Food and Agriculture Organization
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Ex-Ante Carbon-balance Tool for Measurements, Reporting and Verification (EX-ACT MRV)

GUIDELINES

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Towards Sustainable Impact Monitoring of Green Agriculture and Forestry Investments by National Development Banks: Adapting MRV Methodology

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Acronyms

AFD	Agence Française de Développement
AFOLU	Agriculture, Forestry and Other Land Uses
CC	Climate Change
CFP	Carbon footprint
CH_4	Methane
CO_2	Carbon dioxide
CRAAF	Climate Resilience Assessment of Agriculture and Forestry Projects and Programmes
CSA	Climate Smart Agriculture
EX-ACT	EX-Ante Carbon-balance Tool
EX-ACT VC	EX-Ante Carbon-balance Tool for Value Chain
EX-ACT MRV	Ex-Ante Carbon-balance Tool for Measurements, Reporting and Verification
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
GHG	Greenhouse gas
GIRI	Global Incremental Resilience Index
ha	Hectare
HH	Household
IFAD	International Fund for Agriculture Development of the United Nations
IFI	International Financial Institutions
IPCC	Intergovernmental Panel on Climate Change
LFI	Local Financial Institution
MRV	Measuring, Reporting and Verifying
N_2O	Nitrous oxide
NDB	National Development Bank
PES	Payment for ecosystems services
SWC	Soil and Water Conservation
tCO_2-e	Tonne of CO_2 equivalent
UNFCCC	United Nations Framework Convention on Climate Change

Executive summary

Agriculture, forestry production and land use change (overwhelmingly related to agriculture) represent one quarter of all greenhouse gas emissions (GHG) (IPCC, 2014).

Three quarters of the world's poor live in rural areas (in which 80 percent of revenue comes from agriculture) and an increase in Gross Domestic Product (GDP) contributes four times more effectively in reducing poverty when such increases come from agriculture, than another sector (World Bank, 2008). In this context, small farmers are especially vulnerable to the effects of climate change (CC).

The financing of agricultural investments is essential to increase productivity, improve farm incomes and acquire new assets to cope with shocks, allowing increased resilience and adaptation to CC. In general, the development of financial services (credit, savings, insurance) in rural areas allows the establishment of a protective institutional environment that enables rural people to face climate-related risks (decline in agricultural production, e.g. as a result of reduced precipitation or an extreme event).

Many investment projects that have "climate co-benefits" in the agricultural and forestry sector are set up by the financial sector of developing countries, particularly by public development banks. National Development Banks (NDBs) are increasingly integrating CC considerations into their core operations and are becoming more and more active in financing CC interventions. This progressively strengthens the role they play in funding low-emission projects and programmes (Smallridge *et al.*, 2012).

The transformation towards a low-carbon, climate resilient environment requires a large and constant flow of funding, something that governments cannot always easily provide. This is the reason why mobilization of private sector investments is essential for CC mitigation. NDBs can play an important role in scaling up private sector investments and helping overcome some of the existing barriers the private market will not bear. Having a monitoring, reporting and verifying (MRV) system suitable for NDBs’ portfolio of projects, and in line with the national context, allows the institutions to keep track of the mitigation and adaptation impact of their green credit line portfolio for projects in the Agriculture, Forestry and Land Use (AFOLU) sector. It also allows them to improve their accountability in order to have access to public incentives.

The MRV methodology for monitoring green agriculture and forestry investments was developed by FAO in collaboration with AFD. It is designed to measure the impact of both mitigation and adaptation projects in the AFOLU sector, specifically for groups of projects belonging to NDBs’ portfolio.

In particular, the tool shows the most advantageous cost/benefits relationship in its implementation within the institutional system and the ease of use. Some of its strong points are i) the capacity to appraise not only the mitigation and adaptation impact, but also important economic and social aspects of the projects and households’ resilience; ii) the ability to provide not only an ex-ante, but also a mid-term and ex-post analysis of the impact of a project or group of projects.

This quick guidance material is structured into two parts. The first part, *Guide for decision makers*, presents the rationale of the tool and discusses the logic behind it. The second part, *Guide for tool users*, introduces more technical aspects of the methodology as well as data collection and entry.

Chapter 1. Quick guidance for decision makers

1. Climate change and national development banks

Transformation towards a low-carbon, climate-resilient environment requires a constant supply of substantial funding, which is not always easily provided by governments alone. This is why mobilization of private sector investments in CC mitigation is essential and NDBs can play an important role in scaling up private sector investments and help overcome some of the existing barriers in the private market.

The majority of climate finance is not distributed directly by governments to end users, but rather through banks and government agencies. Bilateral and multilateral financial institutions play a key role in the distribution of climate finance, accounting for approximately 40 percent of the total.

Due to their characteristics and deep understanding of the national context in which they operate, NDBs play a key role in creating the financial instruments required to encourage investment by the private sector. They also have the potential to promote market development, creating favorable market structures and provide the necessary financial instruments to leverage financial resources to mobilize private sector investment in sector programs mitigation.

NDBs can play a dual role in this, both complementing and catalyzing private sector investments. Their knowledge and relationship with local private sectors place them in an ideal position to understand local barriers to investment and design a financing package tailored to the needs of local investors. In addition to providing financial and non-financial instruments to directly engage the private sector, they can also act as security devices to generate market and investments, providing additional incentives for this sector to increase their investment. Compared to commercial banks and investment funds, NDBs have greater potential to take risks that stimulate long-term investments.

There are different types of financial instruments that NDBs can use to mobilize climate finance (Smallridge *et al.*, 2013a):

1) **Grants**: grants can be used for a variety of activities in both the pre-investment stage (for technical assistance or subsidizing insurance premiums) and the investment phase (to lower the interest rate).
2) **Tier 1 loans**: they are direct loans in which the NDB takes part or total credit risk of the project's obligor. In this case the NDB directly provides the credit to a project or a company.
3) **Tier 2 loans**: these are granted by NDBs to financial institutions (commercial banks or other financial intermediaries) so that they can be lent again. The NDBs take the credit risk of the Local Financial Institutions (LFIs) directly, whereas the LFIs assume the credit risk of the project.
4) **Guarantee funds to cover part of the risks**: many time guarantee funds are bought by the state to incentivize the intervention of the NDB in more risky sectors.
5) **Equity funds**: the fund intervenes through a contribution of capital resources in specific companies.
6) **Funds management**: the NDB manages these funds on behalf of the government, given the skills, expertise and reliable systems that enforces.

NDBs cannot operate alone, but need technical and financial support from their own governments. To this end, governments should not only strengthen the role of NDBs, but also provide specific support actions such as ensuring the necessary resources to develop their internal capacity, providing technical support and capacity building to develop green financing lines (De Olloqui, 2013).

Therefore, in order to improve green financing, it is important to strengthen the capacity of development banks to invest in green finance. This should be achieved by promoting the creation of "green programs" and "green portfolios" within the banks and by working on a clearer definition, measurement and monitoring of "green finance". These will strengthen the governance of development finance by putting in place the proper monitoring systems to evaluate the social and environmental impacts of both green and non-green financial flows, whilst also increasing the operational capacity of development banks and developing 'green bond' programs (Smallridge *et al.*, 2013b).

2. Agricultural investment projects and their impact on mitigation and adaptation

Agricultural investment projects need to take into consideration their impact on climate mitigation and adaptation. It is therefore important to understand the difference between these two concepts.

Mitigation of CC is a human intervention to reduce the sources or enhance sinks of GHGs. The goal of mitigation is to “stabilize GHG levels in a timeframe sufficient to allow ecosystems to adapt naturally to CC, ensuring that food production is not threatened and allowing economic development to proceed in a sustainable manner” (IPCC, 2014). Initiatives working towards this goal may include those that, for example, avoid dangerous human interference with the climate system, protect natural carbon sinks like forests and oceans or create new sinks through silviculture or green agriculture.

Climate **adaptation** refers to the ability of a system to adjust to CC (including climate variability and extremes) to moderate potential damage, to take advantage of opportunities or to cope with the consequences. The International Panel on Climate Change (IPCC) defines adaptation as “the adjustment in natural or human systems to a new or changing environment” and defines adaptation to CC as “the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities” (IPCC, 2007). Adaptation seeks to lower the risks posed by the consequences of CCs. The goal is to reduce humanity’s vulnerability to the harmful effects of CC (such as sea-level encroachment, more intense extreme weather events or food insecurity).

While adaptation actions are necessary in the short-term for limiting the risks of CC damages, mitigation actions are necessary for limiting damages in the long-term by reducing anthropogenic emissions or enhancing carbon sinks.

There are also significant differences in the policy nature underlying adaptation and mitigation actions. The benefits of adaptation choices will be realized almost immediately but will matter most under moderate CC, perhaps up to the mid-21st century. By contrast, benefits of mitigation may only be realized decades from now, becoming relevant towards the end of the century.

Another important concept to acknowledge is **resilience**. Resilience is the ability of people, communities or systems that are confronted by disasters or crises to withstand damage and recover in a timely, efficient and sustainable manner. This includes protecting, restoring and improving food and agricultural systems under threats that impact food and nutrition security, agriculture, food safety and public health.

Knowing the different aspects of CC and the options for mitigation and adaptation will allow for well-informed decision-making by farmers, policymakers and practitioners. The following chapter will show how climate investment projects in the agricultural and forestry sector can have an impact on climate mitigation and adaptation. For this purpose, a set of mitigation and adaptation options will be presented along with suggestions on GHG effects that might need to be considered to improve climate resilience.

2.1. Agricultural mitigation options

<u>Annual crop management:</u> Project activities that improve crop production are numerous, and may have diverse impact on GHG sinks and sources. Sustainable land management practices (such as changes in crop type or variety, nutrient management, water management, crop residue management or tillage practices) may have direct effects on soil carbon stocks. They may also directly affect nitrous oxide (N_2O) emissions from organic manure or synthetic fertilizers by increasing the efficiency of nitrogen use and reducing emissions. Improved management of crop residues may reduce N_2O and methane (CH_4) emissions from burning and increase soil carbon stocks. In wet rice production systems, the main source of GHG emissions is CH_4, which may be affected by changing irrigation practices. Agroforestry practices may also directly affect woody biomass carbon pools.

Some cropland management practices may increase project emissions, for example if the use of synthetic fertilizers, agricultural machinery or pumped irrigation water is increased. Energy used in irrigation pumping will either cause direct emissions (e.g. if diesel pumps are used) or indirect emissions (e.g. if electricity is the main energy source). Whether or not off-site emissions from electricity production or other agricultural inputs are included in the GHG assessment can be determined.

<u>Grassland and livestock management:</u> Grasslands and other grazing lands are very diverse, both in their initial vegetation types and their responses to management practices. Where grassy vegetation is dominant, improved

management or restoration may be expected to primarily impact soil carbon pools (FAO 2009). Where bushes or trees are common, the main impacts may be on woody biomass carbon pools. Changes in livestock density will affect CH_4 emissions from enteric fermentation and N_2O and CH_4 emissions from manure deposited on pasture. Improved availability and quality of forage after improved grassland management, improved livestock management or improved feeding practices, may also affect CH_4 emissions from livestock enteric fermentation.

However, in extensively grazed systems, due to low livestock densities these effects may be relatively small. In intensive livestock systems, improved livestock management and feeding practices may affect both CH_4 emissions from enteric fermentation and N_2O and CH_4 emissions from manure management, especially if manure management systems change (such as with a shift from grazing to stall-fed systems). Where animal dung is an energy source, changes in grazing or manure management practices may also have direct effects on household (HH) energy use. Changes in fodder and feed production on-farm will affect direct GHG emissions from land use and crop cultivation.

Perennial crops and agroforestry: Trees in agricultural systems, whether perennial crops or other agroforestry systems, affect primarily woody biomass carbon pools, though also soil carbon pools to some extent (Kumar and Nair 2011, Somarriba et al 2012). Perennial tree crops are often intercropped with other crops or vegetation, so activities that improve perennial tree crop management may also impact the structure and management of accompanying crops, with direct effects on GHG sinks and sources. Project activities that expand the area under perennial tree crops may involve biomass burning for clearing, causing N_2O and CH_4 emissions, and displacing prior agricultural activities (e.g. annual crops or livestock grazing), potentially causing leakage emissions. Agroforestry systems closely integrate trees with crop production, so agroforestry activities may affect annual crop management.

Project activities to reduce deforestation and forest degradation: In general, activities that reduce deforestation and forest degradation will affect forest carbon pools (i.e. above and below-ground woody biomass, litter and dead wood, soil carbon, non-tree vegetation and harvested wood products). Depending on site-specific conditions, the main GHG effects are expected to derive from above and below-ground woody biomass. If forest fires are a major issue in the project region, project activities that reduce the occurrence of forest fires may also directly affect N_2O and CH_4 emissions. Globally, agriculture is the main proximate driver of deforestation (Kissinger *et al.*, 2012). In some regions, commercial agriculture is the most important driver, while in others subsistence agriculture is the main driver. Commercial timber extraction and logging are responsible for forest degradation and deforestation in some areas, while in others fuel wood collection, charcoal production and possibly also livestock grazing in forests are important drivers of deforestation and degradation.

Afforestation and reforestation: In general, afforestation and reforestation activities will primarily affect forest carbon pools. Depending on site-specific conditions, the main GHG effects are expected to be on above and below-ground woody biomass. Afforestation and reforestation will most likely affect land use in the target sites, and may induce land use change. Direct effects of land use change may include loss of biomass carbon in vegetation existing prior to afforestation or reforestation. Land clearing by biomass burning may also cause N_2O and CH_4 emissions. Other consequential effects may include land use change outside the newly planted forest locations, such as leakage emissions due to displacement of prior land uses (e.g. livestock grazing, fuel wood collection, timber harvesting or agricultural production). The Clean Development Mechanism booklet provide additional information on this.

Forest management: Project activities that support sustainable forest management, change practices, harvest regimes or other forest management activities are expected to primarily affect forest carbon pools (i.e. above and below-ground woody biomass, litter and dead wood, soil carbon, non-tree vegetation, and harvested wood products). The Verified carbon standard provides additional information this topic. Community-based forest management initiatives may also affect prior forest uses such as fuel wood collection, charcoal production, livestock grazing, timber harvesting or agricultural production.

Infrastructure: Improvements in agricultural infrastructure are often critical components of initiatives to support agricultural and rural development. Construction of roads, buildings and facilities and irrigation systems all involve direct GHG emissions from energy use by machinery in the construction process, whilst also causing indirect emissions from the production of cement, steel and other inputs (World Bank 2010). It should be determined whether these indirect effects should are to be included in the GHG assessment.

Agribusiness support: Support of agribusiness is an important intervention in supporting the development of commercial agriculture. Investments in agribusiness that increase processing capacity may increase total energy use by project beneficiaries, while investment in more efficient technologies in existing firms may reduce energy consumption. Fuel and energy use are likely to be the main GHG emissions sources affected by activities that support agribusiness development, e.g. Notamicola et al 2015. Support of agro-processing may cause changes in agricultural production practices among suppliers and thus GHG emissions. Vice versa, support to agricultural production may also cause increased GHG emissions from product transport, storage and processing by agri-businesses, either as intended or unintended project effects.

Table 1 lists main direct GHG effects from common types of agriculture, forestry and land use activities.

In agriculture, Climate Smart Agriculture (CSA) is emerging as an approach to simultaneously address three intertwined challenges: ensuring food security through increased productivity and income, adapting to climate change, and contributing to CC mitigation (FAO, 2013). CSA aims to improve food security, strengthen resilience to CC and reduce GHG emissions by promoting adoption of appropriate practices, developing an enabling policy and institutional environment and mobilizing finance. Because of the close interactions between land uses, CSA should be implemented through a landscape approach that enables the integrated management of agricultural systems and the natural resources that support ecosystem services affecting all land use sectors. Many options for CSA also reduce GHG emissions per unit land area or per unit of agricultural product, or increase carbon stocks in the landscape, thus contributing to mitigating CC.

Table 1. Main direct GHG effects of common types of activity promoted by agriculture, forestry and other land uses (AFOLU) project

Types of activity promoted by AFOLU projects	Main carbon pools and GHG sources directly affected	Main GHGs directly affected
A1 Reduction in rate of deforestation	Above- and below-ground woody biomass carbon; forest soil carbon	Carbon dioxide (CO_2)
A2 Reduction in forest degradation	Above- and below-ground woody biomass carbon; forest soil carbon	CO_2
A3 Adoption of improved cropland management	Soil carbon	CO_2
A4 Introduction of renewable energy and energy saving technologies	Fuel combustion, wood or animal manure used in energy production	CO_2 (CH_4 and N_2O for animal dung)
B1 Improved animal production	Enteric fermentation	CH_4
B2 Improved management of livestock waste	Livestock waste management, replaced energy sources	CO_2 (CH_4 and N_2O for replaced energy sources)
B3 More efficient management of irrigation water in rice	Anaerobic decomposition of organic material in flooded rice paddies	N_2O
B4 Improved nutrient management	Nitrogen nutrients in fertilizer	N_2O
C1 Conservation farming practices	Soil carbon	CO_2
C2 Improved forest management	Above- and below-ground woody biomass	CO_2
C3 Afforestation and reforestation	Above- and below-ground woody biomass carbon; forest soil carbon	CO_2
C4 Adoption of agroforestry	Above- and below-ground woody biomass carbon	CO_2
C5 Improved grassland management	Soil carbon	CO_2
C6 Restoration of degraded land	Soil carbon	CO_2
D1 Increased livestock production	Enteric fermentation	CH_4
D2 Increased irrigated rice production	Anaerobic decomposition of organic material in flooded rice paddies	CH_4
D3 Increased fertilizer use	Nitrogen nutrients in fertilizer	N_2O
D4 Production, transport, storage and provision of agricultural chemicals	Fuel combustion and energy use	CO_2
D5 Increased electricity consumption	Fuel combustion	CO_2
D6 Increased fuel consumption	Fuel combustion	CO_2
D7 Installation of irrigation systems	Fuel combustion and energy use, embodied emissions in cement or steel production	CO_2
D8 Building other infrastructure	Fuel combustion and energy use, embodied emissions in cement or steel production	CO_2
E1 Timber logging	Above- and below-ground woody biomass carbon	CO_2
E2 Cropland expansion	Above- and below-ground woody biomass carbon in forest	CO_2
E3 Change in crop residue management	Soil carbon	CO_2

Source: adapted from Wilkes et al. 2015

2.2. Agricultural climate adaptation options

This section concerns adaptation and resilience practices that promote resilience to CC shocks and succinctly presents a list of different management practices to face CC, taken from guidelines on "*Resilient adaptation to climate change"* (Ifejika Speranza 2010) and a recent FAO ESA methodological Working document "*Climate Resilience Assessment of Agriculture and Forestry Projects and Programmes (CRAAF)"* (Ifejika Speranza & Bockel 2015), for appraising the incremental capacity of resilience generated by projects. Due to the wide range of adaptation options, it is important to evaluate these in order to determine which adaptation actions should be promoted or implemented under specific circumstances (Dolan *et al.,* 2001).

i) Water-linked management practices

Adaptation of rainwater management practices*:* CC will result in increased frequencies of extreme events (droughts, cyclones, floods), and higher rainfall variability in terms of time, space and amounts. As such, a potential adaptation measure would be to secure water availability for crop and livestock production.

One way of doing this is to harvest rainwater and runoff. Three example techniques are provided below:

- *Sand dams* trap sand during flooding, thereby trapping extra sub-surface water in the sand bed and increasing water availability for harvesting during dry periods.
- *Micro-catchments water harvesting techniques* (contour bunds) are used for planting crops and trees.
- *Rainwater harvesting for crop and livestock production* is an old farm management technology that is being re-examined due to its potential to address CC impacts through stabilizing on-farm water supply.

Adaptation of irrigation management practices: In the absence of water or under conditions of increased rainfall variability due to CC, irrigation of crops from rivers, lakes and shallow groundwater offer opportunities for climate adaptation.

ii) Adaptation of soil management practices

The most limiting input in dryland farming is soil water. CC will affect soils by changing soil climate (moisture content, temperature) and affecting soil chemical processes, soil fauna and flora.

Adaptation of soil management to CC will entail:

- *increasing the infiltration capacity of the soil;*
- *increasing water holding capacity;*
- *improving soil structure and conditions for soil fauna and flora*, thereby increasing natural soil fertility.

Depending on the magnitude of soil degradation, *prevention, reduction and rehabilitation measures* can be implemented. Prevention implies the use of Soil and Water Conservation (SWC) measures that maintain natural resources and their environmental and productive function on land prone to degradation:

- *Conservation tillage / Zero-tillage* is practiced in many dryland areas and involves minimizing soil disturbance and exposure by reducing tillage and using crop residues to cover the soil. Conservation tillage also increases the retention of soil water, improves soil structure and biotic activity, reduces soil loss and increases soil fertility.
- *Mulching* is another way to improve soil resilience to CC. This uses plant residues to cover soils in order to facilitate their incorporation into soil organic matter (soil organic carbon) during tillage.
- *Organic manure and composts* are intended to improve soil fertility and simultaneously enhance soil structure (against compaction and crusting) and improve water infiltration and percolation. Studies show that soils with high humus content contribute to increased crop yields.
- *Terracing* controls run-off down hillsides and depending on where it is practiced can increase soil water storage or enhance drainage in areas of excess rainfall.

iii) Adaptation of crop management practices

Crop management practices affect soil health, soil structure, soil nutrient content and soil climate, and can serve as adaptation strategies to climate change:

- *Crop rotations* (temporal diversity) and *mixed cropping* (within field diversity) should be well managed and synchronized. *Crop rotations* (for example, growing green manure legumes as fallow crops) help revitalize the soil and reduce the persistence and spread of pests and diseases.
- *Switching to other/high value crops* is one form of adapting to CC provided the crop is tolerant to heat and/or dry conditions.
- *Fallowing* involves non-cultivation of arable land for a period of time, with the aim to restore soil fertility. This can be in terms of bush fallows or improved fallows. Since the soil surface is covered by crops, soil loss is reduced and soil structure improved. Improved fallowing can be in form of *green manure* (plants grown for the purpose of reinvigorating the soil, either for use as manure or for mulching).
- *Biologically fixed nitrogen from legumes* (*green manure*) can be used to adapt to CC. By growing nitrogen fixing crops, soil fertility can be increased without causing emissions (as is the case when using inorganic fertilizers).
- *Alley cropping* increases nutrient cycling through increased total biomass production with or without fertilizer. Alley cropping can improve nutrient cycling whereby nitrogen-fixing trees are planted in parallel rows to crops. Through alley cropping, biomass production can also be increased. Food crops are then planted in between the rows in the "alley" while the trees protect the soil from erosion and fix nitrogen in the soil.
- *Use of organic pesticides and insecticides* to address uncommon pests and diseases.

iv) Agroforestry and reforestation as an adaptation measure

Tree management practices can reduce the effects of CC on the ecosystem by increasing ground cover, improving soil structure and infiltration, and decreasing erosion by water and wind. Water erosion, especially under extreme rainfall conditions and in already degraded land, is a major hazard:

- *Indigenous and improved agroforestry*, that is, the cultivation of trees with crops, pastures or livestock, can address many challenges that farmers face in a variable climate. Agroforestry can be another way to reduce competition on the use of crop residues for fodder, mulching and burning. If trees planted can provide fodder for livestock, farmers may be more willing to leave the residues to cover the soil after harvests. Planting trees between crops can help prevent soil erosion, restore soil fertility and provide shade for other crops.
- *Shelterbelts and windbreaks*, that is, trees planted to block or reduce wind speeds, also maintain soil moisture and reduce evaporation.
- *Live fences*, that is, trees planted around homesteads or cultivated land, aim to protect the enclosure from roaming livestock (in many cases to provide fodder for this livestock).
- *Reforestation* is another way to adapt to CC impacts. By reforesting, degraded land is put to use offering local communities access to forest resources.

v) Adaptation of livestock, pasture and rangeland management practices

CC will adversely affect pastures and rangelands, so improving management of livestock production should contribute to adaptation. Improved management of grazing lands involves changing the control and regulation of grazing pressure. This can be achieved through fencing, followed either by rotational grazing, or ‘cut-and-carry’ of fodder, vegetation improvement and changes in management.

- *Fodder substitution* addresses fodder shortage. An adaptation to CC would be to ensure fodder availability for livestock, which can be achieved through fodder banks.
- Grazing and fodder lands can also be conserved through *reforestation, enclosures and zero grazing*.

2.3. Climate resilience options

Resilience is relative because it depends on interactions between factors and their outcomes. Resilience assessment thus also raises the issue of context specificity as social-ecological conditions are dynamic in time and space. Since the aim is not to have a single measure of climate resilience, but to be able to judge if and in what way a project might contribute to climate resilience, all resilience dimensions must be taken into account (Speranza and Bockel, 2015).

Ifejika Speranza and Bockel (2015) identify three characteristic dimensions of resilience (Figure 1): buffer capacity, self-organization and capacity for learning which are further divided into indicators and sub-indicators (Figure 2).

Figure 1. The three dimensions of resilience

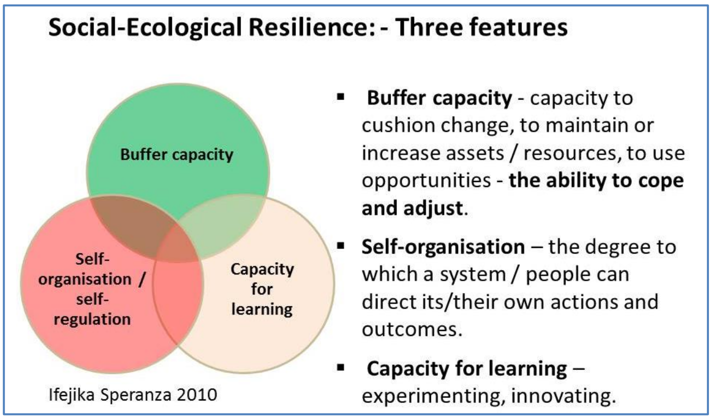
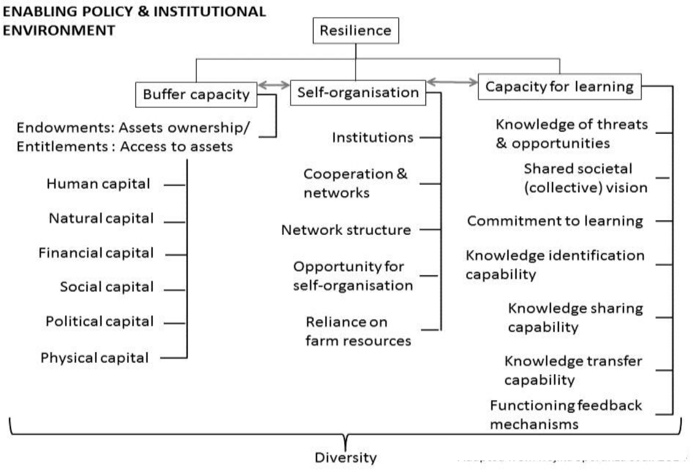


Figure 2. The indicators of resilience



Source: Ifejika Speranza & Bockel 2015.

i) Climate hazards

CC manifests in multi-faceted ways in specific social-ecological contexts. As such, it is important to determine from the beginning which climatic hazards or climate-related hazards are prevalent in the project area and, by extension, to what extent the project is likely to improve resilience to these specific hazards (drought, floods, etc.). An additional aspect to assess is the extent to which the proposed project or programme is climate-proof.

ii) Main components of the agricultural system

Generally, an agricultural system can be divided into three main components: the watershed and landscape level, the plot/enterprise level (crop-livestock) and the operational unit level (which for small-scale agriculture is mostly a HH).

Analysing the contributions of projects to climate resilience at the watershed and landscape level involves asking questions about how the project improves the capacity of the watershed to maintain its functions, e.g. sequestering carbon in vegetation, storing water or regulating run-off. Similarly at the plot/enterprise level, livestock and crop conditions, prevalence of crop and livestock diseases as well as other production factors and agronomy are important. At the operational unit level (HH), understanding the baseline conditions (such as HH food availability, income levels and work burden) is important for gauging the potential contribution of a project to climate resilience.

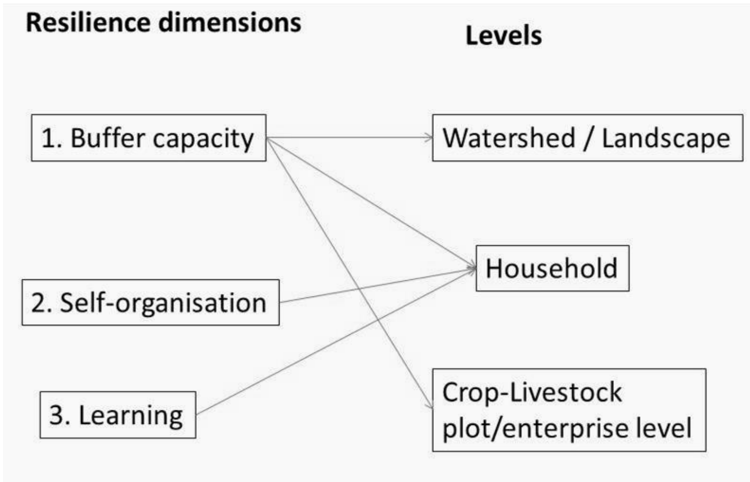
iii) Institutional and regulatory environment

Literature shows that governments play a critical role in, and have a duty to, foster an enabling environment through adequate policy support and regulation. Thus, institutional arrangements (policies, laws and regulations) and socio-political contexts tend to determine whether farmers and pastoralists even have the opportunity to begin the practices. To examine the extent to which the institutional arrangements of a target area foster, or are likely to foster, resilience-building measures it is important to understand to what extent do government policies, laws and regulations as well as strategic plans address a climate resilient indicator variable.

To make the livelihood resilience framework conducive to a multi-criteria and qualitative ex-ante appraisal of projects and national agricultural plans, it has been broken down into three resilience dimensions following different levels, figure 3 (Ifejika Speranza & Bockel 2015):

1. buffer capacity of the watershed/landscape;
2. buffer capacity of the HH;
3. buffer capacity of crop-livestock production;
4. self-organization of HH;
5. capacity to learn of the HH.

Figure 3. Resilience dimensions and assessment levels



Source : Ifejika Speranza & Bockel 2015

3. A notification system for monitoring and verification of the impact of climate-related projects

The adaptation and mitigation of CC has acquired a central position in government priorities and has gradually become considered an essential aspect of any investment decision. As such, it is necessary to estimate the impact of any public investment project in terms of co-benefits or externality on the adaptability and mitigation of CC. The rapid rise of climate funds and their rational use in the financing of public and private development investments demands a rigorous monitoring and evaluation of impacts both to ensure that the expected benefits of these actions are realized and to better guide investments.

As such, MRV is not a new concept. It has been widely used in many contexts at national and international levels to ensure transparency and help in effective implementation of a given activity. In simple terms with regards to the implementation of projects, it is defined as:

- Measurement: collect relevant information on progress and impacts.
- Reporting: present the measured information in a transparent and standardized manner.
- Verification: assess the completeness, consistency and reliability of the reported information through appropriate fact-based review.

Measurement enables assessment of project implementation, the achievement of objectives or goals and that any necessary corrective steps are taken. Reporting and verification ensure the communication of consistent and reliable information to appropriate authorities in order to facilitate assessment.

MRV is thus a management tool for monitoring the achievement of goals and objectives, whether they are of an organization, institution or part of the governance of a country. Governments typically use MRV to measure a number of economic, social and environmental indicators as an objective assessment of progress towards meeting national development goals, as well as the effectiveness of policies, programs and regulations.

Governments also use MRV as a tool for accountability to their constituents. An important aspect of accountability is documentation of the benefits of the actual policies and actions deployed, and cost-effectiveness of the measures. Such documentation provides governments, budget departments, funding agencies and implementation bodies with the information necessary to make objective decisions and provide feedback to improve decision making and implementation strategies.

Monitoring (which falls under measurement and reporting) is a continuous or periodic function that uses systematic collections of data (both qualitative and quantitative), for the purpose of keeping activities on track. It is first and foremost a management instrument.

MRV should be used during different timeframes: 1) ex ante; 2) mid-term; and 3) ex-post. Monitoring may take place on different levels:

a) **Project and program level**—mainly of implementation processes, including the tracking of activities and financial resources.
b) **Portfolio level**—mainly of trends in implementation, outputs, outcomes, and progress toward their achievements; and including the monitoring of focal area portfolios, country portfolios, and agency portfolios.
c) **National and global level.**

A good monitoring system combines information from various levels (corporate, portfolio, and project) in such a way as to provide a comprehensive picture of performance and allow periodic reports to management that facilitate decision making and learning.

MRV of mitigation actions is an international requirement under the United Nations Framework Convention on Climate Change (UNFCCC). But aside from this, it is also an important management tool for countries to track their progress in transitioning to a low-emission development path and in achieving sustainable development goals.

MRV systems also provide lessons learned, strengthen national GHG data quality, help identify national priorities, challenges and future opportunities and demonstrate emission reductions to donors.

MRV elements ensure transparency, consistency, comparability, completeness, and accuracy of information with regard to:

- recognition and visibility of mitigation achievements;
- attribution of quantified impacts to policies;
- accounting of national and international progress;
- identification of gaps and support needs;
- creation of access to public and private finances.

A core component of MRV is the selection of concise and measurable indicators. The judicious use of indicators is considered an important part of monitoring and evaluation efforts as they represent a powerful tool both to reduce the complexity of system description and to integrate complex system information. Moreover, MRV methods need to be cost effective and easy to apply so that they can be used in developing countries where accurate information, and capacity, may be constrained.

Indicators should be specific, measurable, achievable, relevant, and time-bound. These characteristics are denoted by the acronym SMART:

a. **Specific.** The system captures the essence of the desired result by clearly and directly relating to the achievement of an objective and only that objective.
b. **Measurable.** The monitoring system and indicators are unambiguously specified so that all parties agree on what they cover and there are practical ways to measure them.
c. **Achievable and Attributable.** The system identifies what changes are anticipated as a result of the intervention and whether the results are realistic. Attribution requires that changes in the targeted developmental issue can be linked to the intervention.
d. **Relevant and Realistic.** The system establishes levels of performance that are likely to be achieved in a practical manner and that reflect the expectations of stakeholders.

e. **Time-Bound, Timely, Trackable, and Targeted.** The system allows progress to be tracked in a cost-effective manner at the desired frequency for a set period of time, with clear identification of the stakeholder group(s) affected by the project (GEF, 2010).

4. The EX-ACT MRV Tool

What is EX-ACT MRV?

The MRV methodology for monitoring green agriculture and forestry investments, developed by the FAO in collaboration AFD, is designed to measure the impact of both mitigation and adaptation projects in the agriculture, forestry and other land uses (AFOLU) sector, specifically for groups of projects belonging to NDBs' portfolio. The methodology takes into account mitigation, adaptation, resilience and economic impact. Mitigation indicators measure the project's impact on emissions of GHGs, while adaptation indicators measure the reduction in vulnerability of people, livelihoods and ecosystems to climate change.

The impact on climate mitigation is reflected through quantitative indicators, derived directly from the EX-ACT tool (Ex-Ante Carbon Balance Tool), developed by FAO in 2009. EX-ACT is a land-based accounting system, measuring GHG impacts per unit of land, expressed in tonne of carbon dioxide equivalent (tCO_2-e) per ha per year, providing ex-ante estimations of the impact of development programmes, projects and policies in the AFOLU sector on GHG emissions and carbon stock changes (the carbon-balance), (Bockel et al., 2017).

These indicators are used to calculate and analyse the mitigation impact (in terms of tCO_2-e) of the project, as well as the equivalent economic return, which could be important to consider when attempting, for example, to assess payments for environmental services (PES). Climate resilience is assessed using simple quantitative but also qualitative indicators.

Box 1. Practical tips for the easy use of EX-ACT MRV:

- Only modules that are directly impacted by project activities have to be filled.
- Sophisticated main data requirements occur only in the focal areas of the project.
- It is normal that many data entry cells will not be used so will remain empty.

The EX-ACT MRV Tool (EX-Ante Carbon-balance Tool for Monitoring, Reporting, and Verification) is a structured MRV (Monitoring, Reporting, and Verification) system which aims to track the progress, and measures the sustainability of green projects in the AFOLU sector and their impact on climate.

In particular, the tool shows the most advantageous cost/benefits relationship within the institutional system and the ease of use. Some of its strong points are i) the capacity to appraise not only the mitigation and adaptation impacts, but also important economic and social aspects of the projects, including general HHs' resilience; ii) the ability to produce not only an ex-ante, but also a mid-term and ex-post analysis of the impact of a project, or group of projects.

Target users

Adaptation and mitigation of CC have become significant government priorities in recent years and are gradually being considered as essential aspects of any investment decision. As such, it is necessary to estimate the impact of any public investment project in terms of co-benefits or externalities on the adaptability and mitigation of CC. The rapid rise in climate funds and their use in financing public and private development investments has demanded a rigorous monitoring system. This allows evaluation of impacts to guide investments and ensure that expected benefits are realized.

Identification of investments that are both climate smart and socio-economically beneficial, requires an accepted methodology and practical tools for project and programme level GHG accounting.

The EX-ACT MRV Tool targets investment planners and project designers in International Financial Institutions (IFIs) and national planning institutions, particularly NDBs that desire a structured MRV system capable of tracking their progress in financing green investment projects in agriculture.

Chapter 2. Guide for tool users

1. MRV of climate change impacts for the project bank portfolio

The EX-ACT MRV methodology provides a monitoring system for investment projects in the agricultural sector. It is based on the need for simple mitigation, adaptation and resilience indicators that are easy to collect and to aggregate. Together they create a measurable and concrete tracking system capable of accurately assessing the impact of agricultural investments.

The indicators are easy to access and measure and are suitable for monitoring at the portfolio or project assessment levels. They can be used to provide ex-ante, mid-term or ex-post monitoring analyses. The approach is based on aggregated indicators which can measure the overall impact performance at the level of the investment portfolio.

The indicators are associated with methods of collection and structured analysis in an Excel file that constitutes an MRV tool designed to simplify the analysis and follow-up by project and aggregation. The file includes a module on project data, a module on Carbon Footprint (CFP) analysis and a module on MRV Results which combines all results.

The MRV tool has a set of mitigation indicators derived from a quick GHG appraisal conducted with a simplified EX-ACT based tool, providing results at the project level, i.e. carbon balance, performance per ha and performance per beneficiary (both per year and for the whole project). It also provides economic values for the generated benefits, allowing results to be linked with project funding options, and project subsidy options to be linked with national climate funds or PES. Such indicators are designed to allow aggregation for a portfolio of projects.

The ex-ante appraisal of climate adaptation targets the incremental resilience provided by projects. Resilience does not derive from one indicator. As such the relative strengths of resilience dimensions depend on the social, ecological and political conditions. While buffer capacity largely captures farmers' endowments and access to various capitals, self-organization and learning includes more process-like and practice-like indicators, capturing the effect of the farmers in building resilience. The aim of such resilience appraisal is to judge if and in what way a project might increase the climate resilience of beneficiaries.

2. Quantitative indicators of carbon effects

The MRV methodology is designed to measure the impact of both mitigation and adaptation generated by AFOLU projects. Mitigation indicators measure the project's impact on emissions of GHGs, while adaptation indicators measure the change in vulnerability of people, livelihoods and ecosystems to CC.

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

i. tCO_2-e reduced or avoided (including increased removals) over 20 years;
ii. mitigation impact in tCO_2-e per year;
iii. mitigation impact tCO_2-e per year per ha;
iv. project cost per tCO_2-e reduced;
v. equivalent value of the impact of mitigation per year (30 US$ / tCO_2-e);
vi. equivalent value of the impact of mitigation per year per ha (30 US$ / tCO_2-e);
vii. GHG emissions per tonne of production, i.e. CFP.

These indicators allow the user to identify and analyse mitigation impacts in terms of both the GHG balance and economic return. This latter benefit could be an important aspect to consider when seeking, for example, access to PES also known as payment for ecosystems services.

In the EX-ACT MRV tool, these mitigation indicators appear as follows (figure 4):

Figure 4. EX-ACT MRV screenshot - Climate mitigation dimension of the project

Climate Mitigation dimension of the project (s)		
Tonnes of carbon dioxide equivalent (t CO2eq) emitted (+) / reduced or avoided (-) on 20 years	**30,220**	Tco2
GHG impact per year in TCO2	**1,511**	Tco2/ year
Mitigation impact per year per ha	**167.89**	TCO2/ha
Equivalent project cost per Ton of CO2 reduced	**0.00**	US$/TCO2
Equivalent value of mitigation impact per year (US$ 30/TCO2)	**0.00**	US$/year
Equivalent value of mitigation impact per year per ha (US$ 30/TCO2)	**0**	US$/year / ha
Carbon footprint per ton of production	**0.48**	TCO2/ Ton of product

3. Quantitative Indicators of resilience to climate change

EX-ACT MRV quantitative appraisal also allows the user to derive quantitative resilience indicators, presented in terms of area or number of HHs benefiting from increased resilience. These resilience indicators are as follows:

i. increase in hectares (ha) of land managed through practices resilient to climate change;
ii. number of has with improved coverage of trees and vegetation (reducing severity of landslides and erosion and providing flood resistance);
iii. number of ha with enhanced soil carbon content (providing resilience to drought and erosion reduction);
iv. number of HHs benefiting from improved resilience of watersheds and land to climate shocks;
v. number of HHs benefiting from improved resilience of farming systems;
vi. number of HHs benefiting from improved physical, social and financial capital;
vii. number of HHs benefiting from improved self-organization and learning abilities.

In the EX-ACT MRV tool, these resilience indicators appear as follows (figure 5):

Figure 5. EX-ACT MRV screenshot - Climate resilience dimension of the project

Climate Resilience dimension of project (s)		
increase in hectares of land managed under climate-resilient practices	**5**	ha
Number of hectares with improved tree and vegetal coverage (land slide, flood resilience)	**0**	ha
Number of hectares with increased soil carbon (drought and erosion resilience)	**5**	ha
Number of HH having become more climate resilient	**1**	HH

4. Qualitative analysis of resilience factors: Global Incremental Resilience Index (GIRI)

A more thorough assessment of adaptation may be conducted, based on a multi-criteria analysis of different resilience dimensions from a FAO methodical study work (Ifejika Speranza & Bockel, 2015). The three dimensions are: buffer capacity, self-organization and learning capacity. These three dimensions of resilience are based on a series of indicators derived from the project profile. The buffer capacity differs in all three levels of analysis for which an agricultural system can be separated: watershed/area level, HHs parcel level and agro-pastoral production.

Consequently, the resilience index is based on five resilience factors:

i. the buffer capacity of the watershed, landscape and project area;
ii. the absorption capacity of production systems to climatic shocks;
iii. the absorption capacity of HH food security to climatic shocks;
iv. strengthening the self-organizing ability of HHs after the project;
v. improving the learning capacity of HHs following the project.

A general index derived from these factors gives an estimate of the climate resilience created by the project, defined as very high, high, medium, low or very low.

Different criteria are used to assess the impact of the project on each of these factors. Every factor is measured through a set of specific qualitative criteria. For instance, to assess buffer capacity of the watershed, the landscape and the project area, a series of seven questions are proposed: (i) to what extent does the project improve land cover (e.g. agroforestry, cover crops etc.)? (ii) To what extent does the project reduce soil erosion? (iii) To what extent does the project improve soil conditions (e.g. soil moisture, soil structure etc.)? (iv) To what extent does the project improve efficiency of water use? (v) To what extent does the project save water? (vi) To what extent is the project area protected from climate shocks? (vii) To what extent is the project infrastructure (building investments) climate-proof? The complete detail-list of questions is presented in the tables of data entry provided in section 6.7.

Each question of each of the five dimensions should be evaluated by the project team. The team will enter a value from zero to four in the first column, depending on the level of impact the project has on that particular aspect.

Prior to this, in the second column, the team must assign a weight from zero to three to each question according to the importance given to that aspect and to the relevance it has on the community or region.

5. Performance indicators on income and resources (water, energy)

In addition, complementary indicators on income, employment generated and other environmental aspects are also included in the result set, as shown in figure 6 below.

Figure 6. EX-ACT MRV screenshot - Project's performance

Income performance of project		
Total incremental income generated	**742500**	US$/ year
Average income per ha	**82500**	US$ /Ha
Average Incremental income per Household	**742500**	US$/ HH
Other environmental performances		
Volume of water consumption reduced per year	**-5400**	M3/ year
Renewable energy capacity installed	**0**	MW/ year
employment generated	**144**	Addit. Jobs created

These economic values offer a better understanding of the benefits of the project in terms of general HHs' resilience.

6. Modalities of data entry and analysis in EX-ACT MRV

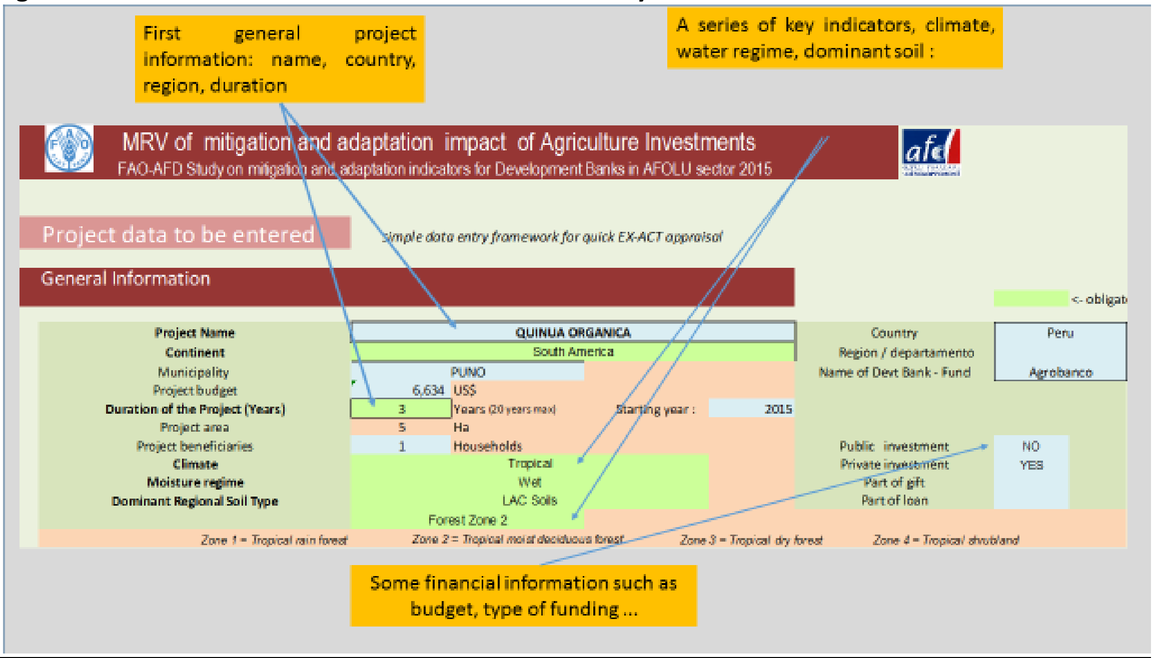
Entering data for an appraisal will involve the following below steps. The system involves a simplified entry format for small public and private investment projects appraised at a Tier 1 level, with a baseline scenario considered to be constant (no change).

This should allow users to rapidly appraise small investment projects, once data entry has been completed in the project data module. Entering information in the first module (general information) will require approximately 30 minutes and can be done by either the project designer or investment manager.

6.1. Entering general data: Project, climate, soil, finances

The first set of data that needs entering is general information about the project. This includes the country, region and duration of implementation and a set of indicators such as climate, moisture regime and dominant regional soil type (figure 7). These data are required to put the project in context and provide a basis for the impact calculation.

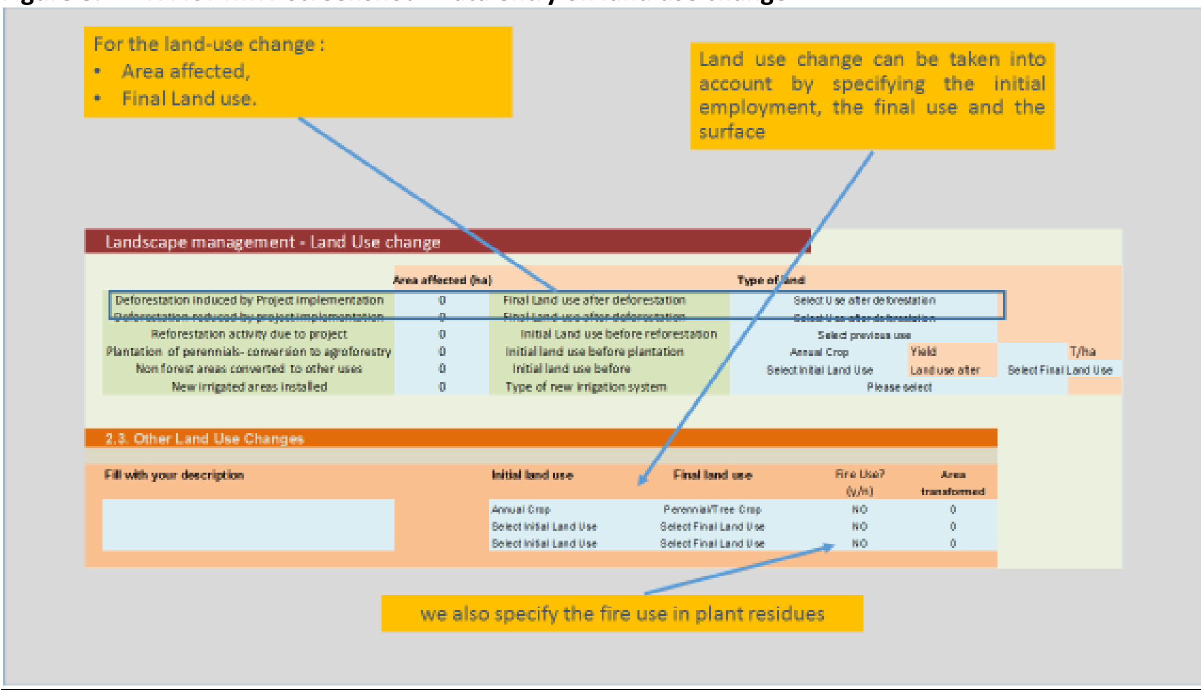
Figure 7. EX-ACT MRV screenshot - General data entry



6.2. Entering Land Use Change data

In the figure 8, the entry process for land use change data is presented. Any land use change that will occur during the project, in terms of affected area in ha, and initial and final use, must be filled in. In «other Land Use Change» use of fire for plant residues can also be specified.

Figure 8. EX-ACT MRV screenshot - Data entry on land use change

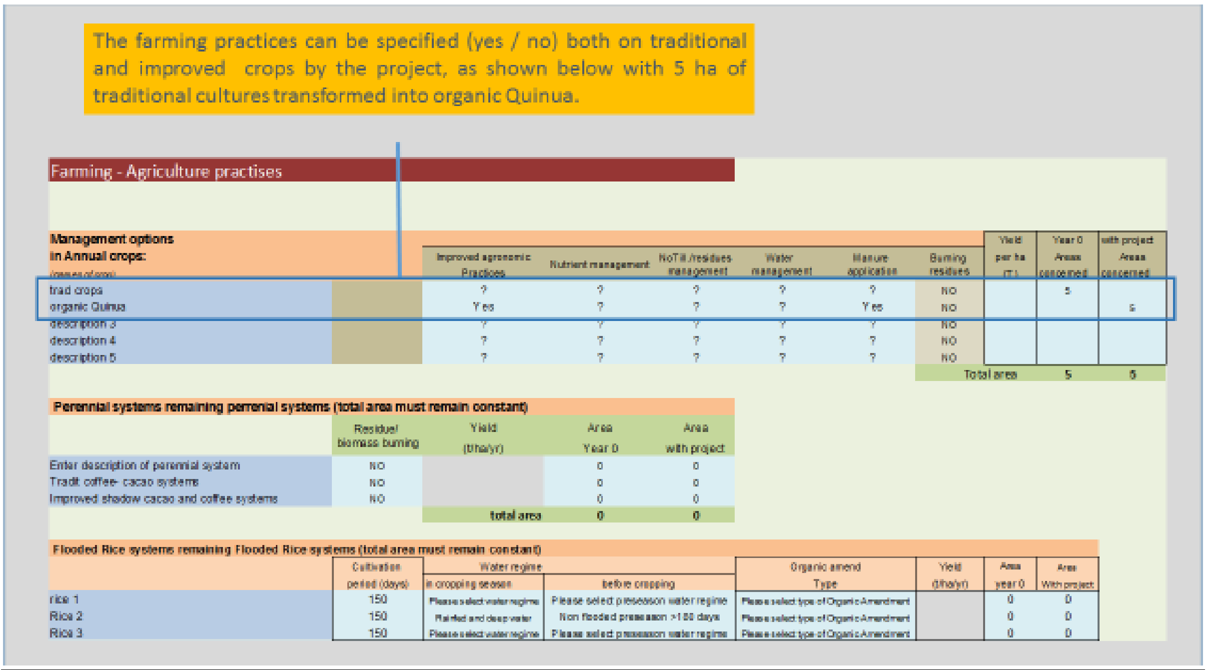


6.3. Entering agricultural activities data: annual crops, perennial and rice

For the annual crops sub-module (figure 9), it is essential that the following improved practices, which fix carbon into the soil, are differentiated between:

- Improved agronomic practices include all practices that may increase yields and thus generate higher quantities of crop residues. Examples of such practices, as reported by Smith *et al.* (2007), include the use of improved crop varieties, extending crop rotations and rotations with legume crops.
- Improved nutrient management includes the application of fertilizer, manure or biosolids in a way that improves either 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 involves the adoption of tillage practices of less intensity ranging from minimum tillage to no-tillage. It may include mulching of crop residues so can be an important element of conservation agriculture.
- Enhanced water management consists of improved irrigation measures, resulting in an increase in productivity and the quantity of residues.
- Manure application: manure or biosolids application to the field as input.

Figure 9. Data entry on agricultural activities



The farming practices can be specified (yes / no) both on traditional and improved crops by the project, as shown below with 5 ha of traditional cultures transformed into organic Quinua.

Farming - Agriculture practises

Management options in Annual crops:	Improved agronomic Practices	Nutrient management	NoTill /residues management	Water management	Manure application	Burning residues	Yield per ha (T)	Year 0 Areas concerned	with project Areas concerned
trad crops	?	?	?	?	?	NO		5	
organic Quinua	Yes	?	?	?	Yes	NO			5
description 3	?	?	?	?	?	NO			
description 4	?	?	?	?	?	NO			
description 5	?	?	?	?	?	NO			
							Total area	5	5

Perennial systems remaining perrenial systems (total area must remain constant)	Residue/ biomass burning	Yield (t/ha/yr)	Area Year 0	Area with project
Enter description of perennial system	NO		0	0
Tradit coffee- cacao systems	NO		0	0
Improved shadow cacao and coffee systems	NO		0	0
		total area	0	0

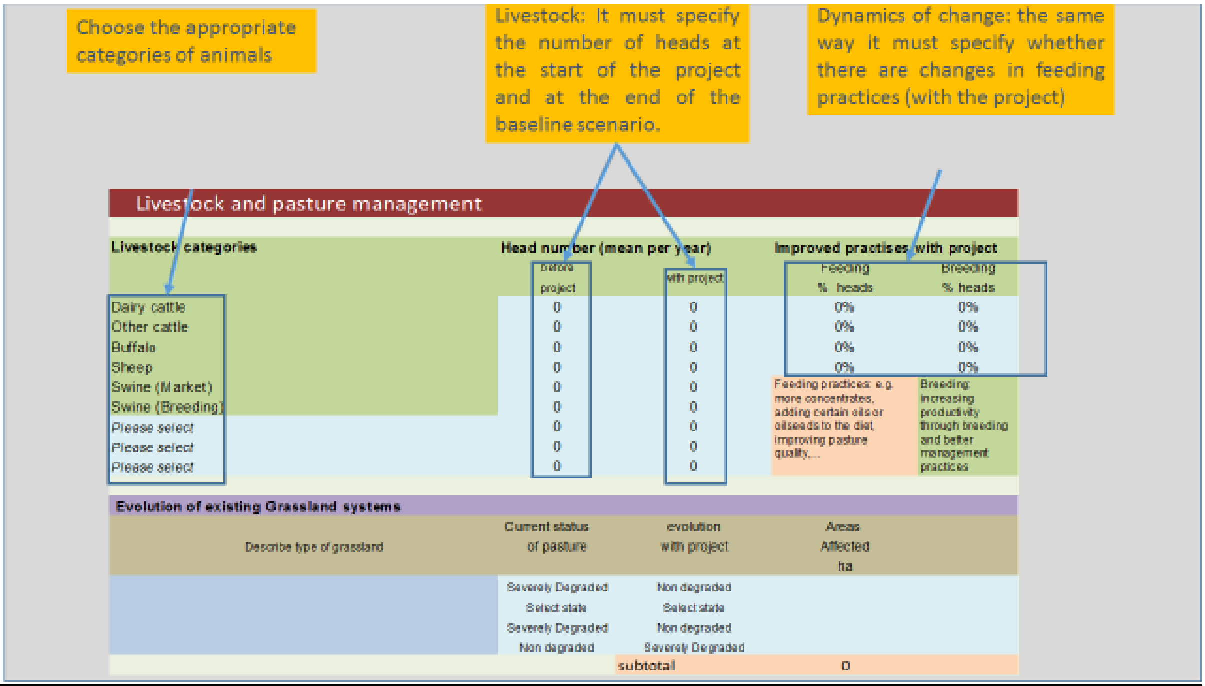
Flooded Rice systems remaining Flooded Rice systems (total area must remain constant)	Cultivation period (days)	Water regime in cropping season	Water regime before cropping	Organic amend Type	Yield (t/ha/yr)	Area year 0	Area With project
rice 1	150	Please select water regime	Please select preseason water regime	Please select type of Organic Amendment		0	0
Rice 2	150	Rainfed and deep water	Non flooded preseason >180 days	Please select type of Organic Amendment		0	0
Rice 3	150	Please select water regime	Please select preseason water regime	Please select type of Organic Amendment		0	0

6.4. Entering Livestock and Grassland Management data

For the grassland module users collect data on the size and state of degradation of grassland, the grass yield, grassland burning practices and the changes in degradation state of the grassland area over time. The livestock section of the module requires information on the type and number of livestock and the percentage of herds that receive improved feeding practices, dietary additives that reduce CH_4 emissions (ionophores, vaccines, etc.) or are subject to improved breeding practices, figure 10.

Information on livestock emissions may be refined by specifying the mean annual temperature, regional specific values for CH_4 and N_2O emissions from manure management and the CH_4 emissions from enteric fermentation.

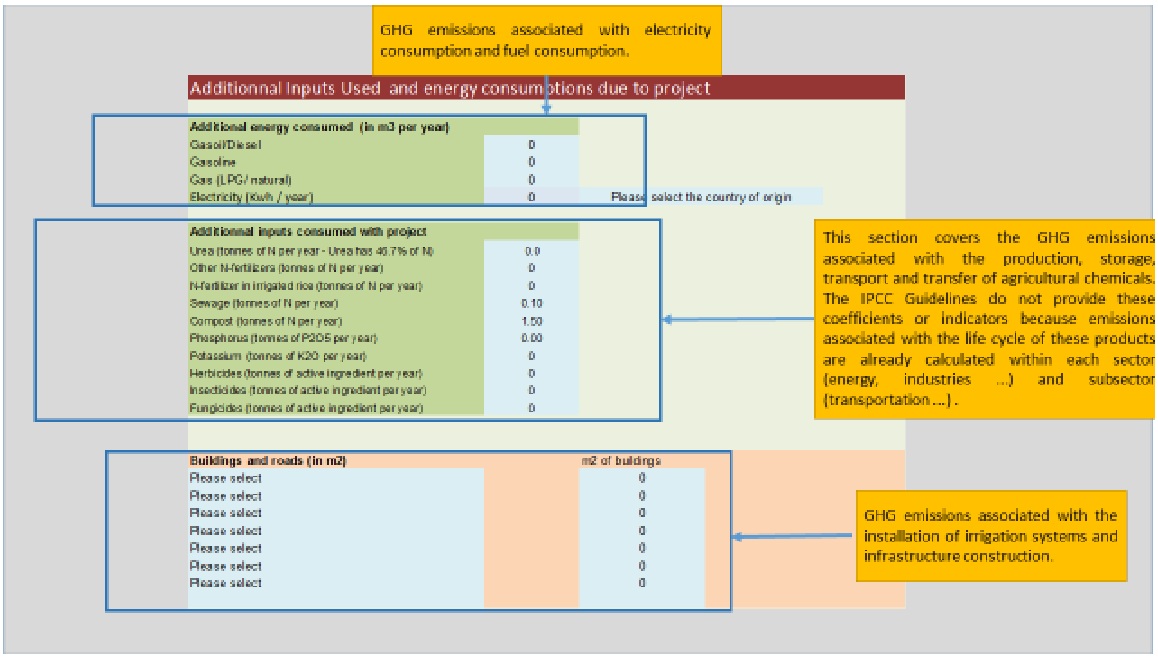
Figure 10. EX-ACT MRV screenshot - Data entry on livestock and grassland management



6.5. Entering inputs and investments data

The following screenshot (figure 11) presents the module concerned with inputs and energy consumptions. This section allows the user to calculate the GHG emissions associated with the production, storage, transport and transfer of agricultural chemicals and the ones associated with electricity and fuel consumption. In the last section, data on the installation of irrigation systems and infrastructure consumption can also be entered.

Figure 11. EX-ACT MRV screenshot - Data entry on inputs and investments



6.6. Entering other data required for MRV

Other data concerning aquaculture, water use efficiency, renewable energy, income and labour generated can be included in the analysis, if appropriate (figure 12).

Figure 12. EX-ACT MRV screenshot - Data entry of other required data

Other data required for MRV				
Aquaculture				
Additional Tons of Fish produced per year	0	T/year		
Water use efficiency				
Volume of water consumption reduced per year	0	m3/year		
Fossil Energy use reduction				
Renewable energy capacity installed	0	MW/year		
Additional Income generated				
Banana	6316	US$/ha	2	Ha
specify agriculture product	0	US$/ha		Ha
Specify livestock income		US$/Household		HH benef
specify other Household additional incomes	0	US$/ Household		HH benef
Additional Labour generated				
Additional Labour	285	Man-days/ ha	0.57	Total 000 MD

6.7. Completing the series of qualitative resilience criteria

The resilience index is based on five resilience factors: (i) increased buffer capacity of the watershed, landscape and project area; (ii) buffer capacity of crop-livestock production systems; (iii) buffer capacity of households in relation to food security; (iv) strengthening the self-organizing ability of households after the project; (v) improving the learning capacity of households following the project. A general index derived from these factors gives a first estimate of the climate resilience generated by the project, defined as very high, high, medium, low or very low. To assess the impact of the project on each of these resilience factors, the specific criteria used are listed below (figures 13 to 15):

Figure 13. EX-ACT MRV screenshot - Qualitative data entry of resilience from the buffer capacity of watershed, landscape and project area

	by project to be done in light blue cells **Buffer capacity of watershed and landscape and project area**	**Expert group Assessment (0-4)**	*Indicator Weighting (0-3)*	
1	To what extent does the project improve land cover? (e.g. agroforestry, cover crops etc.)	0	*3*	
2	To what extent does the project reduce soil erosion?	0	*3*	
3	To what extent does the project improve soil conditions (e.g. soil moisture, soil structure etc.)?	0	*1*	
4	To what extent does the project improve efficient use of water?	0	*0*	
5	To what extent does the project save water?	0	*0*	
6	To what extent the project area is protected from climate shocks?	0	*2*	
7	To what extent is the project infrastructure (e.g. building investments) climate-proof?	0	*0*	
	Sub-Result	**0**	**very low**	*18*

Assessment of the five resilience factors should be completed by either project design team or the team in charge of project implementation. In case of midterm or ex-post evaluation, it could be managed through a participatory appraisal involving beneficiaries or representatives or beneficiaries and other implementing partners.

These criteria are mostly fact-based or action-based to facilitate the ease of answering. They target the content of project actions, project support and specific straight-answer-oriented project aspects.

Figure 14. EX-ACT MRV screenshot - Qualitative data entry of resilience from the buffer capacity of crop and livestock production, and of HHs on relation to food security

	Buffer capacity of crop –livestock production	(0-4)		
8	To what extent does the project reduce crop failure?	0	3	
9	To what extent does the project improve resistance of crops to pests and diseases?	0	2	
10	To what extent does the project improve resistance of livestock to pests and diseases (e.g. through vaccination)?	0	0	
11	To what extent does the project reduce post-harvest losses?	0	3	
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	2	
14	To what extent does the project reduce (crop/livestock) yield variability?	0	1	
	Sub-Result	**0**	**very low**	28

	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 food production or improved household access to food)?	0	3	
16	To what extent does the project improve household food storage ?	0	2	
17	To what extent does the project improve household income?	0	1	
18	To what extent does the project increase agricultural production physical assets?	0	2	
19	To what extent does the project improve access of households to agricultural inputs?	0	3	
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?	0	1	
22	To what extent does the project improve access of households to climate-related social safety nets (e.g. climate-index agriculture insurance, cash, vouchers, warehouse receipt systems etc.)?	0	1	
	Sub-Result	**0**	**very low**	24

Figure 15. EX-ACT MRV screenshot - Qualitative data entry of resilience from the self-organisation of HHs

	Self-organisation of households	(0-4)		
23	To what extent does the project improve cooperation and networks of farmers (e.g. farmer groups, farmer field schools, farmer organisations etc.)?	0	3	
24	To what extent does the project collaborate with national/sub-national farmer/pastoralist organisations (capacity of farmers/pastoralists to influence decisions)?	0	2	
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	2	
26	To what extent are farmers actively participating in the project?	0	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?	0	0	
28	To what extent does the project improve farmer skills to manage groups?	0	2	
29	To what extent does the project link agricultural value chains?	0	1	
30	**On-farm reliance**: To what extent does the project build on local knowledge?	0	1	
	Sub-Result	**0**	**very low**	20

	Learning capacity of households	(0-4)		
31	To what extent does the project improve farmer knowledge of threats and opportunities to agricultural production (e.g. climate specific awareness programmes)?	0	3	
32	To what extent does the project improve access to extension services?	0	2	
33	To what extent does the project improve farmer/pastoralist experimentation (e.g. through farmer/pastoralists field schools, climate field schools, exchange visits)?	0	1	
34	To what extent does the project improve access to climate information (e.g. seasonal forecasts adapted for agriculture, workshops)?	0	2	
35	To what extent does the project improve access to market information?	0	3	
36	To what extent does the project improve access to communication networks (e.g. mobile networking, radio programmes)?	0	2	
	Sub-Result	**0**	**very low**	26

6.8. The set of impact results provided by investment projects

i) Multi-impact summarized results per project

Project impact results are provided as a multi-impact report summarized in one-page excel sheet in the MRV Results Module, as displayed in the screenshot below (figure 16).

The results are distinguished according to the different aspects covered by the tool: climate mitigation, climate resilience, resilience index, income performance and other environmental and social performances.

Figure 16. EX-ACT MRV screenshot - EX-ACT MRV Results

MRV of mitigation and adaptation impact of Agriculture Investments

FAO-AFD Study on mitigation and adaptation indicators for Development Banks in AFOLU sector 2015

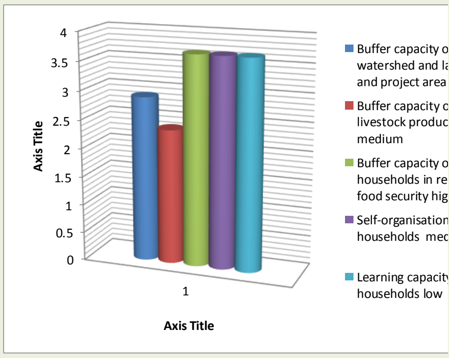
zero draft

Project:	Banana Organico Installacion	Year	2015
Bank:	Agrobanco	Budget (US$)	17235.625
country	Peru	Households	1
region		Hectares	2

Climate Mitigation dimension of the project (s)		
1 Tonnes of carbon dioxide equivalent (t CO2eq) emitted (+) / reduced (-) on 20 years	45	Tco2
2 GHG impact per year in TCO2	2.25	Tco2/ year
3 GHG impact per year per ha	1.12	TCO2/ha
4 Equivalent project cost per Ton of CO2 reduced	0.00	US$/TCO2
5 Equivalent value of mitigation impact per year (US$ 30/TCO2)	0.00	US$/year
6 Equivalent value of mitigation impact per year per ha (US$ 30/TCO2)	0	US$/year / ha
7 Carbon footprint per ton of production	0.037	TCO2/ Ton of product

Climate Resilience dimension of project (s)		
1 increase in hectares of land managed under climate-resilient practices	2	ha
2 Number of hectares with improved tree and vegetal coverage (land slide, flood resilience)	0	ha
3 Number of hectares with increased soil carbon (drought and erosion resilience)	2	ha
4 Number of HH having become more climate resilient	1	HH

Resilience index of projects	
Buffer capacity of watershed and landscape and project area	medium
Buffer capacity of crop –livestock production	medium
Buffer capacity of households in relation to food security	high
Self-organisation of households	medium
Learning capacity of households	low
Global climate resilience generated by project	medium



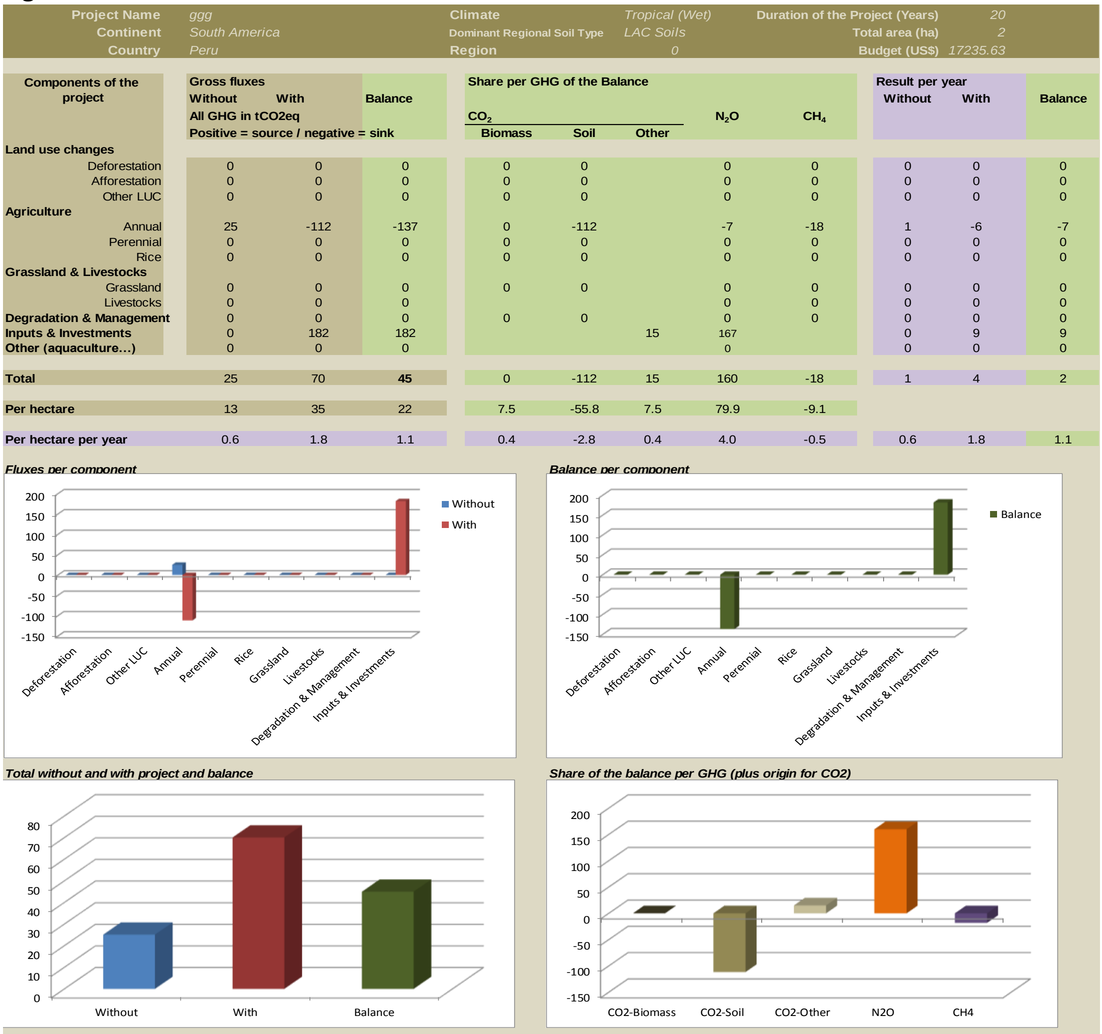
Income performance of project		
Total incremental income generated	12632	US$/ year
Average income per ha	6316	US$ /Ha
Average Incremental income per Household	12632	US$/ HH

Other environmental and social performances		
Volume of water consumption reduced per year	0	M3/ year
Renewable energy capacity installed	0	MW/ year
Employment generated	2.28	Addit. Jobs created

ii) Detailed results of GHG impact per project

In the following screenshot (figure 17), the detailed set of GHG results by module is extracted from the EX-ACT MRV tool as an output of the analysis. This can be found in the results module. It allows the user to understand both emission sources and main areas of mitigation.

Figure 17. EX-ACT MRV screenshot - EX-ACT Results



Components of the project	Gross fluxes: Without	With	Balance	Share per GHG of the Balance: CO_2 Biomass	Soil	Other	N_2O	CH_4	Result per year: Without	With	Balance
All GHG in tCO2eq; Positive = source / negative = sink											
Land use changes											
Deforestation	0	0	0	0	0		0	0	0	0	0
Afforestation	0	0	0	0	0		0	0	0	0	0
Other LUC	0	0	0	0	0		0	0	0	0	0
Agriculture											
Annual	25	-112	-137	0	-112		-7	-18	1	-6	-7
Perennial	0	0	0	0	0		0	0	0	0	0
Rice	0	0	0	0	0		0	0	0	0	0
Grassland & Livestocks											
Grassland	0	0	0	0	0		0	0	0	0	0
Livestocks	0	0	0				0	0	0	0	0
Degradation & Management	0	0	0	0	0		0	0	0	0	0
Inputs & Investments	0	182	182			15	167		0	9	9
Other (aquaculture…)	0	0	0				0		0	0	0
Total	25	70	45	0	-112	15	160	-18	1	4	2
Per hectare	13	35	22	7.5	-55.8	7.5	79.9	-9.1			
Per hectare per year	0.6	1.8	1.1	0.4	-2.8	0.4	4.0	-0.5	0.6	1.8	1.1

iii) Modalities of aggregation by the investment bank projects portfolio

Every project appraised uses the same EXCEL format, saved as a project file. Sets of project indicators could be switched from EX-ACT files to an ACCESS or EXCEL portfolio Database. Such portfolio management should be discussed with each development bank to assess which cumulated indicators they would expect.

More details on data collection and data entry can be found in the *EX-ACT MRV User Manual*[10].

[10] EX-ACT MRV User Manual

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

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

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

Mainly used for simple value chains in developing countries, the EX-ACT Value Chain tool is a multi-agent based tool appraising input supply, production, transport, processing and using numerous indicators. Being multi-impact designed, it gives performance on (i) climate mitigation (GHG emissions, carbon footprint, economic return of climate mitigation), (ii) climate resilience (iii) socio-economic performances (value added, income and employment generated) and other environment indicators (water use, energy use) of food value chain, either for the current situation of the chain, or for an upgrading project scenario. EX-ACT VC covers value chain on crops, livestock, fisheries and aquaculture.

EX-ANTE CARBON-BALANCE TOOL for Measurements, Reporting and Verification [EX-ACT MRV]

The need to appraise GHG impacts of private investment bank portfolios managed by National Development Banks led to development of the EX-ACT MRV tool (Monitoring Reporting Validation). This new tool, is based on the need for simple climate change mitigation, adaptation and resilience indicators, easy to collect and to aggregate, which give a measurable and concrete tracking system, in order to develop an accurate assessment of the impact of agricultural investments. It will enable the impact monitoring of bank portfolios of private investments within National GHG monitoring frameworks.

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