Management and Impacts of Climate Change Programme GICC
CRP 1999

7/99 - Agriculture and greenhouse effect: economic regulation of reciprocal impacts and compatibility of agricultural and environmental policies – Analysis of the situation in France and in the European Union

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Initial research benefited from the participation of CEREOPA (Olivier Lapierre and Frederic Pressenda, 1999-2001) and of Guillaume Gruère, INA-PG student in the 'Economy of the Environment and of Natural Resources' DEA course (Paris X University, INA-PG, ENGREF, EHESS, 2000) and research fellow in the laboratory (new Unité Mixte de Recherche INRA-INA) between March and August 2000. A large proportion of this project appears in one chapter of Stephane de Cara's PhD thesis, defended in March 2001, and is the object of various scientific publications and papers delivered at international seminars linked with the GICC programme (see list at the end). Research on the coupling of biophysical and economic models was resumed by Caroline Godard (October 2001- February 2002).

These investigations cover some of the various tasks featuring in the work programme (see above), according to an adjusted schedule (see section on the difficulties encountered). The research carried out under the five predetermined tasks is presented below, in order of implementation.

Task 2: Adjustment of the 'greenhouse effect' aspect of the model

This particular section was carried out by Guillaume Gruère, as part of his DEA dissertation (DEA EERN and INA-PG, report in September 2000).The technical evaluations were progressively tested to 'IPCC standards'. Three types of balance were proposed: an 'enteric methane' balance, a 'methane – animal dejecta' balance and a 'nitrogen oxyde' balance. In consequence the matrix generator, the parameter-deciphering program and the parameter file of the model were adjusted. Since the IPCC standards are also liable to be modified, the greenhouse gas emissions proposed in the operational version of the model were by default based on 'INRA standards'. As the official IPCC report, originally scheduled for early 2001, was eventually issued long after the completion of Guillaume Gruère's work, the emission-calculating functions have not been fully validated in the operational version of the model. The modifications induced by these functions were nonetheless tested on the 'European' version of the model, applied to France (report by Guillaume Gruère). The findings were presented at the GICC seminar in Toulouse (September 2000).

Task 3: Relationships between animal production, crops, and spreading practices

The transcription, by CEREOPA, of the model in its operational version on HP server written in MGG-SCICONIC into an 'Xpress' version for microcomputer should facilitate testing the existing relationships between animal production, crops, and spreading practices. By default, the transcription of the relationships advocated by IPCC (see Task

2) makes it possible to progress in the evaluation of agriculture-related emissions on the basis of the operational version of this model.
This particular task is still in its exploratory phase.

Task 4: Evaluation on the European scale

Surprisingly, this task, which appeared the most daunting and was only proposed for exploratory purposes, was successfully completed since an initial 'European' version of the model was calibrated. We now have an EU-12 version, calibrated on the basis of 1995 microeconomic data and already used in the referenced academic research. A total of 472 farm-type groups are defined according to member state and region as well as technical and economic orientation (see OTE nomenclature of FADN). Analyses undertaken in France and presented in various publications as well as in the course of the international AERE seminar (Rethymnon, July 2000) were resumed and carried further in a chapter of Stephane de Cara's PhD thesis (defended in March 2001).

With the European Commission's support, we also developed an operational version of the model on the scale of EU-15, used within the framework of a contract with the Commission (European Commission for Agriculture and Rural Development) on the basis of more up-to-date data. It should allow a consistent and systematic analysis of agriculture-related greenhouse gas emissions in the perspective of the implementation of the Kyoto Protocol by the EU. This version is due to be used in future research programmes.

Task 1: Coupling of economic and biophysical models

With support from the GICC programme, this task was launched only recently (October 2001) due to recruitment delays to replace one of the project participants who resigned from INRA. It is currently under way and should be pursued thanks to supplementary funding (including from INRA).

In an investigation undertaken in 1998 as part of a research fellowship INRA-INA-PG (Maugars S., 1998, **Couplage d'un modèle économique et d'un modèle biophysique pour la quantification des impacts environnementaux des cultures (*coupling of economic and a biophysical models to quantify the environmental impacts of crops*)**, INRA-ESR Grignon, Mémoires et Thèses n° 28, Octob er 1998, 46 p. + appendices), initial attempts at coupling economic and biophysical modellings had opened a new promising line of research. The objective was to develop crop yield response functions to varying inputs. The analysis focused on inorganic nitrogen fertilizer inputs.

The methodology needed to be updated. In particular, it should benefit from the substantial progress made concerning the biophysical model STICS, developed by INRA (EA-Avignon) and now extended to cover a wide range of crops and edapho-climatic conditions.

C. Godard (fixed-term contract research engineer) thus reviewed the entire methodology, building on structured data sets. A considerable amount of work was achieved on the data, using particularly favourable access conditions to three types of data, i.e. 'phenology', 'soil' and 'climate'.

The methodology was tested on different types of crops, on typical farms of given regions (according to the economic model AROPAj) and, more particularly, on the basis of physical data from Ile-de-France. The generic response function that will be validated will be of the exponential type (rather than quadratic, as had been projected in the previous study). The yield-calculating module, associated with the AROPAj model, will also be entirely redesigned.

However, the aspect of the project pertaining to agronomy and edaphology is currently in its exploratory phase. Given the perspectives opened, its multidisciplinary nature, the resources to be mobilized (processing of large databases from different sources, integration by geographical information systems capable of associating and cross-correlating different types of information), a project was submitted to the 2002 GICC call for research proposals. It will involve one team of economists and two teams of agronomists and edaphologists.

As things stand, a detailed report of the last six months' work, currently beingexpanded, is available on demand. It describes the methodology, the work achieved on the data, the simulations carried through with the latest available version of the STICS model (installed on PC/Windows), and the treatment of the results obtained from the point of view of an agronomist.

Task 5 : Digital simulations

The simulations carried out concern the upstream studies involved inTasks 2 and 4. They provided the material for several reports, papers presented in seminars and publications, as well as two chapters of Stephane de Cara's thesis.