A web-based GIS tool for environmental footprint estimation of agribusinesses

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Abstract

The deterioration of environmental quality and vulnerability to climate change of the Balkan Peninsula are escalated by the lack of specific financial and strategic measures that can promote sustainable resource management. Environmental problems of the Balkan countries need to be addressed under a unified context targeting the development of common strategies to improve environmental quality and reach European and international markets. To this end, the INTERREG project "Towards farms with zero carbon-, waste- and water-footprint. Roadmap for sustainable management strategies for Balkan agricultural sector - BalkanROAD" aims to provide Balkan agribusinesses with protocols and Information Technology tools conformed to the particularities of the Balkan Peninsula, in order to promote products of high quality and value to the European and international market. Within the project's framework, a web-based GIS application tool was developed, the so-called, ROAD, that assesses all production and processing stages, namely from field to the market, capable to identify processes that can be improved and provide alternatives for reducing carbon, waste and water footprint of the final marketable products. In this work we describe the ROAD tool implementation steps, as well as some of its key functionalities.

Keywords: ROAD tool, environmental footprint, BalkanROAD project, Balkan agribusiness, sustainable growth.

1. Introduction

The Balkan agricultural sector demonstrates an increasing dynamic which however remains significantly behind the respective achievement in the Central and Northern European countries. Moreover, common problems of the Balkan countries need to be addressed targeting the development of common strategies to improve environmental quality and reach European and international markets. To this end, the INTERREG project "Towards farms with zero carbon-, waste- and water-footprint. Roadmap for sustainable management strategies for Balkan agricultural sector-BalkanROAD" aims to provide Balkan agribusinesses with protocols and Information Technology (IT) tools that could conform the particularities of the Balkan Peninsula (Doula et al., 2016a; 2017). BalkanROAD promotes a Common Protocol, which enhances resource protection and especially soil, water and waste recycling, and reuse and ultimately reduction of greenhouses gases (GHG) emissions from the Balkan farms/agribusinesses. Within the project's framework, a web-based GIS application (ROAD) was developed, that assesses all production and processing stages, i.e. from field to the market (Doula et al., 2016b; Hliaoutakis et al., 2016), capable to identify processes that can be improved and suggest alternatives for reducing carbon, waste and water footprint of the final marketable products. This work aims to describe the development steps of the ROAD tool algorithm and its theoretical background, as well as some of its functionalities regarding the estimation of Greenhouse Gases (GHG) emission, using the example of a Greek agribusiness.

2. Materials and Methods

The ROAD tool was developed after studying three pilot agribusiness cases: a winery in Greece, an apple juice plant in Bulgaria and a pepper paste plant in North Macedonia, the processing line of which include all production stages, i.e. cultivation, harvesting, processing, bottling, packaging and distribution. For the development of the algorithm, direct and indirect emissions were considered, as described in the IPCC guidelines (IPCC, 2006). Tier1, and for some processes Tier 2, approaches were adopted. In the beginning, the organizational boundaries of each case were defined and a Life Cycle Analysis (LCA) was performed to identify the impact of each single process, in terms of materials' consumption, energy use, transportation, etc. Results of the analysis were used to identify which of indirect emissions (e.g. production of bottles, closures, packaging materials, etc.) should be included in the GHG profiles of the three cases. For example, the processes considered for emissions by the winery include purchased power, mobile fuel quantity consumed, stationary combustion, fugitive emissions, winemaking practices (calculations were done stoichiometrically; for every mole of sugar fermented, two moles of carbon dioxide are generated), field practices (N_2O from N-based fertilizers addition, N_2O

emission from managed soil and carbon sequestration due to photosynthesis), waste disposal and management, and main packaging areas, (i.e., bottles and containers such as glass, PET, Tetra Pak and aluminum cans), wine bags, closures, fiber packaging and wooden products. The same approach was adopted for the other two pilot cases. Transportation for goods' distribution (ship, rail, air transport) was not included in the systems' boundaries.

3. Implementation

The tool enables the producer to collect and further analyze data regarding all the phases of the marketable product (cultivation and processing stages) while inserting the appropriate quantitative data through a user-friendly and intuitive interface (**Σφάλμα! Το αρχείο προέλευσης της αναφοράς δεν βρέθηκε.**).

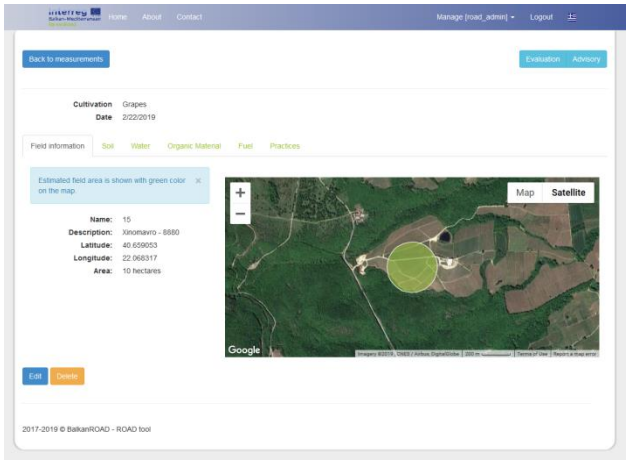

Figure 1. ROAD cultivation area information for one of the fields of the winery agribusiness

For the winery case and considering fuel consumption (Figure 2) and N-based fertilizers and organic materials' addition (Figure 3), the outputs in terms of $CO_{2\text{-eq}}$ through the ROAD tool dashboard are also presented.

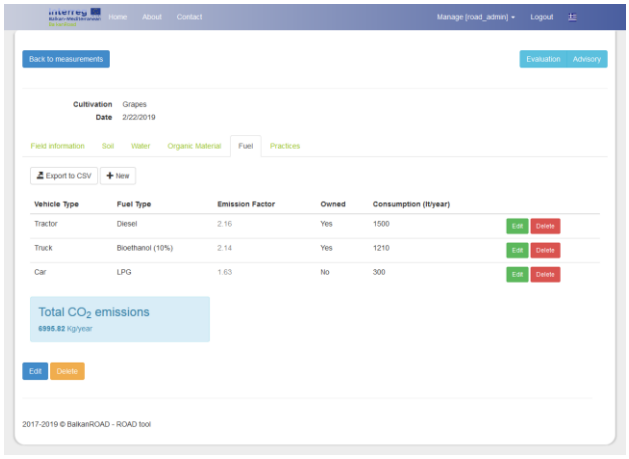

Figure 2. ROAD outputs for CO_2 emission due to fuel consumption of the winery case

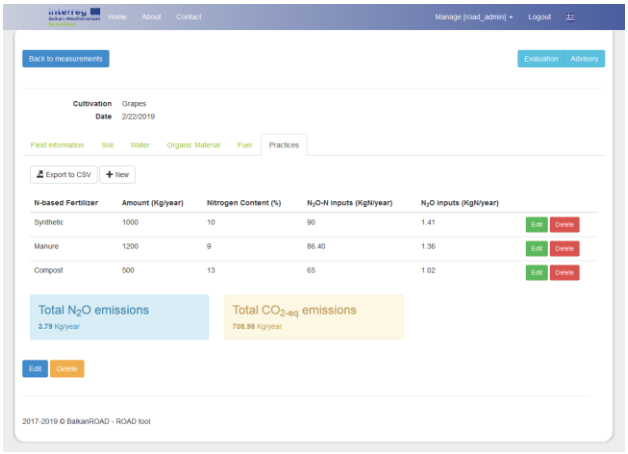

Figure 3. ROAD outputs for $CO_{2\text{-eq}}$ emission due to the addition of N-based fertilizers and organic materials

Still, the ROAD tool is not just a GHGs calculator. The final version will provide alternatives that may reduce further the environmental footprint of the product. Although for energy and fuels' consumption the alternatives are somehow known, ROAD will focus on field practices by exploiting processes through an already developed software, namely Cultivation Management Software (Hliaoutakis et al., 2016). Thus, it will provide consultancy for fertilization and organic materials' application on soils according to soil properties and plant's needs, in our case of vines, apple trees and vegetables. As a result, the ROAD tool is able to model the respective processes identifying the most important aspects of the production system in order to discriminate the activities with the highest environmental impacts that vary from the industry norms. Finally, the user is presented with examples of similar agribusiness, where best practices as suggestions have been already adopted to reduce the environmental impact of their products.

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