Colloque International

organisé conjointement par
l'INRA et le CIRAD et intitulé :

- Partenariats
- Innovation
- Agriculture

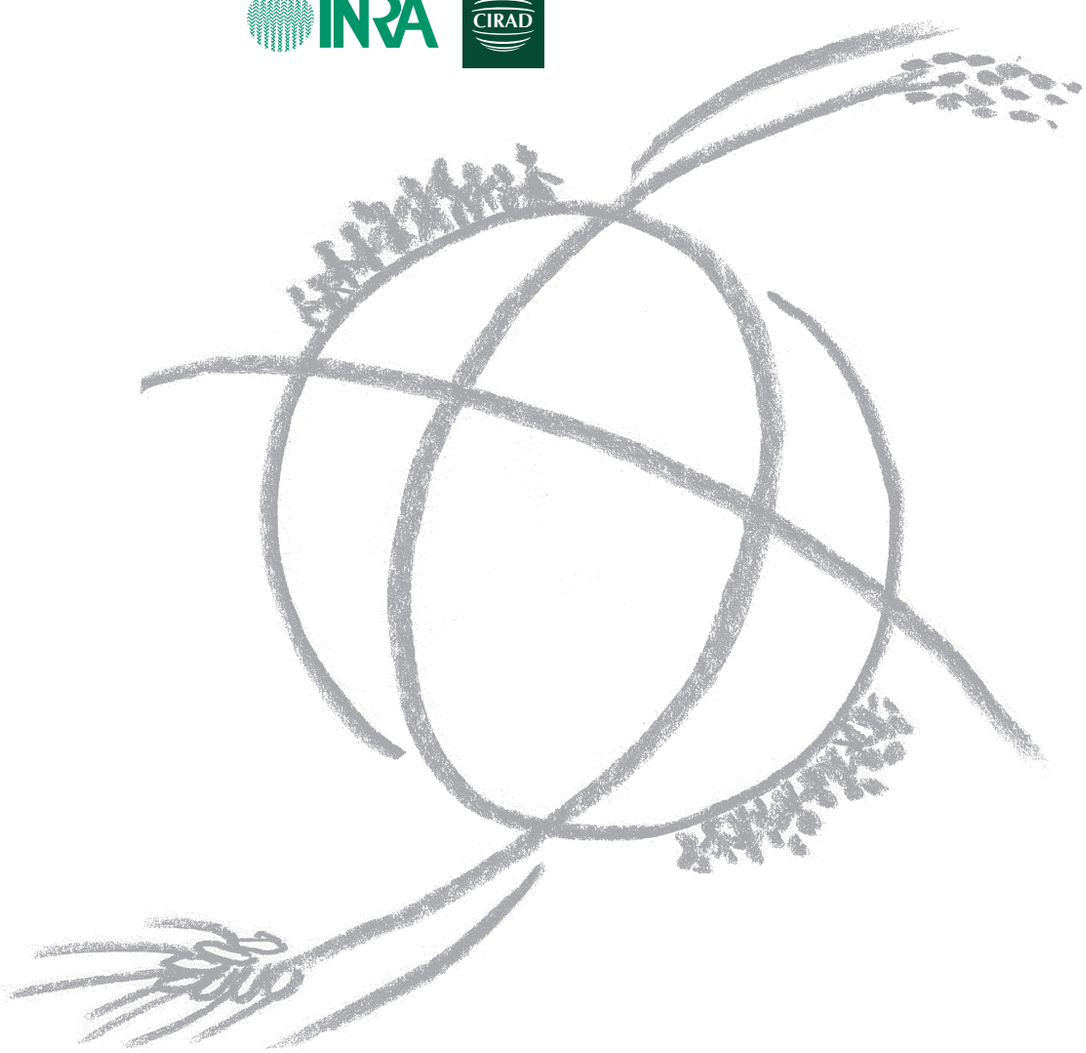
Paris, France / 3 Juin, 2008 /

Open Science Network Meeting

jointly organized by
INRA and CIRAD on

- Partnerships
- Innovation
- Agriculture

Paris, France / 3 June, 2008 /



Résumés/Abstracts

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Partenariats • Innovation • Agriculture
Open Science Network Meeting
Partnerships • Innovation • Agriculture
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Village level Experiences in agricultural innovations and their integration for livelihood under Indian Situation

Suresh B. GOKHALE

A sample of 45651 rural agricultural families, (of which 34660 were below poverty line (BPL) - taking poverty line as 280 $ per family per year (Govt. of India 1992)), spread over to 217 villages grouped under 11 clusters in five provinces of the country was studied.

The main features of the project area were - agriculture as main source of living, small land holding per family, rain fed agriculture system, average family size of 5 of migrating type, low literacy rate and constraints for access to credit. The BPL families were grouped based on their yearly family income as W1 (75$ and below), W2 (>75 to 150 $), W3 (>150 to 225 $) and W4 (>225 to 280 $) respectively. The observed spread of fractionation of families from W1 to W4 was 47%, 34%, 14% and 5% respectively. Majority of poor families (nearly 81%) ranged in the income bracket of below $150...

The fraction of voluntary economic activity intervention adoption was observed to be livestock- 31%, agriculture on farm activities- 34%, non farm resources activities 31% and other miscellaneous - 4%. In livestock- species selection, breeding, feeding and health cover aspects were identified important. The criteria led down by the user community for dairy livestock purchase were different than those favored by either scientific community or local government.

In agriculture – multi species agriculture resources, measures in drought prone area, horticulture, tree based farming systems and community procurement & distribution units approach succeeded well depending on agro-eco-cultural situation.

Among non farm interventions, 128 different activities were tried among the families for providing sustainable employment for economic enhancement of the families, were found suitable and were successfully adopted although the time required for adoption of successful intervention was different in different economic groups. Different social groups reacted differently for adoption of approach to the interventions.

The study revealed that although single intervention approach for family group near poverty line (W4) could bring BPL families to above poverty line (APL), families belonging to lowest income group (W1 and W2) required multi activity innovative approaches and more time for economic upliftment to reach APL level.

It was concluded that agriculture innovation at community level is possible. The process of identification of challenge for innovation can be different in different agro – eco - cultural situations. Innovations can lead to more success when the community actively participates in the process. The form and content of the innovation can be jointly arrived at by scientists and beneficiaries. Success can be enhanced with societal participation in implementation and the process. This is also found to lead to knowledge building and its sustainability.

Suresh B. Gokhale
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Dr. Suresh Balasaheb GOKHALE
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Dr. Suresh Balasaheb GOKHALE

Dr. Gokhale Suresh Balasaheb, born on 10th December 1945 in a village of Maharashtra Province in India, is veterinarian by profession and is specialized (Ph.D.) in Animal Breeding and Genetics. After working for one year (1967) at Government veterinary Hospital in Maharashtra, India, and completing post graduation (1970), he took up to field livestock breeding in BAIF. He worked for establishment of Artificial Insemination, data recording system and procedure evaluation system for selection program in dairy cattle, buffaloes and goats. As a leader of various research and extension projects, he added value to the quality of institutional work for farmer livestock.

He headed Central Research Station of BAIF at Uruli Kanchan, Pune and has guided activities in other fields such as Bio technology, Agriculture, Sericulture, Women empowerment, Self Help Groups, Human Health, training and other rural development component activities including Women Self Help Groups.

Receipient of Laggerloff award 1995 Jointly with his other scientist collegues, he presently is leading execution of five research projects.

He has published more than76 professional papers in National and International research journals, has jointly edited three books and is joint author of two books.

As a Vice President of BAIF, chairman of livestock core group and chairman of Research Coordination Committee Dr Gokhale has significantly contributed to improvement in the quality of institution's working in 12 states of the country. He has worked as expert member for 8 and is presently chairman for two national committees and is an expert member of committee formed by Department of Biotechnology (ministry of Science & Technology Government of India) to decide research direction and priorities on Animal Reproduction Biotechnologies in India. Presently he is also working as Director on the Board of Directors of 4 institutions. He has acted as an external evaluator for National (Council For Advancement of People's Action and Rural Technology – Government of India) and for an International (Australian) research project on sheep. As an Advisor and consultant he has helped many national and international organizations in the field of livestock and other rural development component activities.

He has been working as member of Scientific Council of FARM (Federation pour l'agriculture et la ruralite dans le monde) Paris since 2006..

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Renforcer les capacités d'autonomie des Agriculteurs Noirs: Nouveaux Défis pour le Système de R&D et l'éducation Supérieure de l'Afrique du Sud

Ntsikane Maine, Jeff Mkhari and Jon Daane

Le passé politique de l'Afrique du Sud a abouti à la division de l'économie en deux secteurs. Le premier comporte principalement la minorité blanche nantie, tandis que le deuxième inclut la majorité noire qui a subi des discriminations pendant l'époque de l'apartheid. Cette division se répercute sur les différentes industries, y compris l'agriculture. Les agriculteurs du deuxième secteur économique - qui sont pour la plupart des producteurs démunis, à petite échelle, inexpérimentés et techniquement inefficaces, diffèrent fondamentalement de leurs collègues blancs qui opèrent des exploitations commerciales à grande échelle, à haute efficience technique et intensive en capital. Différentes initiatives gouvernementales, comme la réforme agraire et les reformes visant les agriculteurs noirs pour qu'ils deviennent un acteur économique à part entière, ont pour but de combler le fossé entre les deux secteurs économiques. Comme l'accent a toujours été mis sur le secteur commercial, la recherche et les services d'extension manquent de perspicacité vis-à-vis des besoins en développement et des moyens d'existence des agriculteurs démunis. De nouveaux paradigmes et des approches et des méthodologies innovantes qui répondent aux besoins de cette nouvelle clientèle sont d'une importance majeure.

Ayant reconnu ce besoin urgent et les faibles liens entre les instituts de recherche et d'appui au développement, le Conseil pour la Recherche Agricole (ARC en anglais), principale organisation nationale pour la recherche et le transfert de technologie d'Afrique du Sud, a entrepris de chercher une approche intégrée, participative, multi-acteurs, interinstitutionnelle et transdisciplinaire qui change les mentalités et renforce les compétences pour promouvoir l'innovation et la compétitivité dans le secteur des paysans démunis. Il en a résulté une collaboration entre l'ARC et un consortium néerlandais, conduit par le Centre International pour la Recherche Agricole orientée vers le développement (ICRA), dont le but est d'intégrer la « Recherche Agricole pour le Développement » (RAD) dans le système de R&D et de l'éducation. La RAD se définit comme une approche pour répondre à des problèmes du développement rural et de l'innovation qui recoupent plusieurs secteurs et disciplines, faisant ainsi apparaître un besoin pour l'action collective par un ensemble de différents spécialistes et organisations. Des dispositions institutionnelles, telles que la mise en place d'une Equipe nationale chargé de la RAD, des plateformes provinciales multi-acteurs, et des Comités internes dans différents instituts partenaires ont ouvert la voie à l'institutionnalisation de la RAD.

Dans ce document des représentants de l'Université de l'Etat Libre et du Département d'Agriculture de la Province du Limpopo qui jouent un rôle actif dans ces différents organes de coordination présentent l'étude de cas de ce partenariat national et international sous tutelle de l'ARC pour intégrer la RAD dans la recherche et le développement. Il est prévu d'institutionnaliser la RAD en Afrique du Sud en améliorant les liens institutionnels; en formant à la RAD les personnels de la R&D et de l'enseignement supérieur; et en renforçant les programmes d'enseignement des institutions de formation en intégrant la RAD dans la formation des professionnels de la R&D. Ce papier discute le progrès fait en matière de réalisation de ces objectifs tout en soulignant aussi les défis dans le processus d'intégration de la RAD. Ce papier montre qu'autonomiser les paysans démunis en renforçant les capacités en RAD des professionnels de R&D actuels et futurs peut conduire à améliorer considérablement la compétitivité et la durabilité de ces agriculteurs. Vu que la RAD est basée sur des liens institutionnels, la conclusion est que "l'inter-institutionnalisation" – former un système d'innovation collective – sera un défi, puisque cela demande une vision commune et l'engagement mutuel des institutions participantes. Les leçons tirées des initiatives passées peuvent aider à orienter d'autres initiatives pour l'avenir.

Mots clés:

Afrique du Sud, Recherche Agricole pour le Développement, Innovation, Partenariats

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Abstract

Empowering Black Farmers: New Challenges for South Africa's Agricultural R&D and Higher Education System

Ntsikane Maine, Jeff Mkhari and Jon Daane

As a result of past policies, South Africa's economy is divided into two sectors. The first economy comprises mainly of the affluent white minority, while the second economy encompasses the black majority that were discriminated in the apartheid era. This division cascades into different industries, including agriculture. The second economy farmers - mainly resource-poor, small-scale, inexperienced and technically inefficient, differ substantially from their white commercial counterparts who are technically efficient, capital intensive and operate at a large scale. Different governmental initiatives, such as land reform and black economic empowerment in agriculture are aimed at bridging the gap between the two economic sectors. As the focus has always been on the commercial sector, research and extension services lack insight into the developmental requirements and livelihood systems of the resource-poor farmers. New paradigms and innovative approaches and methodologies that address the needs of this new clientele are of paramount importance.

In recognition of this pressing need and of weak linkages between research and development support institutions, the Agricultural Research Council (ARC), the main national research and technology transfer organization in South Africa, embarked on the journey to find an integrative, participatory, multi-stakeholder, inter-institutional and transdisciplinary approach that changes mindsets and builds soft skills to promote innovation and competitiveness in the resource-poor sector. Collaboration between the ARC and a Dutch consortium led by the International Centre for development-oriented Research in Agriculture (ICRA) ensued, aimed at integrating Agricultural Research for Development (ARD) into the R&D and educational system. ARD is defined as an approach to address issues in rural development and innovation that cut across sectors and disciplines, thus posing a need for collective action of a range of specialists and different organizations. Different in-country institutional arrangements, such as the formation of a National ARD Task Team, provincial multi-stakeholder platforms or "hubs", and In-House Committees at different partner institutions paved the way for the institutionalization of ARD.

In this paper, representatives from the University of the Free State and the Limpopo Department Agriculture who play an active role in these coordination bodies present a case study of this ARC-led national and international partnership to integrate ARD into research and development. The institutionalization of ARD in South Africa is envisaged to be achieved by enhancing institutional linkages; capacitating R&D and higher education staff in ARD; and strengthening the curricula of learning institutions, integrating ARD into the education of R&D professionals. Inroads made in realizing these objectives are discussed, while challenges in the ARD integration process are also highlighted. The paper argues that empowering resource-poor farmers by building ARD capacity in current and future R&D professionals can go a long way towards improving the competitiveness and sustainability of these farmers. As ARD involves institutional linkages, it is concluded that "inter-institutionalization" – building a collective innovation system – will be a challenge, requiring a common vision and commitment amongst participating institutions. Lessons learnt from past initiatives can help shape future initiatives.

Keywords:

South Africa, Agricultural Research for Development, Innovation, Partnerships

Curriculum Vitae

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Ntsikane Maine (35) is a lecturer in the Centre for Agricultural Management and the Department of Agricultural Economics at the University of the Free State, South Africa.

She studied agricultural management and holds a graduate (1999) and doctor's degree (2007) from the University of the Free State.

Her research interests include precision agriculture and agricultural development.

For an outreach programme of the university, she trains small-holder, resource-poor farmers in farm and financial management.

She is also involved in a train-the-trainer programme to form a "hub" of economics education trainers in South Africa.

Dr Maine serves on the National Agricultural Research for Development Task Team aimed at integrating the Agricultural Research for Development (ARD) approach into the research & development and the education system in South Africa.

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Jeffrey MKHARI

Jeffrey Mkhari (1971), he is a Manager responsible for Agronomic Research & Innovation attached to Research & Training of Limpopo Department of Agriculture.

He studied agronomy in the University of Limpopo and completed B.Agric Hons in 1994.

He worked as a Tutor at the University of Limpopo from 1995-1998 and joined Limpopo Department of Agriculture in 1998.

He is currently coordinating Agricultural Research for Development (ARD) programs in Limpopo Province, member of National ARD Task Team and Project Implementing Committee (PIC).

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Jon Daane (1950) is Director of the International Centre for development oriented Research in Agriculture (ICRA). He studied rural development sociology and holds a graduate (1977) and doctor's degree (1982) from Wageningen University (WU).

From 1997-1983 he worked in research collaboration between WU and the University of Malaya and conducted fieldwork on the relation between social organisation and technological innovation in rice production in W. Malaysia.

From 1983-1991 he was full-time professor at the Faculty of Agricultural Sciences (FSA) of the National University of Benin and coordinated collaboration between FSA and several Dutch universities aimed at institutional strengthening of FSA.

He joined ICRA as Director in 1992 and helped it develop into a European centre specialised in capacity development for rural innovation in the South. With partners, ICRA initiated and joined national-level multi-actor 'learning partnerships' for rural innovation in 10 countries in Sub-Sahara Africa, including South Africa, and 3 in Latin America.

These capacity strengthening partnerships include some 25 universities and 10 national agricultural research organisations.

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Abstract

Agriculture and Innovation
From stakes to research challenges

Guy Riba

As never agriculture is in front of huge stakes. The first one is the increase of Human population: even if less than previously anticipated, with 852 millions malnourished persons the food security is still a tricky problem. The extraordinary paradox is that all over the world, obesity affects about the one billion.

The second stake is the land use competition: the urban area is consuming more and more ha per day. 2008 is the first year where urban population in the world is larger than rural one. Agronomic energy supply from biomass is a new and increasing need which will compete more and more with food land uses.

Sustainability of agriculture is considered as a main objective. In spite of progress already realised, water will become the "blue gold" scarcity of it will generate conflicts between urban and diverse rural uses. Agriculture needs living soils with adequate organic matter contents and active mesofauna and microflora. Mechanization and pesticides drastically reduced them in intensive agriculture area where soils must be reactivated. Last, biodiversity becomes an emerging concern of farmers and urbans.

Adaptation of agriculture to climate changes is becoming critical because of erratic weather conditions.

Finally, the economic context is also evolving drastically. Rational factors responsible of increase of prices for agricultural products are over passed by a new aggressive speculation. To reduce alimentary crisis a better adequation between offering and demand is needed through economic organisation, activation of macro economic process, and micro economic supplies to support costs of inputs and commercialisation of local productions.

Facing those stakes, three main challenges can be advanced putting innovations as a fundamental postulate for progress.

The challenge of basic knowledge:

Increase number of forest crops, fruit and vegetable species to face the versatility of several diverse areas is the most urgent decision to take. Correlatively genetic bases of main crops have to be enlarged using molecular analysis (SNP and SSR) and phenotyping. International open programs must be organized between developed countries, emerging countries and CG's to enhance the use of such molecular approaches.

Clone new genes and understand their regulation is still a priority since a lot of key genes have to be yet identified.

Improve quantitative genetic analysis of animal and plant species of agronomic interest is the main methodological challenge to treat in order to develop markers assisted selection. GMO's are a way to resolve few keystone limiting factors of productions but molecular technologies offer several other ways to improve plants and animals.

Genetic, ecophysiological and modelling analysis combined with high throughput phenotyping will be very fruitful.

Finally epigenesis potential to day and glcobiology to morrow have to be assessed as soon as possible in agronomic purpose for plant or animal production.

- Diagnosis capacities are a huge concern to be advanced. Weakness of diagnosis even in developed countries is responsible of drastic reduction of yield in animal and plant productions. Four types of innovations are useful: (1) In silico characterization of plants, pests and weeds species ; (2) Molecular diagnostic kits to characterize animal and plant pathogens, pests and weeds at the infraspecific level; (3) Molecular kits to assess resistance gene frequencies to pesticides within targeted bioagressor populations; (4) Models to anticipate epidemiological development within livestocks and crops.

- Develop all practices to preserve water and soils could be the third urgent question to resolve. Dripping techniques and monitored water uses, no-till, solarisation, mulching and many other agronomic techniques have to be adapted to more

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cultures and more areas. Four main research questions arose: (1) better understanding of soil microflora diversity, and activity ; (2) emphasis on symbiotic rhizospheric microflora ; (3) modelling of pesticides evolution in soils and water; (4) methodologies to assess eco-balance of agrosystems.

The challenge of integrated approaches:

- **The first key issue** is to develop new agronomic cropping systems. Organic farming is necessary but not sufficient enough to furnish the large scale production we need. At the opposite, actual practices in developed countries are no more adapted since they have to high environmental deleterious effects. So agroecological approaches have to be adapted to highly productive agriculture with high ecological value.
- **The second key issue** is to focuse on conception of agronomic practices adapted to multi activity small size farms. Comparative agriculture has to be reinitiated at all levels: mundial agriculture practices; producer organisations; diversity of genetic resources; water scarcity and soils potentials.
- A specific attention has to be given first to very creative initiatives in economy such as the microcredit programs and secondly the economy of ecosystems services.

The challenge of transdisciplinarity:

- **Stakes are complicated** and intricated. Implications of all stakeholders have to be initiated as soon as possible, and they have to be engaged themselves within the project.
- **Set up transdisciplinarity international open programs** implicating public and private sectors is needed. Private foundations are more and more engaged in this way, encouraging all national institutions to be as reactive as they are.
- **At least, future of mondial agricultures and innovations** they need should be anticipated through debates and several foresights and expertises.
- To encourage resolution of those issues, **integrated research and researcher evaluation** has to be based on academic productions but also on several other criteria.

More than ever agricultural practices need a large potential of adaptation. To avoid drastic rural exodus we need to fix agriculture in small farms adapting traditional practices to modern contexts and up to date stakes. In parallel, agro-business must go on to product secure and safe food staff. In both cases innovations are necessary. Innovations have to be urgently developed on biotechnology, ecology, economy and social organisation.

Guy RIBA
Inra
(France)

Guy RIBA

Normalien, agrégé de l'Université et docteur d'Etat, Guy RIBA, 57 ans a une formation en entomologie et génétique.
De 1977 à 1992, il a dirigé une équipe de recherche sur la lutte biologique contre les ravageurs de plantes à l'aide de champignons pathogènes d'insectes.
Il en est sorti une cinquantaine de publications internationales dans des revues à comité de lecture, des chapitres d'ouvrages, un brevet toujours en exploitation et un ouvrage d'enseignement. Reconnu pour son expertise, il a participé à l'évaluation d'articles et de projets européens et il a été membre de plusieurs commissions (Commission des toxiques ; Commission du Génie Biomoléculaire ; Comité de Biovigilance). Il a coordonné un projet du programme européen Bridge.

En tant que Chef du département de zoologie de l'INRA (1992 – 1997), il a principalement cherché à développer les recherches sur la relation des bioagresseurs à leurs plantes hôtes d'une part, et à mettre en synergie les recherches sur la dynamique des populations avec celles sur leur génétique d'autre part.

Il a animé la Direction Scientifique Plante et Produits du Végétal (1998 – 2004). Son action a principalement consisté à mettre en cohérence six ambitions :
(1) préserver et explorer les ressources génétiques ;
(2) connaître la structure et le fonctionnement des génomes de plantes ou de leurs bioagresseurs ;
(3) comprendre l'organisation structurale de la matière première ; (4) élucider les déterminants génétiques et écologiques de la dynamique des bioagresseurs afin de mieux en protéger les plantes ;
(5) focaliser et rendre plus efficace la création variétale et l'innovation phytosanitaire ;
(6) évaluer l'impact agronomique et écologique de ces innovations. Ceci a nécessité la mobilisation de moyens extraordinaires au travers de programmes d'envergure.

En novembre 2004, il a été nommé Directeur Général Délégué en charge des programmes, du dispositif et de l'évaluation scientifiques à l'INRA.
En complément à cette fonction, G. RIBA a présidé (ou préside encore) plusieurs Conseils scientifiques (CIRAD, MNHN) ou Conseils d'orientation scientifique et technique (ACTA, ITV, ONIFLHOR).

A graduate of the Ecole Normale Supérieure, university professor, and holder of a doctorate degree, Guy Riba, 57, received his training in entomology and genetics. From 1977 to 1992, he headed a research team on the biological control of plant pests using insect-pathogenic fungi. The team produced some fifty international publications including articles in peer-reviewed journals, book chapters, a patent that is still in use and a teaching manual.

Recognised for his expertise, Riba participated in the evaluation of several articles and European projects. He was a member of several commissions (toxic products, biomolecular engineering, and biomonitoring) and coordinated a project of the Bridge European programme.

As head of the Zoology Department at INRA (1992 – 1997), he focused on developing research on the relationship between pests and pathogens and their plant hosts, and drawing synergies from research on population dynamics and on their genetics.

Riba was scientific director of the Plants and Plant Products Department (1998 – 2004), where he streamlined six goals: (1) to preserve and explore genetic resources; (2) to discover the structure and function of plant genomes and that of their pests and pathogens; (3) to understand the structural organisation of raw material; (4) to identify the genetic and environmental factors in the dynamics of pests and pathogens to improve plant protection;
(5) to focus and increase efficiency in the creation of varieties and plant health innovation; (6) to assess the agricultural and environmental impact of these innovations. This required the mobilisation of substantial means through large-scale programmes.

In November 2004, Riba was appointed Deputy Director General, in charge of scientific programmes, resources and evaluation at INRA.

In addition to this position, Riba has or continues to serve as president of several scientific councils (CIRAD, MNHN) and technical and scientific advisory boards (ACTA, ITV, ONIFLHOR).

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Résumé

Prospective et innovation : Explorer pour anticiper

Bernard HUBERT

L'avenir est moins à découvrir qu'à inventer
(G.Berger)

Les enjeux auxquels la recherche agronomique doit faire face appellent à innover. Mais est-ce si simple ? Comment contribuer aux innovations dont nous avons réellement besoin pour anticiper et orienter l'avenir dans le sens que nous jugeons le plus favorable ? Comment être à l'origine des inventions qui conviennent, celles qui généreront les conditions d'un avenir viable, vivable et équitable ? Alors que les dispositifs de développement agricole qui ont fait leur preuve, au moins dans certaines parties du monde, depuis des décennies sont déstabilisés par les changements auxquels nous assistons, il faut en concevoir de nouveaux, mais attention, si trop peu de nouveautés endort, trop déstabilise ! En effet, l'innovation fait apparaître des résistances, qui, sans elles, seraient restées cachées ...mais peut-on mieux anticiper, éviter les risques, les désordres et les dégâts générés par de fausses pistes et choisir, à temps, les voies d'innovation qui nous redonneront prise sur notre avenir ?

C'est pourquoi, nous parlons ici d'une vision "écologique" de l'innovation, c'est-à-dire dans sa complexité, sa dynamique et ses nécessaires liens avec le contexte, qui amène à revoir aussi bien les formes que le contenu des processus de l'innovation et de la production de connaissances.

En ce qui concerne le contenu, il s'agit de ne pas se contenter des démarches habituelles d'exploitation de connaissances acquises, en gardant les mêmes objectifs et critères de performances, mais il devient nécessaire de s'engager dans des recherches d'exploration de façon à renouveler les espaces des valeurs, les concepts et les connaissances qui permettront de développer de nouveaux champs d'application, inédits et vraiment originaux, d'inventer la différence qui fera vraiment la différence !

Pour bien conduire ces processus exploratoires, les formes, ce sont, bien sûr, des modalités d'implication et de coopération des différentes parties-prenantes dès l'amont des recherches à conduire, au moment de la problématisation, ainsi qu'au cours de leur déroulement. C'est ce que nous avons commencé à réaliser à l'aide d'un exercice de prospective comme Agrimonde de façon, justement, à dépasser ce que nos propres avis d'experts ne peuvent seulement imaginer. Comme tout exercice de prospective, Agrimonde est fondé sur le rassemblement d'information sur l'état du monde (ici les surfaces valorisées par l'agriculture, les rendements, les consommations ...et leur mise en regard), puis sur des travaux de groupe dont la créativité permet d'identifier et de caractériser les facteurs pertinents d'évolution afin de procéder à la construction de scénarios, c'est-à-dire la mise en récit de futurs possibles. C'est alors sur la base de ces scénarios que nous pouvons imaginer les pistes de recherche qui nous permettront de mieux anticiper et bâtir notre propre avenir.

Du point de vue de la production des connaissances, les chercheurs savent décrire l'état actuel d'un système sur lequel établir un diagnostic, ils savent également caractériser ce que pourrait être un état désiré, mais justement la prospective les oblige à identifier les connaissances dont nous avons besoin pour engager la phase de transition, c'est-à-dire comment passer de l'état actuel à l'état ciblé en prenant en compte les dynamiques à générer, les changements à inciter et les incertitudes qui se dévoilent. Il s'agit alors d'un processus de « conception innovante » et pas seulement de formes de « conception réglée », familière de vieilles recettes qu'il suffirait de renouveler...

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Résumé

Prospective et innovation : Explorer pour anticiper

Bernard HUBERT

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Ainsi Agrimonde met l'accent sur les effets et conséquences des modes de consommation alimentaire (ainsi que les processus de transformation et les formes de distribution qui les conditionnent en partie) sur les produits et leurs modalités de production : la recherche agronomique ne peut pas ne pas s'intéresser à l'alimentation humaine.

De même s'il s'agira bien de maintenir et d'améliorer les rendements agricoles (avec des techniques moins polluantes et moins dangereuses tant pour les travailleurs agricoles que pour la faune et la flore), il va falloir de plus raisonner autrement l'actuelle ségrégation entre les espaces productifs et ceux voués à la conservation : mettre sous cloche une partie de la planète et exploiter le reste n'est probablement pas tenable très longtemps ... d'ailleurs les océans et les activités halieutiques nous le rappellent chaque jour ! Puisqu'il faudra bien étendre les surfaces cultivées, ne faut-il pas, dès maintenant, réfléchir à des modes d'exploitation des écosystèmes multifonctionnels, associant étroitement production agricole et autres fonctions dans le cadre de maillages et de mosaïques bien moins spécialisées que ce à quoi a conduit la spécialisation des techniques actuelles ?

Enfin, l'importance accordée à maintenir une diversité de systèmes de production, et en particulier des formes d'exploitations familiales, garantes à la fois de cette variété d'écosystèmes exploités et de la réduction de la pauvreté des ménages agricoles dans le monde, nécessite de proposer des formes d'organisation aussi bien des producteurs entre eux que des différentes parties prenantes concernées par un même territoire. L'absence d'organisation conduit à la domination des formes sociales de production les plus performantes en regard des critères technico-économiques habituels. La recherche, en étroite coopération avec ses divers partenaires, doit travailler à la production d'une gamme élargie de critères de performance en termes d'emploi rural, d'effets sur l'environnement, de conséquences sur la qualité et la sécurité sanitaire des produits ainsi que sur de nouvelles formes d'organisation sociale indispensables à la durabilité d'un développement ... qui reste encore largement à concevoir et à mettre en œuvre !

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Foresight and innovation: Explore in order to anticipate

Bernard HUBERT

The future is more about inventing than discovering
(G.Berger)

The challenges and demands facing agricultural research undoubtedly call for innovation more than ever. But how simple is that? How can we contribute to these innovations that we really need in order to anticipate and orient the future in the direction we judge to be the most favourable? How can we be at the origin of the inventions that suit us, those that will generate the conditions necessary for a viable, liveable and equitable future? Agricultural development plans that have proved their efficiency for decades, at least in some parts of the world, are now destabilized due to the changes that we are witnessing, compel us to conceive new plans. But we need to be careful as though on one hand too little novelty is unsatisfying but on the other too much novelty is destabilizing! Innovation indeed brings to light the resistance, which without innovation would have remained hidden...but is it possible to anticipate better, avoid risks, disorder and damage generated by false paths and choose, in time, innovation paths which will help us regain control on our future?

This is the reason why we chose to talk about the « ecological » vision, which takes into account the complexity, the dynamics and the context of innovation. It leads to revisiting not just the form but the content of innovation processes and knowledge production as well as the different types of knowledge researchers are acquainted with.

Regarding the content, a standard approach based on further "exploitation" of acquired knowledge with unchanged goals and performance criteria will not suffice. It is imperative to change and engage in exploratory research which calls for a renewal of concepts and knowledge leading to the development of new fields of application that are truly original, and to inventing the difference that will really make a difference!

The form of these exploratory processes depends on the procedures used to promote participation of and cooperation between different stakeholders whose aim is to integrate this vast diversity of knowledge through the different phases of research conception, definition and application. This is what we have started to put in action with the help of a foresight exercise, Agrimonde, in order to surpass what our sole opinion as experts cannot imagine. Like most foresight exercises, Agrimonde is based on the information gathered on the state of the world (in this exercise, the area occupied by agriculture, the yields, the consumptions... and their cross overs), as well as on group workshops whose creativity helped identify and characterize relevant evolution factors that helped in the construction of scenarios, or in other words the narration of possible futures. It is on the basis of these scenarios that we can imagine different research pathways which will enable us to better anticipate and build our own future.

Also, regarding knowledge production, researchers are used to being involved in system knowledge (that describes a current status and allows setting a diagnosis) or in target knowledge (that relates to a desired status). A foresight exercise on the other hand obliges us to identify the different types of knowledge that we need in order to engage in the transition phase or to move from the current to the target state and take into account the inherent dynamics, change and uncertainties. This can be achieved through processes of "innovative conception" and not only through "framed conception", familiar to hitherto known solutions....

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Abstract

Foresight and innovation: Explore in order to anticipate

Bernard HUBERT

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Agrimonde in this manner underlines the fact that agricultural research cannot ignore human nutrition by highlighting the effects and consequences of modes of food consumption (as well as processing and forms of distribution on which consumption partly depends) on products and their methods of production. We are compelled to maintain and improve agricultural yields (with the help of techniques that are less polluting and less dangerous for both agricultural workers and the flora and the fauna), in addition we need to rethink the current way of segregating productive areas versus areas dedicated to conservation. Conserving certain areas and exploiting the rest may not be sustainable in the long run...as is reminded by the ocean and halieutic activities each day! Since we are coerced to expand cultivated areas, should we not, starting from now, think up new methods of management of multifunctional ecosystems that closely associate agricultural production and other functions in a frame of mosaics that are much less specialized than those which the current techniques would invariably lead us to?

Finally, the importance given to maintaining the diversity of production systems, and in particular forms of family farms, that guarantee this panel of ecosystems and the reduction of poverty in agricultural household across the world necessitates forms of organisation not just between the producers but also between the different stakeholders in a given area. The absence of organisation leads to the domination by those social forms of production that are the most competitive as far as regular technico-economic criteria are concerned. Research, in close collaboration with its various partners, should work towards the elaboration of an enlarged spectrum of performance that take into account rural employment, the effects on the environment, the consequences on the quality and safety of products as well as new forms of social organisation indispensable to the sustainability of development... which is today far from being conceived and implemented!

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Bernard HUBERT, Senior scientist at the National Institute for Agricultural Research (*Institut National de Recherche Agronomique, INRA*) and Professor at the Advanced School for the Social Sciences (Ecole des Hautes Etudes en Sciences Sociales, EHESS), trained as an ecologist (his thesis study concerned functional ecology in Western Africa), but his work has broadened as he has questioned the role of human activities in this setting, seeking to understand the contribution of the social sciences to issues in the life sciences.

This approach led him to reflect upon cross-disciplinary studies and the conduct of interventional, mission-oriented research with the actors concerned. He put this thinking into practice by heading a research unit on ecological development oriented towards the links between animal husbandry and forests, the aim being to prevent forest fires in Mediterranean regions (coordination of activities by those involved in animal husbandry, forestry and local government, etc., combining diverging interests between heterogeneous actors), and directing three successive European projects.

This wide-ranging experience led him to become Director of the Agrarian Systems and Development Department at INRA (from 1994 to 2003), to which he gave new impetus on the interface between social sciences and biotechnical sciences after an international review he organised. Then he became the Scientific Director at INRA for Social sciences and applied mathematics and informatics (Scientific direction 'Society, Economic, Decision-making') from 2003 to 2007. He is now, since mid 2007, the head of a joint venture between INRA and CIRAD, the French Initiative for International Agricultural Research (FI4IAR), which will provide the two organizations, at the highest level, with real strategic study forums that will both benefit from and contribute to the evolution of science and will also enable them to work towards pertinent and open proposals of scientific programs aimed at both national and international decision-makers, based on national, European and international partnerships.

In more recent years, sustainable development has provided the intellectual framework for the development of cross-disciplinary work around the notion of integration (of disciplines, social actors, public and private sector actions), by deliberately focusing on the design and conduct of research projects in society.

Thus in 2002, he joined with Olivier GODARD, an economist and Professor at the *Ecole Polytechnique*, to carry out a study on the implications of sustainable development for research at INRA. He thus designed and implemented a programme on 'Agriculture and Sustainable Development' (2004-2007), and then prepared its pursuit in the form of another programme – from which he is chairing the Scientific committee - on 'Ecosystems, Territories, Living resources and Agriculture' (SYSTERRA), starting in 2008 and granted by the French National Research Agency (ANR). Finally, he ensured initiation of the third generation of participative programmes (2007-2011) "For and On Regional Development" in collaboration with ten French regions.

As Professor at EHESS, he is leading a research seminar on the philosophical and social challenges of advances in the life sciences in the context of future sustainable development.

He was a founder member of the journal "*Natures Sciences Sociétés"* (EDP Sciences) which was launched in 1993, and remains one of its chief editors.

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An integrated approach of emerging, vector-borne diseases and the global changes in Europe, Africa and the Middle-East: example and perspective

R. Lancelot [1], G. Aumont [2], S. de La Rocque [1, 3], A. Gouro [4]

Many human, emerging diseases are transmitted by vectors (ticks, insects, rodents...) and have wild reservoirs, making them difficult to survey and control, and sensitive to climate and other changes. European Union was confronted with an increased frequency of such diseases, as well as environmental and social changes. The European Commission thus decided to support a research project on emerging diseases in a changing European environment (EDEN) to catalogue the ecosystems at risk, and set up new methods and tools for improving disease surveillance, control and preparedness.

An integrative approach was chosen to account for the complex interactions between vectors, pathogens, environment, and human behaviour. Useful preventive and control programmes can only arise from a global understanding of the epidemiological processes and the variation factors related to environmental, social and economic changes.

EDEN was designed to represent the diversity of European ecosystems, from the polar circle to the Mediterranean and Black Sea countries. A set of vector-borne diseases were selected to represent a wide panel of health problems: endemic diseases (tick-borne and rodent-borne diseases), diseases presenting a risk of introduction (malaria, West Nile fever) or diseases occurring on the fringes of Europe and showing evidences of extension (leishmaniasis). An African platform was set up in Morocco and Senegal, to assess the risk of disease spread through bird migration or livestock movements. A common framework was implemented to study landscape and environment changes, vectors and animal reservoirs, and public health. Methods were developed to quantify and map environmental changes using high- and low-resolution remote sensing, and for statistical and mathematical modelling of disease risk. Epidemiological studies were achieved to measure the relative contribution of the risk factors for disease installation and spread.

Some results are the ability to draw maps of habitat suitability for vectors and reservoirs, as well as expected changes according to climatic scenarios. Climate changes alone could not explain the upsurge of tick-borne encephalitis: social and economic factors had major consequences on its transmission pattern. In southern Europe, the extension of rice paddies was a key factor to explain the abundance of anopheles mosquitoes. However, their population dynamics were deeply impacted by Common Agricultural Policy, and alternative uses of pesticides and rice cultivars resistant to plant diseases. Simulation studies taking human behaviour into account revealed that in the case of malaria introduction, disease spread was unlikely in southern France.

Thus, complex problems like the impact of environmental and socio-economic changes on the risk of vector-borne diseases may be successfully addressed using an integrated approach.

Many animal or human vector-borne diseases are present in Africa and the Middle East, with heavy consequences on livelihood, national economy and public health. Two examples are bluetongue and Rift Valley fever, with a wide range of vectors, geographical distribution and extension risks related to global changes. An integrated approach should be adopted to disentangle the relative role of climate and other changes on the installation and spread risk of a panel of African diseases. The operational objectives may be to reinforce the diagnostic and human capacities, provide human and veterinary public-health agencies with appropriate tools for implementing surveillance and control strategies, and improve preparedness to manage large-scale crises related to vector-borne diseases.

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Renaud Lancelot is a chief inspector of veterinary public health (French Ministry of Agriculture and Fisheries).

He has been assigned to Cirad where he is currently working as a programme officer on animal health and emerging diseases as well as the coordinator of an integrated project called EDEN (Emerging Diseases in a Changing European Environment), financed by the European Commission.

He has worked as an epidemiologist for about twenty years in various countries (French Guyana, Mauritania, Tchad, Senegal and Madagascar).

His work focused on the relationships between health and productivity, the organisation of sanitary surveillance networks as well as on the epidemiology of various vector borne diseases: bovine trypanosomose, bluetongue and rift valley fever.

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L'intégration, art ou science ?

Bernard Chevassus-au-Louis[1], Michel Génard[2], Robert Habib[3], François Houllier[2], Renaud Lancelot[3], Eric Malézieux[3], José Muchnik[2]

Nous défendons dans cette étude l'idée que l'intégration doit jouer à l'avenir un rôle central dans les recherches sur l'agriculture, l'alimentation et la gestion des territoires ruraux.

En partant de définitions de l'intégration fondées sur l'importance d'un inventaire exhaustif des composantes d'un système, sur l'existence d'interactions nombreuses et complexes entre ces composantes et sur l'émergence de propriétés originales liées à ces interactions, nous soulignons tout d'abord les limites des approches « réductionnistes », qui n'étudient, et de manière séparée, que les composantes considérées comme « majeures » d'un système agricole ou agroalimentaire.

Nous analysons ensuite les raisons qui poussent aujourd'hui à renforcer cette approche, en distinguant celles liées à la dynamique de la science et celles issues de nouvelles interrogations de la société. Dans le premier cas, la possibilité d'étudier de nouveaux niveaux d'organisation du vivant, en particulier cellulaires et moléculaires, se combinent aux progrès des sciences de l'information pour inciter à intégrer les connaissances issues de ces niveaux dans les modèles existants. Mais ces évolutions, en particulier les travaux sur les systèmes non-linéaires, soulignent également, à chaque niveau d'organisation, l'émergence de phénomènes spécifiques, qui doivent donc être étudiés à ce niveau. Les évolutions de la société poussent quant à elles à prendre en compte des dimensions nouvelles – comme les conséquences des changements climatiques – ou négligées par les approches agronomiques classiques, comme la dynamique des territoires ou les impacts de l'agriculture sur l'environnement.

Trois domaines où cette question de l'intégration nous semble particulièrement stratégique sont ensuite examinés. Le premier est celui des différentes échelles spatio-temporelles auxquelles se déroulent les processus agronomiques. Nous insistons sur le potentiel d'innovation que présente la combinaison pertinente d'actions à ces différents niveaux. Le second est celui de l'intégration des disciplines « biotechniques » et « sociétales » pour prendre en compte le caractère « hybride » de nombreux objets agronomiques, qu'il s'agisse de l'alimentation, des OGM ou du génie écologique. Le dernier domaine évoqué est celui des acteurs impliqués dans les processus agricoles au sens large – ou concernés par eux – et de leur diversité croissante, qui oblige à comprendre les logiques d'action de ces différents acteurs pour analyser des phénomènes comme le développement d'espèces invasives, les conflits d'usage pour la gestion d'une ressource ou pour faire interagir savoirs profanes et savoirs experts dans la production d'innovation.

La dernière partie de cette étude propose cinq interrogations-clés pouvant baliser une démarche d'intégration. La première concerne les finalités, c'est-à-dire les enjeux visés par une telle approche. Elle s'articule autour du dilemme entre l'optimisation agronomique classique, en univers prévisible et, souvent, monocritère, et la recherche d'autre propriétés, viabilité en univers incertain ou critères du développement durable. La seconde interrogation porte sur les composantes que l'on souhaite intégrer, avec la question de l'usage pertinent du principe de parcimonie et celle d'une anticipation du comportement de composantes biologiques ou sociales lorsqu'elles seront impliquées dans un processus d'intégration. Vient ensuite la question de la définition de « l'architecture » choisie, c'est-à-dire de l'organisation spatio-temporelle des différentes composantes, qui conditionnera au moins autant les propriétés du système intégré que les caractéristiques propres à chaque composante. La quatrième interrogation porte sur la conduite d'un processus d'innovation, avec la préoccupation d'identifier et de prendre en compte l'émergence, au cours du processus, de propriétés imprévues. Enfin, nous posons la question de l'évaluation d'une telle démarche. Nous insistons sur la nécessité de juger de son efficacité avec des critères adaptés, qu'il s'agisse du recul temporel nécessaire, de l'appropriation effective par les utilisateurs visés ou des conséquences en termes d'amélioration du « capital humain ».

En conclusion, nous soulignons combien le fait de présenter l'intégration comme un aspect, et une responsabilité, de la démarche scientifique – et non comme un « art » se pratiquant en aval de la recherche – conditionnera l'implication effective des chercheurs dans de telles approches. Nous nous interrogeons enfin sur la contribution de cette réflexion à celle, déjà ancienne, sur l'élaboration d'une véritable « technologie », considérée comme un « discours épistémologique » sur les techniques et les pratiques.

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Is Integration an Art or a Science?

Bernard Chevassus-au-Louis[1], Michel Génard[2], Robert Habib[3], François Houllier[2], Renaud Lancelot[3], Eric Malézieux[3], José Muchnik[2]

In this study, we defend the idea that in the future, integration must play a central role in research on agriculture, food and nutrition, and rural area management.

The definition of integration is based on the importance of drawing up a complete inventory of a system's components, the existence of many complex interactions between these components, and the emergence of unique properties arising from these interactions. Taking these as a starting point, we first underscore the limits of a "reductionist" approach that only takes into account, and in a discrete manner, the supposedly "major" components of an agricultural or agri-food system.

We then analyse the reasons that are driving the reinforcement of this approach, drawing a distinction between those stemming from the dynamics of science, and those arising from new questions of society. In the first case, the possibility of studying new levels of organisation - particularly cellular and molecular - of living things, and the progress made in information science, combine to encourage the integration of knowledge gleaned from these levels into existing models. These developments, however, especially work on non-linear systems, also highlight the emergence of specific phenomena at these levels, and that hence need to be studied at those very same levels. Meanwhile, changes in society make it necessary to take new dimensions into account, such as the effects of climate change, or to take into consideration aspects that have been neglected by traditional agricultural approaches, such as the dynamics of territories or the environmental impact of agriculture.

We then examine three areas in which this question of integration is particularly strategic. First, agricultural processes take place at varying spatio-temporal scales. We draw attention to the potential for innovation presented by the relevant combination of actions at these different levels. Secondly, "biotechnical" and "societal" disciplines can be integrated to take the hybrid nature of many an agricultural topic into account, be it food and nutrition, GMOs, or environmental engineering. Lastly, the growing diversity of stakeholders in agricultural processes (in the wider sense), and those affected by such processes, highlight the need to comprehend the logic behind the actions of these different players to analyse phenomena such as the development of invasive species and conflicts regarding the use of certain resources, or to produce the interaction of non-specialist and specialist expertise in producing innovation.

The last section of the study suggests five key questions that can serve to define a course of action for integration. The first concerns the purposes, that is, the issues at stake in such an approach. It centres on the dilemma between traditional agricultural optimisation, in a predictable and often single-criterion context, and the search for other properties, viability in an unforeseeable context, or sustainable development criteria. The second question involves the components to be included, with the issue of relevant use of the parsimony principle as well as the anticipation of the behaviour of biological or social components when they are included in an integration process. Next is the question of the definition of the "chosen" architecture, that is, the spatio-temporal organisation of different components, which will dictate the properties of the integrated system, and the characteristics specific to each component, at the very least to the same extent . The fourth question involves the manner in which an integration process is conducted, with the need to identify and take into account the emergence of unforeseen properties over the course of the process. The last point involves the evaluation of such an approach. We would like to point out the need to judge its effectiveness using appropriate criteria, whether in terms of having the necessary temporal perspective, the effective adoption by target users, or consequences in terms of improvement in "human capital".

To conclude, we wish to underscore how much presenting integration as an aspect and responsibility of the scientific method, and not as an "art" that takes place after research is conducted, will dictate the actual involvement of researchers in such approaches. Finally, we will reflect on the contributions of this discussion to older debates on the elaboration of a true "technology", considered an "epistemological discourse" on techniques and practices

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Bernard Chevassus-au-Louis, 59, geneticist, PhD, is presently "Inspecteur général" at the French ministry of agriculture and fisheries. He was from 2002 to 2006 President of the National Natural History Museum in Paris. As researcher, he developed new methods for the genetic improvement of aquaculture species.

As research managers, he had several responsibilities in the agriculture and food sector: From 1992 to 1996, as Directeur General of the National Institute for Agricultural Research (INRA), he stimulated international relationships between INRA and the different A.R.O.s.(Agricultural Research Organization).
He was the Chairman of EURAGRI (Association of European A.R.O.s) from 1995 to 1996 and has been member of several advisory or review Panels of International research Centers in the area of agriculture and fisheries.

He was also chairman of AFSSA (French Food Safety Agency) from 1998 to 2002 and Vice-chairman of CGB (French Commission for GMO assessment) during the same period.

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