

SEAMLESS: models for farming policies

The Dalle Molle Institute for Artificial Intelligence (IDSIA, USI-SUPSI) is a partner of SEAMLESS (System for Environmental and Agricultural Modelling: Linking European Science and Society), a project of the Sixth Framework Programme of the European Union. The project aims to produce methodologies and IT tools to assess the impact of future sustainable agricultural policies. It brings together 30 research institutes from 13 European nations, besides the US and Mali. IDSIA contributes to the development of a software platform able to manage and represent modelling knowledge, based on artificial-intelligence concepts and instruments.

In Europe, farming accounts for approximately 40% of land use; it is also expanding steadily, owing to factors such as market liberalisation, WTO agreements, globalisation, climate change and social evolution. EU farming policies assure a significant financial support to the rural economies of member states through subsidies: 40% of the EU budget goes to support the common agricultural policy (CAP). SEAMLESS was launched in 2005 as a project designed to evaluate the impact of new farming policies on European society. It is an integrated project of the Sixth Framework Programme (FP6) of the European Union, within the priority area called "Global Change and Ecosystems".

The Dalle Molle Institute for Artificial Intelligence (IDSIA, USI-SUPSI), a member of the project, acts as the coordinator of a team of seven institutes and two enterprises working on the creation of a software platform. Dr Andrea Emilio Rizzoli, an IDSIA researcher, explains: "The project aims to develop an integrated computing system applicable to the development and assessment of EU farming policies and based on a set of mathematical models implemented and executed on word processors. To this end, analyses ought to be of an integrated nature, to ensure that not only economic but also social and environmental aspects are taken into account, hence sustainability may be guaranteed".

The Consortium

SEAMLESS is an integrated project of the EU Sixth Framework Programme, consisting of 30 research institutes and 13 European member states, as well as the US and Mali. Besides IDSIA, partners include Wageningen University (co-ordinator, The Netherlands); the Institut National de la Recherche Agronomique (INRA, France), the Institut Agronomique Méditerranéen de Montpellier (IAMM, France); the Agricultural Research Council (Italy), the EU Joint Research Centre located at Ispra, Italy); LUCSUS, Lund University Centre for Sustainability Studies (Sweden); Alterra, the Research Institute for our green living environment of Wageningen University (Netherlands); Bonn University (Germany); the University of Vermont (USA).



Tractor in a field (© European Community, 2006).

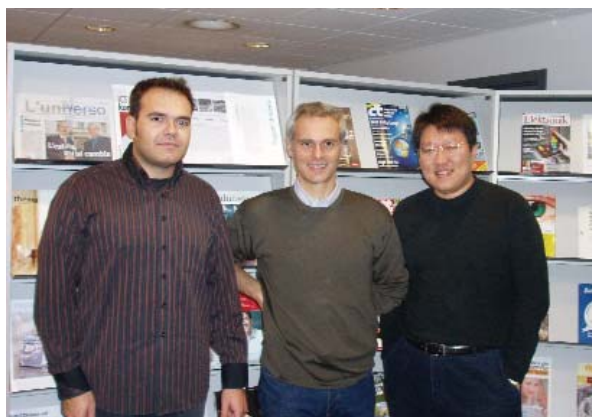
IDSIA is responsible for supplying the IT and computing infrastructure required to manage sets of mathematical models and statistical, economic, and environmental data and indicators, as for instance growth of plants, sale prices and production volumes, the depth of ploughed furrows, average rainfalls observed in a given time interval, or climate change. "The data bank collects several Europe-based sources. We had to pre-process and aggregate a number of different databases and complete them with unstructured data, such as those issued by Eurostat, the Statistical Office of the European Union", Rizzoli specifies. Data thus gathered were subsequently collated, sorted and cross-referenced on different scales: from individual farmhouse, to the farmhouses of a given region, to those of a nation, eventually to be connected up to the whole of the European Union. Once these numbers were integrated into the database, simulation and optimisation programmes were run; these programmes helped to show the impact of given scenarios (for instance, market liberalisation or a hike in the price of beetroot) on a local and global scale. So far a number of micro-economic analyses have been carried out on three sample regions: Flevoland, a Dutch province, the Midi-Pyrénées region in France, and Mali, a crucial partner for the evaluation of the impact of European farming policy reforms on developing countries.

Connecting the environment, economics and politics

IDSIA's contribution to the project is the creation of software architecture able to manage and represent modelling knowledge. "We have devised a system for the management of knowledge in the domains of farming and environmental economics based on ontologies. Ontologies help us construct knowledge in a given field of science and share this knowledge with the scientists responsible for the different disciplines involved in SEAMLESS", Dr Rizzoli explains. Thus, ontologies enable us to fully determine meaning and context of the variables circulated among the different models.

The system integrates mathematical models that describe phenomena relating to different sectors and disciplines (from biophysical growth of plants to the modelling of arable soil, from the economics of the local farm to the economics of European farming as a whole). It is indeed important to make sure that these models can communicate and interact effectively. Consider this example: the 'rotation' concept, derived from the model of growth of crops, must be shared with researchers dealing with microeconomic models. Indeed, the simulation of a sequence of rotations allows us to estimate the crop yield in a given region, which in turn determines supply, which then must be matched to demand, deriving from prices fixed by a macroeconomic model on the European scale. Hence, all data collected have to be arranged in such a way as to be easily processed by computer, and so that any inconsistency can easily be detected between the different data sources.

At a later stage, simulation and optimisation programmes are used, depending on which particular problem needs



The IDSIA research team involved in SEAMLESS. Left to right: Ioannis Athanasiadis, Andrea Emilio Rizzoli (co-ordinator), and Hongtao Li.

solving. An example might be the optimum dosage of fertilizer to be used in order to obtain a given yield of wheat, given the region's climate. Here, IDSIA has come up with some algorithms of combinatorial calculus to generate scenarios of production activities and agricultural rotations.

At the moment, an initial prototype of software has been created on an open-source basis (i.e. codes are not protected by IPRs but may be used freely by other researchers), to check the validity of hypotheses and of methods adopted.

By 2008 (the year the project is due to be completed), a second version of the software is expected to be brought out; as a result, the surveys conducted on the three test regions will be applicable also to other European regions.

"We would love to launch a cooperative venture within the Swiss borders" - this is Rizzoli's wish - "SEAMLESS does not include data on Switzerland, but this tool might indeed turn out to be very useful for an evaluation of our national farming policy and of its interaction with the EU farming policies".

IDSIA

Created in 1988 in Lugano by the Dalle Molle Foundation, IDSIA is an institute affiliated to both USI and SUPSI. It pursues investigations into several aspects of IT research: from computational linguistics to self-learning methods, from artificial learning to optimisation techniques. Its numerous research activities are conducted in association with Swiss and foreign universities. Current research projects are funded by the Swiss National Science Foundation, the Technology and Innovation Commission, and the European Union. IDSIA has developed successful procedures in several fields, achieving outstanding results worldwide. Research on artificial intelligence is turning its attention to building intelligent systems capable of learning by themselves, on the basis of experience alone, as is the case with the human mind.



For further details:

Dr Andrea Emilio Rizzoli
IDSIA - Istituto Dalle Molle di Studi sull'Intelligenza Artificiale
Galleria 2; CH-6928 Manno
Tel. +41 91 610 86 64
e-mail: andrea@idsia.ch
www.idsia.ch/~andrea

Web addresses:

IDSIA: www.idsia.ch
USI: www.unisi.ch
SUPSI: www.supsi.ch
SEAMLESS: www.seamless-ip.org