An initiative of the Food Sector for the protection of the environment

LIFE+ FOODPRINT

LIFE13 ENV/GR/000958

Action A1: Preliminary activities for the development of the innovative carbon footprint software tool

Deliverable A.1bc	**Report on the mapping of CO2 equivalent emission sources of pastry and flour related products. Literature review on the procedures followed and the data that has been collected from each stage of the chain supply.**

EXECUTIVE SUMMARY

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Version 2

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Disclaimer

The information included herein is legal and true to the best possible knowledge of the authors, as it is the product of the utilization and synthesis of the referenced sources, for which the authors cannot be held accountable.

[1]The authors can be contacted for enquiries, corrections or other remarks at ***foodprintlifeproject@gmail.com***

EXECUTIVE SUMMARY

The main objective of Del. A1(bc) is twofold:

- Mapping of CO_2 eq. emission sources of pastry and flour related products.
- Quantification of CO_2 eq. emissions based on literature review and data collected from each stage of the chain supply.

Step A - Mapping of CO_2 eq. emission sources of pastry and flour related products.
This activity involves the general mapping of GHG sources, which will serve as a preparatory work for the quantification of carbon footprint of pastry - flour industry products.

Step B - Quantification of CO_2 eq. emissions based on literature review and data collected from each stage of the chain supply.
This activity involves the quantification of CO_2 eq. emissions based on data that will be collected for all sources identified during step A, as well as on literature review whereas data were not available (mainly upstream and downstream supply chain).

Data collection is of paramount importance in the process of carbon footprint of products. Therefore this action aims firstly to *collect the necessary data* which are related to the supply chain of pastry & flour products namely on farm, food processing, packaging, distribution and retail data using a specific food company (hereafter COMPANY) as a case study.

Data collection shall include all the necessary activity data (e.g. liters of fuel consumed per product unit), the selection of appropriate critically assessed emissions factors (e.g. kg CO_2 equivalent[2](eq.) per liter of fuel) and the use of primary data which will based on actual meter readings or records for the identified CO_2 equivalent emitting activities.

In addition to the latter primary data will be collected from activities from potentially high GHG emitting activities. It must be stressed that it is of paramount importance to provide as many as primary data as possible in each of the aforementioned stages of the pastry & flour food industry using the COMPANY's upstream and downstream supply chain as a case study.

This procedure is critical considering that primary data depict the actual conditions in regard to carbon footprint quantifications of products whereas there are significant limitations in regard to the available and reliable Greek databases associated with food supply chain procedures.

[2] *GHG include carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), and are expressed as CO_2 equivalent (CO_2 eq.).*

In summary, with regard to the carbon footprint of the raw materials, first the production stages for each material were identified and mapped, while the quantities of the material and energy inputs and outputs were recorded. The main categories of inputs and outputs taken into account are fertilizers, pesticides, electricity, fuel, raw materials and co-products. The production stages actually include the farm, where the crops are cultivated or the animals are bred and, the processing stage, where the farm products are being processed to factories before they are sent to the COMPANY as raw materials. Next, appropriate greenhouse gas emission factors were allocated to all inputs and outputs to the different production stages and processes, in order for the carbon footprint of each raw material to be calculated. The functional unit for the calculation of the carbon footprint was one tone of the raw material in question, while the system boundaries included the stages of cultivation/breeding, transportation to the factory, processing at the factory and packaging, that is, "farm to gate".

The assessment of the carbon footprint of the four main raw materials used in the COMPANY (flour, sugar, milk, cocoa) showed that the higher carbon footprint comes from the production of milk with 1,140 kg CO_2 eq., followed by sugar (884 kg CO2-eq.), flour (482 kg CO_2 eq.) and cocoa (320 kg CO_2 eq.) per ton of product. The very high carbon footprint of milk is mainly attributed to the high CO_2 eq. emissions on-farm due to the CH4 emissions from the enteric fermentation of cows. The high carbon footprint of sugar on the other hand is mostly attributed to the high electricity consumption at the sugar factory for the production of steam (50% of the product overall emissions).

Cocoa beans, which are cultivated in developing countries near the equator, are grown with low material inputs and thus the produced cocoa has a relatively low carbon footprint related to on-farm operations. However, emissions due to land use changes are not taken into account in this assessment. Considering that cocoa beans are grown in tropical forests, if land use was also counted for, the cocoa carbon footprint would be much higher.

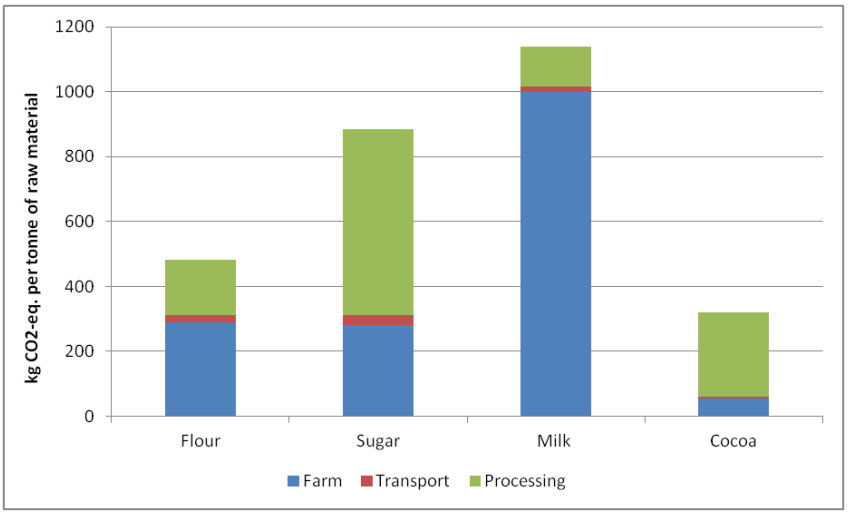

Figure 1: Assessment of the carbon footprint of the four main raw materials (flour, sugar, milk, cocoa)

Regarding energy, the work team focused in the following tasks:

- Review of state of art methods for reduction of GHG emissions in all connected sectors of food production chain
- Analysis of the COMPANY's production and dedicated processes techniques
- Comparing of BATs to existing methods in the COMPANY's process lines
- Development of procedure/method for data collection from food processing (pilot)
- Collection of real time data from selected COMPANY's products production
- Mapping of processes with mass flow and energy flow data
- Analysis of technical market solutions provided with analytical cost estimations
- Preparation of “Best Available Investments” report for efficient decision making procedures (pilot).

The above research is described as a necessity for the optimum characteristics that the under development software tool will have available, in order for it to be proven a significant assistant tool for the food industry sector, that not only will supply information concerning the GHGs emissions, but also will support the decision making procedures of investors in a most beneficial way.

At this point, it should be mentioned that regarding the quantification of thermal energy consumption at each dedicated process and for each product, special equipment is required. This quantification is based on flow measurement of the thermal medium (water or oil) and the temperature difference before and after the heat exchange.

For this reason special equipment have been allocated to the COMPANY's factory and a procedure of technical education has been conducted to specialized personnel of the COMPANY's team, in order for them to be able to properly install and calibrate the instruments, reprogram the electronic equipment and safely gather and store the electronic data before re-installing everything to a new spot for measuring.

This process has to be repeated several times in order to acquire all required data from each process step and for various products.

Especially for the steam heat exchangers, a thorough evaluation of the equipment will take place in order to determine the optimum measuring method. Steam pipes are not always filled with dry steam but with a mixture of steam and (superheated) water. This is not a problem that affects the processes, but it still could provide not proper readings to the flow meters. Natural gas dedicated meter will be used, in order to calculate heating needs, in case there is no other scientifically safe method to measure the absorbed heat.

In regards with the cooling equipment, since:

- heat dissipation finally occurs by means of the evaporative cooling tower
- cooling needs are analog to ambient temperature and thus ambient heat load

It is obvious that measurements of cooling needs measured for the same process and product are not independent of season, thus a collection of yearly data has to be considered in order to achieve defining a representative “weather independent” quantification of the process cooling need.

Final data will be presented and analyzed in a future report.