Innovation Systems and Agricultural Development in Africa : A Capacity Building Needs Assessment

Conference or Workshop Item

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29th September 2005.[1]

I Introduction

This short paper has been written as an input to the forthcoming IFSA Symposium. It addresses capacity building needs for African agriculture from an *innovation systems* perspective.[2] It also summarises a longer report written by the author at the request of the NEPAD and submitted in January of this year[3]. NEPAD plans to design and implement a programme for building the capacity of African scientists and research managers to understand and address science policy issues emerging with developments in agricultural research. This decision has been stimulated by the following factors. *First*, scientific advances, related technological innovations, and accompanying institutional changes are changing the focus and conduct of agricultural research in very profound ways. Agricultural research systems are increasingly being exposed to public scrutiny and confronted with a growing range of complex social, economic, ethical and political issues. In the case of biotechnology for example, its increasing application and importance in agriculture raise a variety of complex policy issues. These range from measures to ensure that economic benefits are shared among all stakeholders in a fair manner, to ethical and risk considerations associated with the manipulation of genes. African scientists and research managers require an understanding of relevant social, economic and legal aspects so that the impact of their research on rural development can be made more successfully than it has been in the past.

Second, the private sector is becoming a major investor agricultural R&D. This is partly due to globalisation, the opening up and integration of national economic systems as well as liberalization of trade, which is changing the locus of agricultural research. Globalisation raises a number of new questions about institutional configurations and change to ensure that commercial interests and goals do not overshadowed the need to address public needs. There is an increasing debate about how to enlarge and sustain public research on priorities for poor people. Scientists and research managers in agricultural research systems are under increasing pressure to identify strategic ways of partnering with private industry without losing sight of their responsibility to address problems of the poor and generate public goods. However, there are also pressures towards privatisation within developing countries simply due to national macroeconomic reform and new entrepreneurial opportunities that have begun to present themselves. This is forcing national R&D systems to seek alternative financial sources for their work.

Third, public agricultural research organizations are faced with fundamental questions about their relevance, performance and accountability. There is increasing evidence and consensus that current configurations of public agricultural research are not responsive to growing demand for new knowledge and innovations, and that they are not changing fast enough to respond to technological and geo-economic developments. Agricultural science policy deals largely with institutional, socio-economic and political factors that either enhance or inhibit innovation in the broad sense of both the generation and application of knowledge in food and agricultural production. It deals with policy and institutional measures to improve the

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[2] There is a huge and growing literature in this field. One of the most complete original sources in Edquist (1997). See also Clark (1992) for an account that relates specifically to the agricultural sector in developing countries.

[3] The study was commissioned to guide NEPAD's Office of Science and Technology and the African Ministerial Council for Science and Technology to develop a comprehensive programme on science policy. Further details may be obtained with reference to the NEPAD website where the complete report is presented.

effectiveness of agricultural research's contribution to social and economic change. The NEPAD study was designed to throw light on the following issues:

(a) To identify and provide a succinct analysis of science policy issues that arise from rapid technological developments in agriculture. What are the key science policy issues that affect and/or emerge with agricultural research at national, regional and international levels?
(b) To identify specific policy capacity needs of African agricultural research systems. Using a questionnaire and other appropriate instruments, identify and assess specific science policy capacity needs of national and regional agricultural research systems in Africa.
(c) To identify and describe current international and regional programmes for building capacities in science policy for better agricultural research. Are there capacity building programmes that meet or address the science policy capacity needs of African scientists and research managers? What are these programmes? What institutions have designed and implement them?
(d) To suggest strategic areas and activities that NEPAD and its international partners should invest in to build the science policy capacity of African scientists and research managers?

The methodology adopted was as follows. A literature survey was carried out to show how the agenda for developing country agricultural research has evolved in recent years. Emphasis was placed on policy and institutional reforms to improve agricultural research and development in Africa. In addition, although technological developments are an important part of this changing agenda, it was felt necessary to include a short analysis of the wider contextual changes that have also been taking place. It became clear from this review that there is now sufficient momentum established both to justify NEPAD's planned interventions and to throw light on science policy issues. A questionnaire survey was then carried out of stakeholder institutions and personnel that are expected to hold informed views on needs in this area. This was followed by an "in depth" series of interviews (using the questionnaire as a focusing device) carried out with key stakeholder figures in two African countries, Uganda and Ethiopia. The objective here was to go more deeply into specific questions than was possible with questionnaire administration. A small number of supplementary interviews were carried out in Kenya. Finally an Internet search was carried out into current practice on the part of selected organisations regarding in-service training in this area. This was supplemented by discussions with a range of stakeholder personnel in the Netherlands[4].

II Innovation Systems

The review of modern literature showed that the agenda for agricultural research has changed dramatically from the days of the Green Revolution, and with it the demands on the relevant institutions. It is this new complex agenda that has created the need for a fresh look at science policy analysis for agriculture. Agricultural R&D can no longer be left on its own to meet the new demands of the 21st century using the old institutional methodologies. There is still a need for science of course but that need must be informed by the needs and expertise of client sectors to a much greater degree than has been the case in past. In turn this means new types of relationship with other stakeholders and new types of capacity on the part of scientific institutions and organisations. This does not mean any reduction in the quality of the science. Rather the reverse in fact. It implies that scientists and the organisations, in which they work, need to improve their capacities to undertake quality science. But to do this they also must become more aware of the socio-economic context of their research and how this can inform the nature and purpose of what they are trying to do.

An important analytical approach to developing such a context is that of the "innovation system." This may be defined as the network of agents whose interactions determine the innovative impact of knowledge interventions including those associated with scientific research. The concept is now used as a kind of shorthand for the network of inter-

[4] The Netherlands were chosen both to gain a developed country perspective and because there is there a wide range of easily accessible and knowledgeable organisations and people.

organisational linkages that apparently successful countries have built up as a support system for economic production across the board. In this sense it has been explicitly recognised that economic creativity is actually about the quality of "technology linkages" and "knowledge flows" amongst and between economic agents. Where the interactions are dynamic and progressive great innovative strides are often made. Conversely where systemic components are compartmentalised and isolated from each other, the result is often that relevant research bodies are not at all productive. In extreme cases they have ceased to provide any innovative output at all. Put another way the key property of a system of innovation is therefore not so much its component parts, or nodes, but rather how it performs as a dynamic whole.

Over the last few years this notion has begun to be applied increasingly in developing country agricultural policy analysis at least partly as one means of dealing with the deficiencies outlined above. Its key property is its ability to focus attention away from an exclusive emphasis on R&D bodies and their extension counterparts and towards other key stakeholders such as NGOs and the private sector. What was interesting from the interviews carried out was been the finding that practically all interviewees explicitly agreed that future funding of agricultural research will need to take much more account of the institutional context within which such research is carried out. It will no longer be possible simply to seek support for peer-reviewed projects and ignore the relevance and impact of whatever results are forthcoming. This has led a number of CG research bodies, for example, to broaden their mandates away from that of crop and livestock research into one of integrated natural resource management (INRM). And to do so effectively means building partnerships with farmers and other relevant stakeholder groups[5]. A second requirement is to develop an interdisciplinary dimension to project management and execution. Again within the CG system ILRI is a good example of this, having reconstructed their programme into 5 “themes” in which innovation systems and client impact figure prominently. Another practice is that of building closer linkages with the private sector where a number of institutes have begun to do this (e.g. ICRISAT)[6]

However, there are still tensions within relevant science communities regarding the professional status of science policy concerns. The basic issue is the familiar one of “mode 1” versus “mode 2”.[7] Research managers worry that bench scientists will become distracted from their research, which will suffer as a consequence. Some still do not yet accept that the agenda for research has changed and wish to return to earlier Green Revolution mandates. The policy-making community is also torn. On the one hand it is used to treating the R&D system as a disinterested source of knowledge of relevance to sectoral ministries. On the other it has becoming increasingly clear that many publicly financed R&D are an expensive drain on resources and are not having the impacts expected of them. The issue here is probably one of awareness-raising. Evidence from industrial sector experience indicates that a focus on “innovation” rather than “science” requires institutional changes that have themselves to be innovated. Such changes mean experimenting with the unknown and are bound to lead to uncertainty.

III Needs Assessment

(a) Science Policy Issues

As a result of the investigations it was decided quite early on that that many of the relevant issues could not be attributed only to the effects of rapid technological developments in agriculture (important though these are) since there is overwhelming evidence that the policy agenda has broadened considerably over the past 50 years. No longer is it possible to regard agricultural science as the key source of crop yield improvements and thus, international food

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[5] See for example Harwood & Kassam (2003) who provide a series of illustrative case examples.

[6] See Hall et al (2004)

[7] See Clark (2002) for an account relevant to international agricultural research. For the original source on this point see Gibbons (1994). Very crudely the distinction is as follows. “Mode 1” approaches (the traditional view) argue for a complete organisational separation between scientific research on the one hand and its practical application for economic and social welfare on the other. Conversely “Mode 2” approaches argue for institutional arrangements that build science policy concerns directly into the conduct of R&D.

security and social well-being. Instead the agenda has expanded to include issues of continued (and worsening) poverty, environmental sustainability, private sector activity, the complementary roles of NGOs and community-based organisations (CBOs), the importance of farmer knowledge, the growth of relevant agribusiness and changing (national and global) macroeconomic conditions. In short the analysis provides a pointer to a new and broader agenda for agricultural science, which has arguably become much more complex and multidimensional. This agenda is partly one of awareness-raising about the need to consider more fully the social and economic contexts that shape in fundamental ways the application of science and technology in the development process. But the agenda also is one of building up knowledge about how to integrate agricultural science better with client need and complementary capabilities, especially with relevance to poor rural communities.

Practically all sources canvassed in the exercise agreed with this proposition in a general sense and also with the corollary one that this means engagement with an issue of great complexity. At the same time there is no clear understanding of the interdisciplinary issues involved, mainly because most stakeholder groups and individuals have been trained in ways that give emphasis to a narrow disciplinary focus and a reductionist approach to the conduct of research programmes. They are aware of the complexity of course, but have difficulty translating this, in their minds and actions, to appropriate change. For example, at one level they appear to accept that an "innovation systems" approach is probably the way forward in agricultural research planning. But at another level they are not quite sure how to implement this as a set of practical projects. And the prevailing fear is that scientific quality may thereby be compromised. For this reason high on the agenda is the need for awareness raising programmes designed to outline the basic nature of science policy in this field and in a sense to disabuse people of residual "anti-science" concerns that this policy perspective has engendered. Such programmes should not just be targeted at bench scientists but should also be offered to all other stakeholder groups.

(b) Capacity Needs

In the course of the investigation a variety of capacity building needs (and initiatives) were encountered. However a relatively small range appears to dominate. Although there are obvious overlaps it is convenient for these to be summarised as follows:

a. *Intellectual Property Rights (IPRs):* The growth of relevant private sector links, particularly in the area of biotechnology, has shown the need for research institutions to develop cognate capacities in this area.
b. *New Technologies:* As economic production becomes much more knowledge intensive the role of new technologies in and for agricultural science becomes more crucial. The main technologies here are biotechnology and ICTs, which are transforming potential and challenges for R&D bodies. One such challenge is that of biosafety, how it can be ensured and promoted. Another is biotechnology itself of course, which impinges at many levels on R&D bodies.
c. *Partnerships with Intermediary Organisations, particularly the Private Sector:* There is now a lot of evidence that bodies such as NGOs, CBOs, and growers associations provide valuable links on many levels. At the same time there is still little systematic knowledge about the strengths and weaknesses of such partnerships. Accordingly this too is an area where capacity development (combined with primary case study research) is advisable. In particular there should be courses available that train different stakeholder groups about how to build and maintain partnerships.
d. *Interactions with Stakeholder Groups*: A related point is that R&D bodies need to develop much greater understanding of such groups not only in the context of delivery to clients (such as farmer groups or agribusiness for example) but also in terms of how to develop a productive division of labour with cognate R&D bodies in the public and private sectors. A good example of this is that of environmental concerns where good links with activist groups can benefit all parties.
e. *Engagement with Interdisciplinary Research*: For some time now it has been recognised that problems facing poor communities require the integrated analysis of many disciplines. However, the research culture in many R&D bodies still often

focuses on fairly narrowly defined disciplinary issues. This will need to be changed and is therefore an important focus for capacity building

f. *Relationships with the Donor Community:* Donors are becoming increasingly demanding, again for a variety of reasons such as the sheer range of potential recipients and changing international demands that have arisen for geopolitical reasons. There is need for scientists to learn more about how to interact with donor groups (through proposal writing for example) so that the research they do may be seen to fit in with evolving patterns of demand.
g. *The Role of the State:* Increasingly and for many reasons, the State is coming more concerned with science policy issues. There is need therefore for scientists to be able to interact with policy makers at many levels to ensure that advice provided is sound and according to current best-practice knowledge. Equally there is need for the civil service to be made better aware of the opportunities provided by scientific research to inform policy procedures.
h. *Learning and dealing with evolutionary contexts:* Because the external context of agricultural research is now changing so fast, organisations need to be able to respond more rapidly to unexpected events. There is therefore a need for management systems to learn how this can best be done and to be informed in this respect by new developments in this area.

(c) Pedagogy

It should be emphasised also that "science policy" capacity building is still at an early stage of development. In fact it is only relatively recently that the issue has become accepted in agricultural science (although science policy studies for other areas have now been in place for some 50 or so years). Although many short courses have now been established and while lessons have been learned there is clearly some way to go. In particular the following (methodological) insights have arisen from this assessment exercise:

a. *Case Study Focus*: It seems that understanding the complexity of science policy issues cannot easily be demonstrated from "first principles". There is no ideal template or cookbook set of recipes. In most of the cases examined what seems to be much more effective is to proceed inductively. Here the use of illustrative case study material has proved quite successful, particularly where such material is chosen to map on to a chosen theme. It is then possible to proceed inductively to more generic principles which in some sense are "owned" by participants. At the same time the opportunities for interactive learning are enhanced.
b. *Policy Research*: There is, however, a considerable shortage of good case study material that is suitable for training purposes. While there is some limited material available, much of it needs to be revised into a form suitable for short course delivery. This means that resources should be made available for appropriate policy research, which can be integrated into capacity building programmes. Prospective programmes are advised to set aside resources for this activity.
c. *Integral Policy Research:* On a related point one of the successful attributes of a number of programmes has been that of "hands-on" workshop activity on the part of participants. This can take many forms from the conduct of short research projects to scenario activities. The important "learning" that these exercises appear to provide is one of getting participants to understand the complexity of any given issue but at the same time being able to throw light on how such an issue might be dealt with in a policy sense.
d. *Accreditation:* It helps a great deal to award certificates (of participation and attainment) to course participants since this gives incentives both to want to attend and to work hard at course material.
e. *Training of Trainers:* One point mentioned by a number of interviewees is the shortage of people who have the pedagogic expertise necessary to deliver science policy material. There is thus a short run need to develop a roster of people who are able to assist in the mounting of such short courses and a longer term "training of trainers" agenda. Three types need to be identified:
    - Experts in specific fields (e.g. in IPRs)
    - People with skills in science policy analysis

- Administrative personnel

f. *Composition of Target Groups:* Experience suggests that short courses in the science policy area are most effective where courses are delivered to scientists alongside representatives from other stakeholder groups (such as NGOs and public servants for example). The benefits of awareness-raising are enhanced through the gaining of greater understanding of the activities of other actors in cognate networks.

IV Conclusions

As a result of this investigation it became clear that capacity building to enhance agricultural science in Africa is an area to which the NEPAD should give high priority. The reasons may be usefully summarised as follows:

- Despite nearly half a century of effort and expense the impact of agricultural research on poor rural developing country communities has been much less than it originally promised. Much of this shortfall is due to the inability of agricultural science to engage effectively with other stakeholders, including primary clients such as farmers and consumers and the enterprise sector. It is thus unable to plan and organise research in ways informed by the nature of a context that is rapidly changing. And this is really a "policy capacity" rather than a "scientific" problem.
- Practically all stakeholders interviewed gave support to this view
- There is also equally strong support from the contemporary literature on African agricultural science
- Although there is still some debate on the topic many organisations at national and international level are now setting up related capacity building initiatives though they are perhaps not as well organised or integrated as they might be. There is little agreement on a guiding framework and there is very little integration.

However, the heart of the gap in science and technology policy capacity provision is not so much the absence of programme related to this subject. In fact there are programmes that pick up specific areas of relevant policy capacity such as biosafety and IPR issues. But the main gap is the lack of recognition that science and how to exploit it needs to be considered in an entirely different framework than has been in the case in the past. The concept of an "innovation systems" perspective may be used as a short hand for this framework. In essence what it implies is a perspective where scientific expertise and endeavours relate and iterate more closely with a range of other organisations and initiatives, and are shaped by evolving concerns.

These concerns range from public perceptions of safety and acceptability, changing global rules on trade and regulation, to evolving political and social processes, which determine how knowledge of all types is brought into productive use in the form of innovation. While this perspective certainly does mean that there are going to be specific policy capacities needed to deal with specific contextual elements, what is possibly of more strategic importance (and needed more urgently) is to establish the policy capacity to deal with the necessary implications of this new framework. Once that is established and starts to be implemented as the overarching frame for the utilisation of science and technology capability, then specific areas of policy (and the capacity to develop these) can be better designed, with greater coherence towards the higher order endeavour of building the capability of developing countries to innovate. The main recommendations to the NEPAD were as follows:

1. *International consensus building***.** NEPAD is advised to organise International consultation on the meaning of capacity development in this area and ways of pursuing a coherent approach. This would draw the international development assistance community, policy researchers in this area and importantly key stakeholders from national policy and other bodies. The purpose of this would be to work through the implications for Africa of a science policy approach underpinned by an innovation systems perspective and attempt to reach consensus on ways of tackling this in a coherent way.
2. *Expert Consultations*. NEPAD is advised also to arrange national level expert consultations and training programmes with senior policy actors and bureaucrats on

the implications of the innovations systems perspective. Such consultations would define objectives, priorities and potential service providers for science policy capacity building initiatives at country level.

3. *Organisational Coherence.* There is a need to find ways to give a coherent identity and focus to expertise in the area of agricultural science and technology policy that draw in the state of the art in this domain and can successfully engage in outreach activities that promote policy capacity development in this area. The way of achieving this may be to strengthen existing networks of policy orientated organisations working in this area, although these are currently limited in number and highly fragmented. An alternative may the establishment of an African agricultural innovation centre or a combination of these two approaches.
4. *Short Courses* The main initial mechanism for capacity building should be that of the short course since this is the most effective way of reaching a wide target group of stakeholders. While there are postgraduate level programmes in the science policy area (mainly located in Northern universities), to focus on such programmes would not represent good value for money, for resource reasons. What seems to work best are short in-service training courses delivered over relatively short periods of around one week. Participants are thus not away from their work too long and are able to concentrate on the new ideas being taught. This does not preclude more substantive initiatives at postgraduate degree level similar to those available in some European universities but that is a longer-term activity requiring separate planning.
5. *Focus of Study.* The focus of capacity building initiatives should on "innovation" rather than on "science" *per se.* This will then permit much greater integration than has been possible in the past. Note that such an emphasis does not preclude standard scientific training activity, which will of course continue much as it has always done. But the need is now to extend capacity building in the wider sense outlined above with the ultimate objective of "adding value" to conventional agricultural science.
6. *Curriculum Development.* NEPAD is encouraged to seek modalities for appropriate curriculum development. Full use should be made of existing activities such as the Millennium Science initiative of the World Bank, the current Rockefeller programme at Makerere University in Uganda, the efforts of the Inter-Academy Council and their "Inventing a better future: A strategy for building worldwide capacities in science and technology".
7. *Integration of Research with Capacity Building.* NEPAD should encourage initiatives in this area to use policy research in the development of appropriate course material capacity building. This is important because of the shortage of suitable pedagogic materials.
8. *Training of Trainers.* Due to the shortage of expertise in the science policy area NEPAD is encouraged to support initiatives to train personnel in science policy and related subjects. To this end it may seek assistance from international centres of excellence such as the Science Policy Research Unit (SPRU), University of Sussex, UK and the UNU/INTECH, in the Netherlands.
9. *Target Groups.* Experience suggests that short courses in the science policy area are most effective where courses are delivered to scientists alongside representatives from other stakeholder groups (such as NGOs and public servants for example). The benefits of awareness-raising are enhanced through the gaining of greater understanding of the activities of other actors in cognate networks.
10. *Courses for High level Personnel*. There is an urgent need to establish shorter (one/two day) orientation courses for senior managers such as centre directors, permanent secretaries and ministers. This category would not normally have the time to attend more substantive courses but will need to understand the broad issues their subordinate staff are being exposed to. In the absence of support at this senior level, capacity building initiatives may not have the full effect.

In summary it may be concluded that the NEPAD is correct in its intention to design and implement a programme for building the capacity of African scientists and research managers to understand and address science policy issues emerging with developments in agricultural research. The main issue is that of deciding how best to pursue such an aim, given the sheer range and ambitions of the actors involved. There are, for example, 12 organisations centrally

involved in cognate programmes with another 10 having programmes in related fields.[8] The analysis in this report suggests that efforts should be made to ensure integration and co-operation across all these initiatives. It also suggests that emphasis should be given to issues of cross-regional coherence, improvements in pedagogy and delivery, integration with policy research and the importance of an "innovation systems" perspective. Efforts in this direction are certain to make a significant difference to the effectiveness of agricultural science on the continent.

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[8] See original report for a summary account of all of these programmes; pages 15-27.