

Draft for comment only

**Progress Report: IAC Study on Science and Technology Strategies
for Improving Agricultural Productivity and Food Security in Africa**

InterAcademy Council Study Panel

Prepared for discussion at the Annual Meeting of the Forum for Agricultural Research in Africa in Dakar, Senegal May 20, 2003 and the meeting of the Executive Council of the Consultative Group on International Agricultural Research in Paris, France May 17, 2003

This report *does not* represent the conclusions and recommendations of the Study Panel nor of the IAC but is intended to stimulate discussion and input into the Panel's further deliberations

May, 2003

Introduction

The Secretary General of the UN, Kofi Annan, requested the InterAcademy Council (IAC) on 7 March 2002, to prepare a report for him providing a technological strategic plan for harnessing the best science and technology to produce a substantial increase in agricultural productivity in Africa, thus contributing to food security. He asked the IAC to engage leading scientific, economic and technological experts in the exercise. A Study Panel of 19 members was constituted for the purpose including 11 from developing countries, 7 of who are from Africa (Appendix 1).

The Process

The Panel has met twice to plan the conduct of the study, delineate its scope, commission the drafting of resource documents, and review progress. The first meeting was in the Windsor Lake Victoria Hotel, Entebbe in September 2002 and the second at the Bibliotheca Alexandrina, Egypt in March 2003. A third meeting of the Panel is scheduled in Stellenbosch, South Africa in June 2003. It is expected that a draft report should be available in July 2003.

The Panel has been engaged in a series of consultative workshops in four regions of Africa during January and February 2003 (Appendix 2). These were organized jointly with the relevant sub-regional organizations responsible for the coordination of agricultural research in three of the four regions. The aims of the workshops were to:

- Understand the regional constraints to improved agricultural productivity as a means of improving food security;
- Identify explicitly the role of science and technology in alleviating constraints and exploiting opportunities.

The Panel was impressed by the interest and commitment to the IAC Study by the 150 participants in these workshops, the vast majority of who were African scientists and policy makers. They viewed the Study as very timely in the light of the renewed interest being accorded to agriculture, and more particularly the role of science and technology in advancing it. They expressed a firm desire to have a continuing association with the Study as it develops, and the Panel enthusiastically welcomed and agreed to this.¹

The Panel has commissioned several resource papers as complements to the consultative workshops. The purpose of the resource papers is to review the literature on subjects that the Panel felt were integral to the Study. The topics were as follows:

- The African food security status

¹ All participants will be provided with a copy of this progress report and a draft of the preliminary report when it is available. Their comments will be sought and considered by the Panel. A web page has been created for this purpose and is also available to the CGIAR and FARA members. The web page can be accessed using the following address: <http://194.171.152.229/iac> User name: workshop Password: participant Edited summary proceedings of all four workshops are available on this web page.

- African agricultural productivity: Trends, constraints and opportunities;
- Constraints and opportunities in African science and technology;
- The promise of new science and technology;
- The social and economic policy environment.

The *scope* of the Study has been defined by the Panel as follows:

- A continental approach that includes all of Africa.
- A consideration of crops and livestock, inland fisheries, aquaculture, and agro-forestry.
- An understanding of the crisis that recognizes agricultural factor productivity as a means to achieve sustainable food security, not as an end in itself.
- A primary focus on food commodity productivity, with recognition that commercial, non-food commodity productivity is also relevant to food security.
- A focus on both pre- and post-harvest productivity.
- A broad definition of science and technology that includes not only agricultural sciences but also related disciplines such as information and communication technologies, geographic information systems, energy, and others insofar as they influence agricultural productivity.
- A consideration of policies that affect agricultural productivity, including those related to science and technology, agriculture, and macro-economics and trade.
- An inclusion of sectors other than agriculture, such as health and education, which directly affect agricultural productivity; the impact of HIV/AIDS on scientific capacity and farm labour supply is but one example.
- An emphasis on bottom-up approaches to the formulation of strategies and priorities and an institutional overview that includes horizontal and vertical dimensions of the policy and institutional environments.
- An agricultural/farming/production systems approach that goes beyond cropping systems.

Priority Issues from Consultations

The consultative workshops provided some consistent messages for the Panel to consider. These are summarized here under three headings: (i) institutional issues, (ii) the policy environment and (iii) science and technology strategies. The order is random and does not represent an order of priority.

Institutional Issues

- Inadequate *intersectoral strategic planning* and priority setting for agricultural R & D on both a national and regional basis. Among the options suggested were for existing institutions such as NEPAD, FARA, SROs, FANRPAN to strengthen their roles in bringing stakeholders together to exploit synergies, analyze options and formulate and implement strategies and programs.
- *Prices for outputs* of smallholders too low and those of *inputs* too high, such that their ability to become more market-oriented is severely constrained; in some countries subsistence-oriented smallholders are not even able to meet their family's food needs because of low productivity and small size of holdings; for them it is not so much moving from subsistence to commercial agriculture but from below subsistence to subsistence levels of production. Requires addressing of issues related to globalization and OECD

subsidies, and consideration of the need to invest in infrastructure such as roads, railways, markets facilities as well as agricultural R & D, health and education in order to increase productivity, reduce poverty and improve food security. At issue here is to what extent improved agricultural productivity of smallholder agriculture in Africa and the resultant improved food security is dependent on first addressing market constraints and hence opening up more economic opportunities for them, including post-harvest value-adding R & D, before added investments in pre-harvest R & D are considered? This is a crucial strategic question for the Study Panel.

- At best there are *weak linkages* between NARIs and the Universities, and often they are non-existent; this represents a failure to exploit synergies when there are acknowledged human and financial constraints to effective agricultural R & D in the NARS. One difficulty is that they are mostly in different Ministries (Agriculture versus Higher Education) hence a national perspective is necessary. Is there a role for National Councils of Science and Technology (NCST) here? Graduate students undertaking thesis research could be located at accredited NARIs for the conduct of their research, thus exposing them to the real national/regional priority problems of smallholders. Universities should be regarded as a key component of NARS and participate actively in national and regional agricultural R & D priority setting and in the emerging competitive and other funding mechanisms being proposed under the MAPP initiative of the World Bank. Such initiatives should ensure that basic research does not miss out, as often short-term impacts are emphasized and basic research is by nature long-term. Undergraduate curricula of Universities should be reviewed in consultation with NARIs to ensure that the students become equipped with how to understand the constraints and opportunities in smallholder agricultural/farming systems (as opposed to reductionist curricula more relevant to large-scale commercial farms in the linear research-extension model now increasingly being questioned). Participatory/diagnostic on-farm research approaches and knowledge and information management techniques using ICT that will enable graduates to play more of an entrepreneurial role in helping to foster and work for and with smallholder organizations in future to make e-farming a reality should be a feature. The i@mak.com reform at Makerere University in Uganda is an innovative approach.
- Inadequate numbers of *smallholder farmer organizations* to ensure their effective and full participation as key stakeholders in national, regional, continental and international agricultural R & D priority setting. Options to be considered include
 - changes to the University curricula as described above;
 - political commitment to the promotion of smallholder farmer organizations;
 - revisit the role of cooperatives in the future;
 - identification of “champions” among scientists and the general community;
 - active involvement of NARS, SROs and FARA in this endeavour.

Is it possible that successfully organized smallholder associations who become effective “stakeholders” in agricultural R & D driving the agendas and reaping resulting benefits, will evolve into politically savvy advocates for increased public agricultural R & D funding? Because of their large numbers this is quite feasible where democratic reforms and improved governance are occurring. Hence the returns to NARS in actively promoting smallholder organizations could be quite large and the “transactions costs” in generating

increased effective demand for agricultural R & D in this manner should be viewed as an “investment” with the dividend being increased resources (supply). Even if smallholder organizations that become stakeholders and participants in agricultural R & D cannot so influence the government through their votes, they may be prepared to finance more R & D themselves if they become convinced research institutions are indeed more responsive to their priorities and needs, and hence can deliver increased income to them. However, unlike farmers who are involved in cash export crops, smallholders primarily growing food crops for home consumption will be much more difficult to convince about financing all or part of the agricultural R & D, as free riding will be a problem and a large share of the benefits of R & D will accrue to consumers, thus reducing the incentive for smallholders to self-fund. Chema and Roseboom in their paper at the Eastern/Central African workshop suggest three possible scenarios for smallholder organizations guiding agricultural research: (i) those for commercially oriented commodities co-organized by trade groups, (ii) poor and unorganized producers relying on a “civil service” structure not yet developed to make them commercially viable and (iii) same as in (ii) but with unfavourable production conditions such that diversification out of agriculture is the only opportunity to escape poverty. Chema and Roseboom also note that non-farm income shares have been rising in rural African households and are higher for the richer households. The shares range from 40-80%.

- Limited extent of *public-private partnerships* in agricultural R & D. There is a need to invest in basic communications and transport infrastructure to facilitate this, as well as cultivating a climate of trust between the two sectors that is currently lacking. Also the IPR regime can be a significant constraint. One needs to recognize though that there will always be a public good agenda (genetic resource conservation and management, agricultural and S & T policy research, etc.), which the private sector will not have an incentive to become involved in. Hence public-private partnerships may not be a panacea for offsetting declining public funding of all agricultural R & D. There is need for transparent and attractive incentive and reward systems for scientists in order for them to pursue such partnerships.
- *Collaboration* among the NARS, SROs IARCs, and the ARIs is not what it ought to be in order to fully exploit synergies. One option is to fully support the strengthening of FARA and the SROs as the focal points of international financial support of agricultural R & D in Africa in future as proposed in the MAPP of the World Bank. The role of NEPAD in this is unclear at present. Is the funding to the IARCs competitive or complementary with those provided to the NARS, SROs and ARIs?
- Excessive and *continuous reforms* and restructuring of NARS, with different approaches being suggested by different donors. Decentralization/devolution and increased stakeholder participation offer many attractions but also pitfalls. Scaling this up requires substantial resources and egalitarian processes don't always equate with egalitarian outcomes. Improved donor coordination is required. Decentralization versus centralization of research is a key issue. But is the appropriate strategy wholesale restructuring or further evolutionary reform?
- Low quality and extent of *science education* at primary, secondary and tertiary levels, which limits capacity building. A major boost in the priority accorded to science education at all three levels is required.

- Paucity of *access* by smallholders to market, technology and other *information*. There is need to capitalize on the unique opportunity provided by ICT to provide such access with the aid of cell phones, radios, telecenters, such as is being done in pilot village and community programs in India (MSSRF), Kenya (Foodnet, KACE) and other countries. Creative public-private partnerships including traders, NGOs and CBOs may be a way to promote information and technology exchange and niche-market-led R & D for smallholders.
- Weak or non-existent *links* between *research and extension*. There is a rejection of the linear model of the research=>extension=>farmer linkage which is highlighted by the apparent failure of the T & V system in Africa. A new paradigm is called for which recognizes there is a need for an information and knowledge system (IKS), with active stakeholder participation, management and perhaps ownership i.e. to privatize research and extension systems. Case studies exist in ISRA in Senegal and in Tanzania with the Tea Research Institute of Tanzania (TRIT).
- Customary and communal *land tenure* systems are often poorly developed and as a result are constraining investments in agriculture by smallholders, especially in some countries of Southern Africa. In such cases, reinforcement and codification of tenure systems and reviews of market-mediated land reform programs implemented recently in Africa are required to determine their effect on smallholder investment in new technologies and on productivity and food security.

The Policy Environment

- *Globalization* and OECD *subsidies* are placing undue challenges and constraints on African countries in pursuing an export-oriented agricultural marketing strategy. This will require more effective international advocacy with the North by African countries, perhaps on a regional basis? Should African countries apply countervailing tariffs and subsidies to those in the OECD countries, as has been the case in Nigeria? Formation of more ‘Think-tanks’ to inform policy formation and build constituencies is necessary, including setting up S & T policy-parliamentary liaison units?
- Poor *governance* is leading to a breakdown of democratic institutions critical to a more participatory involvement of stakeholders in agricultural R & D agenda-setting and resource mobilization. Political reforms, mass civics education and advocacy by stakeholders, increasing the role of civil society are needed. Do the NARS have a role in nourishing civil society in order for demand-driven processes of agricultural R & D to be nurtured?
- Barriers (bureaucracy, corruption) are limiting African intra-regional *trade* opportunities. This will require harmonization of intra- and inter-regional trade policies.
- There are inadequate incentives for the *private sector* to invest in the agricultural sector leading to underinvestment and capital flight. Also often the public sector R & D institutions crowd-out the private sector because they are publicly funded and encroach on the legitimate domains of the private sector that cannot compete. Underpaid researchers supplement incomes by “moonlighting in private”. Taxation and other policies require examination, along with development of improved incentive and reward systems for

public sector scientists, not only to improve public sector performance but also to facilitate complementary public-private partnerships rather than competitive ones.

Science and Technology Strategies

- Inadequate *scientific capacity* and a passive *political will* to influence quality and phytosanitary standards associated with access to markets of OECD countries and in international conventions (desertification, climate change and biodiversity). There is a need to adopt a proactive regional approach to the participation in the establishment of standards and in international conventions. This may require a substantial enhancement of scientific capacities and creation of S & T policy “Think-tanks”.
- Soil, water and fertility management represent key *natural resources* constraints. There are many deposits of rock phosphates, lime and other agro minerals in Africa that could potentially be harnessed to alleviate phosphorous and other *nutrient/micronutrient deficiencies* in the old, highly weathered/leached acid soils of Africa. Addressing these will require local, national and regional research and/or policy interventions depending on the nature of the particular constraints and their extent.
- Loss of *genetic diversity* of wild and domesticated flora and fauna. Enhanced conservation strategies, including *in situ* and *ex situ* approaches, community participation, biotechnology and capacity building are needed.
- Loss of human capital among farmers, scientists and their families due to the increased *human health* hazards associated with HIV/AIDS, malaria and TB, combined with poor *nutrition*, which are having a devastating effect on agricultural R & D capacities and agricultural labour productivity, especially in Southern Africa. One cannot have sustainable food security by ignoring health when some 7 million have already died of AIDS. What is required are much greater investments in anti-retroviral drug programs, primary health care in farm households and agricultural R & D institutions, and multidisciplinary research on modern and indigenous preventative and curative measures and the determinants of regional differentials in incidences and severities of the diseases. A review is needed of the experience of NARS with HIV/AIDS in different regions to determine how their scientific capacities have been affected and what should be the priorities for the allocation of scarce drug treatments among institutional staff? Should scientists have priority on the grounds of the opportunity costs of losing valuable human capital?
- Weak and/or non-existent national *academies of science* and *professional associations*, which reduces the influence of scientists on the formulation of S & T strategies and policies and the mobilization of resources for agricultural R & D. There is a reluctance of many (most?) scientists to enter the political arena which can inhibit their ability to contribute to solutions and be effective advocates. Is there a role for the IAC here in helping this process and in the development of codes of conduct for scientists and accreditation standards?
- There is a need for more *coherent national S & T strategies and policies* which integrate among sectors. There is a reluctance and/or inability on the part of the SROs to enter into the political arena in a more pro-active manner to influence the strategies of governments in ways that accord agricultural R & D higher priority. One option is the formation/revival

of National Councils of Science and Technology; an issue is to whom they should report: the Prime Minister, the Minister of Science or someone else, and how to ensure the NARS have an effective voice in them. Should separate institutions be responsible for (i) setting priorities and strategies, (ii) establishing resource allocations based on these and (iii) adjudicating proposals from R & D institutions?

- There is a lack of an effective *IPR regime*, which especially hampers the private sector in their R & D activities and reduces investments by it, both by national and international firms. This requires that a higher priority be accorded to IPR legislation and regulations, including effective implementation and capacity to administer and monitor.
- There are inadequate incentives and mechanisms for the identification of viable *indigenous technologies* and their commercialization; there is also “*indigenous ignorance*”. This relates to the issue of farmers’ rights; participatory research approaches of scientists with farmers as equal partners can help this process. Farmers’ education and farmers’ schools are needed.
- The underutilization of *universities* as incubators for operational institutions such as enterprises and conservation organizations and as focal points for integration of national S & T activities with the changing global institutional ecology. An option is to broaden the expected role of Universities beyond the creation of specialized knowledge and teaching to include participation in the global economy by increased local, regional and global knowledge networking and strategic alliances.
- The appropriate strategy for *irrigation development* in the various agro-ecological zones of Africa is unclear. It will differ in the humid, sub-humid, savannah and Sahelian zones. The place of large-scale compared to small-scale irrigation development remains an open question, as well as the highest priority NEPAD/CAADP accords irrigation in the continent, as opposed to rainfed agriculture. This important issue requires intensive scientific research (involving the biological, physical and social sciences) as well as debate in national, regional and continental fora.
- The increase in the extent of *competitive grant funding* will exacerbate the tensions among the various components of the NARS (Universities versus NARIs; central institutions versus zonal ones; strategic research versus applied/adaptive/participatory etc.). Competitive grant funding is not a panacea for what ails African agricultural R & D. There will be an increased need for clearly defined and articulated national, regional and continental strategies and priorities, and associated resource allocations, if these new funding mechanisms are to be effective. Public agricultural R & D institutions will still require sizeable core funding from government to be able to tap competitive grant funds and maintain the appropriate investment in public good research. Should NARS, SROs, ARIs and IARCs all compete with one another under these new mechanisms?
- Is there sufficient *agricultural technology “on-the-shelf”* to increase agricultural productivity, if only the policy regimes were conducive to adoption? Or do we still need much more innovative research to identify viable productivity-enhancing technology options for the complex diversified agricultural systems of Africa? Is monocropping a viable alternative to mixed-crop agriculture, and are productivity gains more likely in the former? What are the economics and environmental issues involved in this issue? We

probably need both and the issue of mixed versus monocropping has received a lot of research attention in the past. This could be reviewed.

- Should Africa embrace *genetically modified organisms* (GMOs) and the associated biosafety protocols, as a desirable component of a strategy which aims to substantially improve productivity potentials of the major food and commercial crops and livestock species? The recent book by J. A. Thomson, 2002. Genes for Africa: Genetically modified crops in the developing world. UCT Press, Cape Town South Africa, provides a scientifically based compelling argument in favour of the strategy and the Panel needs to formulate a clear position on it.

Draft Annotated Outline of Report

The Panel developed the following draft annotated outline of the report at its second meeting in Egypt in March 2003.

Chapter 1. Introduction

- Background
- Scope
- Structure of report

Chapter 2. Food Security in Africa

- Extent and nature
- Determinants
- Role of agricultural productivity
- Relation to environmental sustainability
- Winning strategies

Chapter 3. African Agricultural Production and Productivity in Perspective

- Production systems and trends
 - Description of current major agricultural/farming systems
 - Levels and trends in factor productivity
 - Priority systems from food security perspective
- Productivity potentials and gaps
 - In priority systems
 - Factors involved in explaining gaps between current and potential productivity

Chapter 4. Technologies That Can Make a Difference

- Conceptual framework
- Technology options
- Opportunities for closing productivity gaps, sustaining natural resources and maintaining biodiversity

- Potential for advances in science to contribute
- Synergies between indigenous and modern S & T

Chapter 5. Building Impact-Oriented R & D Institutions

- Institutional arrangements
 - Roles of:
 - Universities
 - Science academies
 - NARIs
 - IARCs
 - Extension services
 - Civil society organizations
 - Farmers' organizations
 - Private sector
- S & T Investments
 - Trends by region, commodity and scientific fields
 - Comparative analysis with other continents
 - Effectiveness of investments
 - Effects of HIV/AIDS
 - Reform agenda

Chapter 6. Creating and Regaining a New Generation of Agricultural Scientists

- The historical background of agricultural science in Africa
 - The pre-colonial period
 - The colonial period
 - The post-colonial era
- The current status
- The vision of the future
- The way forward

Chapter 7. Making Markets and Policies Work for the Hungry

- The changing context for national S & T policies
- Enhancing the benefits from R & D

Chapter 8. Recommended Strategies

- Overall strategy
 - The vision

- The goals
- Strategic priorities
 - Technology options that can make a difference
 - Building impact-oriented R & D institutions
 - Creating and regaining a new generation of agricultural scientists
 - Making markets and policies work for the hungry
- Tactics to realize the vision and goals
 - Building consensus and political will
 - Enhancing the influence of science on policy
 - International, regional and national relationships.

Some Key Strategic Questions

The Panel is considering a number of key strategic questions within the framework of a draft annotated outline of the report. These have arisen from the consultative processes outlined in the previous sections, from the commissioned resource documents and from the experiences of Panel members. It is expected that the recommendations of the Panel in Chapter 8 will relate to these and other yet-to-be-identified issues and options. Some of the emerging recommendation domains are as follows. Their order does not reflect their priority:

- *Technology options that can make a difference*
 - Which are the *priority agricultural systems* where food insecurity is most severe and the scope for productivity gains are highest? The Panel is assembling information to assist it in arriving at some conclusions on this important question. One element is the relative emphasis on high versus lower potential or marginal agro-ecologies.
 - What are the major *constraints to improvements in productivity* in these priority systems? In general it seems soil and fertility management is viewed as the highest priority in Africa as a whole, followed by water use efficiency/quality and then biotic stresses. Integrated soil, water and fertility management innovations are considered an imperative for sustainable intensification; organic farming and LEISA offer limited opportunities. The priority to be accorded to irrigated versus rainfed agriculture is a key issue, as is the type of irrigation (i.e. small- versus large-scale) and water pricing strategies. Integrated pest and disease management will have a key role.
 - What is the role of *biotechnology*? There are many options, some of which are not controversial and are already being adopted (e.g. tissue culture, marker-assisted selection etc.). The key issue is the value and desirability genetically modified organisms (GMOs). There are strong arguments in favour of embracing these as complements to other scientific approaches where they can make a real difference. In general it seems there is a case for much greater investments in biotechnology adopting regional approaches.

- There are many *technology options on the shelf* that are not being adopted because of marketing, transport and other constraints according to many. If these could be overcome could productivity be vastly improved? Others maintain that there are at present substantial gaps between actual and potential farm yields. Hence they argue the priority is for greater emphasis on location-specific adaptive research that aims to close these gaps rather than more strategic research that increases yield potentials? What is the right balance?
- What role is there for *mechanization*? As Africa requires more labour-saving types of technology options than Asia, especially since the advent of HIV/AIDS, mechanization has a genuine place in future strategies. The issues are how to promote it and the respective roles for the public and private R & D sectors. Enhancing labour productivity is a key objective. This requires skill development, improved working conditions, health and nutrition.
- What is the future role of *livestock* in African systems and what are the major constraints on raising their productivity? Clearly integrated crop-livestock systems and improvements are imperative. Is there scope for niche marketing of both new crop and livestock enterprises aimed at benefiting smallholders such as with goats in South Africa and pharmaceuticals?
- *Building impact-oriented R & D institutions*
 - How can institutions be built to generate *a green revolution* in Africa? Unlike the South Asian green revolution, which was based upon relatively homogeneous irrigated agriculture, in Africa we are dealing with highly diversified primarily rainfed agro-ecologies and agricultural systems and will be for decades to come. Hence Africa will likely have many smaller “green evolutions” than pervasive green revolutions of the South Asian type. In fact there are numerous examples now documented of very high returns to agricultural R & D investments already evident in many African research programs and projects. These indicate that there is substantial underinvestment in African agricultural R & D and many more opportunities for profitable investments to be made. Because of its heterogeneity though, Africa is likely to require greater investments per unit of agricultural productivity improvement than was the case in South Asia. Governments and the international community will have to recognize this and form their expectations accordingly.
 - Related to the first point is the question of what should be the goal in terms of the *intensity of agricultural R & D* in African countries? At present it is around 0.7% of the value of agricultural production. Some argue for a goal of 3% towards 2015, while others call for a doubling. The latter is a more realistic goal, which would achieve real gains in productivity. The former is considered by some as overly optimistic and beyond the absorptive capacity of NARS.
 - How can the role of the *private sector* be enhanced? Innovative public/private partnerships such as the African Agricultural Technology Foundation can provide strategic opportunities to encourage this. IPR remains a significant constraint in these endeavours but can be successfully addressed. One solution is for the private sector to provide patented processes and materials free to African institutions.

- How should the *IARCs of the CGIAR* operate in Africa in future? There are a number of options that could be canvassed. One is the model that arose from the Strong Review of the CGIAR where the operations of the 16 IARCs in Africa would be subsumed into 2-3 African ARCs, which are African owned and governed and respond more effectively to African priorities, especially those under NEPAD/CAADP. Many African NARS and SROs favour this. Another is to retain the international character of the IARCs (especially those with headquarters outside Africa but programs within) but strengthen their regional program presence to ensure they each have a critical mass of capabilities in Africa. Perhaps the latter option is for the shorter-term on the way to a longer-run scenario like the former option?
- How can the *research-extension system* be improved? There is increasing evidence that the linear research=>extension=>farmers model is not effective and that initiatives such as the T & V system advocated by the World Bank have not improved the situation. There is a need instead for an embrace of an agricultural knowledge and information system approach to technology exchange. In this ICT will play a key role, along with a change in University curricula and in the role and relationships between NARIs, extension systems and Universities. At present extension systems have little linkage with either NARIs or Universities in most African countries. The farmer-research-extension triangle will need to provide the future foundation for an integrated national agricultural research, education and extension system (NAREES), with the farmer and her husband as the focal point. The Land Grant University system introduced in Nigeria could provide lessons in this respect. The privatization of some research and extension could be explored. The proliferation of Universities and students in Africa and stagnant funding since the 1960s has resulted in declining standards, facilities and performance. There is a need to rationalize the University system and identify those which will be regional centres of excellence for research and post graduate training and those that will focus on undergraduate teaching. Universities could benefit from more autonomy and less centralized control. ICT provides an opportunity for virtual Universities. The World Bank policy of not lending or making grants for higher education should be abolished in recognition of the special needs in Africa.
- How can the *fragmentation of agricultural research* in Africa be overcome? This lack of critical mass among many NARS to work on priority national priorities has provided a major rationale for the formation of SROs and their networks. However the regional networks have not been successful in coordinating agricultural research in the manner envisaged. At best they have facilitated information exchange. Is there now a need for creation of African regional centres of agricultural research excellence (ACARE) to ensure cost-effective regional approaches to agreed priorities? These could be patterned on the IARCs and perhaps replace them in due course. They could also provide a timely magnet for the African scientific Diaspora (current and prospective)?
- How to ensure the development of coherent *national and regional S & T strategies and policies*? Is there a greater role for national councils of science and technology, academies of science and professional associations in this respect? How can the contributions of NARS and SROs to this process be strengthened? R

& D priority setting requires improvement, along with greater accountability and stakeholder role clarity through strengthened monitoring and evaluation capabilities and geo-referenced data and information management.

- How to make institutions more *responsive to farmers*? Smallholder farmers' organizations need to be strengthened.
- *Creating and regaining a new generation of agricultural scientists*
 - How can we make *agricultural science* a more attractive profession? This will require action at many levels. Students at primary, secondary, vocational and tertiary levels will have to be given an appreciation of agriculture, the environment and the role of S & T in these. Girls and women will have to be especially targeted as women only represent less than 10% of agricultural faculty at present. This should be raised to at least 30% towards 2015. In addition, salary scales for scientists will have to be substantially raised if the best and the brightest are to be attracted to the profession and remain in Africa. A scientist should not have to forsake science for management/administration in order to be adequately rewarded. The best scientists should have better salary and conditions than their Directors!?
 - How can the *brain drain* be reversed? Maybe the existing Diaspora of African scientists will not be able to be attracted back to Africa? Maybe it is a better strategy to focus on preventing further brain drain from the existing and future generations of scientists, by making agricultural science and its practice in Africa more personally and professionally rewarding?
 - How to make *agricultural scientists* more effective? University curricula and admissions policies need to be changed so that, instead of forests of mono-disciplinary specialized “bamboo trees” graduating, we have “baobab trees” of holistically trained ICT-literate graduates. They would be equipped for the IKS society, be market- and environmentally-savvy, willing and trained to be involved in participatory research with farmers, have a systems perspective and able to network among a wide variety of partners and stakeholders. Agriculture, science and health would all be involved in the curricula. The private sector also should be more intimately involved in the governance of agricultural education institutions and promote its role.
 - How to instill a sense of pride amongst *agricultural scientists*? With declining budgets, recognition and influence, agricultural scientists are becoming disillusioned. Strengthening, and in many countries creating academies of science and professional associations could help to reverse this. More scientific exchanges, joint appointments and advocacy could improve the situation, as well as enforcement of codes of professional conduct and ethics.
- *Making markets and policies work for the hungry*
 - How can smallholder agriculture in Africa be made more *economically viable*? Four elements are seen as vital:
 - Enhanced market opportunities and participation;
 - Market price information systems;
 - Vastly increased investments in infrastructure such as roads;

- Vastly increased investments in agricultural R & D.

All four interventions are viewed as complementary, as one without the others will mean loss of multiplicative effects on productivity and food security. Increased domestic market opportunities for both food and non-food commodities depend crucially on improved access by Africa to international markets. These are constrained by OECD agricultural subsidies and increased use of non-tariff barriers as tariff rates are reduced under the WTO regimes. If trade is to become an instrument of hunger and poverty alleviation, it must be both free and fair. Many otherwise viable technology options produced by past research remain under-exploited because of high input prices and low output prices that result from under investments in markets and infrastructure and distortions in international markets. For all this to be effective will require innovative ways of organizing smallholders to be better informed and more active participants in markets, policy processes and priority setting in agricultural R & D. Increased capacity to address quality standards and phytosanitary requirements of OECD importing countries will be required, as well as regulatory regimes related to GMOs.

- Should Africa imitate OECD *protection and subsidy policies*? Nigeria has had an enviable productivity record since it began to protect its agricultural sector. Some argue that other African countries should do the same, certainly in the shorter term if and until the OECD countries implement real liberalization policies. Intra- and inter-regional trade policies in Africa could also be harmonized.
- How should a *market-driven productivity recovery* in Africa be initiated? Improved market access, information and transport are seen as vital. Some see as desirable government support for strategic value-adding innovation initiatives that exploit niche markets for African produce.
- What other roles are there for *governments*? Improved governance is vital. In addition subsidies for environmental measures, which adversely affect farm profitability and food/nutrition security safety nets, are justified. Risk management policies are also part of the arsenal.

Conclusion

As indicated, *this is a report of work in progress* and is intended to inform stakeholders of the process the Study Panel is involved in, the messages it has been receiving from its consultations and some of the emerging issues and questions it has identified for further reflection. ***It should not be regarded as indicating any conclusions and recommendations at this stage.*** These will come in the following months as it completes its deliberations.

The Panel would like to encourage those who read this progress report to convey any comments or suggestions to the Study Director, Jim Ryan at the following e-mail address:

ryanjim@cyberone.com.au or by fax at +31 20 620 4941.

Appendices

Appendix 1. Members of the IAC Study Panel

Co-Chairs:

Speciosa Wandira Kazibwe, Vice-President of the Republic of Uganda
Rudy Rabbinge, Dean Wageningen Graduate Schools, the Netherlands
M.S. Swaminathan, Chairman M.S. Swaminathan Research Foundation, India

Members:

Mohamed Besri, Professor Hassan II Institute of Agronomy and Veterinary Medicine, Morocco
Maria Manuela Chaves, Professor Faculty of Agronomy, Technical University of Lisbon, Portugal
Avílio Antonio Franco, Member Agronomy Advisory Committee, Brazilian Research Council
Ryuichi Ishii, Professor College of Bio-resource Science, Nihon University, Japan
Jikun Huang, Director Center for Chinese Agricultural Policy, Chinese Academy of Science
Renald Lafond, Senior Program Specialist ICT for Development, International Development Research Centre, Canada
Peter Matlon, Deputy Director for Food Security at the Rockefeller Foundation, USA
Harris Mule, former Permanent Secretary; Executive Director TIMS Ltd, Kenya
Ahmadou Lamine Ndiaye, Vice-President Academy of Sciences and Technology of Senegal
Bongiwe Njobe, Director General National Department of Agriculture, South Africa
Emmanuel Uche Odigboh, Professor Agricultural Engineering Department, University of Nigeria
Gideon Oron, Professor Environment, Water Resources Center, University of the Negev, Israel
Per Pinstруп-Andersen, former Director General IFPRI; Professor Cornell University, USA
Elly N. Sabiiti, Former Dean Faculty of Agriculture, Makerere University, Uganda
José Sarukhan, Commissioner Social and Human Development, Office of the President of Mexico
Jennifer Thomson, Professor Department of Molecular Biology, University of Cape Town, South Africa.

Appendix 2. Regional Consultative Workshops

Eastern and Central Africa (ASARECA/IAC): 31 January-2 February 2003 Inter-Continental Hotel Nairobi Kenya. 43 participants.

Northern Africa (AARINENA/IAC): 3-5 February 2003 Hassan II Institute of Agronomy and Veterinary Medicine, Rabat Morocco. 30 participants.

Southern Africa (National Department of Agriculture, Republic of South Africa/IAC): 7-9 February 2003 Magaliesburg, South Africa. 32 participants.

Western and Central Africa (CORAF/IAC): 10-12 February 2003 Dakar, Senegal. 45 participants.