INTEGRATION OF SOIL INFORMATIONS TO ASSESS AGROTECHNIQUES THROUGH MODELS VALIDATED ON TRUE AGRO-ECOSYSTEMS. METHOD AND EXEMPLES

M. B. BOUCHE. *Laboratoire de zooécologie du sol INRA/CNRS, CEFE, BP 5051, F-34033 MONTPELLIER Cedex 1 (France)*

Introduction. Sustainable agriculture implies both flexibility and grounded predictability. Flexibility, because in our very quick change of economics, type of human techniques and social processes nobody can predict in middle term the soil use in a given area. Grounded predictability, because "sustainable" implies "time" : not only modelling is needed but models must be validated on true systems. Induced climate change by these changes of land use is also linked to this type of predictions. To do these predictions we must use "all" the present knowledge... and in addition to complete it by studies.

The available knowledge is scarcely fully used to assess the various agrotechniques (ploughing, pesticides, cropping choices,...) acting on soils. The various facets of assessments (economical input of crops, sustainable development, soil biodiversity, consequent on global changes, social perception) are also scarcely fully practicized and are difficult to document. The development of 1°) new concepts and method and 2°) new computer means allows a full saving and availability of knowledge. This methodology 1°) describes in full all bio-physico-chemical data related to agro-ecosystems and agrotechniques, 2°) modelizes typology and functionning of these systems and techniques and validate models on them, 3°) explains in full this models in a flexible (understandable) way to decision makers.

Materials and methods. The starting point was 1°) the study of interactions of earthworm roles on soil physics, on soil chemistry (especially nitrogen cycle, carbon storage and humification) and on soil biology (esp. root and microbial life) under 2°) various agronomical, grassland and forestal managements and 3°) in connection with socio-economical constraints. This interdisciplinary knowledge gave the material to improve a methodology which has been extended, improved and validated in agricultural machinery, agronomical performance studies (especially rice crop, vineyard, ...), forestry changes in landscape use and farm economy management. Today twelve research teams work together with this method.

Results. Our results are essentially methodological and conceptual. To be optimal, decisions at each level (choice landscape use and management ; choice of each agrotechniques by practicians ; choice of regulations, ...) must be grounded on the Exhaustive Relevant and Explicit Knowledge (EREK). "Exhaustive" needs a full availability. "Relevant" means immediate selectivity (no delay, *i.e.* by electronic way) to get exactly what we need to every peculiar purpose (technique, type of soil or crop, or land use, ...). "Explicit" means the expression of knowledge from general understanding to, if needed, very precise facts without technical non explained jargon and in the users tongue.

This EREK could be today managed by modern computer software and hardware but is impossible because our common practice in soil sciences : the prevalence of the analytico-synthetic method. In fact, three fields of knowledge must be clearly distinguished. 1) The "real", on which we observe elementary facts : each Datum Initially observed and Controlled (DIC) without any interpretation. 2) The cognition, which is the classical sector of technico-scientists making their choices for sampling, their intellectual, material and mathematical models trying to represent the real by interpretations of facts (DICs). 3) The society, asking questions often wide, unpredictable or vague which do not fit easily with results of technico-scientists. This society use more or less well the results of cognition.

The knowledge is managed and accessible in this three sectors very differently 1°) *versus* real, by ordering DICs from general to peculiar thanks to an open Related Relational Data Bases (1), 2°) by analytico-synthetic accretion of predicates related to descriptive or functional models (2) and 3°) by access from general to peculiarities thanks to Explained Knowledge Dispensers (3), easy to translate in various tongues.

The paper illustrates this integration by the validated models relating effects of intensive agriculture (espacially pesticide uses), on soil water infiltration and nitrogen bioavailability to plants, and gives some consequences for soil conservation (slakking, erosion) and general biota.

Discussion. The enormous knowledge acquired by the various soil technical and scientific disciplines is practically not accessible to practicians and decision makers. Today the spectacular development of computer sciences allows the full availability of knowledge. Alas, this is impossible because the maze created by the splitting of science and techniques in a myriad of insulated micro-disciplines. Environmental problems and poor land use result widely of this maze examplified by the poor state of the so-called ecology (4). Fortunatly we can, in addition to our specialist practice, adopt in soil science, not in speech but in fact, the recently available transdisciplinary integration methodology.

Literature cited

(1) Soto, P. 1990. Proposition d'un système informatique ouvert pour la gestion transdisciplinaire des données dans le cadre de l'IFEN. Mémoire de fin d'étude INFI et Mémoire DPE CNAM Paris, 1-239 + Annexes.

(2) Bouché, M.B. 1990. Ecologie opérationnelle assistée par ordinateur. Ed. Masson, Paris, 1-572.

(3) Bouché, M.B. in press. L'intégration éco-environnementale en agronomie, industrie, aménagement, etc. ; Théorie et méthode.

(4) McIntosh, R.P. 1985. The background of ecology : concept and theory. Cambridge studies in ecology. Cambridge University press. 1-383.