) Perennial systems:

Figure 17: Perennial system section - Agricultural production module



1. **Description**: Users have to set up the description of the perennial systems in order to avoid any misunderstanding in the data entry.
2. **Residues management**: Users have to define which type of residues management is realised for this type of practice (burnt, exported or maintained).
3. **Yield**: Users have to enter the average yield for this crop practice, which will be integrated into the economic analysis)
4. **Area concerned**: Users have to specify the area affected by this practice for the current situation and with the upgrading value chain scenario.
5. **Tier 2**: A tier 2 option is added in this section, concerning the biomass growth for agroforestry system. Users have to enter data in tC/ha/yr if the value is different from the default value corresponding to the forest chosen.

(iii)Flooded rice systems remaining flooded rice systems:

While all other annual crops are dealt within the above described sub-module, the production of flooded rice systems, be it under irrigation or rainfed but deep water conditions, has special implications for CH_4 emissions and is thus dealt separately in this sub-module. Systems are differentiated between non flooded preseason of either less or more than 180 days and those cultivation systems with flooded preseason of at least 30 days or longer, as shown in figure 19. It is secondly differentiated between three water regimes during the growing period:

- **Irrigated – Continuously flooded:** Fields have standing water throughout the entire growing season and only dry out for harvest (end-season drainage).
- **Irrigated – Intermittently flooded**: Fields have at least one aeration period of more than three days during the cropping period; no difference is made here for single or multiple aeration.
- **Rainfed, deep water**: Fields are flooded for a significant period of time, while the water availability depends solely on precipitation. It includes the following subcases: (i) regular rainfed (the water level may rise up to 50 cm during the cropping season),

(ii) drought prone (drought periods occur during every cropping season), and (iii) deep water rice (floodwater rises to more than 50 cm for a significant period of time during the cropping season).

Figure 19: Water regime prior to rice cultivation (schematic presentation showing flooded periods as shaded

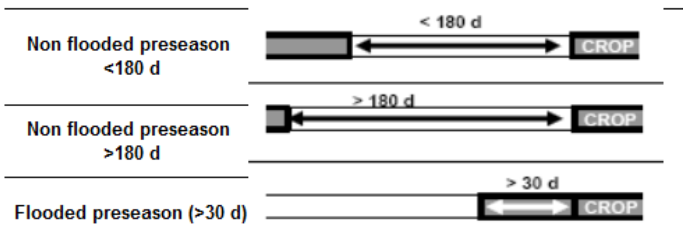


Figure 20: Flooded rice system section

Fill with your description	Cultivation period (days)	Water regime: In cropping season	Water regime: Before cropping	Organic amend type	Yield (t/ha/yr)	Area concerned: Current situation	Area concerned: Upgrading VC
Description #1	150	Irrigated - Continuously flooded	Non flooded preseason <180 days	Straw incorporated long (>30d) before cultivation	3.4	149100	0
Description #2	150	Irrigated - Intermittently flooded	Non flooded preseason >180 days	Green manure	4.3	0	142400
Description #3	150	Please select water regime	Please select preseason water regime	Please select type of Organic Amendment	0	0	0

To fill the flooded rice sub-module users need to specify:

1 **The specific cropping system**: Users specify the cropping system in order to avoid any misunderstanding in data entry or later data modification.

2 **Cultivation period**: Users specify the length of the cultivation period.

3 **Water regime during the cultivation period**: Users then choose whether the rice field is continuously or intermittently flooded. As another option it may also be managed as a deepwater, rainfed system. And **Water regime during the pre-season**: then, users specify from a drop-down list, whether the preseason is flooded, or not flooded and whether the non-flooded preseason is shorter or longer than 180 days.

4 **Organic amendment**: The next step specifies how crop residues are managed and utilized. The different options are: *Straw burnt / straw exported / straw incorporated short or long before cultivation / compost / farmyard manure / green manure.*

The project aims at transforming traditional rice by a System of Rice Intensification, using green manure and with better yield.

5 **Yield and surface of concerned**: Users have to enter the average yield for this crop practice, which will be integrated into the economic analysis. **Finally,** users have to specify the surface area for the current situation and with the upgrading value chain scenario.

(iv) Production lost at the farm level

The last section of the module concerns the lost and wasted production at a farm level. Users have to enter the percentage lost on average for both situations. This option allows users to analyse whether a reduction in production loss with better production management is at the origin of a mitigation impact.

Figure 21: Production lost and wasted at farm level

3.2. Production loss at a farm level	Current situation	Upgrading project
Percentage of lost or wasted production (%)	8%	4%

3.2.4 Production inputs module:

Specific to one type of crop production, inputs are very important in terms of environmental and socio-economic performances. Users should be able to specify data on input consumed. Three sections form this module: Energy consumption, agricultural inputs, and infrastructure.

Entering data in this module on production inputs contribute to the calculation of GHG emissions and socio-economic performance. It can be filled either for the current situation or the upgrading situation.

(i) Energy consumption:

Energy consumption is associated to electricity, gas and fuel consumed at the farm scale by mechanization, irrigation or other infrastructure energy-dependant. Users have to specify:

1. Quantity of fossil energy consumed annually for each energy source in m^3 per year and in Kwh per year for electricity in both situations. If renewable energy is used within an upgrading scenario, it is assumed that the consumption of fossil fuel stops and is reduced to 0 m^3 per year.

2. In which country the consumed electricity was produced, since this determines to which extent it is related to GHG emissions. Thereby it has not necessarily to be the country of project implementation.

Figure 22: Energy consumption at production level - Production input module

4.1 - Energy consumption at production level :

Energy consumed (m^3/yr)	Current situation	Upgrading project	EF (tCO_2-e)
Gasoil/Diesel	0	0	2.62
Gasoline	0	0	2.92
Gas (LPG/ natural)	0	0	0.00
Pls fill if other	0	0	
			Country of origin for electricity
Electricity (Kwh / year)	0	0	Other Africa

(ii) Agricultural Inputs:

This section concerns every inputs directly used in agricultural practices (pesticides, fertilisers)

Figure 23: Fertilizer and pesticides consumption at production level - Production inputs module

List of specific fertilizers (kg/ha/an)	Specify NPK parts N	P	K	Current situation (Kg/ha)	Upgrading project (Kg/ha)
Please enter your specific NPK fertilizer					
Urea	47%			385	385
Lime				0	0
Sewage	5%	N		0	0
Compost	4%	1.5%	1.2%	2500	2500
SSP	18%	46%	0%	308	308
KCL	0%	0%	0%	83	0
Green manue	0%	0%	0%	500	6500
Pesticides					
Herbicides (kg of active ingredient per year)				2.0	0
Insecticides (kg of active ingredient per year)				2	2
Fungicides (kg of active ingredient per year)				3	2

1. **List of specific fertilizers:** A specific fertilizer list have been pre-defined but users can add other crop-specific fertilizers by filling the description part.

2. **Specify NPK parts (%):** Associated to the description, users have to specify the nitrogen (N), Phosphate (P) and Potassium (K) share into the fertilizer, in order to associate the right emission factor.

3. Users have to specify the **quantity used** in kg per ha, on average for every type of production mentioned in the previous module for both situations.

4. **Pesticides:** Specification in kg of active ingredients per year has to be made for pesticides consumption and for both situations.

In the upgrading scenario, an increase of organic amendment (green manure) is observed despite a decrease of chemical one (KCL).

(iii) Infrastructure construction

If upgrading a value chain implies infrastructure construction, e.g. road or building, users have to choose in a drop-down list the type concerned and fill the area in square meters*:*

Figure 24: Infrastructure construction - Production input module

4.3 - Infrastructure construction with upgrading scenario	
Buildings and roads (in m2)	**surface**
Please select	0
Please select	0
Please select	0
Please select	0
Please select	0
Please select	0
Please select	0

3.2.5 Processing module:

Before starting the data entry concerning specifically processing, packaging and storage steps, users have to define the percentage of food self-processed and/or self-consumed by local populations, that doesn't necessarily involve the local firm. This is important for GHG and socioeconomic analysis. Users have also to specify the percentage of production in the processing activities. Crop being seasonal, operators can have different types of production.

Figure 25: Upstream data entry in processing module

Before starting			
% of production selfprocessed and consumed	21%	% of production in the processing activities	67%
% processed	*79%*		

This module is divided in three sub-sections. Two modules concern the set of consumable used during processing, storage and packaging:

(i) Consumable linked to energy consumption:

Figure 26: Consumable at processing level - Processing module

5.1 - Consummable at processing, packaging and storage level

5.1.1 - Processing, packaging :

	Current situation	VC upgrading scenario		Default emission factor (TCO2 eq)	Tier 2 : Emission factor (tCO2-e)
Electricity use *(KW / ton)*	0	0		*0.43*	
Country of electricity production	Other Africa				
Fuel / gas consumption (L/ton)					
Wood	0	0	1	*0.01*	
Peat	0	0		*0.02*	
Gas (LPG/natural)	0	0		*0.02*	
Gasoil/Diesel	0	0		*2.62*	
Gasoline	5	5		*2.87*	
Description here if other	0	0			

5.1.2 - Storage

Type of storage					
Refrigeration				0.0083	
	2 ent tion	Upgrading VC	Unit		
Electricity consumption	0	0	*KW / days*		
Fuel consumption	0	0	*L / days*	3	0.01
Type of fuel	Propane				
Period of storage	0	0	*Days*		

Since there are different steps that can be interconnected between each other such as processing and storage, energy consumption is divided in two subsections.

1 **Processing and packaging:** users have to specify electricity, fuel and gas consumption in unit/ton of product. To make this tool more flexible for each type of product, users can specify another type of energy and the emission factor equivalent.

2 **Storage**: Users have to specify the **type of storage** considered for this production. Several types of storage are defined in the top-down list: *Refrigeration, involving specific gases at the origin of GHG emission and energy consumption, Ventilation, None, Other*. Users can use the default emission factor or use its own values for the type of conditioning, which is context-specific.

3 Moreover, storage can be more or less long for different types of food products. Users have to specify **electricity and fuel consumption per day** – by choosing the type in the drop-down list and filling the emission factor corresponding if it is another one. The **Period of storage** then has to be necessarily filled, in order to calculate the right amount consumed for this production.

(ii) Other consumables:

Processing steps also involve other types of inputs and consumables. Users have to specify:

1 **Type of packaging** for transportation and conditioning. Data entry corresponds to the weight of packaging per ton of production. Emission factors are associated to every type of packaging, but users can specify other types of packaging with an emission factor corresponding.

2 **Water consumption** has to be specified in the corresponding section in order to analyse the water use efficiency by upgrading a value chain at processing level.

Figure 27: Other consumable at processing level - Processing module

5.3 - Other input and consummable

Type of packaging	**Current situation**	**VC upgrading scenario**		**Emissions factors** *(TCO2 eq / ton of product)*
Wood	0	0	kg / ton of product	0.44
Paper and card	0	0		2.1
Aluminium	0	0		8.53
Plastic (mixed)	0	0		3.57
Specify here if others				
Jute bags	2	2		
Description	0	0		
Water consumption				Water use efficiency at processing level
Volume of water consumption	0	0	L / an	0

For transporting rice, jute bags are used.

They represent a weight of 2 kg per ton of rice transported.

(iii)Production lost and processing rate:

Production lost and **processing rate** at processing level have to be determined in this module.

Processing rate is defined as the quantity transformed after processing with one tone of raw production. For instance, the production rate for producing rice from paddy is between 60 and 69%. 1 ton of paddy allows to produce between 600 kg and 690kg of rice. By upgrading a value chain it is possible to increase this rate to enhance efficiency of processing and the amount of food available.

Figure 28: Production lost at processing level

5.4 - Production loss and processing rate at processing and storage level

	Current situation	VC upgrading	
Total loss on PPS level	5%	3%	
Processing rate (if any transfo)	66%	68%	(example 60-69% for paddy transformed in rice)

3.2.6 Transport module:

The transportation module corresponds to every step of transportation from farm to retailers that involves different types of transport and conditioning.

(i) Type of transport and distance travelled:

Figure 29: Transportation within the different stages of the value chain

We ... the transport will not change during the impl... ion phase

1 2 3

	Place of departure	Type of transport	Nb of km
1	Farm	*Between 1 and 2*	
		Truck in country	35
2	Processing/storage	*Between 2 and 3*	
		Truck in country	70
3	Wholesaler		
		Truck in country	70
4	Retailers		

In this region of India, only truck transportation is considered to transport rice from farm to retailers for local consumption. The distances in the screenshot are an average between every type of operator. No conditioning is taking into account.

1 **Place of departure:** Via a drop-down list users can choose departure points from every stage of the value chain: *Farm, processing/storage, wholesaler, harbour initial, harbour final, airport initial, airport final, retailers.*

2 **Type of transportation:** The type of transportation has to be chosen also via a top-down list between the two departure points: *Truck in/out country, air, rail, inland water, international ship.*

3 **Nb of km**: Finally, users have to specify the number of kilometres done between point 1 and 2.

For this section we assume that no change will occur within an upgrading scenario. It remains the same for both situations.

(ii) Conditionning during transportation:

A second section allows to determine the type of conditioning used during transportation: *Refrigeration, ventilation, none, other*. Users have to specify which type is used for the production analysed in order to associate the corresponding emission factors. Context-dependent, they can be changed for every type of conditioning.

Figure 30: Conditioning during transportation

	Truck transport	See transport
Type of conditioning	None	None
Default Emission Factor (TCO2eq)	0	0
*Emission factor if **different** or **other***		

(iii)Production lost at transportation level:

In the same way as previously seen, the percentage of production lost at transportation level has to be filled by users for both situations. It is an average calculated or estimated for every step of transportation.

Figure 31: Section loss of production at transportation level

6.3 - Production loss at transport level		
	Current situation	Upgrading VC scenario
Production loss at transport level	4.00%	2.00%

3.2.7 Socio economic analysis:

In order to be able to analyse the socio-economic performance of food value chains, this module has been developed to allow users to enter quantified data on input prices, labour, salary and other costs for the two types of possible analysis.

This module is divided into three sections. The first one concerns the agricultural production, the second one the packaging and storing activities and the downstream transportation. The last one finally concerns every stage after processing, i.e. the steps about selling the banana production to wholesaler and retailers.

In order to simplify data entry in the module, prices, costs and salary are specified in local currency. Users only have to enter a **change rate** in order to compute every cost at every stage of the production in US$. Costs are computed by multiplying quantity of inputs, yield or area previously entered in the tool, by prices in local currency assuming that input prices don't change within an upgrading project scenario. However, an option allows to change the selling prices between the two situations (increase of selling prices because of upgrading the quality of the product).

Other data not specified in the other modules such as taxes, renting equipment, maintenance, number of operator, transport capacity of one truck should be specified by users to provide a precise and relevant analysis.

Finally, this module provides total costs per hectare or per ton of production that will be used to compute the different socio-economic indicators described in the previous chapter.

For example, the section dedicated to packaging and storage is presented as follows:

Figure 32: Socio-economic analysis - Packaging and storage level

Current situation

		Unit	Price : local currency	Production cost (US$)
Additional data	processed		79%	
Nb of ton / truck			20	ton
Nb of liter consumed / truck			40	L
Nb of operators			184	
We assume 1 collector = 1 truck x 100 truck loads / year			2000	ton collected
Intermediate processing consumption / t of production				
Energy consumption				
Electricity use (KW / ton)	-	*KW*	0	-
Wood	-	*kg*	0	0
Gas (LPG/natural)	-	*L*	0	0
Gasoil/Diesel	-	*L*	0	0
Gasoline	5.00	*L*	44	3.28
Electricity use for storage	-	*KW*	0	0
Other cost			0	-
Packaging cost				
Wood	0	*kg*	0	-
Paper and card	0	*kg*	0	-
Aluminium	0	*kg*	0	-
Plastic (mixed)	0	*kg*	0	-
Sac de jute	2	*kg*	2	0.06
Description	0		0	-
Labor per ton of production (man-days)				
Full time practical workers employee	0.4	*MD/t*	302	2
Full time manager employee	0		302	0
Seasonnal employee	0.4		302	2
Familly workers	0		302	0
Total	**0.8**			
Other costs at processing level				
Road, local taxes			0	0.00
Purchase of product			23182	346.00
Transportation cost			price of fuel	
Upstream transportation	35	km	44	0.46
Upstream transportation labor			wage + driver	
Nb of truck driver eq	184	Man	342	0.47
Nb of driver assistants	368		*241*	0.66
Other costs at transportation level per ton				
Food, …			0	0
Various			0	0.0
Total cost per ton of product				355
Other cost per operator				
maintenance of processing equipt +oil			2300	34
Maintenance and reparation of truck			1500	22
renewed equipement and bags			2000	30
Building renting			0	0
Stocking chemicals			0	0
Capiltal amortization per year			0	0
Credit costs			0	0
			Local currency	US$
Ex-factory price / ton of product			36,180	540.0
Gross margin per ton of product				185
Agregate value chain at processing level				
Net production processed (before preocessing)			368444	ton
Net quantity of product after processing			243173	ton

Upgraded Value Chain

Is only shown data that can be changed within the upgrading project

	Quantity	Production cost (US$)
Nb of ton / truck	20	ton
Nb of liter consumed / truck	40	
Nb of operator	243	
	2000	ton collected
Intermediate processing consumption / t of production		
Energy consumption		
Electricity use (KW / ton)	-	-
Wood	-	-
Gas (LPG/natural)	-	-
Gasoil/Diesel	-	-
Gasoline	5.00	3.28
Electricity use for storage	-	-
Other		-
Packaging cost		
Wood	0	0
Paper and card	0	0
Aluminium	0	0
Plastic (mixed)	0	0
Sac de jute	2	0.06
Labor per ton of production (man-days)		
Full time practical workers employee	0.4	2
Full time manager employee	0	0
Seasonnal employee	0.4	2
Familly workers	0	0
Total	**0.8**	
Other costs at processing level	*Cost / t/ yr*	
Road, local taxes	0	0.00
Purchase of product	23182	346
Transportation cost		
No difference in transportation in an upgrading scenario		
Total transportaiton cost per ton of product		2
Total cost per ton of product		355
Other cost per operator		
maintenance of processing equipt +oil		34.32835821
Maintenance and reparation of truck		22.3880597
renewed equipement and bags		29.85074627
Building renting		0
Stocking chemicals		0
Capiltal amortization per year		0
Credit costs		0
		US$
Ex-factory price / ton of product		540.0
We assume the price will not change within the project implementation		
Gross margin per ton of product		185
Agregate value chain at processing level		
Net production processed	486233	ton
Net quantity of product after processing	325776	ton

The two other sections have the same framework. Only the type of labour and the type of input and costs change. Some other additional data can be also required. Please refer directly to the tool to see how the framework looks like.

3.2.8 Value chain resilience module:

According to the methodology described in the chapter 3.3.2 on the qualitative multi-criteria analysis of value chain resilience, this module allows to answer the 36 questions corresponding to the 36 qualitative criteria.

These questions that have been raised being relevant to analyse in the qualitative appraisal of the value chain resilience, are divided into 5 sections in the module.

This appraisal is only realized according to how the upgrading project scenario can improve the resilience of households, ecosystems and markets. It doesn't concern the current situation of the project.

An expert assessment between 0 and 4 is realized, raising the most relevant performance indicator. According to the context of the value chain analysed and the type of project, a weight is addressed to each question. For instance, a project concerning agroforestry do not consider the crop failure as much as a project concerning monocrop banana upgrading. This module is presented as follows:

Figure 33 : Qualitative value chain resilience appraisal

Data entry for qualitative appraisal of climate resilience induced by project to be done in light blue cells

		Expert group Assessment	*Indicator Weighting*	
	Buffer capacity of watershed, landscape and project area	**(0-4)**	*(0-3)*	
1	To what extent does the project improve land cover? (e.g. agroforestry, cover crops etc.)	0	1	
2	To what extent does the project reduce soil erosion?	2	2	
3	To what extent does the project improve soil conditions (e.g. soil moisture, soil structure etc.)?	2	2	
4	To what extent does the project improve efficient use of water?	3	2	
5	To what extent does the project save water?	3	2	
6	To what extent the project area is protected from climate shocks	0	2	
7	To what extend the project infrastructure - building investments are climate-proof	0	2	
	Sub-Result	**20**	**low**	*26*
	Buffer capacity of crop –livestock production	**(0-4)**		
8	To what extent does the project reduce crop failure?	2	2	
9	To what extent does the project improve resistance of crops to pests and diseases?	2	2	
10	To what extent does the project improve resistance of livestock to pests and diseases? (e.g. through	0	0	
11	To what extent does the project reduce post-harvest losses?	2	2	
12	To what extent does the project increase practice of mixed cropping/intercropping?	0	3	
13	To what extent does the project promote on-farm **diversity** (annuals/perennials, mixed cropping, mixed farm enterprise e.g. livestock-crop)?	0	3	
14	To what extent does the project reduce (crop/livestock) yield variability?	0	0	
	Sub-Result	**12**	**low**	*24*
	Buffer capacity of households in relation to food security	**(0-4)**		
15	To what extent does the project improve household food availability (e.g. through increased household	3	3	
16	To what extent does the project improve household food storage	2	2	
17	To what extent does the project improve household income?	4	3	
18	To what extent does the project increase agricultural production physical assets?	3	2	
19	To what extent does the project improve access of households to agricultural inputs?	1	2	
20	To what extent does the project support (existing or new) farmer groups and networks?	0	2	
21	To what extent does the project increase agricultural skills?	3	2	
22	To what extent does the project improve access of households to climate-related social safety nets	2	2	
	Sub-Result	**43**	**medium**	*30*
	Self-organisation of households	**(0-4)**		
23	To what extent does the project improve cooperation and networks of farmers (e.g. farmer groups,	1	1	
24	To what extent does the project collaborate with national/sub-national farmer/pastoralist organisations	1	1	
25	To what extent does the project support farmer-networks across scales (e.g. local farmer groups being connected to national farmer organisations; bridging/linking social capital)?	0	1	
26	To what extent are farmers actively participating in the project?	4	2	
27	To what extent does the project foster good governance (keeping of records; accounting for exclusion, elite capture and corruption) in farmer cooperation and networks?	4	2	
28	To what extent does the project improve farmer skills to manage groups?	1	2	
29	To what extent does the project link agriculture value chains?	4	1	
30	**On-farm reliance**: To what extent does the project build on local knowledge?	4	1	
	Sub-Result	**28**	**medium**	*20*

Chapter 4: EX-ACT VC Results, a multi-impact appraisal

4.1 Presentation of the "Value Chain results" module:

The situation of the analysed value chain, either for the current situation or for an upgrading scenario is summarized in one page-excel sheet using the set of agro-ecological, energetic and socio-economic data entered in every module of the tool. Three dimensions result from data entry in the different modules of the tool: climate mitigation dimension, climate resilience and socio economic analysis. Some of the different indicators summarizing the performance of the value chain are detailed for the different stages of the chain and for both situations of the value chain (current or upgraded). A balance between the two results is computed allowing users to estimate the improvement realised by an upgrading scenario. This methodology is based on the idea of measuring and have access simultaneously to environmental and socio-economic

Figure 32: Value chain results module

Price tCO_2-e: 10 US$

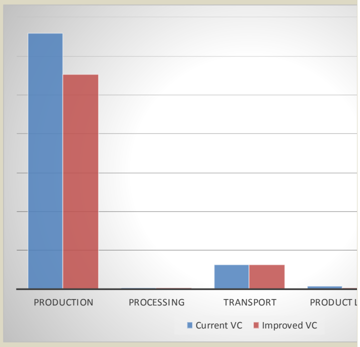
Climate Mitigation dimension of the value chain (s)	Current situation	Value chain upgrading project	Balance
GHG impact in tCO_2-e per year	1,671,006	1,585,660	-85,346
GHG impact in tCO2-e per year per hectare	11	10.63	-0.6
Carbon footprint per tonne of production, in tCO_2-e per tonne of product	3.7	3.11	-0.6
Incremental in tCO_2-e [emitted (+) / reduced or avoided (-)]		- 85,346	
Equivalent project cost per tonne of CO_2 reduced or avoided, in US$ per tCO_2-e		0	
Equivalent value of mitigation impact per year , in US$ /tCO_2-e		853,464	
Equivalent value of mitigation impact per year per ha, in US$ /tCO2-e per year per hectare		6	

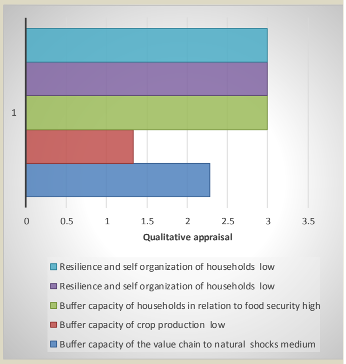
Carbon footprint at the different levels of the Value Chain	Emissions (tCO2/t product) Current VC	Improved VC	Balance
PRODUCTION	3.296	2.762	-0.534
PROCESSING	0.014	0.014	0.000
TRANSPORT	0.315	0.315	0.000
PRODUCT LOSS	0.037	0.018	-0.019
RETAIL	0.000	0.000	0.000
TOTAL	3.663	3.110	-0.553

Climate Resilience dimension (s)	Current situation	Improved VC	
Hectares of land managed under climate-resilient practices	149100	149100	ha
Hectares with improved tree and vegetal coverage (land slide, flood resilience)	0	0	ha
Number of hectares with increased soil carbon (drought and erosion resilience)		0	ha
Number of HH having become more climate resilient		0	HH

Resilience index of the value chain upgrading	Current situation	Value chain upgrading project
Buffer capacity of the value chain to natural shocks		medium
Buffer capacity of crop production		low
Buffer capacity of households in relation to food security		high
Resilience and self organization of households		low
Resilience and self organization of households		low
Global climate resilience generated by Value chain		medium

Socio-economic performances of the value chain	Current situation	Value chain upgrading project	Balance	
Production level				
Nb of operator eq	48308	34591	-13717	jobs
Gross production Value (GPV)	161369	212958	51589	000 US$
Value Added (VA)	64382	184104	119722	000 US$
Gross Income (GI)	2079	136587	134509	000 US$
VA / tonnes of product	138	299	161	US$
VA / ha	432	1235	803	US$
Gross income / farmer - beneficiaries	28	1833	1805	US$
Processing and upstream transportation level				
Nb of operator eq	1179	1556	377	jobs
Gross processed value	3832	7682	3851	000 US$
Value added	2431	5833	3403	000 US$
Gross income	687	3854	3167	000 US$
VA / ton of product	7	18	11	US$
Gross income / operator	3734	15862	12128	US$
Downstream transportation level				
Nb of operator eq	243	326	83	jobs
Gross production value	-1581	570	2151	000US$
Value added	-1730	370	2100	000 US$
Gross income	-1767	214	1981	000 US$
VA / operator	-21339	3411	24750	US$
Gross income / operator	-21793	1973	23766	US$



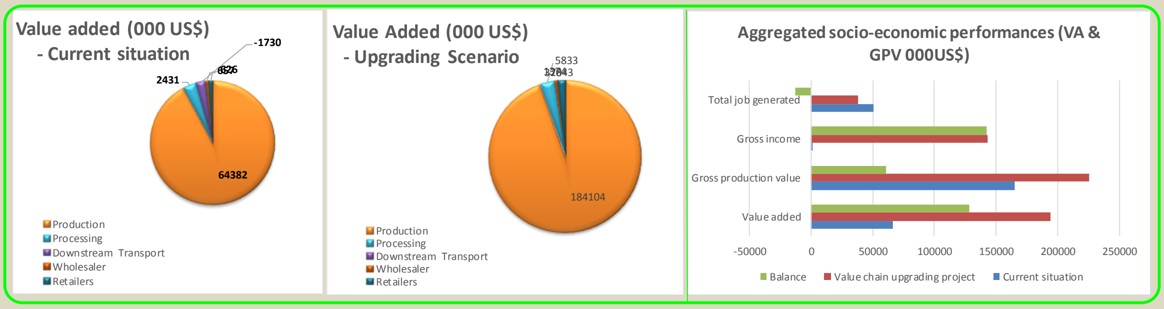


performance of the value chain that are deeply linked. It helps users to have a global overview of the value chain performances. This module is presented as follows:

Wholesaler				
Nb of operator eq	613	834	221	jobs
Gross production value	803	1572	770	000 US$
Value added	657	1374	717	000 US$
Gross income	15	463	448	000 US$
VA / operator	26268	91593	65326	US$
Gross income / operator	582	30869	30287	US$

Retailers				
Nb of operator	460	642	182	Jobs
Gross production value	626	2843	2218	000 US$
Value added	626	2843	2218	000 US$
Gross income	107	2120	2013	000 US$
VA / retailers	95	310	215	US$
Gross income / retailers	16	231	215	US$

Aggregated Socio-economic performances	Current situation	Value chain upgrading project	Balance		
Value added	66365	194524	128159	000 US$	0.341167
Gross production value	165048	225626	60577	000 US$	
Gross income	1121	143239	142118	000 US$	
Total job generated	50804	37949	-12855	Jobs created	



4.2 <u>How to analyse the results given by EX-ACT VC ?</u>

This section will help users understanding how it is possible to analyse the results given by EX-ACT VC after entering every data concerning the analysed value chain.

Two types of analysis can be done with the tool. The different indicators are either present for both situations or they only concern the upgrading scenario. As mentioned previously, the current situation is used as a reference for the upgrading scenario. It means that for analysing the performances of the value chain upgraded, the upgrading scenario has to be compared with the baseline scenario (current situation).

To better understand how it is realised, the SRI support project realised in India (IAM WARM) is taken as an example in this section (Please refer to the different figures in the previous chapter for the data entered to have access to these results).

<u># Case study: IAMWARM – Tamil Nadu Irrigated Agriculture Modernization and Water Basin.</u>

In India, the potential improvement of agriculture performance has been identified in the region of Tamil Nadu, where a majority of the population lives in rural areas depending on rice income. This program is a unique World Bank funded project implemented with the prime motive of maximizing the productivity of water leading to improved farm incomes and products. Under this project, 63 selected sub basins were covered in a period of six years (2007-2013) with Water Resources Organization (WRO), PWD, and Government of Tamil Nadu as the Nodal Agency.

The **project objective** is to achieve sustainable economic growth as well as poverty alleviation through maximising productivity of water. One component of the project is to work toward supporting a large scale adoption of specific technologies such as SRI in paddy.

World Bank has collected data about socio-economic performance of this project in order to implement a second phase : IAMWARM II, that is going to start soon. For EX-ACT VC, we only focus on the paddy production in this region of India using Tropical Moist climate where HAC soils are the dominant soil in the region. Starting in 2017 within a period of 10 years the project will affect 74,500 farmers or households in the region. Seven different crops are anaylsed in the project and the main activities are to increase the diversification of crop production by applying inovative practices. For this analysis, we only focus on the paddy. The project currently concerns 149,100 ha of traditional rice, wich will be reduced in the upgrading scneario to 142,440 ha of SRI rice for the first rotation.

After entering every data on production, processing and transportation consumable, users can have access to the value chain results in terms of socio-economic and environmental performances. Every indicators have to be analysed simultenaously considering the context of the value chain. For instance the value added cannot be analysed without taking into consideration the agricultural practices applied and the mitigation impact resulting from it.

In terms of mitigation dimension, the upgrading project scenario of the value chain is at the origin of 10.4 tCO2-e per year/ha but it is reduced as compared to the current situation due to a diminution of the area covered by rice production and by implementing improved agricultural practices. Because processing doesn't use a lot of input, and because transportation is mainly done in the country, the detailed carbon footprint, even though it is lower for the upgrading scenario, shows that the main sector with mitigation potential is the production stage of the value chain. This reduction of GHG emission can be assessed in terms of economic returns. Those indicators are only present for the value chain upgrading scenario. Implementing SRI systems allows to earn 8US$/ha/yr, that can be used, for instance, to seek access to payments for environmental services.

The shift from traditional rice to SRI increases the value added generated at every level of the value chain, gross production value and gross income available for farmers and operartor among the rice chain. For instance, the value added goes up from 7 to 18 US$ per ton of product at the processing level between the two situations.

However we can observe that the volume of employment generated decreases within the upgrading scenario due to the diversification and the new system applied. The detailed results show that it is only present at production level due to less man-day per hectare needed for SRI than for traditional rice. Because the productivity of rice increases with SRI and because there is less work force needed, the amount of income available for every farmer increases considerably from 28US$ to 1751 US$.

Implementing new systems in India has a positive impact both in terms of environmental performance with a diminution of GHG emissions, and in terms of socio-economic performances. The diversification applied in this project reduces the area covered by rice but it is compensated with the increase of yield and thus with an increase of value added. This implies a better distribution in the revenue and consequently a reduction of poverty in the rural areas where rice is produced.

Conclusion:

The greening trend in local, national and international economy creates a need of multi-performant tools in order to raise awareness and help policy makers, investors and actors to take part in development actions to support sustainable food value chain development. Tools such as EX-ACT VC allow to face societal and environmental trends that reduce or at least limit food value chain performances. EX-ACT VC is an innovative tool linking all these dimensions. Allowing to ex-ante or ex-post analyse the impact of a food value chain on dimensions linked to its sustainability, it is possible to assess if the international objectives are reached, the progress realised and pre-assess the impact that could occur on a given time period. It is a performant tool to analyse simple food value chains in a given context, with a low amount of data needed and normally easy to collect. Derived from EX-ACT, which has already been used for numerous agricultural project development all around the world, the methodology applied in EX-ACT VC seems to be relevant and adapted to the international demand to have access to easy and multi-performing tools.

Being able to use such a tool allows to facilitate the decision making for the strategic orientation of the different operators linked to every value chain in the world. The chosen indicators to analyse environmental and socio-economic performances are complementary and simultaneously allow to have a global overview of the performances and the upgrading that are able to be reached on the different stages of the chain. It is thus adapted to a wide set of actors, as well as for those directly linked to the chain or for those that only have a role in the decision making to the upgrade value chain.

With an increasing demand for analysing co-benefits of value chains also for livestock and fisheries, we are currently developing other tools, based on this one, for analysing fisheries value chain and livestock value chain which will be available soon.

Such tools would also be adapted to the value chains in developed countries that are more complex, more diversified and which imply more operators.

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