Biosystems Engineering for sustainable agriculture, forestry and food production

International Mid-Term Conference 2019
Italian Association of Agricultural Engineering (AIIA)

Potenza/Matera, University of Basilicata, September 12-13, 2019

Biosystem Engineering for sustainable agriculture, forestry and food production

Conference Proceedings Book

https://sites.google.com/unibas.it/aiiamatera2019

Matera, 12-13 September 2019

Organization

SAFE - School of Agriculture, Forestry, Food and Environmental Sciences - University of Basilicata, with the technical support of Ninetek Innovazioni per l'Agro-industria s.r.l., spin-off company of the University of Basilicata

Presentation

Sustainable development of agriculture, forestry, and food production sectors is closely related to the research developments in the field of biosystems engineering. On one side, biosystems research is oriented to efficiently produce and process biological resources to satisfy the demand of consumers and a wide range of industries for food, feed, bio-energy and bio-based products. At the same time, it provides and develops engineering-based methodologies and decision support tools for management and protection of soil, water and environmental resources; design of structures, facilities, equipment and infrastructures; planning and design of rural areas and landscape; mechanization and technologies for agricultural production; agricultural electrification and energy usage; ergonomics and work organization and safety; computer and communication technologies.

Matera, 12 September 2019

The Organizing Committee

- Antonio Coppola
- Giovanni Carlo Di Renzo
- Giuseppe Altieri
- Paola D'Antonio
- Alessandro Comegna
- Francesco Genovese
- Attilio Matera
- Luciano Scarano
- Luigi Gioviale
- Cosimo Marano

Table of Contents

1 Foreword

The aim of this Conference is to stimulate contributions related to the engineering technological applications to the agriculture, forestry, and agro-food sectors. Researchers involved in activities related to Biosystems and Agricultural Engineering, as well as Agricultural, Forestry and Food Engineers, farm and food company managers are warmly invited to attend the Conference.

The Conference will deal with the following major topic

Innovative biosystems engineering for sustainable agriculture, forestry and food production

The specific subjects will include (but not will be limited to)

- Agricultural hydraulics
- Water resources management in agriculture and forestry ecosystem
- Design and management of Farm and District-Scale Irrigation Systems
- Remote Sensing in agricultural and forestry systems
- Monitoring and modeling of the interactions among soil hydrological, plant and atmosphere processes, and agricultural management practices
- Soil and contaminant hydrology
- Forestry hydraulics and hydraulics protection of agricultural and forestry systems
- Bioengineering Techniques for soil protection and slope stabilization
- Rural buildings, facilities and territory
- Spatial and landscape analysis
- Planning and design of rural areas
- Mechanization and technologies for agricultural production
- Agricultural electrification and energy usage
- Ergonomics and work organization
- Computer and communication technologies
- Machines and facilities for agricultural products and food processing

CODE: 110

Reference Topic: Spatial and landscape analysis.
AIIA Section: 2a. Proposal for Oral presentation or Poster: Oral presentation.

10.3 ASSESSMENT OF FOREST BIOMASS AND CARBON STOCKS AT STAND LEVEL USING SITE-SPECIFIC PRIMARY DATA TO SUPPORT FOREST MANAGEMENT

Luca Nonini[1*], Calogero Schillaci[1], Marco Fiala[1]

[1]Department of Agricultural and Environmental Sciences. Production, Landscape, Agroenergy, University of Milan. Via G. Celoria 2, 20133 Milan, Italy.
[*]Presenting Author: Luca Nonini. E-mail address: luca.nonini@unimi.it, Tel.: 02 503 16694.

1. Introduction

To estimate wood biomass (WB) and carbon (C) stocks of forests, several models have been developed; they differ in terms of details and scale of application. Stand level models are particularly important because stands represent the reference forest management units (FMU). The aims of the study were: (i) to assess WB and C stocks of Valle Camonica forests (Northern Italy) at stand level and (ii) to map the spatial distribution of these stocks.

2. Material and methods

A first model has been recently developed to calculate WB and C stocks at stand level in different pools: (i) aboveground and (ii) belowground WB and (iii) dead organic matter, using site-specific primary data collected in forest management plans (FMPs). In the study, new information and calculation methods were introduced to provide a more reliable and flexible model. For each stand, starting from the initial growing stock volume (GSV, t DM), the gross current increment (GCI, $t \cdot year^{-1}$ DM) is estimated each year, applying the first derivative of the Richards growth function. Specific parameters are used, according to stand's characteristics (species and type of management). For the year *n*, GSV is calculated starting from GSV of the year *n-1*, adding GCI and subtracting losses in the year *n* due to: (i) harvesting, (ii) small-scale mortality and (iii) disturbances (wildfires, windstorms, avalanches, and insects' outbreaks). For the latter, the model allows the quantification of GSV fraction that is transferred to dead organic matter pool, according to the type of disturbances. Starting from GSV, annual aboveground and belowground WB – and the corresponding C stocks – are calculated applying specific coefficients, defined according to stand's characteristics and derived from literature. For each stand, dead organic matter (dead WB and litter) – and the corresponding C stocks – of the year *n* are calculated taking into account, as inputs: (i) small-scale mortality, (ii) fraction of WB due to disturbances and (iii) harvesting residues, and, as outputs, dead organic matter decomposition. In the study, the model was tested to the dataset of 2019 stands of Valle Camonica forests (45 FMPs; 37000 ha), covering the period from 1984 to 2016. The model was then integrated with a Geographic Information System (ArcGIS software®) to produce digital maps and analyze the spatial distribution of WB and C stocks.

3. Results

For each stand under analysis, a classification sheet (SCC) with a user-friendly interface was developed. Each SCC is organized in two hierarchical levels (L_1 and L_2). L_1 contains general input information extracted from FMPs (e.g. location, species, type of management, initial growing sock volume and gross increment). L_2 is organized in two sublevels (L_{2A} and L_{2B}). L_{2A} contains specific input (e.g. harvestings or disturbances) and output (calculated by the model, related to WB and C stocks in the pools over the time) information; L_{2B} includes specific input information related to mechanization (type of biomass cutting performed and characteristics of the biomass harvesting chains). The model described here can be efficiently used to support forest management and decision-making processes at a local or district level.