ERA-ARD
The Agricultural Research for Development (ARD) Dimension of the European Research Area (ERA)

Promote collaboration in European ARD to strengthen Agricultural Research for the world's poor

SIXTH FRAMEWORK PROGRAMME

Working document

Report

A Strategic Vision for European ARD in 2015 and Beyond

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FOR DISCUSSION WITHIN ERA-ARD MEMBER STATES

www.era-ard.org

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ABBREVIATIONS

AIDS	Acquired Immuno-Deficiency Syndrome
AR	Agricultural Research
AKST	Agricultural Knowledge, Science and Technology
ARD	Agricultural Research for Development
ASARECA	Association for Strategic Agricultural Research in Eastern and Central Africa
BASIC	Building African Scientific and Institutional Capacity
CAADP	Comprehensive African Agricultural Development Programme of NEPAD
CGIAR	Consultative Group on International Agricultural Research
CORAF	Conseil Ouest et Centre Africain pour la Recherche et le Développement Agricoles (West and Central African Council for Agricultural Research and Development)
DFID	Department for International Development (UK)
EC	European Commission
ECART	European Consortium for Agricultural Research in the Tropics
EIARD	European Initiative for Agricultural Research for Development
EMBRAPA	Brazilian Agricultural Research Cooperation
ERA	European Research Area
ERA-ARD	European Research Area-Agricultural Research for Development
EU	European Union
FAO	Food and Agriculture Organization
FARA	Forum for Agricultural Research in Africa
FP6	6th Framework Programme
GDP	Gross Domestic Product
GFAR	Global Forum on Agricultural Research
GNP	Gross National Product
GMOs	Genetically Modified Organisms
HIV	Human Immunodeficiency Virus
IAASTD	International Assessment of Agricultural Science and Technology for Development
IAC	Inter-Academy Council
ICT	Information and Communication Technologies
IFPRI	International Food Policy Research Institute
IPCC	International Panel on Climate Change
MDGs	Millennium Development Goals
MEA	Millennium Ecosystem Assessment
MS	Member State
NARS	National Agricultural Research Systems
NEPAD	New Partnership for Africa's Development
ODA	Official Development Assistance
PPP	Public Private Partnership
RAIN	Regional Agricultural Information Network
R&D	Research and Development
RTD	Research, Technology Development and Demonstration
SADC/FANR	Southern Africa Development Community/Food, Agriculture and Natural Resources
SCAR	Standing Committee on Agricultural Research
SSA	Sub-Saharan Africa

UN	United Nations
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations International Children's Emergency Fund

PREFACE

This working document "A Strategic Vision for European ARD in 2015 and beyond" is developed within the framework of the ERA NET for Agricultural Research for Development. This ERA-ARD NET was launched within FP6 by the EC and aims at better cooperation and increased efficiency and synergy between policy makers responsible for funding Agricultural Research for Development. 14 EU member states participate in the ERA-ARD project.

The Strategic Vision is the output of Task 2.4 of the ERA-ARD programme. Task 2.4 was implemented under the responsibility of the Dutch Ministry of Agriculture, Nature Conservation and Food Quality (LNV). Wageningen International was subcontracted by the Ministry of LNV to facilitate the process, to write the discussion papers for the several workshops and to compile the final working paper.

This Strategic Vision presents a strong narrative about the role of Agricultural Research for Development in contributing to solutions of poverty and hunger prevailing in large regions of the world and socio-economic development in general. This working document gives a concise overview of ARD as it developed from history to the actual setting, where the Millennium Development Goals are main drivers that set the ARD research agenda and guide funding and implementation of ARD activities. However, due to globalization and economic development in a large number of former developing countries, and the emerging issues of global concern, it is expected that the ARD agenda and the role of European countries will change in the medium future.

In the Strategic Vision, a number of scenarios and their potential impact on the future ARD research agenda are summarized. These scenarios have been discussed within the ERA-ARD project to formulate the common ground for the future ARD. These common grounds are described in the final chapter of this Strategic Vision.

The Strategic Vision concludes that the challenging emerging issues for ARD require a strong collaboration between the involved stakeholders in European countries, developing countries and emerging economies; that Europe has comparative advantages in terms of innovation capacities dealing with complex problems relevant for development related issues; and that it is necessary to work towards a common European vision on the future of agriculture and of Agricultural Research for Development.
The shared vision for European ARD should be developed upon shared European ambitions for ARD as well as upon common scenarios of ARD in the longer term.

Based on, amongst others, this Strategic Vision, policy makers and donors of research in the ERA-ARD project member countries will explore possibilities for joint formulation and funding of projects and/or programmes on ARD.

This Strategic Vision will be presented on the ERA-ARD conference in Brussels on 28 and 29 June 2007. Abstracts of this conference will be added as annexes to the final version of this Strategic Vision.

S. van Opstal, Task leader project 2.4. Ministry of LNV, the Netherlands

EXECUTIVE SUMMARY

This working document is designed to be a contribution to the formulation of a common vision and a common strategic agenda for European ARD based upon the identification of shared European ambitions for ARD, as well as common scenarios of ARD in the longer term (e.g. 20 years from now). The paper identifies some major issues to be debated in the coming years by all ARD stakeholders but in particular European ARD policy makers and donors of ARD and research institutions with the ARD stakeholders in countries in transition, emerging economies and developing countries.

Key questions considered in this working document are:

1. What will the ARD landscape/context look like in 2015 and in 2025?
2. What options exist for positioning and shaping European ARD in the context of evolving global ARD, and to enhance the contribution of ERA-ARD to the MDGs and other objectives?

The important drivers and trends that will influence the future agricultural research agenda are:

- Climate change, bio-physical changes and ecosystem functioning.
- Trends in global fossil fuel use, bio-energy, and energy security
- Globalisation of agricultural production and food systems and other economic trends; countered by civil society drivers toward more localised food and farming networks.
- Increasing demand from developing countries to improve market access, for more equal access to negotiations and decision arenas, as well as wider access to information and technology.
- Rapid differentiation among developing countries, with an increasing number becoming 'new consumer markets" for global, regional and domestic trade in food and agriculture, centred on urbanising populations with rising incomes.
- Rapidly growing ARD capacities in most developing countries and emerging economies. South-South ARD partnerships are developing fast and will become stronger, including funding mechanism. More balanced research agenda setting and "healthy" competition between the traditional knowledge providers with emerging knowledge economies.
- A shift in the European ARD agenda from solving problems in developing countries to solving global issues that are the common interests of the global community. The main focus will be on issues like biodiversity, water, ecosystem functions and services, climate change, bio-energy, food system trade and regulation, pharma crops, zootic disease and related epidemics. Development issues will be mainstreamed in these global research questions.
- Changes in European interests and policies concerning issues such as improved food quality and food safety but also changing perspectives as the EU expands to the East.
- Changes in European policies towards collaborative funding arrangements and cooperation mechanisms.

These important changes will affect the topics considered a priority within the European Research Agenda for ARD and by 2025 the European agricultural research is likely to focus more on:

- Contributing to new global and regional initiatives to strengthen developing countries' sciences related to global change and enhancing the resilience of food systems and agro-eco-systems.
- Working actively with civil society, scientific associations and governments in developing countries for increased understanding of the implications of global change and to develop shared pathways for mitigation and adaptation.

- Strategic and policy oriented research in the fields natural resource and environmental management (including resolution of competing claims on agricultural and natural resources and engineered solutions for ecosystem functioning) human behavioral change, multi-stakeholder processes and risk management, all also aiming at hunger and poverty alleviation.
- Mitigation of eco-system decline and global change effects.
- Multi-scale, interdisciplinary and trandisciplinary, cross-sectoral approaches to tackle the increasingly complexity of the global challenges.
- High-tech research, ICTs, Robotics, GMOs, and specialist skills in fundamental sciences. Capitalizing the results of this fundamental research relevant for ARD related issues.
- Training and education.
- Specialist support and capacity development in knowledge management and management of information services.

It is less evident what the role of European ARD will be in the following fields of research:

- Supporting agriculture in developing countries under climatic change.
- Supporting agriculture in developing countries in a globalizing and competing world.
- Supporting agriculture in developing countries producing for global food-safety.

Although the over-all picture of European ARD-activities will change, European ARD will still be important, influential, and necessary, and there is a strong case for this to be explicitly recognized. The over-all picture will be that, because Europeans have a long "institutional memory" of ARD and are co-creators of a global knowledge- and information society, there will be still a need for a vibrant European research area for ARD in 2025 with sufficient critical mass to meet the common global challenges, which are foreseen. Measures to ensure the continuity of significant public support to European ARD (both science and R&D institutions) will be necessary if Europe is to maintain its ability to play a responsible role in addressing issues of pressing global concern.

Five types of arrangements dominate the collaboration mechanism and its funding among European institutes, comparable institutes in developing countries and emerging economies, and other stakeholders.
Current provisions include:

1. The ownership type
2. Programme or project type
3. The partnership type
4. The technical assistance type
5. The channelling type

It is expected that, within this mosaic, the ownership and partnership types of collaboration will become more dominant, which will be reflected in stronger collaboration between consortia of European R&D centres (old and new EU member states) and regional research consortia in developing countries and emerging economies.

Besides, partnerships among civil society (including Farmers' Organisations), the private commercial sector, and public agencies, will become much more common. The role of private commercial R&D will continue to increase strongly, to become the predominant form of collaboration in research, technology transfer, and information exchange.

It is important to explore what can be considered as public goods, that only governments can or will fund, and what can be considered as private goods in ARD and therefore will be funded by the private sector (so long as markets are working efficiently and are able to internalise the social and environmental costs of their activities).

The role of publicly funded ARD will remain strong or even increase, to address the needs of those people and areas not reached by the market, to address health and environmental issues, and to develop strong mitigation and adaptation responses to climate change.

In summary, significant transitions are required to ensure that European ARD expertise continues to be available **and** relevant to meeting the strategic important, emerging challenges and opportunities in 2025; this from a European perspective as well as providing support to developing countries as they develop their own coping strategies to the changes identified.

1 INTRODUCTION

Context
This discussion paper is an output of the ERA-ARD NET project funded by the European Commission. The development of the paper coincides with, and contributes to a dynamic and consequential period of reflection and transition in ARD. The future of science, knowledge, and technology for agriculture, food and the environment is under intensive discussion, supported within the EU by SCAR foresight studies on food, rural development and agriculture futures within Europe, and by policy deliberations among EU Member States orchestrated by the European Commission. Also at the European ARD level, EIARD is currently revising its strategy. The international push to build consensus on the content and implementation of the MDGs, the emergence of countries such as India, China, and Brazil as contributors to regional and global ARD and capacity development, and recent continent wide agricultural reviews, such as that conducted by NEPAD for sub-Saharan Africa, require a new response from the ERA. At the global level, the foundation of GFAR and the CGIAR offer (re)new(ed) organizational frameworks for the governance of ARD and for channeling European ARD. The World Development Report on Agriculture (to be published mid-2007), and the on-going International Assessment of Agricultural Science and Technology for Development (to be published early 2008) offer major reviews of the current situation and future needs, risks, and opportunities. The fate of the Doha round of trade negotiations also will be decisive for the shape and direction of future food and agricultural trade. The Millennium Eco-system Assessment, Report (2005), the recent the global Water Assessment (March 2007, UNESCO), and the 2007 reports of the International Panel on Climate Change (IPCC) and IPCC working committees, dramatically underscore a range of new threats and the speed with which 'worst case' scenarios are drawing closer, with already severe consequences for poverty and hunger trends.

Agricultural Research for Development (ARD)
Agricultural Research for Development is commonly taken to be research that addresses the agricultural challenges and issues faced by developing countries, emerging countries and countries in transition. Agriculture is used in its broad sense and includes crops, livestock, forestry, fisheries, environment and natural resources management. ARD includes capacity-building and research into agricultural production, productivity, storage, processing and marketing; dissemination, up-scaling, uptake and distribution of the research products; as well as policy, institutional and societal issues.

More than 70% of the poor live in rural areas and most developing countries rely on agriculture as the engine for their economic growth. In Europe, agriculture and food chains are increasingly confronted with challenges such as food safety, obesity, animal health and welfare, agro-biodiversity and climate change which clearly have a global dimension.

For historical, economic, and cultural reasons, many European MS have developed a unique field-based scientific expertise in ARD, and support ARD directly or indirectly through their bilateral and multilateral programmes. Within the EU, the MS and EC contribute to the funding of the international agricultural research centres of the CGIAR, providing more than 140 million euros per year. The EC also supports ARD through its development assistance programmes, and under the international dimension of the 6th RTD Framework Programme.

In the EU MS, the responsibility for ARD programme planning and funding is often dispersed and shared between different ministries, public institutions and/or foundations. This means that there are often different drivers and objectives for investments in ARD.

Agricultural Research (AR)
This refers to research that addresses wider agricultural challenges and issues and not just those relating to developing countries, emerging countries and countries in transition.

European AR naturally focuses mainly on issues relating to Europe. In recent years it has become closely allied to the development of value-added chains and innovation in food systems but also to a range of sciences beyond the classic range of agricultural sciences.

Outline of the paper

The paper provides a summary overview of the historical evolution of ERA-ARD and considers the current place of ARD in relation to the MDG's as well as broader development objectives. Using existing strategic studies[1], it identifies two broad approaches to considering the future i.e. ***material change*** and ***historical trajectory***. Based on these, a summary review of likely future ARD trends and drivers is provided together with the probable consequences for ERA-ARD in 2015, in 2025 and beyond.

[1] Citations in the text to these studies refer to the numbered references in the reference section. Other more specialist publications that are cited only are referenced in footnotes.

2 BACKGROUND AND CONTEXT

2.1 Some key historical issues relating to ARD and the role of the European Countries

The role of the European countries in ARD in developing countries
EU-ARD in the 1960s began a decisive transition from a focus on plantation agriculture and commodities of economic interest to Europe in colonial times, to support for the development of the ARD infrastructures and capacity of the newly-independent countries. At first, European nationals continued in considerable numbers to hold advisory and scientific functions in developing countries; R&D and training institutes within Europe played a fundamental and strategic role. Technology development and transfer for increasing the productivity of food and non-food commodities were key goals, for the purposes of relieving poverty and hunger, and for kick-starting national economic growth. Agricultural engineering and animal traction were seen as offering important opportunities for efficiency gains in cultivation and post-harvest operations. The sciences relating to plant breeding, seed management, fertilisation, plant protection, processing and storage, forest management for lumber, veterinary science and epidemiology, formed the core EU-ARD effort.

EU countries subsequently began playing a leading role on increasing food staple productivity in smallholder agriculture systems. A driving force was the fear that political instability would ensue if populous but poor countries failed to feed themselves. Building on early gains in plant breeding by what were to become the international research centres, the organisational landscape for global ARD rapidly became more diverse, with an expanding number of CGIAR institutes as well as a more diverse science agenda and ARD policy goals. EU-ARD (and the UN system/World Bank, etc) also began to address the ARD agenda in relation other issues such as the environment; sustainable soils, forests and water; non-timber forest products; conservation and biodiversity; etc.

Somewhat later the social sciences were recognised as important contributors to achieving EU-ARD impact; monitoring and evaluation became seen as core EU-ARD activities. Strong emphasis was placed also on development and testing of methodologies (e.g. participatory plant breeding, farming systems research) and institutional innovations (e.g. ARD networks) that could link expertise across disciplines and sectoral research agendas. Greater attention also was given to rain fed areas, the poorest, minor crops, and special needs, as well as for emerging market opportunities in intensive animal husbandry, dairying, fruit, and vegetables. An expanding range of sciences was brought within the scope of EU-ARD; the geographic and nutrition sciences also began to make a greater impact.

Local capacity and infrastructure
Capacity and infrastructure in some newly independent developing countries grew quickly and achieved significant mass. For example, India organised its ARD through state-based Research Councils, with thematic or crop specific mandates, coordinated centrally through a national research council, state departments of agriculture and extension, and agricultural universities with extension functions. In Brazil, a state agency, EMBRAPA, brought together R&D and extension throughout the country; in association with university-based capacity. China kept all R&D and extension under party control, which ensured strong focus on raising the productivity of the basic crops, principally rice, but also maize, and wheat, and on intensive pig-keeping and poultry.

Some countries, notably in much of Sub-Saharan Africa, gave less priority to agriculture as a motor of growth and invested relatively little in ARD or related infrastructures and services. By 2000, donors contributed some 40% of total ARD spending in SSA. SSA became over

time increasingly dependent on food imports and on aid for ARD, as well as on the technological products and training capacities of industrial countries.

Down turn in global interest in ARD

By 2000, the world had achieved aggregate food surplus, the rate of growth in population had slowed and some poor but populous countries (notably India, China, Bangladesh, and Indonesia) became food exporters. Technology exchange between and scientific networks among developing countries had also become stronger. Apart from SSA, the challenge of food security seemed to have been met and agriculture in general and ARD in particular were no longer seen as a priority concern at the global level.

A 'new' start of ARD

In 2000 the MDG's were defined with the overriding objective of reducing poverty by half by 2015. Agriculture does not feature explicitly in the MDGs and around this time the international (including the EU) agenda for ARD turned attention to a new set of issues, which affected both North and South. Thus questions such as food quality and safety[2], biodiversity[3], environmental sustainability[4] and trade/regulatory issues became prominent. Science-informed global protocols and conventions were set in place to reduce or eliminate the use of harmful chemicals in farming, conserve biodiversity, and mitigate environmental harm. Markets for agricultural commodities and food products became increasingly competitive and global. The EU-ARD agenda also became more heavily influenced by science outputs in non-agricultural areas, notably, related to energy demand, water constraints, and climate change: trend data indicated a rapid onset of widespread instability, driven by human actions that were seen as irreversible in the short term. As China's economic growth increased domestic demand for meat, and as major grain producers began to convert crops to bio fuel, grain prices began to rise, raising some farmers' incomes but harming poor consumers. Foresight exercises suggested food security might become again a problem (28).

Increasing focus on the role of the market

Poor people earn their living in diverse and dynamic ways. There are estimated to be 1.1 billion income poor people in the world and developing market-oriented innovation rather than improving agricultural productivity per se is becoming an increasing focus (9, 13, 23 and 25) in the drive to lift the poor out of poverty. Thus, ERA-ARD has begun to re-position itself in the context of broader livelihood development goals, and with renewed emphasis on the entire food chain and market opportunity (7, 8, 11, 15, 16 and 30). The balance of public and private provision of products and services has swung in favour of private commercial interests, with state actors focusing more on public goods and common pool resources (2, 18 and 31). With this market focus, mobile telephony has offered poor people everywhere improved chances to access local, regional, and global information and to become informed.

But basic needs (expressed as MDGs), the consequences of the spread of HIV/AIDS, and perceptions of increased human health risks from zootic diseases remain high on the EU-ARD agenda. The MEA (19, 20 and 29), the Global Water Assessment (2007) and the 2007 IPCC reports (17) indicate that agriculture contributes 13-14% of the gaseous emissions driving climate change. These reports also indicate that up to 2bn living in the drier parts of the world might be at risk in the near to medium term from decline in ecosystem functioning and climate threats. Appreciation of the risks of relying on engineering solutions to ecosystem functioning and of the surprises attendant on climate change has become an important research area. None the less, as the world engages in global negotiations to mount an

[2] Codex Alimantarius; EURO-Gap regulations for horticultural products, stipulating maximum permitted chemical residues on products entering the EU.

[3] European Support for Biodiversity Research in Developing Countries (www.eurobiodivesa.org); BIODIVERSA ERA-NET; European Platform for Biodiversity Research Strategies (www.epbrs.org).

[4] Global IPM Facility, based at FAO, Rome; ENDURE; EU-ARD support to IPM Farmer Field Schools

adequate, concerted response, some countries' agricultures began to profit from the 'clean development mechanisms' set up under the Kyoto Protocol.

2.2 Why have EU member states invested in ERA-ARD?

Initially, post-colonial obligations and the geo-political links existing at time of independence formed the basis of commitments and to a considerable extent, these links continue to influence investment patterns and European ARD networks.

Fear of political instability arising from failures to feed the hungry in poor but populous countries and humanitarian concerns drove the agenda during the 'green revolution' era. As the fears of widespread famine lessened but the negative socio-economic and environmental impacts of the 'green revolution' became evident, ARD became more driven by a broader range of issues, including agro-ecological sustainability, income poverty, institutional development, social inclusion (including gender issues), and the provision of safety-nets for those not able to survive by farming or agriculture-related employment. Fear of mass migrations driven by persistent poverty, hunger, and localised environmental collapse became an issue.

More recently, four main thrusts (15, 23 and 25) are evident under the ERA-ARD and poverty elimination labels:

- Market-led innovation, to address income poverty and to help developing countries to compete in an era of global trade in food and agricultural products.
- Livelihood development, to assist the transition out of farming occupations and employment and into alternative rural or urban livelihoods.
- Innovation in local, landscape-scale and global natural resource management and conservation, to sustain the base which makes agriculture possible.
- Safety-nets, to assist those who cannot sustain a dignified life on the base of their land resources.

Meanwhile, ERA investments not specifically targeted to ARD have had considerable and increasing spill over into ARD. They have been motivated by the desire to:

- Maintain a competitive agricultural sector within the EU.
- Manage and regulate threats to food safety and human health arising from contamination, pollution, and zoötic diseases.
- Meet changing consumer preferences for food qualities and attributes that meet changing lifestyles, ethical choices, household composition, and demographics.
- Manage demographic transitions and migration flows within and into the EU
- Sustain incomes and the quality of life in rural areas, through diversification of employment and enterprises.
- Sustain ecosystem functioning, conserve biodiversity, and manage public goods and common pool resources.

A latent motivation has been the recognition of the instability and migration pressures caused by the growing numbers, especially in West and North Africa, and in many settings, of disenfranchised youth with no future in farming, exposed to a modern lifestyle though modern media, but with no immediate prospects of gainful employment within their own countries in either a rural or urban environment.

2.3 In who, what and how much has the EU member states invested?

Regarding institutional arrangements (32), some EU countries (e.g. France) maintain large public R&D system, with depth and breadth in ARD and a strong presence on the ground in selected developing countries; others have shifted public good and market-oriented ARD largely to the universities and former colonial institutes, and increasingly to PPPs (e.g. Netherlands), or to a mix of universities, foundations and specialised institutes, PPPs, and private sector actors (e.g. U.K., Germany). Some, in addition to national AR, have dedicated ARD institutes, like Italy's Trieste Academy of Sciences of the Developing World. Others have no or very small identifiable institutional arrangements dedicated specifically to ARD.

The main themes addressed in ERA-ARD historically have been plants, animals, production systems; natural resources (especially water, agro-forestry, biodiversity). Social issues such as gender relations have also received considerable attention. The MDGs more recently have received attention, both directly and implicitly, however, approximately 1/3 approx. of 84 funding mechanisms reported focus on progress in science (22).

With respect to funding flows (32), the Nordic countries and the Netherlands have achieved the UN target of 0.7% of GDP devoted to aid. However, the proportion of aid budgets devoted to ARD by the EU member states has been very uneven, between countries and over time. The balance of contributions to national, voluntary sector, and multilateral organisations with ARD components has fluctuated and recently there has been:

a) A notable shift from project-based to programme-based support for ARD,
b) A shift away from bilateral interventions toward multi-organisational and multi-lateral arrangements

The ARD portion of national AR budgets has been and remains very small. ARD funding in national organisations is small but still generally far larger than ARD funds channelled directly to developing country institutes.

The geographical focus of ERA-ARD still largely relates to perceived national interests, historic commitments and obligations. The absorptive capacity of developing countries also shapes the geographical focus with low middle-income and upper middle-income countries having received a relatively large share of funds and attention (22).

The CGIAR institutes have been widely perceived as a major vehicle for ERA-ARD funding since the 1960s although the level of support has fluctuated over time. EU Member States have been active from the mid-1980s in seeking reform of the CGIAR, principally to improve governance and management efficiency, maintain the pro-poor focus, and increase attention to farming's role in livelihood development and environmental impacts. The CGIAR currently receives less than 10% of the total ERA-ARD budget but of 34 ARD-specific funding mechanisms reported (22), 2/5 involve a CG/IARC institute, accounting for approx 50% of the research funding channelled through ARD-specific funding mechanisms.

2.4 Trends in developing countries and emerging economies

Differentiation between countries

The 'old' conventions for ranking countries on the basis of GNP no longer provide an adequate picture of salient trends. Strong economic growth in some regions has led to rapid differentiation. Commonly used categories with contrasting emphases are based on:

- Sets of indices (developed with support from the UNDP and UNICEF) that highlight progress in 'human development'; these show that even countries with modest GNP can significantly better the lives of the majority by social investments and welfare measures;

- An emergent group of 'new consumer countries' with populations above 20 million (Argentina, Brazil, China, Colombia, India, Indonesia, Iran, Malaysia, Mexico, Pakistan, Philippines, Poland, Russia, Saudi Arabia, South Africa, South Korea, Thailand, Turkey, Ukraine, Venezuela)
- Further differentiation on the basis of: the fossil fuel energy suppliers (e.g. Saudi Arabia, Venezuela, Russia), the industrial and service exporters of hardware and software (e.g. Thailand, China, India), and sizeable consumer markets (e.g. Brazil, Argentina, China).
- Indices that estimate the 'ecological footprint' of food and farming systems, as a measure of sustainability. For instance, Chapagrain & Hoekstra[5] categorise the following as the twelve top net water exporters in terms of the virtual water exported in crop and livestock trade (1995-99) USA, Australia, Canada, Argentina, Thailand, India, France, New Zealand, Vietnam, Brazil, Guatemala, Paraguay; the following as the top 12 net water importers for the same period: Japan, Sri Lanka, Italy, South Korea, Netherlands, Indonesia, China, Hong Kong, Egypt, Taiwan, Spain, Mexico.

The conclusion is that economic, social, and ecological trends are pulling in different directions and that food and farming systems, and the opportunities and needs for ARD, will become more and more differentiated.

Science and technology as drivers for economic growth

Overall, in all areas except SSA, there has been a strong transition, from dependency on external ARD support and capacity building to meet basic food needs, to rapidly maturing national R&D capacity, sourcing expertise and/or buying technologies from the rest of the world, as needed to meet national agendas and commercial interests.

Some developing countries view science and technology as strategic drivers of economic growth. Over the period 1990-2000 China invested 5.46% of GDP in R&D, India 6.37%, and Latin American countries an average of 2.06%. In 2006, China announced a 15-year Medium to Long-Term Plan for the Development of Science and Technology. The Plan calls for 60 % of economic growth to be based on science and technology by 2020, raising investments to US $ 115 bn, and the proportion of GDP spent on research from 1.3 % to 2.5 % a year.

Economic growth of 7 % a year or over is estimated to raise out of poverty some 1 - 2 % a year of those counted as income poor. China, India, Brazil (most years), and some oil-rich Middle Eastern countries have consistently met or exceeded this target over the last decade, but also an increasing number of other Asian and Latin American countries, and some African countries through mineral and oil development, are beginning to reach this target.

Brazil recently (2007) has embarked on a US $ 4.7 m expansion of its biotechnology programme. It is clear that all developing countries want to join the 'biotech bandwagon". Most want to develop capacity specifically in genomics, although there remain considerable scientific and civil society concerns in developing countries about the effects of GMOs on human health and biodiversity, especially given the generally weak capacity to regulate or enforce health and bio safety regulation[6]. Countries such as these have signalled a desire for a

[5] Chapagrain, A.K. & A.Y.Hoekstra. 2003. Virtual Water Flows Between Nation in Relation to trade in Livestock and Livestock Products. Value of Water research Report Series No. 13. UNESCO-IHE. Delft, The Netherlands.

[6] FAO Research and Technology Paper 11, entitled "Results from the FAO Biotechnology Forum: Background and dialogue on selected issues", by J. Ruane and A. Sonnino, presents the background and summary documents from a series of six moderated e-mail conferences hosted by the FAO Biotechnology Forum from 2002 to 2005, relating to agricultural biotechnology for the crop, forestry, animal, fisheries and agro-industry sectors in developing countries. Three of the six conferences focused on genetically modified organisms (GMOs), dealing with gene flow from GM to non-GM populations; regulation of GMOs; and participation of the rural people in decision-making regarding GMOs. Two conferences covered the entire range of biotechnology tools (including GMOs), dealing

changed relationship with ERA-ARD, based on collaboration in specific areas of high science and on investment in targeted longer-term institutional and human capacity building, driven by their own priorities.

By contrast, in the SSA the average proportion of GDP spent on R&D through the 1990s was 0.8% p.a. Institutional and staffing capacity in many countries has collapsed; the impact of HIV/AIDs on qualified staff at all levels has further weakened capacity. In countries such as Malawi, ARD has become profoundly dependent on aid. Commercial enterprises buy-in from overseas much of their ARD needs, or, especially overseas investors, sources it in-house.

SSA recently has made efforts, with UN support, to mobilise the political commitment to realising the MDGs and the investment necessary to develop agriculture, and to develop a comprehensive strategic plan for agriculture. Three recent trends (16 and 21) are:

1. An increase in cross-country, multi-stakeholder collaboration in ARD;
2. Establishment of an ARD umbrella organisation, FARA, and three regional ARD consortia (ASERECA, SADCC/FANR, CORAF);
3. Renewed determination to apply appropriate 'on the shelf' ARD and technologies.

The IAC Report (16) estimates a minimum increase in ARD expenditure to 1.5% per year of national GDP is required in SSA; the CAADP report (21) estimates SSA needs to be investing an additional US $ 4.6 bn per year through to 2015 to meet MDGs. The Halving Hunger report (30) estimates that if the MDGs are to be met, 10% of national budgets should go to the agricultural sector and at least 2 % of agricultural GDP should go to national ARD by 2010. Progress toward these investment targets in SSA has been slow to negligible.

China's current and projected investments in SSA, primarily in mineral, oil, industrial development, and in consumer retailing, offers new opportunities for (and threats to) livelihood development, urbanisation, and food marketing in SSA.

with the role and focus of biotechnology in the agricultural research agenda and, secondly, applications of biotechnology in food processing. The remaining conference dealt with molecular marker-assisted selection. See ftp://ftp.fao.org/docrep/fao/009/a0744e/a0744e00.pdf (See also: http://www.fao.org/biotech/news_list.asp?thexpand=1&cat=131).

3 AGRICULTURE, ARD AND THE MDGs

3.1 Revival of interest in agricultural investments and poverty reduction

Currently, use of ODA for investment in agriculture (of which ARD is a sub-component) is predicated on the assumption that this impacts on the MDGs and poverty elimination in particular. Following a global turn down in interest in agriculture in the late 1990s, agriculture has regained prominence as a key area in achieving poverty reduction and sustainable development.

There is a strong linkage between investment in agriculture and poverty reduction (MDG 1), however there are direct or indirect linkages with all MDGs. Agriculture contributes to achieving MDG 1 through directly improving incomes, agriculture-led economic growth, improving food production and improved nutrition. MDG 2, on universal education, has the least direct link to agriculture, but there are indirect and two-way linkages. A more dynamic agricultural sector may change the assessment of economic returns to educating children, compared to the returns from keeping children out of school to work in household (agricultural) enterprises. Agriculture can contribute to MDG 3 directly through the empowerment of women farmers and indirectly through reduction of the time burden on women for domestic tasks. Women's access to and control of resources and outputs will be key in determining actual outcomes. Agriculture can contribute to reduce child mortality (MDG 4) indirectly by increasing diversity of food production and making more resources available to manage childhood illnesses. Agriculture directly helps improve maternal health (MDG 5) through more diversified food production and higher-quality diets, and indirectly through increased incomes and, thus, reduced time burdens on women. Agriculture can also directly help to combat HIV/AIDS, malaria, and other diseases (MDG 6) through higher-quality diets and indirectly by providing additional income that can be devoted to health services. Agricultural practices can be both direct causes of and important solutions to environmental degradation (MDG 7). For example, more productive agricultural technologies can allow the withdrawal of agriculture from marginal, sensitive environments. Developing a global partnership for development (MDG 8) can help to increase agricultural trade and increase ODA to the sector, which can help sustain the benefits from agriculture in the longer term.

A series of recent reports[7] concerned with the relationship between agriculture and poverty reduction also provide detail on the policy changes and practical action that is now felt needed for agriculture to contribute more effectively to pro-poor growth.

These are:

- Enhance agricultural sector productivity and market opportunities.
- Support pro-poor international actions, e.g. a fairer global trading environment
- Enhance private sector participation, including public-private partnerships.
- Public sector agencies to create enabling environments for market participation by the poor.

[7] OECD (2006). Promoting Pro-Poor Growth: Agriculture.
Commission for Africa (2005) Our Common Interest. Report of the Commission for Africa' www.commissionforAfrica.org
DFID (2003) Agriculture and Poverty Reduction: Unlocking the Potential. London. Department for International Development.
NEPAD (2003) Comprehensive Africa Agricultural Development Programme (CAADP), Midrand: New Partnership for Africa's Development
Thirtle C, Irz X, Wiggins S, Lin L, and McKenzie-Hill C (2001) Relationship between changes in Agricultural Productivity and the Incidence of Poverty in Developing Countries. Paper prepared for DFID.
UN Development Project (2005) Task Force on Hunger 2005. Halving Hunger It Can Be Done, London, Earthscan.,
World Bank (2002) From Action TO Impact: The Africa Region's Rural Strategy, Washington DC, World Bank.

- Adapt approaches to diverse (social, biophysical and economic) contexts – different rural worlds.
- Build institutions and empower stakeholders, e.g. producers' organisations, women's organisations, through building capacity to influence policy processes.
- Foster nationally-led partnerships.
- Promote diversified livelihoods on and off the farm.
- Reduce risk and vulnerability, including impact of climate change.

3.2 Link between agricultural research and MDGs

A strong relationship between investments in agricultural research and poverty reduction is indicated by various studies. For example, in India and China, IFPRI showed that public investments in agricultural research, infrastructure and education provided the highest poverty reduction effects (Byerlee and Alex 2002[8]). Thirtle *et al*. (2003[9]) conclude that investment in agricultural R&D raises agricultural value-added to give satisfactory rates of return on average in Africa (22%) and Asia (30%), but not Latin America. The increase in agricultural productivity is linked to broad-based growth and poverty reduction estimated at a 1% increase in yields reducing the number living on under $1 per day by almost 6 million. The per capita cost of this poverty reduction in Africa and Asia is estimated at $180.

The trend of stagnant or even declining agricultural productivity in much of Africa would seem to contradict the above analysis. However, it may be that productivity would have been even lower without the contribution of Research and Development (R&D) and that the positive contribution of R&D was not sufficient to offset population increases and limited economic opportunities (Chema *et al.* 2003[10]). The strength of the link between agricultural growth (and by implication research) and poverty is influenced by a range of factors including: agro-ecological conditions, level of technology use, access to assets, infrastructure, markets and institutions (Byerlee and Alex 2002). Further complicating factors include the time lag between investment in research and impact and difficulties in attributing specific research investments to poverty impact.

[8] Derek Byerlee and Gary Alex (2002) Designing Investments in Agricultural Research for Enhanced Poverty Impacts. The World Bank Rural Development Family Sustainable Agricultural Systems, Knowledge and Institutions (SASKI) Good practice note. World Bank. Washington DC

[9] Thirtle, C., Lin L., Piesse, J. (2003) 'The Impact of Research-Led Agricultural Productivity Growth on Poverty Reduction in Africa, Asia, and Latin America,' *World Development*, Vol. 32, No. 12, pp. 1959-1975.

[10] Chema, S., Gilbert, E. & Roseboom, J. 2003. A review of key issues and recent experiences in reforming agricultural research in Africa. *ISNAR Research Report* **24**, 70pp

1. TRENDS, DRIVERS AND POSSIBLE IMPACT ON ARD: A REVIEW OF SELECTED STRATEGIC STUDIES

The strategic studies are deeply divided on the future trends and drivers which relate to ARD and two broad divisions can be identified, i.e. "***material changes"*** and "***historical trajectories".***

4.1 Trends in material changes and historical trajectories

Trends- ***material changes***
On the one hand, there are those that consider Agricultural Knowledge, Science and Technology (AKST) for development from the perspective of profound and accelerating material changes (17, 19, 20 and 29). They bring into view the data that demonstrate the 'earth system' is currently operating in a 'non-analogue' state as far as human history is concerned. They show that human activities and institutions are significantly altering the environment at the global scale and that climate change is 'very likely' caused by people. These changes are considered to be irreversible in the next hundred years and threatening to food security and farming because gaseous emissions, climate change and biodiversity exist in tightly structured relationships: the faster the rate of change, the greater the risk of ecosystem changes damaging to farming and human existence.

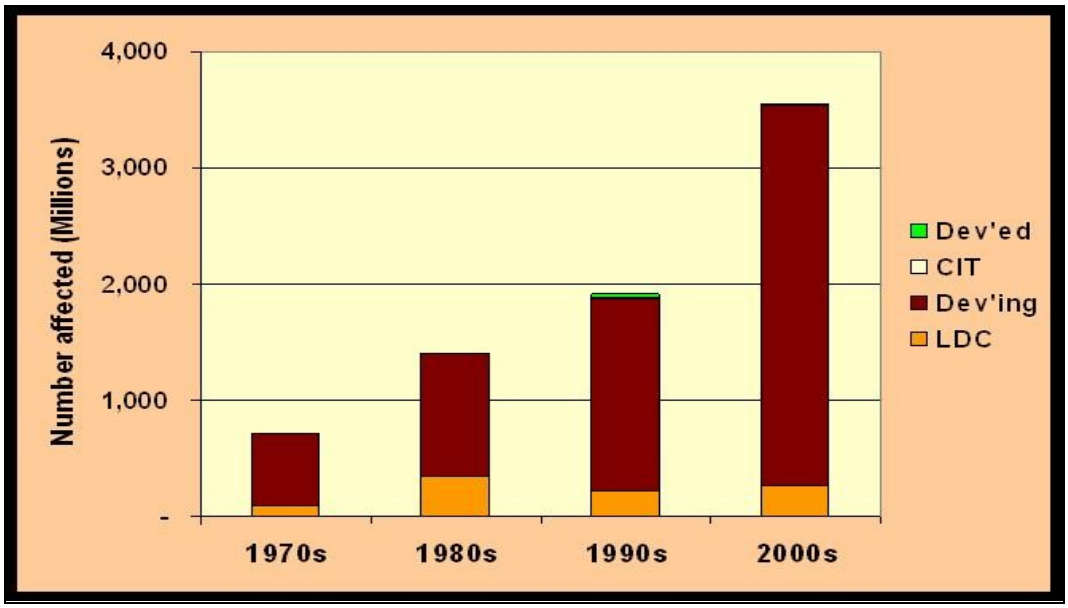

Figure 1. Number of people affected by climate change (Bob Watson, Darwin Lecture).

All countries are vulnerable to climate change but the poorest countries and the poorest people within them are the most vulnerable. They are the most exposed and have the least means to adapt. The IPCC 2007 reports estimate that over 2 bn people in the current decade are likely to be affected by climate changes. People in developing countries are affected at 20 times the rate of those in developed countries.

These scenarios foresee a decisive fracturing in the historical trajectory sketched in section one of this paper. This will stimulate further in a decline in eco-system functioning and in natural resource condition and availability, and an increase in the global atmospheric concentration of carbon dioxide, methane, and nitrous oxide, leading to an unequivocal warming of the global climate system. The main effects of climate change include warmer

temperatures, changing precipitation, higher seas levels, retreating glaciers, reduced arctic sea ice, and more frequent extreme weather events (heat waves, floods, droughts)[11]. The interaction of an increasing human population and economic wealth is identified as particularly important in forcing the trends in resource consumption and emission underlying the material trends.

Trends- *historical trajectories*
On the other hand, there are strategic studies that consider AKST for development on the basis primarily of an extrapolation of historical trajectories (5, 12, 14 and 29). In these studies environmental and climate trends are treated as important but not over-riding. Thus, the main social, economic, and political trends are identified and extrapolated using existing demographic trends, economic growth, developments within science and technology, rural employment prospects, urbanization, changes in household size and composition, lifestyles, and changes in food consumption patterns and preferences. Migration patterns are seen as inter-acting co-causally with all of these.

There is so far relatively little overlap between the "material changes" and the "historical trajectories". The IAASTD report due in spring 2008 will attempt to integrate them in a substantive way.

4.2 Drivers in material changes and historical trajectories

Drivers - material changes
The main proximate drivers of change in material conditions are identified as:

- Fossile fuel use (carbone dioxyde émissions).
- Land-use change (carbon dioxide emissions; loss of forest cover; biodiversity loss; habitat loss; soil degradation; declining water quality and availability).
- Agriculture (methane and nitrous oxide emissions; soil degradation; nutrient run-off; declining water quality and availability; conversion of forest land).

Demographic and socio-economic pressures are seen in these studies as related to these drivers, but in complex ways, with innumerable feedback loops over time and space. The pressures may appear in specific localities as proximate drivers.

The fundamental issue at stake is identified as the human choices that will be made and the institutional arrangements that might be created in response to these pressures. The existing market institutions that both stimulate and respond to rising demand, and policy frameworks that serve to channel demand and technology development along particular pathways, are clearly identified as leading to unsustainable outcomes. Conversely, changes in the incentive frameworks within which markets operate, and change in policy drivers, are seen as decisive for more sustainable futures. Science and technology, and institutional innovation are identified as critical resources in driving societal evolution toward a more sustainable existence.

However, these studies warn that the instabilities that cannot any more be avoided will they become disruptive drivers, especially in poor countries and for poor people. Issues of sustaining agricultural productivity and basic food security are seen as becoming again a driving concern, leading to decisive changes in the way that agricultural output is secured, and food and agricultural systems are organized.

[11] IPCC studies to be published this year are likely in addition to indicate: increasing oceanic acidity; regional increase in temperature that could trigger the melting of the Greenland ice-cap; the possible de-stabilisation of the antartic ice sheet; the North Atlantic Thermohaline Circulation may slow down or cease.

Drivers - *historical trajectories*
There is no consensus in these studies concerning the key social, political, and economic drivers of hunger and poverty outcomes or of scientific and technological innovations, or the relative weight to be given to each. Some emphasize primarily economic drivers; others demographic patterns; others science and technology as forces of change that can operate largely independent of social and economic trends. Little mention is made in these studies of the potential effects of fossil fuel availability and fuel pricing on the evolution of agricultural and food systems, or of emerging water-related constraints.

Changes in household size and composition, consumer lifestyles and consumer choices are identified as particularly powerful in driving innovation in food industries.

Generally speaking the trends and drivers identified by these studies are seen as pushing agricultural and food systems toward greater resource use efficiency, less dependence on chemical pest and disease control, engineered solutions to questions of ecosystem functioning, and genomic or biotechnological solutions to biotic and a biotic stresses. The underlying assumption is that rising economic wealth, and mature science and technology systems, will allow most countries to sustain agricultural productivity. Food security is seen as a problem mainly for the destitute, extremely income poor, and people living in areas experiencing exceptional problems.

4.3 Possible outcomes of the different scenarios

Possible outcomes - material changes scenario
Strategic studies assuming a material change scenario suggest that by 2025 agriculture will be experiencing:

- New opportunities for northward expansion; and in some areas for carbon sequestration and bio-energy.
- Increasing pressure to reduce, eliminate, or mitigate its contribution to methane and nitrous oxide emissions.
- Increasing competition for water.
- Decreasing potential in some areas, such as parts of southern and northern Africa.
- Increasing incidence of extreme weather events.
- Increasing risks of collapse of eco-system functioning.
- Increasing risks of disease in intensive animal husbandry, of animal-human disease transmission, vector- and water-borne diseases.

These trends mean that even by 2020 crop yields in some part of SSA and Asia may fall by up to 20%. Food systems will be experiencing:

- An increasing scale and range of geo-political risks related to the above.
- Higher prices, driven by higher demand for meat as income continues to rise in populous countries; and by higher energy prices, changes in the inter-sectoral allocation of fossil fuels, and transitions from fossil fuels to other energy sources.
- Weather-related disruptions of supply; increasing demand for food aid.

Moreover, the opportunities for new agro-industries (e.g. bio fuels) and energy sources (e.g. hydropower) will be most constrained (least possible) in areas that are already most subject to hunger and famine, water shortages, and disease pressures. Efforts to control carbon dioxide emissions by restricting fossil fuel consumption by poor countries, and poor people, would severely restrict their opportunities for escaping hunger and poverty, unless substitute cheap energy sources can be developed.

From this perspective, European and global agricultural research could be pulled in two directions that offer divergent benefits for developing countries:

- Toward a concentration of ERA and global AR on: (1) 'high science' for the development of options for sustainable production agriculture in areas that are able to generate sufficient, competitive, and reliable tradable global surpluses in basic food and forage grain; and (2) on global food systems that are able to move products quickly to where there is market demand or emergency need. This will be complemented by localized exploitation of high return niche markets, high value-added products, and multi-functional production systems where ecosystems allow. This transition relies for its articulation on the further evolution of the global governance and mobilization of AR, climate change responses articulated at global and national levels, and global governance of trade in food and agriculture. By driving food and farming in the direction of engineered systems, new systemic risks will emerge, accompanying the new market opportunities.

- Toward the development of 'high science' and applied AR to support a mosaic of relatively de-centralized agriculture and food systems, less reliant on global trade and extended food chains, and based on deep multi-functional capacity to adapt to and develop resilience in the face of long term material trends and surprise events, and to mitigate climate change. This transition gives more attention to restoration of eco-system capacity. It envisages profound changes in institutional arrangements and market relationships, aiming to reduce the dominance of economic thinking in (agricultural science) policies and of the measurement of change by means primarily of financial and economic indicators. It would increase the role of ecological and physical sciences in (agricultural science) policies and of the measurement of change by means of ecological and physical indicators. The expansion of indicators used to guide decision-making would complement the advances already made in the development and use of indicators for the measurement of human welfare (e.g. the Human Development Index).

Either transition would be accompanied by accelerated transitions out of subsistence agriculture and the increasing dominance in agenda setting of urban consumer preferences, exerted through purchasing choices, and citizen concerns for the future, expressed either through political processes or through consultative processes. Both demand the internalization within agriculture and food systems of the environmental costs presently 'externalized' to the public commons, to ecosystems, to poor farmers and agricultural workers, or to other economic sectors.

The costs of acting decisively now to mitigate the effects already in train, and to reduce future emissions and ecosystem damage are seen as less than the costs that will be incurred by delayed or insufficient action. Significant opportunities for profitable new industries and services, also in agriculture and food systems, are foreseen.

Possible outcomes - historical trajectories scenario

These scenarios are more equivocal in their implications. They rely a good deal on assumptions that freer markets and technology choices are positive forces that, given appropriate political leadership and policy frameworks, will solve eco-system and climate change problems and allow surprises and stability to be managed. The social, economic, and political scenario studies enumerate the identified factors as co-causal and acknowledge the increasing complexity of interactions. They rely on trend extrapolation primarily of socio-economic data in order to build scenarios that basically envision smarter, more efficient, more effective and increasingly engineered solutions. The costs of acting decisively to mitigate and reduce climate change effects and eco-system harm are seen as excessive, and tending to

detract from the actions needed to deal with existing problems and known hunger and poverty needs.

5 A COMON VISION OF ERA-ARD IN 2025 AND BEYOND

5.1 Introduction

With the increasing ARD capacity in (an increasing number of) developing countries and emerging economies, the rapid expansion of the role of commercial market actors, major breakthroughs in science, and the changing global context for food and agriculture, the priority topics within the European Research Area for ARD will change (5, 12, 14, 24). The current commitment to maintaining an ERA-ARD is heavily influenced by history, although this commitment may also be blocking new opportunities. It is impossible to predict exactly what ERA-ARD will be like in 2025.

The scenarios described in earlier sections are discussed within the ERA-ARD NET programme during two workshops. The first was in Firenze, Italy, in March 2007 (33). The second workshop was held in Ede, the Netherlands, in May 2007 (34). In between, the national representatives in the ERA-ARD project organized a national consultation process to get input from different national stakeholders in the formulation of a shared vision on ARD in the future. The following common understanding of the emerging ARD landscape has been established, that steers a path between the two sets of scenario studies.

5.2 Common ground for ERA-ARD in 2025 and beyond

- ARD will be positioned in rapidly globalising research systems.
- There will be a stronger research capacity for ARD in developing countries and emerging economies. South-South partnerships will become increasingly important to solve locally specific development issues in developing countries. Developed countries are loosing their comparative advantage also because of the decreasing level of location specific knowledge.
- The development of the ARD research capacity will vary between development countries. It is expected that especially in SSA a number of countries still need support in further development of their ARD capacity (financially and intellectually).
- "One-World" issues are increasingly setting the international ARD agenda. These include fossil fuel use, biomass energy, competing claims on natural resources, water availability and quality, food safety, commodity trade and chain management, health, ecosystem services, emerging diseases, the multi-functionality of agriculture, and the relation between climate change and agriculture with respect to mitigation and adaptation measures. Development related issues remain an integral part of the agenda within these globally important thematic issues.

5.3 Common ground on the role of European countries in ARD

- The role of Development in ARD for developing countries (the South) will diminish. ARD will become Agricultural Research focussed on Global issues, requiring multi- and trans-disciplinary research, cross-sectoral collaboration, and the integration of knowledge from diverse stakeholders.
- Within Europe, Agricultural Research with and for Eastern and Central European Countries with significant small farmer populations, and between these countries and their neighbours outside the EU will remain a special focus of interest.
- There will be a continuing need and opportunity for capacity-strengthening and collaboration in both ARD and AR between Europe and developing countries, that plays to the ERA's comparative advantages:
    - Europe avails of expertise in huge diversity and depth;
    - It commands unique data-bases and experience related to the tropics;
    - It maintains strong ARD networks with developing countries;

- Europe has been at the leading edge of policies, research, and practical applications that address ecosystem functioning, agro-ecosystem sustainability, and the vitality of rural communities and cultures.

It is likely that in 2025 European agricultural research for development will focus on:

- Contributing to new global and regional initiatives to strengthen developing countries' sciences related to global change and enhancing the resilience of food systems and agro-eco-systems.
- Working actively with civil society, scientific associations and governments in developing countries for increased understanding of the implications of global change and to develop shared pathways for mitigation and adaptation.
- Strategic and policy oriented research in the fields natural resource and environmental management (including resolution of competing claims on agricultural and natural resources and engineered solutions for ecosystem functioning) human behavioral change, multi-stakeholder processes and risk management, all also aiming at hunger and poverty alleviation.
- Mitigation of eco-system decline and global change effects.
- Multi-scale, interdisciplinary and Tran disciplinary, cross-sectoral approaches to tackle the increasingly complexity of the global challenges.
- High-tech research, ICTs, Robotics, GMOs, and specialist skills in fundamental sciences. Capitalizing the results of this fundamental research relevant for ARD related issues.
- Training and education.
- Specialist support and capacity development in knowledge management and management of information services.

It is less evident what the role of European ARD will be in the following fields of research:

- Supporting agriculture in developing countries under climatic change.
- Supporting agriculture in developing countries in a globalizing and competing world.
- Supporting agriculture in developing countries producing for global food-safety.

Although the overall picture of European ARD-activities will change, European ARD will still be important, influential, and necessary, and there is a strong case for this to be explicitly recognized. The overall picture will be that, because Europeans have a long "institutional memory" of ARD and are co-creators of a global knowledge- and information society, there will still be a need for a vibrant European research area for ARD in 2025 with sufficient critical mass to meet the common global challenges, which are foreseen. Measures to ensure the continuity of significant public support to European ARD (both science and R&D institutions) will be necessary if Europe is to maintain its ability to play a responsible role in addressing issues of pressing global concern.

5.4 Common ground for institutional arrangements

Five types of collaboration currently exist between European ARD institutes, comparable institutes in Developing Countries and other stakeholders. It is expected that within this mosaic of different types of collaboration, important changes will occur. Current provisions include:

- The ownership type. This implies that European money for ARD is transferred directly to Research Institutes in developing countries on the basis of core, programme, or project funding. The recipient organisation sets it own research agenda that responds to

nationally identified needs. The recipient organisation buys in European or other expertise as necessary to implement its research activity.

- Programme or project type. The recipient organisation sets it own research agenda that responds to nationally identified needs. The recipient organisation buys in European or other expertise as necessary to implement its research activity.
- The partnership type. This implies that Europe research institutes and other research institutes that have ARD expertise and financial means are collaborating on a more or less equal basis. The research and capacity development agenda reflects shared interests and shared expectations regarding the outputs of the research collaboration.
- The technical assistance type. The developing country formulates its research and capacity development agenda and European institutes are selected on the basis of a tender procedure to help carry out the agenda. European expertise is paid out of programme or project funding. Universities and/or research institutes in the developing country are positioned as the beneficiary of the advice and assistance delivered.
- The channelling type. Under this form of collaboration European ARD funds are channelled to multilateral organisations like the FAO, CGIAR, and other similar organisations.

In practice, programme (project) support and technical assistance arrangements can be considered as one type. The remaing four main types can be ranked against different interests to reveal which is fit for which purpose. It can be seen that – from the perspective of the ERA-ARD project - the ownership model is considered most fit for the purpose of meeting the development interests. The partnership model is considered fit for the purpose of future challenges. With increasing research capacity and improved governance in developing countries, One World issues will be incorporated also into the research agendas in developing countries. The technical assistance model was considered outdated. The channelling model was considered unfit for the purpose of maintaining European research capacities; on the other hand, the FAO and CGIAR were seen as offering good opportunities for collaboration in tackling One World issues.

At the European level, there is a strong need to harmonize the ARD related policies of the different EU member states to create a critical mass and synergy in Europe to deal with the future common ARD challenges. This will avoid duplication and fragmentation. New partnerships between new and old EU member states and developing countries will be mutually beneficial.

5.5 Common ground on funding ERA-ARD

There is a need that European countries continue funding ARD research. Presently, the ARD is funded mostly through allocated ODA funds and this will be needed in 2025 too, to support the southern countries, which lack sufficient resources to build and support their own ARD capacity. Taking into account the changing ARD agenda towards global issues, with development related issues as integral part, and the role the ERA-ARD community has to play, non-ODA funds must become available for the new ARD research agenda.

The role of private commercial R&D will continue to increase strongly, to become the predominant form of collaboration in research, technology transfer, and information exchange.

It is important to explore what can be considered as public goods, that only governments can or will fund, and what can be considered as private goods in ARD and therefore will be funded by the private sector (so long as markets are working efficiently and are able to internalise the social and environmental costs of their activities).

The role of publicly funded ARD will remain strong or even increase, to address the needs of those people and areas not reached by the market, to address health and environmental issues, and to develop strong mitigation and adaptation responses to climate change.

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