Decision support system in French agriculture: The need for information exchanges. Scientific and technical information and rural development

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Abstract

ACTA co-ordinates a network of agricultural searchers (RMT Modélisation) who are developing models in our R&D Institutes. Within this network, we performed a survey of models developed by Agricultural organizations. These models are many, and only a few of them are really used either by farmers or by their advisors. Within a new R&D project called GI-E-EA (Gestion de l'Information "Environnement" de l'Exploitation Agricole), ACTA Informatique and its partners are trying to perform a survey of information used by the above models, and to check whether or not information used by these models is already input in (or may be computed from) farm internal Information Management Systems. We believe that the decision support systems developed since the end of the eighties are not really used because they make necessary to input several times much information already managed by farm accounting systems or farm technical tools. We are verifying that many data that the models requires are already included in farm Information Management Systems and develop the message that will be exported from these internal systems to models running on servers of e.g. our R&D organizations. In this paper, we will present the activities of the Modelia network together with the first results of the GI-E-EA project. We will discuss the environmental traceability that farmers may have to manage together with the physical traceability of their products.

Résumé

L'ACTA anime un réseau d'ingénieurs et de chercheurs en agronomie qui développent des modèles dans nos instituts de R&D (RMT Modélisation). Au sein de ce réseau, nous avons réalisé une enquête sur les projets de modélisation des organisations agricoles. Ces modèles sont nombreux et seuls quelques-uns d'entre eux sont réellement utilisés, soit par des agriculteurs ou par leurs conseillers. Au sein d'un nouveau projet de R&D, GI-E-EA (Gestion de l'Information "Environnement" de l'Exploitation Agricole), ACTA Informatique et ses partenaires tentent d'effectuer un inventaire des informations utilisées par ces modèles, et de vérifier à quel point l'information utilisée par ces modèles est déjà disponible dans les systèmes d'information des agriculteurs. Nous pensons que les outils d'aide à la décision développés depuis la fin des années quatre-vingt ne sont pas réellement utilisés, car ils nécessitent la saisie de nombreuses données en entrée, déjà gérées par les systèmes existant dans les exploitations ou au sein des organisations de développement agricole. Nous vérifions que ces nombreuses données en entrée sont déjà incluses dans le système informatique des agriculteurs et nous cherchons à développer des messages qui permettront de les exporter vers les modèles fonctionnant sur les serveurs distants de nos organismes de R&D. Dans cet article, nous présentons les activités du réseau Modelia ainsi que les premiers résultats du projet GI-E-EA. Nous discutons de la traçabilité environnementale que les agriculteurs ont ou auront à gérer parallèlement à la traçabilité physique de leurs produits.
Mots clés: outils d'aide à la décision, échange d'informations

Introduction

In front of environmental expectations of the society and our political leaders, we wondered about what the agro-environmental traceability of agricultural productions could be, widening the objectives of the traceability which limited itself until now to the logistic aspects (identification of origin and following batch of products) and to the quality of products (precise description of production processes and sanitary aspects).
Does this agro-environmental traceability meet real needs and how to define it? We assume that this traceability exists and we observe that it matches real needs. For a better understanding, we propose the following definition: environmental data correspond to all the agronomic data (crop and animal productions) needed to estimate and/or pilot the agricultural production system by taking into account the evaluation of environmental impacts. So we take into account at the same time the impact of agricultural activities on the environment within the framework of relevant regulations and the impact of the environment on farming.
Thus, we proposed to draw up an inventory of the most relevant environmental data that agricultural actors share and that permit environmental traceability of the agricultural operations for crop and animal productions. We also intend to create the corresponding data model, in the three studied domains: inputs, water and energy. This work is currently conducted by ACTA Informatique within the project "management of the environmental information of the agricultural exploitation" (GI-E-EA) funded by the French Ministry of Agriculture and Fishing. Other partners are ACTA, Institut de l'Élevage, Arvalis-Institut du Végétal, Ctifl, Cemagref, Agro EDI Europe.
ACTA is also leading a French network “modelling for agronomy” of agricultural searchers ("RMT modélisation", see: http://www.modelia.org) who are developing models in our R&D Institutes (INRA, ACTA, CIRAD…). Within this network, we performed an analysis of models developed by Agricultural organisations. These models are many and present a great diversity, but only a few of them are really used either by farmers or by their advisors. A lock-in could be data to be input and we believe that data exchanges between these technical tools and farm internal Information Management Systems could facilitate the use of models.
In this paper, we present the first results of the GI-E-EA project together with the relevant results of Modelia network. We discuss the environmental traceability that farmers may have to manage together with the physical traceability of their products.
This results discussed in this paper are the follow-up of previous works achieved by ACTA in the past (Dekkers & Waksman, 1997; Waksman G. & Masselin-Silvin S., 2005) and more recently within the RESAGRI project supported by the French Ministry of Industry and leaded by Agro EDI Europe.

Examples

A good illustration of what we are seeking is the automatic verification service of control points for grain production proposed by Arvalis and IRTAC. Grain storage farming cooperative transmit to the service numeric exchange files describing cultivated fields and cropping operations (EDIFACT DAPLOS exchange message created by Agro EDI Europe, UN/CEFACT TBG 18), and in return receive a diagnosis for the cultivated fields including 70% of the control points of the specification contract.
A second example is the decision support system for irrigation of sugar beet proposed by the French institute of industrial beets (ITB, 2006). With a thin client, the farmer sends to the ITB server the information on cultivated field localization, soil water characteristics, sowing date and past water supply. In return, he receives a concise diagnosis on current or future water stress experienced by the beets from a water balance calculated using the ITB weather database (rainfall and evapotranspiration). This information supports the decision to irrigate. Similarly, fruits and vegetables producers use the website of technical centre for fruits and vegetables industry to compute risk indices for pests and diseases depending on localization, plant variety and sowing date in order to optimize control treatments at the field scale (CTIFL, 2009).
A third example is the pollution diagnosis of surface water by manure, for which a diagnostic tool called DEXEL was developed by the Institut de l'Élevage (Manneville, 2006). The difficulty here is the huge

amount of data to collect and to input into the software. Although it is illusory to expect extracting all the information required for diagnosis from the farmer's information system, we can still hope to extract the greatest part of it in order to facilitate the user work for diagnosis with DEXEL.
Therefore, it consists to use available information stored locally in the farms in conjunction with additional information stored or computed by the R&D Institutes or by farm advisory service companies to facilitate agro-environmental diagnosis or technical indicator calculations at the cultivated field, husbandry or exploitation scale.
In order to generalize these information exchanges, we must start with defining data dictionaries and exchange formats that would allow system interoperability, which could be defined as compatibility of hardware and software tools used both at farm scale and at farm service organization scale.

Agro-environmental traceability and modelling tools

Since the beginning of the 80's, important work has been done on modelling and simulation of biological, technical or economic processes. Thus, many models exist nowadays (although rarely used in practice) and we made the assumption that agro-environmental data used for traceability purposes constitute necessary input information for these models. We achieved an inventory of models existing in our country together with their input data, which could be partly present in farm information systems.
The analysis of projects of the technical institutes and INRA led us to distinguish two types of modelling projects used for the agricultural development, which mainly differ by their objective and their use (Figure 1).

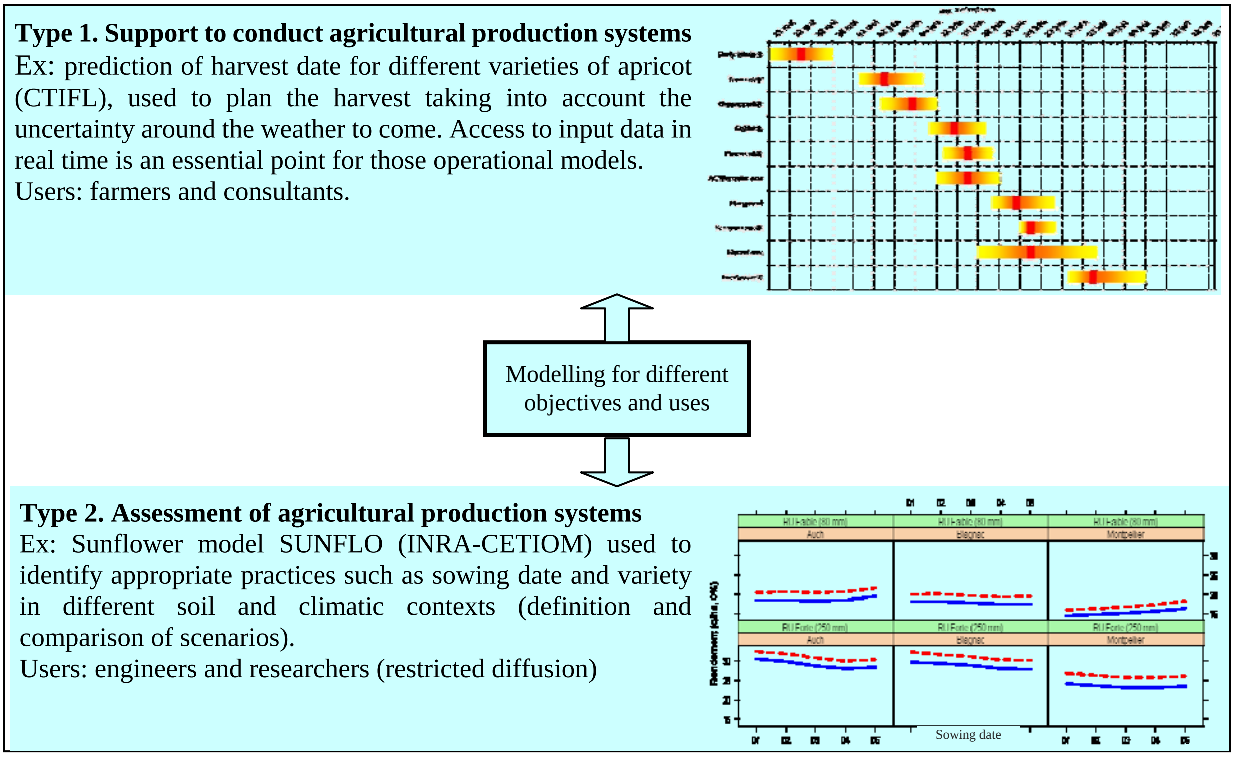

Figure 1. Two types of modelling project for different objectives and uses

The first type, "Support to conduct agricultural production systems", corresponds to decision support tools which can bring personalized information (related on a particular context) to the decision maker - the farmer. The diffusion can concern a large audience as the target user is the farmer or an agricultural consultant. Either the user run the model directly or he uses the simulation output (map, chart, warning bulletin…). Examples (Table 1) include a number of tools: forecasting pests and diseases, managing water supply, predicting harvest date, environmental diagnosis, technical and economic calculators…

Type	Users	Model	Objectives
1	Farmers, consultants	INOKI Apricot (CTIFL, 2009)	Prediction of harvest date for different varieties of apricot (CTIFL), used to plan the harvest taking into account the uncertainty of the weather forecast.
		SEPTOLIS (Arvalis – Institut du Végétal, 2008)	Forecast of wheat leaf blotch to optimize the first fungicide treatment date.
		IRRIBET (ITB, 2006)	Water balance to control irrigation.
		DEXEL (Institut de l'Élevage) (Manneville, 2006)	Establishing nitrogen pollution diagnosis of a husbandry farm by identifying on a hierarchical basis the potential pollution sources coming from buildings, equipment and practices of effluents spreading.
		DIAPHYT (ACTA) (Delval, 2007)	Establishing risk index measuring the impact of pesticide application practices on the health of the operator and on the agroecosystem.
2	Engineers, searchers	SUNFLO (CETIOM-INRA) (Casadebaig, 2008)	Identifying appropriate practices such as sowing date and variety in different soil and climatic contexts.
		MELODIE (IE-INRA) (Chardon et al. 2007)	Assessment of environmental impacts of the dairy cow or porcine livestock farms.

Table 1. Examples of two types of modelling projects: objectives and users

The second type, "Assessment of agricultural production systems", corresponds to models used at the interface of research and development activities, to conduct studies and to establish technical references. The diffusion is more restricted since the target user is the researcher or the engineer of the technical institute related to their working themes. Examples shown in Table 1 include study of the Genotype X Environment interactions, comparison of farming system design for integrated protection management, assessment of the environmental impacts of different husbandry systems… These projects can also provide scientific material for new projects of the first type.

The availability of input data required to use these models seems to be a major lock-in preventing a wider use. Indeed, apart from the question of data for design and evaluation of these models, their usage in order to run simulations requires new and appropriate input data such as weather data, soil characteristics, cropped field areas, varieties, type of manure, herd characteristics…

For models of the first type, "Support to conduct agricultural production systems", these data generally are specific of a situation (example: updated weather data and/or soils characteristic for a particular field) (Table 2). It is thus necessary to provide particular and updated data for each simulation, which can be time expansive and appear as a major lock-in as farmers or consultants have other priority activities on the farm.

For models of the second type, "Assessment of agricultural production systems", the problem of the input data is quite different (Table 2). After defining scenarios, models of the second type are used to compare them. Scenarios do not need to be specific of a typical context. The choice of a standard case representative of a set of context (area mean climate, soil depth, livestock size…) is often privileged. The idea is to make a comparative study of various production systems. For example this kind of model does not require having access to updated weather data, but one will choose climatic series representative of the studied case.

Constitution and formatting of this input database remain a consequent work, even if more punctual than for the first type of model. Furthermore, the end-user and the designer of the model must ensure the adequacy between the required input data and the available data, resulting from experimentation, inquiry or existing agricultural databases.

Type	Models	Input data
1	INOKI Apricot (CTIFL, 2009)	Specific data for a context: - updated weather data - climatic series passed for the calculation of uncertainty - variety
1	SEPTOLIS (Arvalis – Institut du Végétal, 2008)	Specific data for a context: - updated weather data - sowing date - variety
1	IRRIBET (ITB, 2006)	Specific data for a context: - updated weather data - water reserve - quantity of water used for irrigation
1	DEXEL (Institut de l'Elevage) (Manneville, 2006)	Specific data for a context: - livestock buildings - storage and effluent processing - area and means for effluent spreading - crop and herd characteristics
1	DIAPHYT (ACTA) (Delval, 2007)	Specific data for a context: - general environment - modality and equipment for application and cleaning - exploitation staff - cropped fields and buildings - pesticide treatments
2a	SUNFLO (CETIOM-INRA) (Casadebaig, 2008)	Definition of a scenario: - climatic series for several past years - soil characteristics - variety characteristics
2b	MELODIE (IE-INRA) (Chardon et al. 2007)	Definition of a scenario: - climatic series for several past years - farm characteristics

Table 2. Input data of the models cited as example

The "arable crop" message for the agro-environmental traceability in crop productions

In France, the EDIFACT DAPLOS "arable crop" message, describing the cropped field and the farming interventions carried out on it, is used to record the traceability in crop productions (see above the example of specifications for grain production by Arvalis and IRTAC).

From our work, we argue that this message is not sufficient to product relevant input data for existing models and decision support tools. Indeed, pest and disease forecast models for crop (for example), as well as models used to assess the agricultural production systems, need more information than could provide this existing "arable crop" message.

We point out the lack of two essential points to use these tools:

- the first is the description of the biological or plant health state of the crop (description of the diseases, deficiencies…). This description is currently worked to become a standard in France.
- the second is the description of the means of intervention (irrigation, fertilization, crop protection treatment).

The agro-environmental traceability in livestock productions

The analysis of the software which aim at achieving, for example, an environmental diagnosis of the husbandry (reduction of the impact on the water pollution related to a manure management plan), or a diagnosis for energy and greenhouse effect contributions, was a difficult task. We have not yet identified all the common input data required so much those are numerous and their definitions are complex.
So, we limited our objectives to a coherent definition of some reference tables to be used by all these software, which is not the case today.
We however do not give up identifying a certain number of information which could be transmitted directly from the farm information system towards diagnostic tools because this would make them more easy to use.

The need for specific expertise in message creation

The creation and maintenance of gateways and messages require know-how. For example, in France (Agro EDI Europe, an association of which ACTA is a member), in the Netherlands and in Germany, organizations have developed such expertise in message elaboration for agriculture. A number of these organizations work within an international working group of the UN/CEFACT dedicated to the agriculture questions. The specific expertise of these organizations presents several aspects:
- Ability to gather stakeholders (users, companies that offer services, R & D organizations...).
- Control of analytical methods for creating data models with UML and maintaining messages. For example, they can use software as Enterprise Architect (UML Design Tools and UML CASE tools).
- Ability to create and maintain a large number of reference systems, because information systems in agriculture rely on many reference tables.
- If necessary, experience in international standardization.

The role of software publishers

The agricultural software publishers play a crucial role at two levels:
- They have a good knowledge of their customers' needs and are in the best position to encourage them to adopt an approach of "environmental traceability" and use the available tools.
- They are the only ones being able to implement the exchanges of information between the existing information system of the farmer and models.
In this context, one can imagine that the use of some of these models and decision support tools becomes obligatory and then the agricultural software publishers will make all the required efforts so that the communication between the information system of the farmer and these supplementary tools is as easy as possible via messages that we will have been able to work out (at least partly).
One possibility could be that some editors perceive a commercial interest in this kind of approach and that they invest in developing gateways that we consider essential to the development of the agro-environmental traceability, which required a real uses of modelling tools.

Conclusion

In a country like France, where in 2010 more than 60% of farms are computerized and more than 50% connected to the Internet (a majority with a high speed access), almost all economically significant farms are computerized and are using Internet services, we cannot say any more that a model or a decision support tool remains little used because of a low level of computer equipment of farmers. Of course, we can explain the low use of this kind of tools by several other reasons (complexity, poor ergonomics, training needed, amount of input data, predictions reliability…).
The development of the agro-environmental traceability requires the use of these tools and thus appears conditioned by:
- Co-operation between the organizations of R&D designing these environmental traceability tools and the software publishers who develop and maintain the information systems of the farms.

- The development of gateways like messages gathering information resulting from the information systems of farms and allowing to produce input data for these tools. There is a real need to work with an organization specialised in message standardization such as Agro EDI Europe.
- Effort of R&D organizations to limit information to be manually input before getting a result with their tools and to limit as much as possible to input twice data already available in the information systems of the farms.
- Possibility for the software publishers to develop the market for environmental data management and open some trading perspectives.

Similarly, in the new agriXchange project (funded within the European seventh framework program "Food, Agriculture and Fisheries, and Biotechnologies"), we intend to have a similar work at the European level in order to share with other research groups of our experience and generalize such electronic gateways to make farmer job always easier.

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