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AGeNDA: A NEW TOOL FOR SUSTAINABLE FARM MANAGEMENT,  
INTEGRATED IN THE AGRI-ENVIRONMENTAL POLICY OF THE EU

by  
Carlo Giupponi

Prepared for the  
8<sup>th</sup> Joint Conference on Food, Agriculture and the Environment  
August 25-28, 2002  
Red Cedar Lake, Wisconsin

Sponsored by

**Center for International Food and Agricultural Policy**  
University of Minnesota



Research, Food and Nutrition, Commodity and Trade,  
Development Assistance, Natural Resource and Environmental Policy

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## **AGeNDA: a new tool for sustainable farm management, integrated in the agri-environmental policy of the EU**

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**Abstract:** AGeNDA is an Italian acronym which stands for Analysis and Integrated Management of the Farm (Analisi e GESTione iNtegrata Dell’Azienda agraria). It denominates a new software developed by a research project carried out at the Department of Agronomy, Environment and Crop Production (DAAPV, University of Padova) in collaboration with the Environmental Protection Agency of the Veneto Region (ARPAV).

Although developed from scratch, the software originates from a past joint research carried out by the two above mentioned institutions in collaboration with the Department of Agricultural Economics and the Center for Farm Financial Management (CFFM) of the University of Minnesota. The joint research started in the early 1990’s, focussing on the Planetor software and, in particular, on the evaluation of its potentials for Italy and the development of an Italian version.

The source codes and the elaboration procedures of the old and new software tools have nothing in common. Nevertheless, the methodological approach of the two tools is very similar and so is the input structure of the databases. AGeNDA, in fact adopts an approach similar to that of the previous software in utilising an extensive knowledge base about the environment and the production processes (crops and livestock) saved on databases, which are browsed (and edited if required) at the moment of the practical on farm implementation.

The paper presents the results, current activities and future prospects of the AGeNDA Project, with the aim of informing the Italian – American group and stimulating possible new collaborations in the future.

**Keywords:** Farm management, Agri-environmental policy, Software

## INTRODUCTION

Environmental concerns for the negative externalities of modern agricultural systems have become a major issue for many agencies and organizations worldwide, since, at least, the early 1980's. A great wealth of research has been thus financed to investigate, quantify and describe the various mechanisms of agricultural production systems (crop and livestock), which may determine negative environmental consequences: water pollution, soil erosion, salinization, aquifer depletion, etc.

In very few words, one could say that research results emphasized, in general, the possibility of substituting current production systems aimed at short-term economic optimization, with others aimed at optimizing – or compromising – environmental compatibility with – usually long-term – economic performances. Another relevant outcome of the research efforts was the evident impossibility of deriving general and simple rules for describing the relationships between agricultural systems and environmental impacts, and their economic and policy-related effects. Therefore, tools, such as models and decision support systems, became necessary to assess the – site – specific combination of environmental (soil, climate) and human factors (production systems) and to derive multi-disciplinary evaluation indicators.

As a consequence a strong need for multi-disciplinary approaches and tools emerged and several methodological proposals and software packages were proposed. Amongst others, in 1990, the initiative of the National Extension Sustainable Agriculture Task Force, who asked the University of Minnesota's Center for Farm Financial Management to develop a software program that would help farmers:

- understand the environmental impact of their individual farming practices
- evaluate alternative production practices from an environmental perspective
- evaluate the potential alternatives from a financial perspective

The result of this effort – with the cooperation of the USDA's Natural Resource Conservation Service (NRCS), the USDA's Agricultural Research Service (ARS) and other land grant universities – was the development of the Planetor software program in 1991 and the subsequent revision resulting in Version 2.0 in 1995 (See Box 1).

This paper presents the results, current activities and future prospects of the research started within the US – Italian collaboration which leads every second year to the Joint Conference on Food, Agriculture and the Environment, with the aim of informing the Italian – American group and stimulating possible new collaborations in the future.

## THE PLANETOR JOINT PROJECT

The potential interest of the software for an application in Italy was expressed since 1992 in a paper on a national technical journal (*L'Informatore Agrario*) by C. Giupponi and P. Rosato: "Planetor: un software per conciliare convenienza economica e compatibilità ambientale" (Planetor: a software to reconcile economic profitability and environmental compatibility). In the paper, the authors presented the software and the results of the first tests on Italian data, and emphasized the remarkable potentials for agri-environmental management of the Italian farms, together with some relevant problems which the existing software not suitable for an immediate application. In particular: foreign language, US units, lack of supporting data bases for local conditions. Box 2 briefly describes the history of the US-Italian collaboration for Planetor.

Since that time, the agri-environmental question has evolved dramatically both in Europe and in the US. The issue of the environmental compatibility of agricultural systems has seen continuous re-evaluations on both sides of the Atlantic Ocean, driven by the evolution of the international socio-economic contexts, the subsequent reforms of the agricultural policies and the changes of political administrations.

The changing emphasis on agri-environmental issues has also influenced the fate of the Planetor Program and the development of the software tool. At the time of the presentation of the second version of the software (mid 1990's), the interest for agri-environmental farm management and supporting tools partially lost its impetus in the US, while it was still increasing the EU following the reform of the Common Agricultural Policy in 1992.

As a consequence, while the new tool found little opportunities for being extensively adopted in the US, a great potential was foreseen for its application in the Italian situation, as a tool for supporting the implementation of the agri-environmental regulations (in particular Reg. 2078/92 and Reg.2080/92). A formal contract was signed in 1995 between CFFM and the Agricultural Extension Service of the Veneto Region (now part of the ARPAV, the regional EPA), for the realization of the Italian version of Planetor-II. The prototype was released in 1997 and then a collaboration between ARPAV and the University of Padova allowed the testing of software and its improvement and adaptation to the specific socio-economic situation, environmental conditions and policy context of the Veneto Region. The supporting data bases were completely rebuilt with data describing local production processes, products, tools and environments (soils and climates).

A new CAP Reform known as "Agenda 2000", and its specific implementation in the Veneto Region, together with the special law for the preservation of the city of Venice and its lagoon, recently changed once more the policy context by addressing special attention to sensitive areas, where funds for environmentally sound practices are actually available. This is the case of the

Watershed of the Lagoon of Venice (WLV). The application context changed as well: a tool for the extension service that supports the re-orientation of farm management towards environmentally sound practices is less needed than a tool that quantifies and evaluates the benefits deriving from public funds made available to the farmers of the WLV, as required also by the European Commission, during the negotiation with the Regional Administration.

In such a context, a completely new tool, AGeNDA, was developed under a research project of the Department of Agronomy, Environment and Crop Production (DAAPV, University of Padova) in collaboration with the Environmental Protection Agency of the Veneto Region (ARPAV), with the supervision of the author of the present paper.

### THE AGENDA PROJECT

As previously stated, the interest for the implementation of a software like Planetor in Italy, in support of the adoption of environmentally friendly and economically sound agricultural practices was strong since the early 1990's. The presentation of the software tool to farmers, technicians, universities and research and institutions, arouse great interest among potential users, but also highlighted its limitations. Although in the Italian version of 1997 the main problems had been solved, it was evident that:

- the effective implementation of the tool required the launch of an *ad hoc* research project aimed at building and maintaining the massive data bases, which were not previously available in Italy and which are a pre-requisite for its practical use;
- extensive tests were required for the functioning of the whole software, because it never entered into a an extensive application phase, thus remaining at the level of prototype;
- the extensive application of the tool and its formal adoption by the Regional Administration required profound evaluations and adaptations of the methodological approaches and algorithms implemented in the US version, not only for what concerned the economic valuation, but also for the environmental impact assessment models.

Considering the above, a research project involving the University, the Regional EPA and farmers associations and extension services, was launched. The project produced the required support data bases for Planetor, tested the tool in 50 farms of the WLV and ended up with the conclusion that a new tool, built upon such experiences and interfaced with Planetor was needed.

The results of the Planetor tests in WLV together with the development plan of the new software were presented to the Regional Administration at the end of 2001 and, as a result, the proposed approach and the tool were adopted for the implementation of agri-environmental

measures in that area. The first prototype of the new software, called AGeNDA, was presented to ARPAV at the beginning of June 2002.

AGeNDA is an Italian acronym that stands for Analysis and Integrated Management of the Farm (Analisi e GEstione iNtegrata Dell'Azienda agraria). Although developed from scratch, the software originates from a past joint research carried out by the two above mentioned institutions in collaboration with the Department of Agricultural Economics and the Center for Farm Financial Management (CFFM) of the University of Minnesota. The joint research started in the early 1990's, focussing on the Planetor software and, in particular, on the evaluation of its potentials for Italy and the development of an Italian version.

The source codes and the elaboration procedures of the old and new software tools have nothing in common. Nevertheless, the general approach of the two tools is very similar and so is the input structure of the databases (See Box 3). AGeNDA in fact adopts an approach similar to that of the previous software in utilising an extensive knowledge base about the environment and the production processes (crops and livestock) saved on databases, which are browsed (and edited if required) at the moment of the practical on farm implementation.

The main characteristics of the new tool, in comparison to Planetor, are:

- Windows™ environment
- Simpler structure
- More flexibility
- Easier implementation and comparison of alternative farm management scenarios
- Adoption of a flexible set of evaluation indicators (modular structure). Metamodels and look-up tables to substitute complex and generic environmental models (i.e. Rusle and Nleap), or implementation of modelling routines targeted to the specific application requirements (i.e. Roimpel model for nitrogen and water balances)
- Support of the local implementation of the EU agri-environmental policy in particular for what concerns the required evaluations (*ex ante*, *in itinere* and *ex post*) of the benefits deriving from the funds utilised by farmers.

#### **SOFTWARE IMPLEMENTATION IN THE WLIV**

The Planetor software was tested in about 50 representative farms of the WLIV with the aim of testing the algorithms, and identifying needs for further development. A brief description of the WLIV is given in Box 4. Realistic alternative scenarios were designed for the current decisional contexts for the farmers. "Ante" scenarios were defined based upon ordinary techniques adopted for cultivating crops and rearing animals, while "Post" scenarios derived from the introduction of agri-



environmental measures specific for the WLV:

- implementation of Reg. 2078/92;
- implementation of measures proposed by the Rural Development Plan of the Veneto Region (Agenda 2000);
- implementation of the Code of Good Agricultural Practice as defined by the Nitrate Directive;
- implementation of investments supported by the “Plan to prevent the pollution of the Watershed of the Lagoon of Venice” (PCR 255 del 19-12-1991 e n. 1115 del 8-3-1995), for better structures in livestock rearing plants and in irrigation systems.

The experience was positive and successful on the one side, as it resulted in the formal adoption of the Planetor approach by the Regional Administration and the European Commission, but on the other it highlighted the practical limitations of the software which led to the design of a new tool as previously described. In particular:

- some limitations were found in the sensitivity of the models used to describe the specificities of local environments;
- the data input was very tedious in particular for what concerns the implementation of alternative farm management scenarios;
- the economic valuation was too generic and simplistic and not tuned to the approach adopted by the EU accounting system;
- the software code was not designed for the MS-Windows<sup>TM</sup> environment causing several problems in the execution and adaptation of the tool.

The most recent contacts with the Department of Agriculture of the Veneto Region allowed the definition of an implementation plan for AGeNDA, tuned to the regional programs in terms of calls for farmers willing to be involved in the agri-environmental measures in the WLV.

An *ad hoc* course will form technicians in farm surveying next fall, which will be ready to start the field work at the end of 2002. This will allow the implementation of the tool in a number of farms, ranging between 500 and 800, during the next two years and the evaluation of the environmental benefits of a total expenditure above 110 M Eur.

#### ACKNOWLEDGEMENTS

Research carried out with the financial contribution of the Agenzia Regionale per la Protezione dell’Ambiente del Veneto and of the Italian Ministry of Education, University and Research (grant “ex 60%”).

**BOX 1: MAIN CHARACTERISTICS OF THE PLANETOR SOFTWARE**

Planetor integrates in a single piece of software the analysis of economic and environmental performances of the farm. It combines site specific environmental models with individual farm economic data to evaluate the impacts of reducing or changing pesticide, nitrogen, phosphorus and manure applications, tillage systems and crop rotations. Planetor evaluates alternative management plans for individual farms and compares the impacts on soil erosion, nitrate leaching, phosphorus runoff, pesticide movement and profitability.

Planetor approaches planning from a whole farm long range perspective. It can evaluate crop rotations of up to 10 years in length. It evaluates the environmental factors for each field on the farm and projects a long range financial analysis for the whole farm business. Planetor was designed to help farmers better understand the current environmental impacts of their farming practices and evaluate alternative practices from both an environmental and an economic perspective. In addition, incorporating multiple environmental factors into one system allows farmers and advisors to evaluate the interaction between environmental factors when proposing a change to the farm operation.

The approach adopted for farm analysis foresees the integration of pre-existing and widely used methods, and in particular:

<u>Model</u>	<u>Evaluates</u>
RUSLE	Soil water erosion risk
NLEAP	Nitrate losses in leaching water
Phosphorus Index	Phosphorus in runoff
PMDSS	Pesticide pollution risks for ground- and surface water
FINPACK	Profitability, liquidity and solvency

**BOX 2: THE US-ITALY COLLABORATION FOR PLANETOR*****The Beginning: 1990:***

- The National Extension Sustainable Agriculture Task Force asked the University of Minnesota's Center for Farm Financial Management (CFFM) to develop a software program that would help farmers:

1. understand the environmental impact of their individual farming practices
2. evaluate alternative production practices from an environmental perspective
3. evaluate the potential alternatives from a financial perspective

***The Story***

- 1990 (2nd Conference):

- CFFM presents Planetor: Environmental and Economic Farm Planning Software
- first talks about the new tool under development (Planetor 1) and its potentials for Italy

- 1991:

- CFFM releases the first version of the Planetor Software

- 1994 (4th Conference):

- presentation of the "beta" version of Planetor 2
- the Agricultural Extension Service of the Veneto Region (ESAV) examines the software and decides to support the development of an Italian version
- interests of colleagues of the University of Perugia

- 1995:

- agreement between CFFM and ESAV signed: C. Giupponi and P. Rosato in charge of the development of the Italian front end and necessary adaptation of the software

- 1996 (5th Conference):

- The framework of the Italian version presented by K. Klair and C. Giupponi

- 1997:

- First prototype of Planetor-It released

- 1998:

- First contract between ESAV and the University of Padova for the experimental application of Planetor-It in the area of the Watershed of the Lagoon of Venice (WLV)

- 1999:

- Use of Planetor-It required by the Regional Administration to farmers applying for public supports in the area of the WLV

- 2000:

- Planetor-It applied in 50 farms of the WLV
- Second contract between Arpav and the University of Padova, for the development of a new software tool, called AGeNDA

- 2002 (8th Conference):

- The framework of AGeNDA presented by C. Giupponi
- Use of Planetor/Agenda agreed between the Regional Administration and the European Commission as a tool for evaluating and reporting of public investments/expenses in the area of the WLV

**Box 3: Planetor databases**

The primary databases adopted by Planetor as knowledge base to be implemented in the description of the farm:

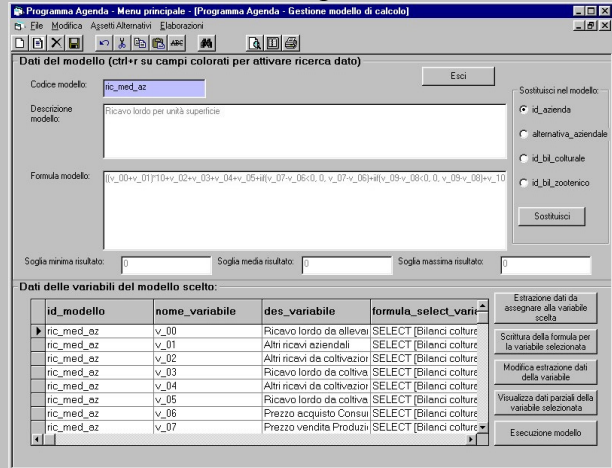
1. Soil properties database which includes all the soil properties required for RUSLE, NLEAP, the Phosphorus Index, and the pesticide movement models.
2. Pesticide properties database which includes the chemical properties of the pesticides (Wauchope and Hornsby, 1992), the active ingredients, and the toxicity data, (Crop Protection Chemicals Reference, 1994).
3. Climate databases which include site specific temperatures, pan evaporations, and precipitation quantities, energy intensities, and annual distributions.
4. Machinery operations database which includes both economic data (Fuller, et. al. 1992) and the physical data relating to soil disturbance and residue incorporation and removal.
5. Fertilizer database which includes both the fertilizer's analysis and application methods.
6. Livestock database which includes financial data and the nutrient levels of animal waste produced by different species and animal weights.
7. Manure database which contains the nutrient losses from different storage and applications systems.

Box 4: The user interface of the AGeNDA software

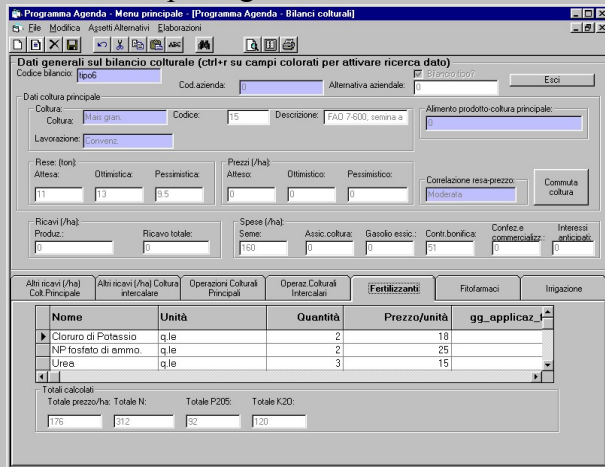
The main menu



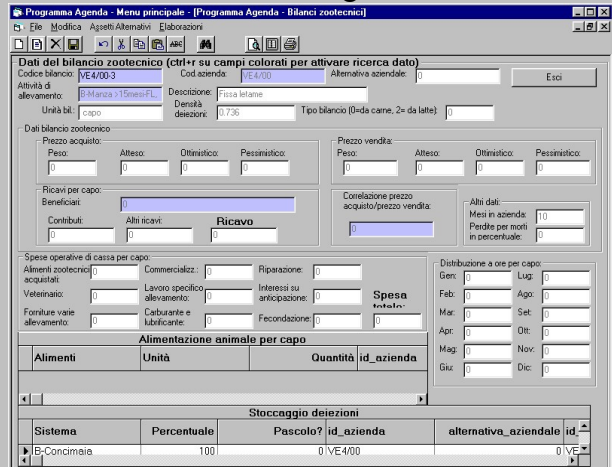
The model development menu



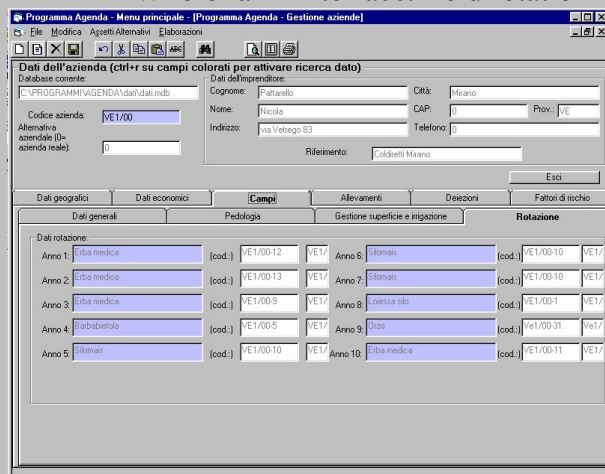
Crop budget interface: fertilizers



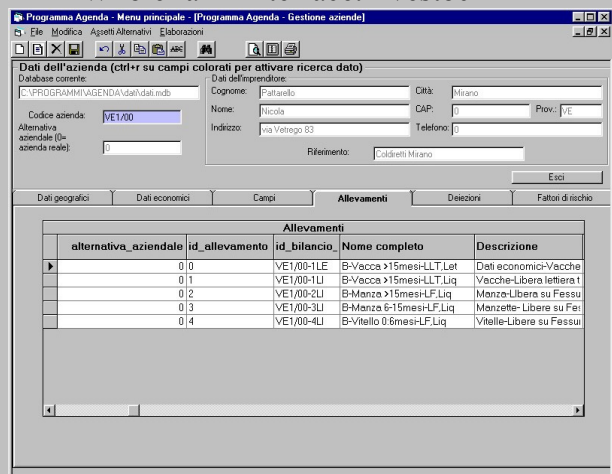
Livestock budget interface



Whole farm interface: field rotation



Whole farm interface: livestock



### Box 5: The Watershed of the Lagoon of Venice (WLV)

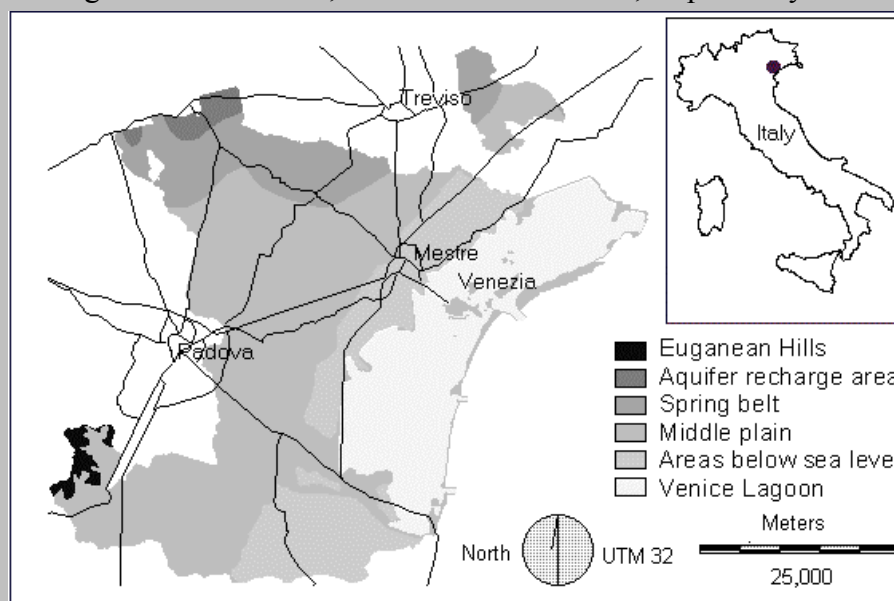
The Watershed of the Lagoon of Venice is an almost entirely flat area, some of which lies below sea level. Given this geomorphological situation, its delineation is not unique, nor stable; on the one hand the identification of the surface boundaries of aquifers contributing to spring rivers flowing to the lagoon is a matter of debate and, on the other, the management of surface water carried out day by day by competent local authorities may change the extent and location of areas tributary to the lagoon or flowing directly to the Adriatic Sea.

The WLV, in one of its versions, covers circa 184000 ha, of which around 2/3 is cultivated and, from a geographical point of view can be divided into the following areas (see Figure below):

- a small high plain in the north, where deep aquifers originate, with a broader spring belt located further south;
- to the south, there is the so called mid-plain area;
- towards the landward edge of the lagoon, there are vast areas of reclaimed land lying below sea level, which are maintained by pumping systems;
- to the south-west, there is a small hilly area, forming part of the Eugean Hills.

Census information on the agriculture of the area is available for commune administrative boundaries; a total of 96 communes (Provinces of Treviso, Padova and Venezia) lie within or partially within the territory of the WLV. The most important crops are maize, soybean, sugar beet and small grains. From the pedological point of view, 6 main types of cultivated soils were traditionally distinguished: gravelly, medium textured, sandy-silt, sandy, organic and clay soils. The medium textured soils are in the NE and southern part of the watershed and are generally associated with clay soils. The sandy-silt soils are in the NW and central part of the area, while the gravelly soils and sandy soils lie in the extreme NW. The organic soils are mainly towards the SW. A completely new soil map, which adopts classification systems internationally recognized, has been almost completed by the same branch of Arpav dealing with the development of the AGeNDA software.

From the climatic point of view the watershed area can be divided into three zones that correspond to the southern, central and northern parts and are distinguishable essentially for an increasing rainfall pattern. Representative weather stations may be identified for each of the three areas with annual average rainfall 734 mm, 802 mm and 1049 mm, respectively.



*The Watershed of the Lagoon of Venice.*