Introduction

The coffee production in Costa Rica is of great economic and historical importance and, at the same time, presents an integral part of the national identity, because the coffee production is one of the main agricultural activities in the country, representing around 8% of the Costa Rican workforce. The sector contributes about seven percent of emissions of greenhouse gases (GHGs) in the Costa Rican agriculture. Due to this outstanding significance of the coffee sector for the Costa Rican economy and its overall GHG emissions, the Costa Rican government has encouraged the development of a Coffee NAMA (Nationally Appropriate Mitigation Actions) to lower emissions in the sector.

The Coffee NAMA is the first agricultural NAMA of the world that is ready for implementation. It aims to reduce GHG emissions and improve the efficient use of resources at both plantations and mills in order to create the first low-emission coffee worldwide. Important participants of the Coffee NAMA are the Ministry of Environment and Energy (MINAE), the Ministry of Agriculture and Livestock (MAG), as well as the implementing partners like the Costarican Coffee Institute (ICAFE), the Central American Bank for Economic Integration (BCIE), the Fundecooperacion for Sustainable Development, the Center of Tropical Agricultural Research and Higher Education (CATIE), the National University of Costa Rica (UNA), the Inter-American Institute for Cooperation on Agriculture (IICA) and the University of Costa Rica (UCR). Additionally, the NAMA Support Project (NSP), financed by the NAMA Facility, will support the implementation of the Costa Rican Coffee NAMA with technical and financial assistance.

The NSP Coffee NAMA consists of five components, constituting the practical basis of promoting low emission coffee production in Costa Rica. The first component aims to promote low emission cultivation on the level of the coffee plantations. The second component focuses on encouraging the use of low emission practices in the processing at coffee mills. While the third component of the Coffee NAMA intends to implement a reliable system of Measuring, Reporting and Verification (MRV) of emissions, the fourth component is seeking to provide access to differentiated markets for low emission coffee. The last component attempts to create a Coffee NAMA fund and financial incentives.
The MRV framework, through current emissions on farms and mills are measured, reported and verified using a robust and simple actions, from the design and to application of internationally accepted methodologies.

### Emission Measurement

The process of measuring and monitoring emissions, as a key element of the Coffee NAMA, is mainly based on the standards of the World Resources Institute (WRI) called “Product Life Cycle Accounting and Reporting Standard” and “Agricultural Guidance-Interpreting the Corporate Accounting and Reporting Standard for the agricultural sector”. Furthermore, the method of measuring emissions complies with the parts 1 and 2 of the ISO 14064:1-2(2006).

Besides, the monitoring system of the Coffee NAMA applies methodologies of the Clean Development Mechanism (CDM) in areas like energy efficiency, biomass treatment (pulp) and wastewater treatment. Other international methodologies like 4C provide formats to monitor emissions caused by the processes of fertilization and furthermore, with these methodologies it is possible to monitor GHG emission removals that have been realized by introducing a coffee agroforestry system (Coffee SAF).

As the first step of the MRV system, all activities that are carried out in the coffee sector along the production line need to be identified, determining possible emission sources for each activity on each production level (farms, mills, roasters and exporters). Therefore it is essential to first define the scope of the coffee carbon footprint, by identifying all activities within the production process that should be taken into account when calculating the carbon footprint.

The scope of the coffee production applied in the Coffee NAMA only includes coffee growing (coffee plantations) and the coffee processing (coffee mills).

On the level of the coffee plantations possible emission sources or sinks include the fertilization process and the use of agroforestry systems. On the level of the coffee mills, the treatment of solid agricultural organic waste (e.g. coffee pulp), as well as water waste (e.g. honey water) are considered possible emission sources. Furthermore, biomass burned in order to create heat or energy is an additional source of emissions.

In order to be able to sum up all different GHGs into one number, the carbon footprint is measured in carbon dioxide equivalent (CO₂e). The unit in which the carbon footprint is expressed is kg CO₂e per kg of green (not roasted) coffee produced. To calculate the GHG emissions or reductions within the sector, there are three different methods to apply:

- **Method 1**: Using EF IMN
- **Method 2**: Using EF IPCC
- **Method Both**

Therefore, the emissions of a specific source (t₁) are calculated by multiplying the specific emission factor (EF) of this emission source with its global warming potential (GWP) and activity data for each source (AD) (see formula below)

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\text{AD}_{t₁} \times \text{EF}_{t₁} \times \text{GWP}_{t₁} = \text{CO}_2\text{e}
\]

The information of each emission source was collected and calculated. Whereby, the emission factor depicts the average emission rate of a given pollutant from a given source, while the global warming potential (GWP) is a relative measure of how much heat a greenhouse gas traps in the atmosphere and the data of activity presents the amount in which a polluting activity has been undertaken.

The activity data (emission sources previously mentioned) used for the calculation of emissions within the Coffee NAMA is collected by ICAFE, which runs records of each of the identified emission sources along the production line. However, there are certain emissions sources in the coffee sector for which do not exist adequate emission factors, as for example for sprinkler or drainage systems in the wastewater treatment. Currently, by implementing "early actions", though pilot projects more adequate emission factors will be calculated in the fertilization process, drainage systems and gasification with coffee pulp were adapted to reality of the coffee sector.
In order to have a reference point to identify emission reductions that have been realized, the carbon foot-print of the coffee sector for a certain base year needs to be calculated. For this purpose the ICAFE has a template with the major results, presenting the sector wide baselines for the harvest 2014 that have been used specifically for the MRV system of the Coffee NAMA. The following graphics show the emission distribution by source:

The total emissions caused during the harvest 2014, as the baseline for the coffee sector, are 57.311.71 tons CO₂-e. The average carbon footprint of one kg of green coffee is 0.1159 kg CO₂ equivalent (0.1159 kg CO₂/kg of green coffee). This amount was calculated using each data activity, emission factor and the GWP of the emission source mentioned before. The main emission source was the fertilization process, followed by the treatment of coffee pulp and finally biomass combustion and wastewater treatment (see graphics 1 and 2).

Furthermore, improvement on the baseline calculation will come from additional parameters (emission factors) and uncertainties. It is crucial to include this information in the inventory as soon as it has been obtained through the implementation of pilot projects within the Coffee NAMA.

**Emission Reporting**

Collecting and reporting high quality information on emissions and updating this information constantly presents a major challenge within the MRV system. Especially as the accuracy and transparency of the data used, is crucial for the credibility and quality of the MRV system as a total. The data generation is carried out in a decentralized manner at each level along the production line. The system information will be a "bottom-up" scale, the coffee farms report the data on emissions caused during the coffee growing process on the plantation. In the next step, the coffee mills or coffee cooperatives are in charge to report the information of the coffee farms and to submit the totaled emission information, including the emissions caused during the coffee processing, to the ICAFE.
ICAFe is identified as the organization responsible for coordinating emissions reporting under the NAMA and related information; will be responsible for collecting information and making it public, with the help of extensions personnel at each of its regional offices and at the MAG; and finally reporting to SINAMECC (National Metric System on Climate Change) and BURs (Biennial Update Reports).

It is also important to follow-up on the related benefits that can be derived from the implementation of the project itself. An important aspect of a NAMA is the different related benefits to be gained in implementing the project, be taken to monitor and report results unrelated to GHG reductions, such as the social, environmental, economic or institutional benefits, it is necessary to show the co-benefits in the implementation of the objectives or mitigation capabilities.

The report depends on the international standards each farm and mills want to apply, since it is necessary to follow different requirements. Emissions and reductions generated in the sector will be reported regularly, year after year. However, at the farm or plant level, the timing of reporting on emissions or reductions will depend largely on the intended user. It is advisable to compile a report every year at the end of the harvest, so that processing plants should conduct a review each semester, and an evaluation of the data collection and analysis process.

Emission verifying

Costa Rican Accreditation Entity (ECA) is in charge of issuing accreditation at national level in topics like verification and validation of greenhouse gases. EARTH and INTECO are nationally accepted entities for carrying out 3rd party verification and certification. Furthermore, the mills are trained to accomplish an internal verification of the carbon footprint.