NITROGEN AND PHOSPHORUS ESTIMATION IN AGRICULTURAL PRODUCTS TO DEFINE AGRI-ENVIRONMENTAL INDICATORS: NAPA PROJECT

Filiberto Altobelli[1*], Flavio Lupia[1], Silvia Vanino[1], Pasquale Nino[1], Iraj Namdarian[1], Simone Orlandini[2], Anna Dalla Marta[2]

[1] INEA, National Instituite for Agricultural Economics, Via Nomentana, 41, 00161, Roma
[2] DIPSA, Department of Crop, Soil and Environmental Science, piazzale delle Cascine, 18, 50144, Firenze
* altobelli@inea.it

Abstract

This paper introduces the project NaPA (pilot studies on estimating the content of Nitrogen and Phosphorus in Agricultural products), funded by Eurostat, for the development of a methodology for estimation of N and P contents in the main crop products in Italy. The methodology takes into account the dependency of crop nutrient contents on climate (temperature and rainfall), N and P inputs (organic and mineral fertilization) and main agricultural practices. The content coefficients of these two elements is fundamental for the definition of the Gross Nutrient Balance (GNB), that is one of the most important agri-enviromental indicators adopted by the EU as they provide insight into the links between agricultural nutrient use, losses of nutrients to environment and the sustainable use of soil nutrient resources.

Keywords: Agri-Evironmental Indicators (AEIs), Gross Nutrient Balances (GNB), sustainability

1. Background of the action

The Gross Nutrient Balances (GNB) are some of the most important agri-eviromental indicators (AEI) adopted by the EU; "they provide insights into links between agricultural nutrient use, changes in environmental quality, and the sustainable use of soil nutrient resources".

The GNBs are estimated using basic data such as livestock numbers, fertilizer consumption and crop output, and coefficients. The recent Dire Data project, study financed by Eurostat (European Commission), with general objective to create a framework for setting up a sustainable system for collecting a set of data from farmers and other sources for creating the 28 agri-environmental indicators (AEIs), made several recommendations on how to improve both the basic data needed for the calculations, and the supporting parameters. Eurostat is, together with other commission services and international organization, identifying actions that are to be taken in this respect (Velthof, 2011).

The GNBs can be used to identify the underlying drivers of pressures on environment that should be addressed by policies. The GNBs are required in a number of different monitoring and evaluation exercises, such as Rural Development Programme, Water Framework Directive, Nitrates Directive, and at the same time, part of several indicator lists in Eurostat, OCED and EEA.

2. Methodology

The NaPA (pilot studies on estimating the content of Nitrogen and Phosphorus in Agricultural products) project, is a study financed by Eurostat.

The project is focussed on the development of a methodology for the estimation of N and P contents in the main crop products (in detail between the main product, the by-product and the crop residual) in Italy. The methodology will take into account the dependency of crop nutrient contents on the climate, N and P inputs and main agricultural practices.

The main objective is the identification of the best practice methodologies and technical solutions for calculating the N and P contents, based on available data, of harvested crop production as available from the Eurostat crop production statistics at national level, as well as regional level where relevant. The methodology will be developed by discussing and comparing actual experiences of nutrient crop content coefficient setting at national and regional level in other studies with particular attention to the harmonization at an international level by collaborating with other European countries directly involved into the project or in similar studies.

To achieve this goal, some specific objectives are foreseen, in particular:

– Construction of an inventory of existing data and methodologies;
– Collection and analysis of available data about fertilization practices (organic, mineral, manure);
– Collect and analysis of data and coefficients on nitrogen biological fixation and atmospheric deposition;
– Assessment the relationships between climatic characteristics and the movement and partitioning of P and N nutrients into the crop parts;
– Use of the collected data and metadata for the setup of an organized database for storing the data necessary to nutrient coefficients calculation;
– Identification of a more reliable source of data needed for the calculation of crop nutrient contents;
– Calculation of crop nutrient content coefficients;
– Ensuring the quality of the methodology by developing and implementing validation procedure, Assessment of the sustainability of the methodology through the identifications of the methods for updating the used data;

On these bases, the proposed methodology will be articulated in the following five actions:

1) Identification and verification of information sources
In this action, data will be collected and analysed in order to identify the most suitable for the estimation of crop nutrient contents. The survey and inventory of following data will be made:
– published data and methodologies used in Italy and abroad for estimating nutrient crop removals and/or contents;
– experimental data coming from field experiments and on-going research projects at European level;

– data concerning the partitioning of nutrients in the different parts of the crop considered;
– survey of data available in Eurostat statistics.

2) Identification of main variables influencing the nutrient content of crop products
During this action, the role of the main variables in determining the nutrient content of products will be evaluated and established. In particular, the analysis will take into consideration: cultivated crop; agricultural production system particularly in relation to the use of mineral or organic fertilizers; farm management practices; soil type; climate. The analysis of the effect of climate represents an important point and on the basis of the obtained results, the study area (Italy) will be classified into homogeneous areas (sub-regions).

3) Database set up
This action will deliver an updated and structured database containing the different data for the computation of the nutrient content of crop products and the description of data, included metadata.
In particular the following activities are foreseen:
– harmonization of measuring units involved in the estimation procedures (e.g. volumes, weights, extensions);
– harmonization of reference products involved in the estimation procedures (e.g. dry or fresh weight, grain);
– design of the relational database structure;
– set up of the relational database.

4) Model development
The model will be based on the found methodology and shared at international level. In particular, the action include the following activities:
– development of the model for determining nutrient content of crop products on the bases of considered factors;
– development and implementation of a simple model for determining nutrient content of by-products on the bases of considered factors;

– calibration of the methodology through application to specific case studies coming from scientific literature;
– Assessment of the quality and the sustainability of the methodology.

5) Design of a prototypal system
The developed model will be implemented in a WEB based system or as a stand-alone software in order to facilitate and allow the use and the application of the methodology to the end users. The system implemented will be easily exportable to other countries due to the shared methodology on which it will be based on. The specific activities of the action are the following:
– identification and selection of the most suitable tool for the system implementation (e.g. web, software);
– design of the system architecture (e.g. data format, query system);
– design of the Graphic User Interface (GUI).

3. Conclusion
The expected result is to come up with the national and regional N and P crop content coefficients needed for producing harmonized Gross Nutrient Balances.
The results should include sub regional N and P crop content coefficients to convert Eurostat crop production statistics and other crop production data used in the GNB in nutrient contents.

Literature
Velthof, G., 2011. Agri-environmental Indicators: recommendations for priority data collection and data combination. ISBN 978-92-79-22062-3.