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Global challenges and international agricultural research

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Food and agriculture: today's situation

What are the main issues?

In June 2007, the US Senate adopted the new Energy Bill aiming to increase biofuel production from four billion gallons in 2006 to 36 billion by 2022, most of it coming from maize ethanol production. This example indicates the tension created on the agricultural product market by energy requirements. It comes in addition to higher and more diverse food demand from the emerging countries. The need to increase production for demographic or economic reasons has been well documented during the last 10 years and the case made by specialised institutions (FAO, 2007; IFPRI, 2007). For example, urbanisation changes food preferences, i.e. for more animal and horticultural products: if 229 million tonnes of meat were necessary in 2000 to supply the world, 465 million will be needed in 2050 (FAO, 2006; Steinfeld et al., 2006). These campaigns that were aiming at giving priority to agriculture for food reasons have had little impact on development or agriculture policies; agriculture has been mainly associated with natural resources destruction and water and soil pollution. Reduced investment led to a decrease in stocks of cereals and animal products. The tension was boosted by the rapidly growing oil price (von Braun, 2008). The US government subsidizes the farmers to produce crops for energy and a growing part of the maize shifts to ethanol. Fertilizers, pesticides and the transportation of the agricultural products are more expensive. These conditions attract the investors who speculate since 2004 on agricultural commodities. They contribute to increase the volatility of the prices with the risk that the prices fall down if they decide to leave these markets. All these factors contributed to making consumers in food-importing developing countries (mostly all African countries) unable to afford the products on sale. The interplay of the tensions created by energy, food prices (see Fig. 1) and the markets nowadays generates very strong political concern throughout the world. It is the main global challenge that agricultural research must address at international level.

The sanitary crisis caused by the emergence of zoonotic diseases is another important challenge for health and agriculture science. It affects the developing countries, where recent achievements in controlling infectious diseases that disappeared in Europe a hundred years ago (e.g. rinderpest, to be eradicated by 2010) do not preclude other endemic pathologies from becoming prevalent. European livestock is very sensitive to these pathologies when the changes in climatic conditions open the door to vectors that did not use to cross tropical countries' border (de la Rocque et al., 2008; Perry & Sones, 2007). For example, bluetongue affecting cattle and small ruminants in France and the UK has had a significant impact on the meat sector: up to 30% mortality among the sheep contaminated by the virus; the measures taken to isolate livestock prevent, on the one hand, importation of ovine carcasses from the UK and a 25% price increase, and, on the other hand, exports of young animals to Italy, causing losses estimated at €1 billion in France in 2007 (Saegerman et al., 2008).

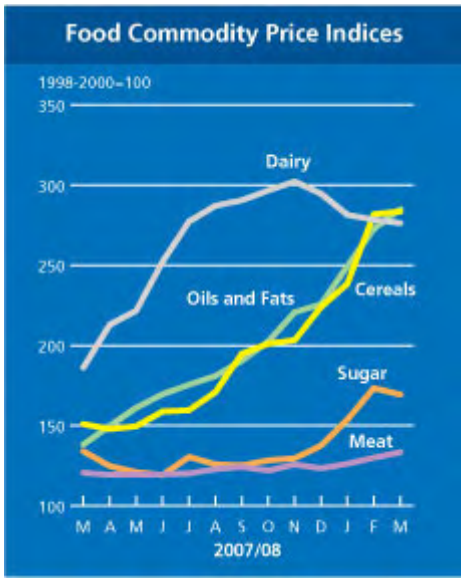

Figure 1: Recent evolution of food commodity prices (source FAO, 2008)

P. Gregory and J. Ingram mentioned in their presentation the impact of climate change.

What are the consequences?

In 2007, farmers responded quite well to the increased demand and higher prices. Cereals production rose by 6% throughout the world, also thanks to favourable weather conditions (with some exceptions like Australia). However, 2007 followed two years of reduced production and world stocks are at their lowest levels (450 million tonnes of cereals predicted in 2008 as against 650 million in 2000). The European Union's milk and meat stocks have disappeared. Cereal yields in Africa have been stagnating for the last 30 years.
Many measures are being taken to increase production. Brazil is extending its arable lands; in September 2007, the Europe Commission abolished the 20-year rule requiring farmers to assign 10% of arable lands to fallows.
The economic consequences are not negative for all stakeholders. European export refunds have not been applied and a part of the CAP budget is available. The exporting emerging countries benefit from the price increases in terms of tax income. By contrast, the governmental budget of the developing countries is seriously affected when they have to cut taxes on imported agricultural products in order to protect their consumers. As for farmers, their income in the industrialised and emerging countries has generally increased after many years of decreasing. The competitiveness of local produce in the South is much better in relation to expensive imported products. As a consequence, the production growth rate of high-value produce (vegetables, fruit, meat, milk) has been much higher in developing countries (2.9%–4% in 2004–2006) than in developed ones (0.2%–0.6%) (IFPRI, 2007). Nevertheless, in developing countries, the situation of family farmers who harvest just for home consumption has been made worse by the higher prices of inputs (fertiliser, mechanic cultivation, pesticides, etc.). Regarding consumers, the urban population of the food-importing developing countries is terribly affected by the food price increases. In the industrialised countries, the part of the household budget devoted to food has decreased by half since the Sixties, but this trend has already changed with the price increases and higher demand for products of better quality.

As regards the scientific community, more attention is being paid to issues that were until recently the preserve of a small category of scientists, experts in "tropical" questions.

The challenges science must address

The situation of food and agriculture in the world is now well documented and regularly reported by the media. It is no longer a concern limited to the population in the developing countries. In both South and North alike, rural and urban communities as well as politicians (Brown, 2008; Chirac, 2008; Diouf and Séverino, 2008) are calling on the scientific community to propose innovations to improve the situation. What are the scientific challenges behind this situation?

A human and social challenge
Lack of food is strictly linked to poverty. Undernutrition and malnutrition result more from lack of resources than from low food production. One of the challenges is therefore to secure the income of the urban poor population. An equally important challenge is to mobilise human farming capacities to feed the world. Today, urban and transboundary migrations are decreasing human farming capacities. This trend would be reversed by creating technical, economic and policy conditions that provide rural communities with a decent income.

An environmental challenge
There is a risk today that the technological pathways that will be developed will be driven by global markets and agricultural outputs. In such a case, the cost in terms of biodiversity, climate changes, food security, sanitary risks and world inequities would be very high. Issues such as greenhouse gas emissions, reduced weather hazards or the impact of climate change on emerging diseases make it necessary for countries in the North and the South to work together on resource uses.

The energy challenge
Tropical conditions have a clear comparative advantage when it comes to agricultural production for bioenergy. The most efficient crops in terms of biomass production for energy are grown in wet climates and hot temperatures. Some of them do not compete with food. Technological solutions must dovetail with local communities' needs, and that also requires some social changes.

Finally, agriculture is called on today simultaneously to feed the world and provide energy for even the poorest while preserving the environment: the combination of these three challenges creates strong tensions; agriculture today is not able to address them at the same time without large changes and research and development investment.

A research agenda to fill the main scientific gaps

These challenges that agriculture is called on to answer lead the scientific community to reshape its agenda. The main international actor, the Consultative Group on International Agricultural Research (CGIAR, 15 centres working in Africa, Latin America, Asia, $ 500 M budget in 2007) did it in 2005 (CGIAR Science Council, 2005). One of the main European actors, the French Agricultural Research Centre for International Development (CIRAD, 800

scientists, more than 40 % being located in tropical regions, € 200 M budget in 2007) recently adopted a new strategic plan (CIRAD, 2007). Most of the regional fora such as the West and Central West and Central African Council for Agricultural Research and Development (CORAF/WECARD) have done it too.
In addition to those mentioned by P. Gregory, some of the proposed research priorities match up more particularly with the evolving challenges and the existing gaps in research agendas.

Invent an ecologically intensive agriculture
The intensification of agriculture has used inputs and transformed natural areas. The alternative option proposed here under this approach is to use the ecological services that biodiversity and biological interactions naturally provide. It requires analysis of the innovation practices adopted by the various stakeholders. The changes proposed in terms of agricultural intensification are based on better knowledge of the ecological process of agro-systems and the social conditions for knowledge adoption (Griffon, 2007).

Anticipate and manage the risks associated with wild and domestic animals
The emergence of zoonotic diseases has been recently facilitated by, among other things, the migration of people and goods, climate change and promiscuity among people and among domestic animals. The knowledge of the links between demography, ecology and epidemiology should be used to define predicting models and customise biotechnology tools to fight against the emergence of such diseases.

Elaborate public policies shaped to reduce poverty and inequities
Local authorities, national governments and development policy-makers need to have a clear vision of the role that agriculture could play to reduce structural inequities and poverty. With rapidly increasing prices, knowledge about how consumers, producers and markets adapt in different policy contexts calls for comparative studies. Combining agronomic and socioeconomic data would help to create models and to design regulations that are appropriate, e. g., to limit price volatility.

Better understand the relations between nature and societies for sustainable management of landscapes
In order to have better knowledge about the interactions between agriculture and ecosystems, it is necessary to analyse the impacts of agriculture, forestry or livestock systems as well as the environmental services they provide. As the interests of the different stakeholders involved in these systems may diverge, analysis of the change process occurring in these systems makes it necessary to combine the natural, life, human and social sciences. Here too, in order to help the decision-makers, models have to be created that combine biophysical functions, human impact and collective decisions at landscape level.

A favourable political context

Until recently, the 850 million undernourished people, the sanitary risks created by the demographic and health conditions of the developing world, the illegal migrations of populations and the energy crisis were the main factors of global political concern. Now the food crisis means that, instead of halving the number of undernourished people by 2015 as adopted during the World Food Summits, 1.2 billion people could be in such a situation at that date. The political context is even rife for reform of the Common Agricultural Policy or

for driving the World Trade Organisation (WTO) Doha Development Round in such a way that market liberalisation is not seen as the only means to help the economy of developing countries highly dependent on agricultural imports. The Bretton Woods institutions and the political leaders share an interest in supporting agricultural policy based on the fact that this sector creates the main economic activities for 2.5 billion rural dwellers and the resources to nourish the poor urban populations who are nowadays taking part in demonstrations all over the world.

Alongside the permanent awareness efforts by the FAO and the IFPRI, and the call to be launched by the G8, the most important initiatives taken recently are:

- The World Bank has focused its 2008 annual report on Agriculture for Development (World Bank, 2007) and analyses what agriculture can do for development.
- The European Commission issued a Communication on Advancing African Agriculture (EC, 2007).
- The African leaders adopted a target of a 6 percent agricultural sector annual growth (NEPAD, 2005).
- The International Assessment of Agricultural Science and Technology for Development (IAASTD, 2008), which delivered its final report on the most promising knowledge, science, technology and policies for agriculture.
- In France, the agricultural research organisations (CIRAD, INRA) launched a prospective exercise to be concluded in June 2008 (called Agrimonde 2050)

All these initiatives stated that interaction between the stakeholders and the scientific community is a unique way of launching the absolutely necessary innovation process in agriculture, notably in order to improve the adoption rate for new technologies. This approach will have to be privileged by the new investments that agricultural research requires for this purpose at national, regional and international levels.

The existing international agricultural research mechanisms

Until the 1980s, the international agricultural research system was shaped by the US universities and foundations which set up and run the CGIAR In Europe, former colonial countries run tropical research centres (French agricultural tropical institutes, ORSTOM, KIT, NRI, IAO, ICCT, etc.). In Africa, countries were building up agricultural research centres from their colonial heritage.

In the 1980s, two main centres emerged in Europe with the Wageningen University and Research Centre (the Netherlands) and in Montpellier (France) with Agropolis, CIRAD, INRA, IRD, Supagro and Universities. The European Commission launched the programme Science and Technology for Development in the first Research and Technological Development Framework Programme (RTD FP 1). In Africa, the structuring and networking of agricultural research were facilitated by the creation of regional agricultural research fora (CORAF, ASARECA, SACCAR) and regional research centres. Most donor agencies supported reinforcement of these national and regional structures.

In the 1990s, the Global Forum for Agricultural Research was created to facilitate dialogue among all agricultural research stakeholders. Regional fora also emerged in Latin America, Asia/Pacific and North Africa/Middle East (see Fig. 2). In Europe, several coordination

initiatives were launched at policy or actor levels: the European Initiative for Agricultural Research for Development, EIARD; the European Forum for Agricultural Research for Development, EFARD; the European Consortium on Agricultural Research for the Tropics, ECART; Natura, a consortium of universities; etc. (see Fig. 3). However, at the same time, in Africa and Latin America structural reforms boosted by the IMF and World Bank, together with the decline in development assistance for agriculture (The World Bank, 2007), strangled the national agricultural research systems, resulting in dramatic staff reductions and insufficient infrastructure investments.

The global picture gives the impression that Agricultural Research for Development is probably the most organised public research sector, perhaps somewhat over-structured.

How do these mechanisms make agricultural research more efficient today?

- These mechanisms facilitate political concertation, in Europe between the Commission and the Members States, in the world between the different stakeholders. The priorities are defined and the research agendas are drawn up in a more inclusive way today.
- The programmatic approach is more open. The concepts of Global Partnership Programmes defined by the Global Forum or Challenge Programmes adopted by the CGIAR in principle allow equal participation of the partners in the research activities.

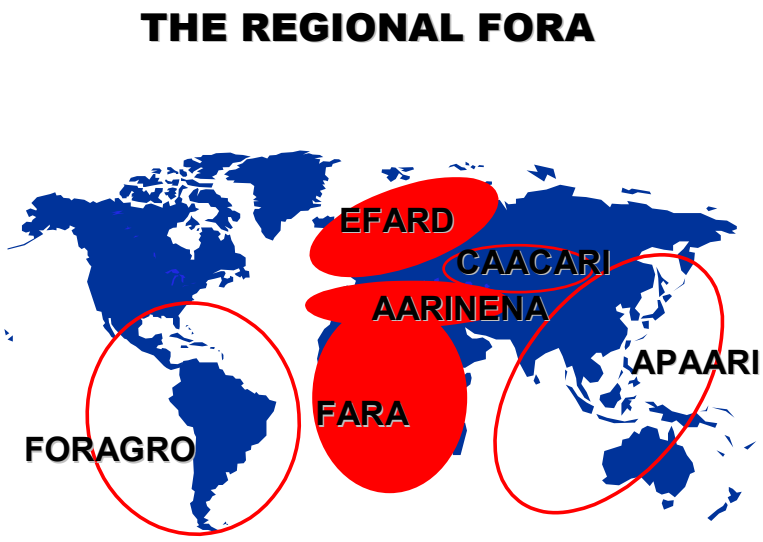

Figure 2: Regional Fora on Agricultural Research for Development (source Hoste, 2006)

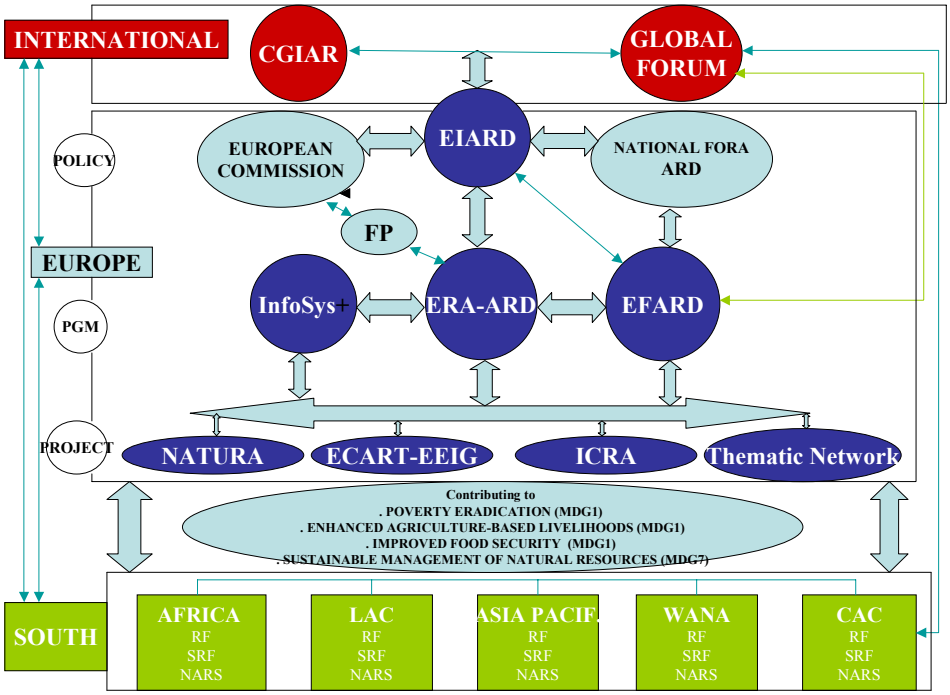

Figure 3: Organisation of agricultural research for development in Europe in terms of the regional and international system (source Hoste, 2006).

- With issues common to North and South agriculture, these mechanisms facilitate joint mobilisation of the best research and agricultural research specifically dedicated to development: for example in France, CIRAD is involving INRA research capacities to questions raised at international level by emerging diseases or policies for forestry sustainable conservation and use. The mapping of the European capacities assigned to international agenda is better known (ERA-ARD, 2007).
- The synergy of the instruments of the different European Community policies is also improved, and complementary actions are defined for common priorities (e.g. DGs DEV and AIDCO with the Food Security Thematic Programme and DG Research with the FP 7 Food, Agriculture, Biotechnology thematic priority).
- Strong national agricultural systems have emerged from middle-income economies like Brazil (Embrapa), China (CAAS) or India (ICAR); they project visions from the South with a strong voice and lead South-South scientific cooperation.

What does not work?

- Investments are not on a par with the political commitment. In 2000, one third of the $37 billion total investment in agricultural research in the world was made by the private sector; 90% of this budget was spent in OECD countries (Pardey et al., 2006). The agricultural research private sector does not invest in developing countries. Combined with very low public investment in RTD, the gap between industrialised and least developed countries in agricultural research is widening.
- Joint programming of international agricultural actions by the European actors is far from being optimal. Synergies are found in EC programme priorities but the selection criteria foster competition. New FP 7 instruments (large-scale instruments, ERA-NET) encourage joint programming at the level of R&D actors or national programmes. The EEIG Ecart is

facilitating strategic discussions on priority areas between its members (CIRAD, IAO, IICT, IRD, NRI and soon INIA). But common investments, bringing together scientists to create the conditions for multidisciplinarity, robust critical mass, impacting on national and regional agricultural R&D capacities at European level, have still to be worked out. The RTD Framework Programme was a pioneer in the field of international cooperation. However, the FP 7 was defined in 2004–2005 when political concern was not as intense as today. Its ambition vis-à-vis international cooperation is very limited, with no overall financial target, a small number of specific international cooperation actions supported, and a budget devoted to agricultural research being one third of that allocated to the health priority.

- The Global Forum for Agricultural Research is not playing its facilitating role sufficiently. Its credibility is based on its initiatives being taken on board by the different stakeholders. Recent changes in its leadership may improve the conditions for better use being made of its mandate.
- The existing competition between the agricultural sectors in Europe and some emerging or neighbouring countries does not facilitate joint knowledge production between scientific communities; some commodities are clearly in competition on the global market.

Proposals for the ERA

The European Union has a role to play in facilitating the innovation process to meet the challenges that agriculture is facing. It can develop a new comprehension of these challenges, shared by a huge diversity of stakeholders, and pinpoint the scientific questions that are behind these challenges. It may encourage integrative approaches, facilitate "de-fragmentation" of the European partners and make compatible the most sophisticated research with access to knowledge for development.

The objectives and conditions of international scientific cooperation have to be clarified. As the results of this international cooperation are expected to impact on countries' social and economic development, these objectives and modalities cannot be the same for Brazil and Burkina Faso. A set of criteria must be defined in order to differentiate the types of countries. They can be based on:

- their comparative advantages in terms of science quality (existing centres of excellence, full reciprocity in opening up R&D programmes to European actors, unique natural resources for joint European and foreign interest, etc.);
- the external policy goals (development goals, such as reducing poverty and inequities, are relevant for developing countries, not as much so for emerging countries; global public goods management is a more appropriate objective with that type of country; full association objective with neighbouring countries, etc.);
- possible interactions with the European agro-farming sector (avoiding scientific cooperation for crops in competition; taking into consideration the interests of the European private sector regarding resources or market access);
- the welfare of European citizens (food safety for non-competing imported products, for example).

These criteria, when combined, constitute a framework that can be applied to each scientific priority in order to select the types of countries which are eligible for European scientific cooperation: industrialised countries, emerging countries, low-income countries, neighbouring countries. It is a tool intended to help the decision-makers involved in the negotiations

between the European Union and third countries or regions. It will clarify the European positions in these programmes vis-à-vis the third countries or regional partners as well as vis-à-vis European society that invests public funds in these programmes.

Mobilisation by the European Union of the existing mechanisms makes it easy to define a common vision of the global challenges faced by agricultural research, and to discuss within Europe and with third countries at regional level the implementation of this vision. ERA-ARD has started this exercise (Jiggins and Poulter, 2007). The criteria framework will help to create win-win conditions for R&D international cooperation and to adopt joint objectives. Combining different DGs of the European Commission with representatives of the Member States will facilitate the synergies between RTD and external policies programmes in the interests of better efficiency.

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ACRONYMS

AARINENA	Association of Agricultural Research Institutions in the Near East & North Africa
APAARI	Asia-Pacific Association of Agricultural Research Institutions
ARD	Agricultural Research for Development
ASARECA	Association for Strategic Agricultural Research in Eastern and Central Africa
CAACARI	Central Asia and the Caucasus Association of Agricultural Research Institutions
CAADP	Comprehensive African Agricultural Development Programme of NEPAD
CAAS	Chinese Academy of Agricultural Sciences
CAP	Common Agricultural Policy
CGIAR	Consultative Group on International Agricultural Research
CIRAD	Centre de coopération internationale en recherche agronomique pour le développement (France)
CORAF/WECARD	Conseil Ouest et Centre Africain pour la Recherche et le Développement Agricole (West and Central African Council for Agricultural Research and Development)
EC	European Commission
EEIG ECART	European Economic Interest Grouping - European Consortium for Agricultural Research in the Tropics
EFARD	European Forum for Agricultural Research for Development
EIARD	European Initiative for Agricultural Research for Development

EMBRAPA	Empresa Brasileira de Pesquisa Agropecuária/Brazilian Agricultural Research Corporation
ERA	European Research Area
ERA-ARD	European Research Area-Agricultural Research for Development
EU	European Union
FAO	Food and Agriculture Organisation
FARA	Forum for Agricultural Research in Africa
FORAGRO	Foro Regional de Investigación y Desarrollo Tecnologico Agropecuario
FP7	7th Research and Technological Development Framework Programme
GFAR	Global Forum on Agricultural Research
IAASTD	International Assessment of Agricultural Science and Technology for Development
IAO	Istituto Agronomico per l'Oltremare (Italy)
ICAR	Indian Council of Agricultural Research
ICRA	International Centre for development oriented Research in Agriculture
IFPRI	International Food Policy Research Institute
IICT	Instituto de Investigação Cientifica Tropical (Portugal)
IMF	International Monetary Fund
INIA	Instituto Nacional de Investigación y Technología Agraria y Alimentaria (Spain)
INRA	Institut national de la recherche agronomique (France)
IRD	Institut de recherche pour le développement (France)
KIT	Royal Tropical Institute (The Netherlands)
LAC	Latin America and the Caribbean
MDGs	Millennium Development Goals
MS	Member State(s)
NARS	National Agricultural Research Systems
NEPAD	New Partnership for Africa's Development
NRI	Natural Resources Institute (Greenwich University, United Kingdom)
ODA	Official Development Assistance
OECD	Organisation for Economic Cooperation and Development
ORSTOM	IRD's previous name
R&D	Research and Development
RTD	Research, Technology Development and Demonstration
SACCAR	Southern Africa Council for Agricultural research
SUPAGRO	Centre international d'études supérieures en sciences agronomiques (Montpellier, France)
UK	United Kingdom
UN	United Nations
WTO	World Trade Organisation