Science policy and agricultural research in Africa: a capacity building needs assessment

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Science Policy and Agricultural Research in Africa

A Capacity Building Needs Assessment

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1 Background

The New Partnership for Africa's Development (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. The proposal is 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 effectiveness of agricultural research's contribution to social and economic change.

NEPAD intends to facilitate efforts aimed at raising awareness and building the capacity of agricultural scientists and managers to handle emerging science policy and related issues of institutional change. This background "needs assessment" 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. It 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. The assessment should provide a clear indication of awareness, skills and infrastructure needs in terms of science policy.

(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 (e.g. The Japanese International Development Agency) should invest in to build the science policy capacity of African scientists and research managers?

The report consists of the following sections. Section 2 provides a short account of the methodology opted for the study. Section 3 gives a summarised account of the genesis of science policy[2] analysis with a specific focus on agricultural science and impacts on poverty in the developing countries with emphasis on Africa. This section relies heavily on published research in cognate fields but is written to put recent issues in context. In particular it makes brief mention of the recent change of thinking (explicit in many of the interviews conducted) from a traditional "science push" approach to one that places more emphasis on multi-stakeholder, interdisciplinary and client-driven research agendas. Largely, this has been driven by changing contextual circumstances since the days of the Green Revolution but it has not proved easy for research organisations to change their established practices. This is true both within the international centres (mainly the Consultative Group for International Agricultural Research (CGIAR)) and within component national research systems (NARS). Many of these are making efforts to adapt but all are finding it hard.

Section 4 moves directly into the needs assessment. It begins by summarising the results of interviews conducted with a number of the main experts and organisations involved. The notion of "capacity building" is hard to define in general but when applied to agricultural science policy issues there seems no one accepted agenda. Every stakeholder agrees that something of this kind is needed but no one is precisely sure exactly what to do. The result is one in which moves towards achieving greater coherence are advised. So great are the overlaps among stakeholder agendas that there is need for an over-arching scheme that can help integrate such initiatives for the betterment of all concerned. The discussion then returns to the overall objectives and suggests 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. Section 5 describes current international and regional programmes for building capacities in science policy for better agricultural research in Sub-Saharan Africa (SSA). The picture that emerges is one of a small range of initiatives in a field that is new to many of the relevant organisations. On the whole it is difficult to avoid a feeling of incoherence, however, and it is clear that there are many gaps to be filled. Section 6 presents final conclusions and recommendations. The Appendix at the end gives details on questionnaires/interview schedules adopted for the empirical work. It presents details of written materials and individuals consulted in the course of the study. It gives a short CV for the main consultant. It also gives an example of a training course carried out in the Centre for the Semi-Arid Tropics (ICRISAT) during which a "focus group" exercise was attempted. This example is particularly relevant since the topic concerned capacity development in rural innovation policy and the participants were drawn from a range of stakeholder groups including agricultural scientists. Finally it provides a summarised account of the main interviews held.

Deleted: An approach is also needed that will address the need to raise the quality of undergraduate training of whole cadres of graduates because the present reliance on strengthening training in single departments of individual institutions does not address the human capacity requirement for African agricultural development.

2. Methodology

The approach taken to fulfil the above tasks has been as follows:

For objective (a) 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 that are necessary 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. Inevitably perhaps, the sheer volume of this

[2] The phrase science, technology and innovation policy (STIP) will also be used later in the text to emphasise the importance of innovation in the new agenda for agricultural science. This is keeping with the focus adopted by Task Force 10 of the United Nations Millennium Development Project. The Project focused on measures that are required to achieve the Millennium Development Goals (MDGs)
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literature combined with the time available has prevented a fuller scale survey. However, it is clear from even a relatively brief account that there is now sufficient momentum established both to justify NEPAD's planned interventions and to throw light on science policy issues. For objectives (b) and (c) a number of methods were used. To begin with a questionnaire survey was carried out of stakeholder institutions and personnel that are expected to hold informed views on needs in this area though a poor response limited the conclusions that could be drawn. Secondly, an "in depth" series of interviews (using the questionnaire as a focusing device) was carried out with key stakeholder figures in two African countries, Uganda and Ethiopia, and with a cognate research group in India. 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. Thirdly 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[3]. Finally, the consultant participated in a "specimen" training course on a cognate theme with a group of scientists in South India. This course not only provided useful feedback on the types of training that may ideally be required. It also gave an opportunity to use the participants as a "focus group" that was able to provide greater insights into all the relevant issues. Further methodological details may be found in the Appendix.

3. Science and Public Policy for LDC Agriculture

3.1 Changing Agricultural Research Context

The social studies of science as public policy (or science policy) may be defined very broadly as how and why resources are committed to science and technology, what sorts of problems arise in so doing and what sorts of improvements might be made. Much of the reason for its development has depended upon demands on the part of the state for 'expert assistance' in the making and monitoring of policy, demands that have grown rapidly in recent years, as economies have become more knowledge dependent. The subject goes back a long way, certainly as far as the famous C P Snow lecture in the 1950's and probably also to the earlier writings of Bernal and Blackett in the period just before the 2nd World War[4]. However, the debates and discussions it has engendered have until recently tended to focus on industrialisation prospects for the richer countries and those "middle-income" parts of the world that are now beginning to play a significant part in global economic change. This is now beginning to change as a result of the growing recognition that there are large parts of the world's population that are still living in dire poverty and under poor and worsening environmental conditions. It was mainly to address this issue that the achievement of the Millennium Development Goals (MDGs) by 2015 were adopted by the United Nations General Assembly in 2000. These have since been articulated by a number of Task Forces into steps that need to be taken if these goals are to be achieved over the coming 10 years and all will need science to help[5]. The role of science in improving agricultural development was addressed recently by the President of the UK Royal Society (Lord May) in a recent address as follows:

> "Take for instance the goal of eradicating extreme poverty and hunger. There are economic, political and cultural social science elements to achieving this aim. But the physical and biological sciences and technologies will also be crucial, for instance in improving agricultural methods and technologies, food preparation and distribution techniques and systems, and building up basic education about nutritional needs. ------ Quite simply, without significant scientific infrastructure and expertise within the poorest countries, it will be difficult if not impossible for them to help themselves in finding solutions. This will make them ever more reliant on aid and assistance from more scientifically developed nations. In other

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3 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.

4 See Snow (1963) and Bernal (1969)

5 Reference in particular should be made to Task Force 10 on Science, Technology and Innovation, which has now been published (See reference to the Millennium Development Goals Project Task Force 10 Report in the bibliography).

> words, without the capacity embedded in the educational system at school, university and in research laboratories, and without the institutions such as academies to provide the support structure for good scientists to work in the countries concerned, there is little chance that science will be able to be harnessed to address these countries needs, or even that these countries will be able to absorb and use the science generated elsewhere."[6]

As May points out it is in agriculture and the rural sector that problems of poverty are most acute. Paradoxically, however, agricultural research until recently has remained relatively immune from much of the modern debates about science policy. Hall et al (2000) argue that it was the early successes of the science-based *Green Revolution* that have led to this complacency. The application of crop improvement principles-notably dwarfing, hybrid vigour and fertiliser responsiveness to the cereal crops of the developing world (rice, wheat and maize) created a series of high yielding varieties (HYVs). Judged in terms of increasing productivity and food supply (the policy agenda for which research systems were established) agricultural research was clearly succeeding. Moreover, the initial impetus for the Green Revolution did not come from the national agricultural research systems (NARS) of the developing countries themselves, but from two international research centres that subsequently became the model for the sixteen or so centres that now comprise the Consultative Group for International Agricultural Research (CGIAR) system ---CIMMYT in Mexico for wheat and maize, and IRRI in the Philippines for rice.

The CGIAR system (sometimes called the CG system) came into being (in 1971) because despite international help for the NARS, many developing country governments did not support local research sufficiently. In compensation, therefore, multilateral and bilateral aid, along with support from private foundations, was channelled to international centres of excellence that would undertake strategic research for developing countries without becoming enmeshed in the administrative and political arenas of client countries. What emerged was a two-tiered system. The CG centres developed production technologies and varieties for mandated crops (and geographical regions) that were subsequently passed on to the NARS for applied, contextual research and final transfer to the farmers. This essentially is the "transfer of technology" (TOT) model, which became the "engine" of the Green Revolution and which has really dominated policy thinking until very recently. Its chief characteristics are a belief in the existence of scale economies in the R&D process, a faith in the scientific method as the main source of improved technological practices for the poorest of the poor, relatively little attention paid to the tacit knowledge and local preferences of the farmers themselves (Chambers & Ghildyal, 1985)[7], and the belief that issues of technology transfer and needs assessment are largely the responsibility of other "non-scientific" organisations. What then has changed? Recent analysis appears to highlight the following interrelated factors:

(i) The Macroeconomic Context

There have been radical changes regarding the role of the State in socio-economic governance. In simplistic terms the approach has been as far as possible to withdraw from direct state control of the economy, shifting emphasis away from state implementation to that of providing an appropriate (macro) policy environment. Central to this is the move to allow the market to provide services and to use competition to generate efficiencies that the public sector arguably cannot achieve. The developing world first felt the consequences of the new ideology in the structural adjustment packages implemented by international financial institutions in the 1980s. The "adjustments" referred to macroeconomic and trade policy reforms (such as exchange rate reform for example) but they also had to do with changes in the structure of the economy, mainly the extent to which the state provided public services and controlled key economic sectors. The approach was an attempt to reduce large and apparently unproductive, public sector bureaucracies, to break up state monopolies and to open up markets to competition, both nationally and internationally. As a result agricultural

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[6] See May (2004)— Similar sentiments are expressed in the recent DFID Select Committee Report. See DFID (2004)

[7] See pp 1-30

research systems began to face new challenges particularly in agricultural research and extension funding, which in Africa has declined considerably as a consequence (Pardey, Roseboom and Beintema [1997]).

(ii) Private Sector

A key change that is making this all the more pertinent is the emergence of private sector research. This was partly a result of improved intellectual property protection regimes and the technical advances associated with biotechnology. But also significant are the opportunities that economic and trade liberalisation and globalisation are now presenting for private investments in agro-industries such as seed production. The net result is that public agricultural research systems have to consider more complex agendas. Often these new agendas actually conflict with traditional internally driven policies and beliefs of the research sector, particularly where these remain focused on production and productivity and continue to reflect the food security concerns of an earlier period (Roseboom and Ruttan; 1998). Increasingly the difficulty concerns the integration of multiple sets of agendas, with policy makers having to choose between serving, for example, the commercial needs of the agricultural sector while simultaneously serving the interests of society at large. In this way agricultural policy is no longer one-dimensional.

(iii) Poverty Impacts

While in earlier periods it is clear that big productivity gains were achieved, particularly with respect to maize, wheat and rice, as time has gone by the evidence on real poverty impact has become much patchier. In particular Green Revolution technology tended to require high levels of ancillary inputs such as water and fertiliser, and supportive institutional structures dealing with extension, credit and marketing. Richer farmers had access to these but poor farmers relied heavily on state support such as subsidies for key inputs like fertilisers. Such support was forthcoming in the 1970s but as global financial crises impinged in the 1980s this began to vanish. In this context it is important to note that while earlier criticisms of agricultural research performance concerned the appropriateness of the new varieties and technology in terms of their suitability for poor farmers, this criticism left the agricultural research system largely blameless. That is, application questions were assumed to be "exogenous" to the technology/poverty equation. However during the 1980s increasing criticism emerged of this (institutional) model of agricultural research, including the role of the Consultative Group for Agricultural Research (CG) centres. Biggs (1990) in particular has drawn attention to the key institutional dimension of the problem and specifically the hierarchies inherent in agricultural research systems fashioned on the “linear” model of innovation. As we shall point out below most donors are no longer willing to fund research that does not have precise operational links to application to the poorest sections of rural society where food security is still a major issue.

(iv) Environmental Issues

Over the past 40 years the issue of environmental degradation has become much more significant. In particular intensive agricultural development often relies on chemical inputs and heavy consumption of water. A specific example is the salinity effects of large-scale use of ground water. A more general issue is the falling of the water table in areas where recharge capacity is hampered by vegetative depletion. Another area that now causes popular concern is the use of transgenic technology in plant breeding and livestock production. The watershed here was probably the Biodiversity Convention at the Rio UNCED “Earth Summit” in 1992 and the subsequent ratification of its Biosafety Protocol by most African countries between 2002 and 2004. But the impact has had far reaching consequences, particularly in export sectors. A good example here is the current controversy over genetically modified food aid being provided by the United States of America and Canada to countries that are experiencing increasing food insecurity in Sub-Saharan Africa. Over the past year an intense debate has emerged on whether African countries that faced with severe food and increasing malnutrition as a result of food shortages should accept or allow human consumption of genetically modified food.

This controversy is pronounced in Zambia where there are now very large numbers of starving families while the government through presidential directives has rejected genetically modified food aid. In early 2002 Zimbabwe also had rejected genetically modified food aid on conditions of potential risks on human health and the natural environment as well as possible contamination of its future agricultural exports to the European Union. It reversed the decision later in the year after intervention by some local scientists, the World Food Programme (WFP) and US diplomatic circles. At present many African governments are now formulating regulations on the handling, development, transfer and use of modern biotechnology, particularly genetically modified products. They are doing this to respond to international policy and law. For example, with financial support from the Global Environment Facility (GEF) more than 15 African governments are developing guidelines and laws on biosafety to ensure the safe development and application of biotechnology. These are important issues and indeed most African countries are now putting in place biosafety policies with clear implications for the pattern and effectiveness of agricultural research. However, it is not all clear to what extent local and international scientists are participating in informing such policy processes.

(v) Stakeholder Groups

Traditionally the job of passing on the results of agricultural research was given to state-funded extension services. Not only have these suffered through structural adjustment measures, however, but there are also increasing questions raised about the extension systems themselves as an operant organisational mechanism. For example Uganda has recently radically revised and partially privatised its extension services for precisely such reasons[8]. There is also evidence of increased need to engage in partnerships in order to deliver new technologies successfully to client groups. These partners include private sector organisations but they also involve NGOs and CBOs that are able to bring skills and knowledge to bear simply due to the close relationships they have established with specific communities. Hall et al (2004) is one of an increasing number of studies that show how the ability of new technologies to impinge directly on poor farming communities has been considerably enhanced through the use of well-selected NGOs.

(vi) Farmer Knowledge and "Participation"

A related issue concerns how to involve farmer knowledge in R&D activity. Starting in the mid-1980s there has been a growing acceptance of the necessity to involve the "client" not only in "needs definition" but also in how local conditions are likely to affect agricultural interventions. For example, a recent study of hybrid maize in the Siaya region of West Kenya shows that despite vigorous (and costly) promotion of hybrid maize on the part of scientific and government authorities over a twenty-year period, "local" varieties continue to remain widely grown while hybrid varieties are hardly grown at all. The reasons for this are fundamentally ecological. Local "landraces" fulfil needs associated with pest and water tolerance, costs of expensive inputs such as fertilisers, product acceptability on the part of consumers, productivity of "saved seed", and credit scarcity. Conversely, modern hybrids need reliable rainfall, expensive inputs, rigorous planting schedules, timely labour availability---in fact the entire supportive institutional framework that exists on the typical experimental station[9]. It is clear that formal research systems would benefit from an awareness of such problems but they still have difficulty engaging with the issue.

In recent years agricultural research systems have begun to try and accommodate (with varying levels of enthusiasm and success) this new agenda in both research practice and research focus (see for example Hall and Nahdy, 1999). However, all too often much of the advocacy for this change in approach has focused on participatory methods rather than underlying institutional issues[10]. Biggs and Smith (1998) argue that this "methods bias"

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[8] Interview data

[9] Wiskerke and van der Ploeg (2004),

[10] Abundant examples of this methods-driven debate can be found in the general literature. For critics see Tripp 1989; Biggs 1995; Biggs and Smith 1998; and Hall and Nadhy 1999.

masks the fact that the most successful participatory methods have arisen in specific institutional and political circumstances and have often evolved to deal with a specific problem area in that context. In addition they have often been characterised by a significant degree of institutional innovation. Agricultural scientists all too frequently find themselves struggling to apply participatory approaches in an institutional and professional context that implicitly denies such patterns of client interaction (Hall and Nahdy, 1999). The contradictions and compromises that this has led to have neither helped maintain focus on the research process and its institutional arrangements, nor necessarily contributed significantly to more farmer responsive technology.

(vii) The New Agriculture (and Challenges of Creating Dynamic Innovation Capacity)

Part of the problem that agricultural research faces is the fact that the “one-size fits all” model of an agricultural research system is simply not suited to the emerging reality of the developing country agricultural sector. While production, sale and consumption of major food crops remains important, a number of niche sectors are emerging with impressive rates of growth and this is couple with fundamental changes in the nature of the sector as whole. These include the growing importance of the livestock industry, particularly aquaculture; the diversification into horticulture and cut flowers, particularly for export; the duel use of roots, tubers and course grains for food and industrial use (animal feeds, bio-fuel, starch); increased consumption of processed foods and the growth of a processing industry; the increasing role of the private sector; corporatisation of craft based industries such as herbal medicines; the exposure of producers and firms to competition, changing international trade rules and regulations such as sanitary and phytosanitary standards; the knowledge intensive nature of these niche sectors; and the importance of innovation as a source of competitive advantage in rapidly evolving market and technological conditions. Factors driving these changes include globalisation of markets, rapid urbanisation, changing food preferences and the industrialisation of the food chain

Niche sectors in the “New Agriculture” are not necessarily going to benefit the poor in the traditional way of providing new opportunities to the poor as farmers – although it does not necessarily preclude that. Instead, it will be rural non-farm employment opportunities that will be important. Take for example cut flowers in Kenya. Not only did it achieve an annual growth rate of 20% between 1991 and 2001, the third best foreign exchange earner after tea and tourism, but is highly labour intensive employing 50,000 mainly women workers (Opondo 2003). In Bangladesh small scale food processing is a sector growing at 32% per annum providing employment for both men and women. ITDG (2004) estimate that in a Bangladeshi town of 40,000 the annual turnover of the street food industry is US$2 million. The aquaculture industry, which has grown very rapidly in many Asian countries, has also shown impressive rates of growth. In the 1980s while the number of people employed in agriculture grew by 15% the number of people employed in the fisheries sector grew by 72%. The reality of the New Agriculture is characterised by the emergence of new players, needing to respond rapidly to changing conditions, often in increasingly knowledge intensive sectors.

(viii) New Technologies

As pointed out in the introductory section, the knowledge intensity of all economic production has increased due to technological developments. For agriculture, however, biotechnology is of central importance although the threats and promises are considerable[11]. For example, on the one hand biotechnology promises the capacity to improve radically rates of growth of food production and of other primary commodities such as cash crops for export. It also can help reduce environmental damage through curtailing the use of pesticides and herbicides, and help deal with problems of growth stress. On the other, there are dangers that new synthetic substitutes derived from biotechnology can drive traditional export products out of the market. Already companies based in the North can produce products like pyrethrum and artificial sweeteners without any recourse at all to traditional products and the chances are that this capacity will grow considerably over the coming decades. Similarly with the use of modern techniques of tissue culture. Wambugu et al. (2001) shows how tissue culture has been used

11 See Clark, Stokes and Mugabe (2002)

to promote the production of disease-free bananas in East Africa. The potential benefits for many subsistence farmers are likely to be considerable. On a more industrial scale, as noted above, tissue culture is now being used to promote the production of export led high value horticulture crops such as cut flowers, although international markets (particularly the EU) are calling in question environmental and social methods of production. In addition concerns have been expressed in recent years regarding the way international seed corporations have begun to dominate agricultural production in many developing countries, for example through using genetically engineered seeds in a proprietary fashion. All this is not to say that the agricultural “knowledge economy” is confined to advances in the new “genomics”. On the contrary there are many other areas where traditional agricultural science is equally important. The point is rather that agricultural science systems need to build the capacity to select what are the most effective mechanisms to invest in so that the impact of their R&D programmes is at its greatest.

(ix) Donor Attitudes

Finally, as noted above, it is clear that the donor community has become much more demanding in fulfilment of poverty agendas. They are more determined to support projects that show clear impact on rural livelihoods and are less inclined to support agricultural research for its own sake. In other words they are less inclined to tolerate the “assumptions” column of the logframe matrix. A good recent example is that of a USAID project to upgrade sorghum and millet research in the Africa SADC region. Hall et al (2004) show that the donor in this case was unwilling to accept only the development of new plant varieties but demanded also to be shown quantitative evidence that these had been actually been adopted by farming communities. In this case the scientists themselves enlisted the support of local NGOs to ensure success in this wider sense. At the same time it should be noted that many donors are only slowly getting involved with science policy issues as such and are still focusing on R&D from a natural science standpoint. A good example here is the UK Department of International Development (DFID), which has recently been criticised by a UK Parliamentary Select Committee for its reluctance to engage with the technological basis for development aid.[12]

In short modern literature shows 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 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, as May has pointed out. 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.

3.2 Innovation Systems

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-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

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12 See DFID (2004). In response the DFID seems to have accepted this criticism and has now appointed a Chief Scientist to help fulfil such a function

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.

Recently the NEPAD has recognised the usefulness of the "innovation system" concept. For example its recent Ministerial Conference report[13] argued that "science and technology are most effectively developed and applied in national and regional settings using a "system of innovation" approach, which is defined as a network of interactive public and private institutions, policies and programmes that generate, import, modify and diffuse new goods and services, based on research and development, to achieve economic growth and improve the quality of life".[14] It went on to endorse the use of a system of innovation approach, and decided that a common set of indicators for assessing Africa's S&T status be developed and adopted. A key output of this effort would be an African innovation outlook produced frequently. To give effect to these goals, the conference decided that the NEPAD Secretariat promotes the system of innovation approach by:

- Developing country processes for senior policy-makers, assisted by consortia of experts, to explore and experiment with the application of NSI concept or approach.
- Holding sub-regional workshops to explore and/or elaborate the use of the system of innovation processes.
- Securing funding from national governments and development partners, and
- Involving of regional development banks, UN organisations and agencies and other regional structures as key partners.
- Developing indicators for surveying or assessing National Systems of Innovation

It also advocated the initiation of processes to develop national capacity to conduct science, technology and innovation surveys based on or guided by agreed a set of measurable indicators. Governments and all partners would be the key beneficiaries of such improved access to reliable and comparable data. The following steps would be required:

- A process to define the indicator set and develop core methodologies,
- An agreement and commitment by African governments and their partners to adopt the methodologies and definitions in their own data acquisition and use,
- A budget requirements for initial indicator work, and
- The facilitation of adoption by national governments.

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 in this assessment has 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 this 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[15]. 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

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13 NEPAD (2003).

14 See NEPAD (2003), op. cit.

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

“themes” in which innovation systems and client impact figure prominently[16]. 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)[17]

However, as will be pointed out below 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”.[18] 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.

4. Interview Data and Needs Assessment

(i) Interviews

As outlined in Section 1 while the response to the mailed questionnaire was poor it proved possible to carry out a number of interviews with key individuals having specialist knowledge in this area. The questionnaire was used as a summary of issues where relevant responses were sought.[19] Three groups of stakeholder were interviewed, two at developing country level (Uganda and Ethiopia)[20] and one from an industrialised country (The Netherlands) where there is a concentration of organisations and people with relevant expertise and experience. In the former two cases emphasis was placed on the influence of new technologies, particularly biotechnology, and the implications for agricultural science. Those interviewed were broadly representative of both scientific and policy communities. In the latter case emphasis was broadened to consider also the changing context within which LDC agriculture now needs to operate in the new millennium. Those interviewed were mainly academic researchers but a representative from the Dutch bilateral aid department (DGIS) was also consulted. Summarised versions of the interviews are provided in the Appendix.

Research in agricultural science and technology remains a major element of development strategy in both Uganda and Ethiopia. Both countries have a large agricultural research organisation –the National Agricultural Research Organisation (NARO) in the case of Uganda and the Ethiopian Agricultural Research Organisation (EARO). Each country also has a University with a large agriculture department. Yet despite the importance of the sector neither country has policy and research management professionals with specific training in contemporary perspectives on science, technology and innovation policy (STIP). In the main professionals in these positions are either agricultural economists or (and particularly in the case of biotechnology) recycled scientists. Those at Ministry level (with obvious exceptions) often do not have the technical background to understand issues such as biotechnology and this further hampers effective policy making.

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[16] Interview with Dr A Freeman (ILRI)

[17] See Hall et al (2004)

[18] 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.

[19] See Appendix for a list of organisations and individuals contacted

[20] Supplementary interviews were carried out in Kenya but these told the same story, by and large

Contemporary perspectives on STIP refers here to the understanding of knowledge production and use in a systems sense where innovation is embedded in and shaped by contexts, relationships and actor groupings that include but go beyond formal agricultural organisations. A lack of this holistic systems perspective undermines laudable policy efforts and capabilities to utilise and safeguard advances in new science (bio-safety, public private sector partnerships, IPR/biodiversity) to shift agricultural science and technology to more inclusive modes (participatory research). To make the same point differently, policy perspectives which tackle issues like biotechnology in a piecemeal fashion without understanding the need to deal with (and often strengthen) the overall system for producing and using knowledge are going to continue to encounter "second order problems" that such a narrow perspective will fail to recognise as important to the effective functioning of the system. A more general point about capacity development has been the tendency to separate out technical skills from socio-economic and policy skills and perspectives, in the belief that good science should be equated to knowledge (and practice) in a restricted disciplinary field. This not only reflects the piecemeal approach described above, but perpetuates this problem by producing new professionals without the training to view their work as part of a wider endeavour.

The picture that emerges from these stakeholder consultations is one of agricultural research and development taking place in a non-conducive environment, in which co-operation does not take place, and which is characterised by the dominating rules, laws and practices of institutionalised agricultural R&D that are unsupportive of innovations arising from alternative sources. All of the stakeholders drew attention to the need to address the context of agricultural R&D as a priority – specifically to facilitate greater co-operation and interactions amongst participants in agricultural innovation in order to generate meaningful outputs. Thus, the key science policy issue facing agricultural R&D is how to create an innovation environment in which interactions amongst a variety of agricultural practitioners are enabled?

Some of the stakeholders drew attention to the lack of science, technology and innovation policy understanding amongst scientific and governmental establishments, which may be sustaining the sub-optimal innovation circumstances. A means through which this could be redressed is raising awareness and building capacity in innovation systems thinking. Innovation systems theory could provide not only a tool for analysing the existing innovation context, but also a set of principles through which a more favourable environment could be created. The stakeholders also commented on the need to strengthen specific science policy skills (for instance, in IPR management, biosafety, participatory research) within a functioning agricultural innovation system. However, many pointed out that these must be situated in a context, which realises their importance – in other words, one that appreciates the interactive, multidisciplinary nature of agricultural innovation.

There appear to be, therefore, two 'levels' of policy capacity building – one addressing the broader context surrounding agricultural innovation, and one addressing specific science policy issues (although this demarcation is only made for the purposes of illustration. It is unlikely that in practice such a division exists). The stakeholders also raised the following points:

- Policy formulation, and resulting policy capacity building, needs to be based on local multi-stakeholder consultations, and may therefore differ from context to context.
- Capacity building efforts in both broader contextual issues surrounding agricultural innovation, as well as specific science policy, should be targeted at scientists at all levels – from the directors of research organisations and project managers to students. Interviewees emphasised the importance of raising awareness of science, technology and innovation policy amongst research project managers, since they will be dealing with related issues on an everyday basis. One interviewee suggested that it might be relevant to provide different training courses (in terms of content and duration) to individuals at different levels.
- Any capacity building programmes for Africa must be based geographically in Africa.

(ii) 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 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 above 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 this 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 this 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 has focused 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. The main reason for this is that 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:[21]

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. This means that resources should be made available for appropriate policy research, which can be integrated into capacity building programmes. One example where this is not happening is the FARA SSA Challenge “research” programme, which has been bureaucratically separated from its counterpart BASIC “pedagogic” programme. At least two interviewees (including a donor) have questioned the logic of such separation arguing that the result will simply perpetuate the incoherence that has been such a problem in African agricultural science. Conversely the NEPAD is encouraged to find ways of supporting capacity building that integrates policy research and related pedagogy.

[21] See discussion on the next section where examples are given of current practices.

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 as with the CTA programme, to scenario activities as adopted by a recent ATPS course. 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. For example, in the original ACTS programme certificates were validated at an international university. ACTS now intends to do something similar with its new programme, in this case the plan is to link to a consortium of Kenyan universities with a cumulative credit-based slant to permit the attainment of higher qualifications.
e. *Development of Case Study Material:* While there is some limited material available, much of it needs to be revised into a form suitable for short course delivery. Prospective programmes are advised to set aside resources for this activity. Already some groups (such as the CRISP/ICRISAT team) have begun to develop illustrative case study material that is now being used as the basis for short science policy courses. Much of this has consisted of material developed by the DFID CPHP programme run since 1996 and due to be completed in 2005. The objective here has been to focus in on particular issues such as public/private partnerships, biotechnology and IPR policy for public research institutes. In all of these areas there is now a demand for expertise that will both protect the mandates of such bodies but at the same time allow them to engage with the changing contexts for poverty focused agricultural research. Very recently the World Bank has commissioned a similar study with UNU/INTECH designed to explore cognate methodological issues and come up with approaches that will allow better diagnosis on relevant policy issues. It seems clear that this is an area that needs to be vigorously pursued, probably in the form of a data bank of course materials that may be used for more focused programmes. It may be also be used as the basis for new case study research to produce further knowledge.
f. *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

    The NEPAD is encouraged to seek out mechanisms to meet this need.
g. *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.

5. Current Programmes

As part of the assessment a Website search was conducted to determine the existence and content of science policy capacity building programmes. Data on this point was supplemented by information coming from the stakeholder consultations. The results are split into three sections:

- International Programmes
- Regional Programmes
- Programmes of marginal relevance

5.1 International Programmes

1.) UNU/INTECH. This organisation is likely to become a major player in science policy capacity building in future years. At present it is operating through three sub-programmes as follows:

(a) Design and Evaluation of Innovation Policy in Developing Countries (DEIP) courses These are targeted at senior and middle level officials from science and technology, industry and other relevant ministries; the participant profile also includes research managers. The courses promote an innovation systems approach towards the analysis of innovation policy. The course takes place over a five-day period, and is divided into two modules – module 1 deals with design issues, and module 2 deals with issues and techniques related to the monitoring and evaluation of innovation policies. The course targets agricultural scientists and research managers and covers the following themes:

- Innovation Processes and Innovation Systems: a framework for analysis
- Building the Knowledge Infrastructure
- From Science and Technology to Innovation Policies
- Applying an Innovation System Abroad to FDI
- Patents as an Innovation Tool
- Participatory Policy-Making, Evaluation and Monitoring
- Designing Innovation Surveys as a Tool for Policy
- Innovation Surveys and Measurement of Innovation Activities
- Evaluating Financial and Fiscal Policies to Stimulate Innovation
- Policies to Promote Clustering and Partnering
- Programme and Project Evaluation and Monitoring

The participants are given time for self-study, as well as group discussions. The course takes place in Maastricht, the Netherlands, and participants who complete the course will be given a certificate from UNU/INTECH.[22] None of these have so far linked to the rural sector but the experience gained will inform the planned activities summarised below

(b) CTA-UNU/INTECH Training Workshop on Agricultural Systems of Science and Technology Innovation (ASTI) for researchers and policy-makers. This workshop was the first part of a research and competence building process, with the goal of completing innovation systems-based analyses of key agricultural sectors in ACP countries. These were presented at the 3rd Annual Meeting of the Science and Technology Advisory Group of the CTA in Wageningen, The Netherlands, at the end of November 2004.[23] The training course aimed to raise awareness of the importance of science, technology and innovation in general, and in the ACP countries in particular; to investigate the nature of science, technology and innovation policy making, and to introduce the concept and application of innovation systems; to indicate the application of the innovation systems framework to ACP country agricultural sectors; and to introduce WTO trade and intellectual property rights rules and their impact on science, technology and innovation policy in developing countries. The modules included:

- Innovation Policy and Innovation Systems: concepts and perspectives (definitions, importance, differences between systems of production and systems of innovation, developing countries as 'users' and 'producers' of technology, strengthening national and sector-based innovation systems, approaches to learning and capacity building through technology transfer with emphasis on 'production systems'-oriented versus 'innovation systems'-oriented development)
- Learning and Technological Capability Acquisition: concepts and applications (mechanisms for technology acquisition and use, function of a technology market in ACP countries)
- Case study: Learning in Agricultural Systems of Innovation (process of building up a case study of an agricultural system of innovation)
- Applying the Innovation Systems Framework (application of the framework to international examples of relevant policies, processes and outcomes)
- Applying the Systems Concept to Agricultural Innovation (differences and similarities in innovation between the agricultural and industrial sectors, the

[22] www.intech.unu.edu (accessed in November/ December 2004)

[23] The results will be posted on the CTA 'Knowledge for Development' website http://knowledge.cta.int

implications of this for innovation policy and policy analysis using systems concepts, relevance of innovation systems perspectives to contemporary agricultural development with reference to biotechnology, implications of systems concepts for capacity development)

- Agricultural Innovation in Action (case studies of horticultural export, biotechnology, packaging technology and forest products as illustrations of successes and failures in innovation, capacity development in a systems sense, role of institutional learning in innovation, and the role of donor policies in shaping innovation in development)
- Agricultural Systems of Innovation: Lessons from Asia (national development policies in East Asian economies using the evolutionary national innovation systems framework, with a structural focus on moving up the value chain)
- Trade Rules, Trade Policies and Innovation in Agriculture
- Intellectual Property Rights on Agricultural Varieties, Learning and Capability Building in Agriculture (implications of intellectual property rights on plant varieties under TRIPS with respect to agricultural production, innovation and capacity building, and options for ACP countries following the WTO TBT and the Cartagena Biosafety Protocol)
- Innovation Policy and Agricultural Exports: a case study of fisheries in Uganda
- Methodological issues (tools for country-level research)

The workshop took place in February 2004, in Maastricht, the Netherlands over a period of seven days. It consisted of a series of lectures, and practical exercises using case studies. The participants were also asked to present preliminary data collected prior to the workshop.[24] Following this exercise, the Science and Technology Advisory Committee of the CTA recommended that CTA continue to be involved in the sensitisation and training of ACP country actors in innovation systems concepts.[25] In addition, CTA is involved through its partners (such as BIO-EARN and ISNAR) in the provision of training in topics such as data collection and analysis, management of information systems, scientific and proposal writing, and the use of new information and communication technologies.[26]

(c) UNU/INTECH Proposed East African and South Asia Regional Hubs. At UNU/INTECH research and capacity development activities relevant to agricultural science technology and innovation policy are the responsibility of the innovation in agriculture and rural development (InnARD) group. This recently established group is advancing activities in this area, building on earlier work such as the CTA capacity development programme discussed above. Beginning in April 2004 this group began a programme of work addressing the question of the nature of agricultural innovation system capacity and how, within the framework of sustainable development this capacity can be developed to cope with changing technological, institutional, policy and social contexts.

To take this programme of work forward plans are currently being developed to relocate this work from Maastricht to a regional hub in East Africa, at Addis Ababa, Ethiopia. The East Africa hub will be accommodated in the campus of the International Livestock Research Institute who along, with the co-located International Food Policy Research Institute ISNAR Division (ISNAR), will collaborate and partner with INTECH. The purpose of this regional hub is to connect the research of INTECH to a constituency of local policy and practice stakeholders in focus regions and embed INTECH's work more intimately with relevant policy processes and contemporary development concerns. In addition to conducting original research and relevant training activities, the hub will also act as a focal point for collecting, synthesising and promoting, both locally and internationally learning emerging in these regions on pro-poor innovation. In this way the hub will enable INTECH to play a strategic role catalysing and adding value to a series of on-going activities by other scientists, policy

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[24] www.cta.int, www.intech.unu.edu, (both accessed in November/ December 2004) CTA & UNU/INTECH (2004) *Draft Training Programme on the Agricultural System of Science, Technology and Innovation*. Maastricht: UNU/INTECH.

[25] Francis, J.A. (2004)

[26] Personal communication with J.A. Francis, www.cta.int (accessed in November/ December 2004)

researchers and agencies that are exploring and implementing the concept of an innovation system as a way of reducing rural poverty.

Taking this initiative forward, a Memorandum of Understanding has been signed between UNU/INTECH and ILRI "to collaborate in the design and implementation of the modular training programme on the application of the innovation systems approach to agricultural research and development".[27] An INTECH staff member will be out-posted on a part time basis in Addis Ababa from April 2005. An expert consultation on the implications of innovation systems perspectives will be held in April 2004 with senior actors from the national and regional agricultural research organisations. The first training programme will be conducted in May 2005. It is anticipated that a small group of INTECH staff will be based full time at the regional hub within the next 12 months.

2) International Agricultural Centre (IAC), Wageningen University. The IAC focuses on building capacity in agricultural, food, rural development and natural resources management sectors for sustainable development. Its activities are divided into themes, which include Agricultural Systems and Chain Management, Food and Nutrition Security, Integrated Land, Water and Biodiversity Management, Livelihoods and Market Access, and Innovation Systems. The IAC's activities in Innovation Systems are realised through selected training courses and workshops, as well as through supporting networking, knowledge exchange and co-operation amongst a variety of stakeholders in agriculture. These activities are further carried out under the following programmes:

- Facilitating Processes and Social Learning. This programme focuses on enhancing skills to meet challenges in integrating participatory development ideas with established institutions and governance mechanisms. A number of training programmes are provided under its auspices, including Governance for Responsible Fisheries, and Interactive Forest and Nature Policy in Practice.
- Institutional Development. This programme addresses the increasing importance of networks and co-operation amongst a range of stakeholders, such as government, civil society and the private sector, within institutional and organisational contexts. Particular focus is placed on a 'social learning approach', according to which learning is defined as the shared result of stakeholders from different sectors arriving at common views and understandings that form the basis for change. Courses provided by this programme include Management of Change (organisational learning, change management, motivation and gender issues) and Network Development for Agricultural Innovation (rethinking research, agribusiness, extension and farmer linkages, importance of networks in agricultural sectors following increasing market orientation, privatisation, sustainability and livelihood issues).
- Participatory Planning, Monitoring and Evaluation: Learning for Impact. This programme aims to enhance the ability of development projects to create an impact, develop learning capacity, and include appropriate participation by stakeholders. Specific focus is placed on institutionalising such activities. Courses provided by this programme include Participatory Planning, Monitoring and Evaluation (designing and institutionalising participatory planning, monitoring and evaluation processes).[28]

3.) International Centre for Development-Oriented Research in Agriculture (ICRA) ICRA's mandate is to enhance the capacity of individuals and institutions to co-operate in order to develop and disseminate innovations that will improve and sustain rural livelihoods. ICRA is increasingly shifting its activities to the South, and focusing on capacity building programmes that address institutional change and development. It is particularly active in promoting the "integrated agricultural research for development" (IAR4D)-methodology (the interdisciplinary, demand-driven research approach that is central to the Sub-Saharan Africa Challenge Programme coordinated by CGIAR and FARA, and described briefly above). This is similar to the "agricultural research for development" (ARD)-framework, which was the guiding principle of ICRA's past activities.

[27] Personal communication with Andy Hall.

[28] www.iac.wur.nl (Accessed in November/ December 2004)

ARD refers to research and development activities that, *firstly*, respond to the needs of clients (extension agencies, development project, NGO's, farmers' organisations) and beneficiaries (farmers, traders, agribusiness, consumers); *secondly*, contributes to wider development objectives (poverty reduction, sustainable resource use, food security, competitiveness of farming enterprises); and *thirdly*, uses participatory and systems approaches to integrate the perspectives of different stakeholders. According to ICRA, IAR4D echoes features similar to its past approach, with its emphasis on participation, a holistic perspective towards agricultural innovation, and adaptive learning and management.

ICRA's capacity building programmes involve learning in inter-institutional and interdisciplinary teams, through solving collectively identified complex problems. Focus is placed on the application of the ARD principles to real-world examples. Until 2004, ICRA provided a 28-week in ARD, which included modules in, among others:

- Facilitating Teamwork
- Gender and Equity
- Interdisciplinary Teamwork
- Systems Thinking (soft and hard systems, definitions, etc.).

This course also included a field exercise component. ICRA is now focusing on 'training of trainers', as part of its efforts to shift its activities to institutions in the South. Additionally, it provides tailor-made courses based on the 28-week ARD programme, with the aim of minimal disruption to participants' schedules (altering the duration), and the immediate integration of ARD principles to participants' work.[29]

4.) Harvard Executive Programs – Science, Technology And Innovation Policy
This programme is intended for high-level leaders from government, academia, industry and civil society from developing countries, and focuses on the integration of science and technology into national development policy. The course takes place over a five-day period, and emphasis is placed on case study material, collective approaches to problem-solving and interactive learning amongst a diverse group of participants. The course covers:

- Technology and Development Trends (the role of technological innovation in development; the role of international trade in shaping patterns of technological development in emerging economies)
- Innovation Systems (the link between technological change and innovation, and the production, distribution and use of various kinds of knowledge; the roles of knowledge-based institutions in improving national competitiveness; identifying key institutions, gaps and incentives for innovation and participation in the global economy)
- Business and Development (role of entrepreneurship in development; role of infrastructure as a foundation for business development and technological innovation)
- Technology and Sustainability (role of science and technology in sustainable development; policy issues associated with the introduction of new technologies; institutional and policy options for managing benefits and risks associated with new technologies)
- Science and Technology Advice (principles and procedures of science and technology advice)
- Technology and Foreign Direct Investment
- Intellectual Property
- Emerging Technologies (policy themes related to biotechnology, ICTs and environmentally sound technologies; science and technology advice; human capacity; enterprise development; investment in research and development)

5.) Global Bioscience Development Institute (GBDI) A private organisation, which facilitates the formulation of coherent strategies in developing countries to develop biomedical, biotechnology and bio-agricultural products, and other biologically derived technologies and products. The GBDI provides training in biodiversity, conservation,

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[29] www.icra-edu.org/ (Accessed in November/ December 2004). See also Daane & Booth (2003).

bioprospecting, biotechnology and law on a consultancy basis in Africa, Asia and Latin America for lawyers, scientists, economists and policymakers. The GBDI offers modules in:

- The Business of Biodiversity (markets for biological sources; pharmaceuticals; agrochemicals; industrial enzymes; genetic resources; fragrances and flavours; phytomedicinals; economics of natural product research; market economy instruments and incentives to promote biodiversity conservation; research, discovery and development processes; technology platforms for successful bioprospecting)
- Constructing a Contractual Agreement and Benefit-Sharing (Convention of Biological Diversity; procedures, implementation and monitoring; critical issues in access and benefit-sharing contractual arrangements)
- Managing Intellectual Property (international frameworks for intellectual property; instruments relating to IPRs over biological resources, such as the Paris Convention, Budapest Treaty, TRIPS and UPOV; philosophies underlying IPRs; managing IPRs; case studies of well-known and controversial patents; agreements and contracts; technology transfer; institutional policies)
- Biotechnology and Biosafety (biotechnology regulation; biosafety assessment; regional approaches for implementing biosafety risk assessment; agricultural biotechnology indicators and managerial considerations; priority-setting in agricultural biotechnology research; public-private collaboration in biotechnology).

6.) IFPRI provides training primarily through two channels. The first is the ”Training for Capacity Strengthening” theme. This aims to develop the capacity of policy analysts, policymakers, policy researchers, decision makers, and their institutions to meet the policy challenges related to food, agriculture, natural resources, and poverty. The ISNAR programme in “Learning for Institutional Innovation” takes place under this theme, and is currently based in Addis Ababa. Training activities in policy issues that include scientists are provided by ISNAR through the following courses:

a. Agricultural Research Management and Organisation. According to Dr. Zenete Franca, the coordinator of ISNAR training in Addis Ababa, the primary activities of the division concentrates on this course. Training is provided over a 12-day workshop for mid-level research managers under three themes – planning, monitoring and evaluation, and financial management. The first two days of the workshop focus on leadership in agricultural research management, with emphasis on participatory approaches to managing an organisation. The following four days cover research programme formulation. The subsequent four days concentrate on planning, monitoring and evaluation of agricultural research projects. The last two days are dedicated to training in financial management. There is, however, little science policy content in this course. Other courses that complement this activity include the recently held course, which was carried out in partnership with CTA (see above).
b. Monitoring, Evaluation and Impact Assessment (carried out in partnership with CTA).
c. Scientific Writing and Presentation (carried out in partnership with CTA).
d. Innovation and Organisational Learning. This is a new area for IFPRI-ISNAR and is designed to raise awareness about innovation and organisational learning. IFPRI-ISNAR will provide a 12-day workshop on with the following composition. The first two days will focus on promoting innovation. This is a chance for participants to explore their own creativity and attitudes towards innovation, while simultaneously investigating how the workplace encourages/discourages this. The following four days focus on facilitating linkages between stakeholders in innovation. In the past, this component relied on a linear model of technology development and transfer, but has recently taken a new approach following ’innovation systems’ literature. The remaining six days will focus on engendering participatory research.

IFPRI-ISNAR is planning to transfer the implementation of training in agricultural research management and organisation to individual universities and other research organisations, which carry out agricultural R&D. The aim is to enable the individual organisations to create their own short- and long-term training capacity in this area. The transfer will begin with the identification of an organisation in Ethiopia that will be a pilot for eastern Africa. This will form a ”virtual centre” where organisations to tap in to training expertise according to their needs. Additionally, IFPRI-ISNAR will begin a new course in 2005, ”Law and Policy of Relevance to the Management of Plant Genetic Resources". One possible stumbling block here is the paucity of science policy expertise in African universities. And since IFPRI/ISNAR is only now itself beginning interests in this area, it may encounter difficulty in effecting a productive transfer.

The second vehicle through which IFPRI provides training targeted at scientists is its research themes (29 themes are listed).[30] These include the *Program for Biosafety Systems (PBS*) which is supported by USAID and coordinated through IFPRI. PBS focuses on the development of policy and regulation for biotechnology-related activities through stakeholder consultations, technical training in environmental and food risk assessment, communication and outreach, as well as providing grants for research into environmental risk issues. In 2003 and 2004, PBS focused on enabling the authorization and safe conduct of confined field trials. This was reflected in the provision of PBS training activities during this period, which included:

- A one-day introductory workshop on biosafety (introduction to the science, and commercialised products; the design of biosafety regulatory systems; GM-food safety assessment)
- A one-day introduction to compliance management approach to carrying out confined field trials (process for handling and inspection of confined field trials)
- Reviewing applications for confined testing of GM plants (improving the capacity of regulators to review and evaluate applications for confined field testing; approaches to standardisation, systemisation and improvement of the review process for applications for field testing).[31]

5.2 Regional Programmes

1.) Africa Technology Policy Studies Network (ATPS) This organisation has been designed firstly to expose governments to a greater awareness and understanding of the generic "technology and industrial policy" problem. The second objective has been the need to improve radically the capacity of technical experts, particularly economists, scientists and technologists (and the organisations in which they work), to understand and engage with issues of public policy. For the former group the need is to be able both to recognise the issue's importance and to access associated policy knowledge more efficiently. For the latter group the need is one of building capacity to move beyond the narrow confines of their disciplines and to learn constructively how their esoteric knowledge can contribute best on the wider socio-economic arena. Building on previous related work the programme aims to establish a series of capacity building initiatives that will focus on both types of stakeholder in a sustained way. It will also act as a template for similar initiatives that could follow on. Indeed "learning" how best to proceed will form an important part of future activity since in many senses it aims to break new ground in educational provision. So far courses have been conducted in Lesotho, Nigeria and Kenya. In addition ATPS has combined forces with The UNU Institute of New Technologies (UNU/INTECH—Maastricht) to mount similar courses in fields of relevance to African countries. Its staff have also taken part in the CTA programme run out of the University of Wageningen in the Netherlands (see below). A feature of the ATPS programme is its aim to target different groupings. Hence different but related courses will offered to researchers, policy-makers and their technical advisors, as well as parliamentarians on underlying technological issues in development policy and practice.[32]

2)FARA. FARA is about to implement the Sub-Saharan Africa Challenge Programme (SSA CP) in partnership with the CGIAR. The SSA CP aims to "realize the potential of agricultural research to overcome the constraints to sustainable development with improved technologies and policies that will enable resource-poor smallholders and livestock producers in sub-

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30 This is according to Valerie Rhoe (Senior Research Assistant for the Training for Capacity Strengthening Programme); the Research Themes can be viewed from www.ifpri.org under "Research"

31 www.ifpri.org/themes/pbs/pbs.htm (Accessed in November/ December 2004), PBS (2004) *Annual Performance Report May 2003- May 2004*.

32 Personal communication with Banji Oyeyinka, www.intech.unu.edu (accessed November/ December 2004)

Saharan Africa to achieve sustainable improvements in their livelihoods"[33]. As part of these efforts, FARA is placing considerable focus on capacity building, namely through the Building African Scientific and Institutional Capacity (BASIC) initiative. BASIC aims to "raise the quality and relevance of agricultural education to encompass the crosscutting issues that are pertinent to attaining sustainable and profitable agriculture in order to develop new cadres of professionals capable of assuming key roles in national, regional and international agricultural science, extension, business and policy forums"[34]. The BASIC aims will be realised through a partnership of African universities, Northern universities and CGIAR centres in the following manner:

- The agenda is set by Africa universities
- Pedagogical support is provided by Northern universities
- Relevant course materials are provided by CGIAR centres
- Products and outputs are disseminated by African universities
- Transaction costs are kept to a minimum by utilising existing institutional arrangements (including ANAFE, ICRA, NATURA)[35].

BASIC will coordinate capacity strengthening through training modules, the first of which will focus on Integrated Agricultural Research for Development (IAR4D). This research paradigm attempts to overcome the unresponsiveness of traditional agricultural technology development by "integrating levels of analysis; merging disciplinary perspectives; guiding research on component technologies, while making use of a wide range of technological options; generating policy, technological, and institutional options; improving the adaptive capacity of stakeholders to manage the resilience of the agro ecosystem; moving from training to social learning; advancing knowledge management; and increasing awareness of the environmental costs of poor natural resource management"[36]. In other words, IAR4D is an interdisciplinary research methodology aimed at generating demand-driven innovations. The IAR4D-framework has also been adopted by ICRA (discussed below). However, a major problem with the FARA initiatives is the separation of its research component (SSA CP) from the pedagogic one (BASIC).

3) ASARECA. ASARECA engages in promoting efficient agricultural research to meet socio-economic objectives in eastern and central Africa. The organisation engages in such activities through networking activities, some of which are detailed below:

i.) *ECAPAPA* - The aim of this programme is to promote regional economic growth through appropriate agricultural policies and, in the process, to help build sustainable capacity in eastern and central Africa to utilise and contribute to agricultural policy research and analysis. The programme focuses on, *firstly*, capacity building of the NARES, to increase their ability to affect policy and to relate their technology development programmes to existing policy; *secondly,* on the improvement of regional agricultural policy by supporting policy analysis in selected thematic areas; and *thirdly*, on supporting a network of interest groups, policy analysts and decision-makers to coordinate and link agricultural policy activities in the region[37]. According to Dr. Isaak Minde, the ECAPAPA co-ordinator, the programme emerged in response to the inability of NARES scientists to participate in the agricultural policy environment. It is primarily a policy research and analysis initiative, and does not undertake formal training as such. However, it is involved in capacity strengthening activities, mainly through the first two objectives stated above. Objective 1 is approached by convening a range of stakeholders (NARES and university scientists, representatives of the for-profit and not-for-profit private sectors, and representatives from the regional political and economic integration bodies) to take part in its policy research and analysis activities, thereby sensitising a wide range of actors to issues, which they may otherwise encounter on a superficial basis. Objective 2 is approached through consultative, participatory processes involving a range of stakeholders that identify agricultural issues that are

[33] CGIAR (2001) p 1

[34] Von Kaufmann &Temu (2004) p 9

[35] See Von Kaufmann (2004)

[36] Jones (2004)

[37] www.w1.co.ug/asareca/htdocs/ecapapa/ (Accessed in November/ December 2004)

relevant to the region in order to set an agricultural research agenda. Specific policy issues that have arisen through these activities, and in which capacity needs to be strengthened, include plant variety protection and IPR management, phytosanitary issues, pest management issues, and in particular trade issues. Consequently, ECAPAPA is planning a plant variety protection capacity-strengthening programme for 2005.

Starting in 2005, and led by Dr. Michael Waithaka, ECAPAPA will initiate an innovation systems component, with the aim of raising awareness of innovation systems thinking (working in partnerships, identifying and managing partnerships, etc.). This is as part of efforts to improve the impact orientation of agricultural research within eastern and central Africa. According to Dr. Waithaka ”the project is founded on the premise that impact assessments are not useful unless they are used by research managers to change the direction of on-going or future research. Our experience is that there has been little interest in impact assessments partly because research institutions were locked in their own mandate areas and did not want to venture out...(T)he current situation is different, we have diverse actors and non linear innovation systems; research agenda [sic] is expanding by the day and the impact question is being asked more frequently”[38] These objectives feed into ECAPAPA's involvement with the Regional Approach to Biotechnology and Biosafety Policy in Eastern and Southern Africa (RABESA). RABESA aims to rationalise and harmonise regional policies, rules and regulations pertaining to agricultural practice in order to create a functioning market. Dr. Minde is coordinating this initiative, which also involves COMESA, ASARECA, PBS and ACTS.[39]

ii.) *Eastern Africa Plant Genetic Resources Network (EAPGREN*) – EAPGREN aims to harness, conserve, and to promote the use of plant genetic resources for food security, improved health, and socio-economic advancement of rural communities. It approaches these objectives through capacity building and developing sustainable linkages amongst the various stakeholders affected by issues concerning plant genetic resources. EAPGREN's activities include raising awareness of plant genetic resources-related issues amongst policy-makers, scientists and farming communities, along with training in new techniques in the conservation and utilisation of plant genetic resources and policy analysis skills.[40]

iii.) *Biotechnology and Biosafety Programme* – a recently launched, USAID-supported initiative that aims to promote demand-driven biotechnology products, facilitate the formation of an enabling biopolicy environment, and strengthen institutional capacity as well as promote advocacy and awareness[41].

iv.) *Agricultural Technology Transfer* – This programme focuses on the promotion of agricultural technology transfer through innovative partnerships between sub-regional IARCs, commodity networks, NARS, NGO's, the private sector, local CBOs, farmers and processors. The programme objective is mainly approached by providing competitive grants for agricultural research projects carried out on a collaborative basis between various institutions and beneficiaries. Experiences from such research projects are then used as guidelines for technology transfer activities in the region – these experiences are detailed on the programme's website.[42] The project was initiated in response to the shortcomings of conventional extension in technology dissemination. It appears as though the programme approach echoes an innovation systems-based analysis of participants and partnerships involved in agricultural innovation (including the role of policy). It is unclear from the website whether the project is still taking place

38 Personal communication with Dr. Waithaka.

39 According to the RABESA website, the goal of the initiative ”is to support COMESA explore options of putting in place a harmonized regional policy and decision-making mechanism on issues of biotechnology and biosafety”. www.acts.or.ke/ECAOAOA-Project.htm (Accessed in November/ December 2004)

40 www.asareca.org/eapgren/ (Accessed in November/ December 2004)

41 www.asareca.org/biotech/index.htm (Accessed in November/ December 2004)

42 www.asareca.org/ttp/about/about_ttp.htm (Accessed in November/ December 2004)

(it was definitely active between 1995 and 2001), although some web pages are under construction.[43]

4.) East African Regional Programme and Research Network for Biotechnology, Biosafety and Biotechnology Policy Development (BIO-EARN). BIO-EARN was launched in 1999 with support from the Swedish International Development Cooperation Agency (SIDA) and the Biotechnology Advisory Centre of the Stockholm Environment Institute. BIO-EARN aims to build capacity in biotechnology research and policy in Ethiopia, Kenya, Tanzania and Uganda. BIO-EARN has three programme areas: 1.) Biotechnology 2.) Biosafety 3.) Biotechnology Policy Development BIO-EARN capacity building activities target scientists, regulators, the private sector, special interest groups and policy-makers and include training through short courses and workshops, for instance, in:

- Biosafety (biosafety assessment and risk management, field evaluation of transgenic crops, case studies of industrialised country experiences)
- Policy (biotechnology policy formulation, analysis and implementation, intellectual property rights, technology transfer, technology assessment, public-private partnerships)

BIO-EARN also aims to facilitate greater dialogue amongst these actors through its training activities.

Examples of courses that BIO-EARN has been involved in include “Biotechnology and Public Policy” and “Building National Biotechnology Innovation Systems: New Forms of Institutional Arrangements and Financial Mechanisms”. The former took place in September-October 1999 and covered the following topics:

- Concepts in Science and Technology Policy (systems, industrialisation, technology transfer)
- Nature and Historical Evolution of Biotechnology
- Diffusion and Transfer of Biotechnology
- Biotechnology R&D Challenges for Africa
- Intellectual Property Protection: Concepts and Forms
- Intellectual Property Rights in Biotechnology
- Bioprospecting Issues and Policies for Eastern Africa
- Access to Genetic Resources and Benefit-Sharing: Principles and Provision of the Convention on Biological Diversity
- Mechanisms to Regulate Genetic Resources
- Biotechnology and Developing Country Agriculture
- The WTO Agreement on Agriculture: What are the key issues for eastern Africa? This took place in December 2000 and covered the following topics:
  - National Biotechnology Innovation Systems Strategy
  - Biotechnology R&D, policy priorities and funding strategy
  - Building Biotechnology Innovation Systems: On institutional and Financial Systems in Ethiopia, Kenya, Tanzania and Uganda.[44]

5) African Centre for Technology Studies (ACTS). One of the earliest examples of science policy capacity building is the “Capacity Development Programme” launched by ACTS in 1994 and carried on through the period up until 1998.[45] Its main focus was to build capacity amongst public officials to implement sustainable development programmes related to the major international environmental conventions with special emphasis on the Convention on Biological Diversity and the Framework Convention on Climate Change. The training courses held under the Programme were also made available to selected personnel from research institutions, the NGO sector and private enterprise. The concentration was on public policy analysis and the skills imparted covered policy research, formulation, implementation, monitoring, control and evaluation. Over the four years between 1995 and 1998 nine courses took place including the initial trial course at the beginning of 1994.

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[43] The contact cited on the WebPages is b.kiflewahid@cgiar.org.

[44] www.bio-earn.org (Accessed in November/ December 2004)

[45] See Clark & Mugabe (2004)

Altogether some 80 people benefited from the training. Typical issues covered included IPR protection and technology transfer promotion, protection of indigenous knowledge, regulation of access to genetic resources, the regulation of biosafety, environmental planning, the valuation and sustainable use of biodiversity, local incentives for environmental protection and the transfer and adoption of clean technologies. ACTS has now returned to this general theme under its new programme and has just been commissioned by USAID to establish a new set of short courses in the science policy area linked to East African Universities.

5.3 Programmes of Marginal Relevance

Other potentially relevant initiatives that emerged, but could not be further investigated, include:

1.) African Institute For Capacity Development (AICAD) Based in Nairobi, AICAD is supported by JICA. It provides demand-driven training activities to universities, farmers, research, development and training organisations, NGO's, government departments and industry in areas such as agriculture and food security, appropriate technology, environment management, and gender issues.[46] However, it appears to do little science policy or innovation training

2.) UNEP/Global Environment Facility Builds capacity in the development and implementation of national biosafety systems in accordance with the Cartagena Protocol on Biosafety.[47] No science policy or innovation training is done beyond this topic.

3.) USAID Competitiveness Hubs The "Trade for African Development and Enterprise" (TRADE) initiative of USAID provides assistance for African countries to develop their competitiveness and gain greater access to global markets. It also promotes the development of regional trade, and helps strengthen capacity in technical assistance and economic policy formulation. TRADE operates through Regional Hubs for Global Competitiveness located in Botswana, Kenya and Ghana that respond to area-specific issues pertaining to trade, investment and business activities. These Hubs also collaborate with regional economic organisations (SADC, COMESA and the Economic Community of West African States). Amongst other activities, the Hubs engage in capacity building for agricultural trade, which covers topics such as sanitary and phytosanitary measures**.**[48] The focus is substantially on economic policy analysis.

4.) Sustainable Food Security in Central West Africa (SADAOC) This organisation engages in policy-oriented research and dialogue with stakeholders from research institutions, universities, government institutions, NGO's, etc. in order to improve the formulation and implementation of food security strategies and policies in West Africa (Burkina Faso, Ivory Coast, Ghana, Mali and Togo). One of SADAOC's objectives is to enhance applied research capacities in agriculture that are relevant to food security issues through promoting interactions between researchers and policy-makers.[49] There may be some interesting training done here but we could find out little substantive information.

5.) Agricultural Research for Developing Countries (CIRAD) CIRAD provides extensive training activities mainly in natural science and technology subjects.[50]

6.) ODI Research and Policy in Development (RAPID) This programme aims to promote the better utilisation of research and evidence in development policy and practice. Their activities focus on four main themes: the role of evidence in policy processes, better

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[46] www.aicad.or.ke (Accessed in November/ December 2004)

[47] www.unep.ch/biosafety (Accessed in November/ December 2004)

[48] www.usaid.gov/locations/sub-saharan_africa/initiatives/trade.html (Accessed in November/ December 2004)

[49] www.sadaoc.bf/ (Accessed in November/ December 2004)

[50] www.cirad.fr/ (Accessed in November/ December 2004)

communication and information systems for policy and practice; improved knowledge management and learning for development agencies; and approaches to institutional development for evidence-based policy. According to the ODI/RAPID Information and Communications Officer, ODI/RAPID does participate in strengthening dialogue between African policy-makers and agricultural scientists as part of its activities.[51]

7.) SADC/ Food, Agriculture and Natural Resource Policy Analysis Network (FANRPAN) FANRPAN co-ordinates, influences and facilitates policy research, analysis and dialogue at the national, regional and global levels in order to develop the food, agriculture and natural resources sectors through networking, capacity building and generation of information for all stakeholders in the SADC region.[52]

8.) University Of Kwa-Zulu Natal Food Security Programme This programme targets a range of actors concerned with food security, from policy-makers to agricultural researchers. Among other activities, it offers a short, two-week course in food security, which covers food production, food storage, sustainable livelihoods, macro and microeconomics, genetically modified food, etc.[53]

9.) CORAF The project WebPages of CORAF are still under construction but it is likely that the organisation is involved in activities relevant to this project, stemming from FARA's Sub-Saharan Africa Challenge Programme.[54]

10.) The CGIAR Initiative for a Global Open Agriculture and Food University (GO-AFU) This proposal is for a distance learning postgraduate university that will provide courses to supplement existing national organisations in the food and agriculture area. The proposal document (see Appendix reference) says little about what kinds of courses will be provided but the likelihood seems to be that the orientation will be primarily a technical one. However, there is no reason in principle why such an organisation could not engage with science policy issues as well.

5.4 Summary

While not exhaustive, this section provides a fairly good indication of the types of science policy capacity building and strengthening initiatives currently available in/for Africa. These may be summarised as follows:

(a) There are few organisations actively involved just now and many of these are just beginning to show interest in science policy training (e.g. IFPRI/ISNAR). The major exceptions here are the regional programmes pioneered by ACTS, ATPS, CTA and UNU/INTECH.

(b) There is some degree of interconnectedness between the programmes, although it is unclear how much overall awareness there is of other science policy capacity strengthening activities. Thus there are a number of science policy related initiatives, but these are poorly connected and at present there is a lack any coherence or shared vision of what the capacity development agenda in the area of agricultural science and technology policy should be.

(c) In terms of content what there is, is confined to relatively few topics such as biotechnology, biosafety and IPR management issues.

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51 www.odi.org.uk/RAPID/Index.html (Accessed in November/ December 2004), personal communication with Fiona Drysdale

52 http://www.syngentafoundation.com/organizations_index_f.htm (Accessed in November/ December 2004; FANRPAN's own website was down – according to John Komen, this may be a result of the network moving its headquarters from Harare to Pretoria)

53 www.ukzn.ac.za/foodsecurity/programme%20aims.htm (Accessed in November/ December 2004)

54 www.coraf.org/ (Accessed in November/ December 2004)

(d) There is some acceptance of the notion of an innovation system but it does not figure prominently except in a few on-going programmes like those associated with UNU/INTECH and ATPS.

(e) Where relevant programmes do exist many target not only scientists, but are also geared towards an interdisciplinary audience including other stakeholder groups and individuals.

(f) In a small number of cases, the pedagogy is an inductive one. However, there are very few examples of relevant case study research being combined with capacity building. In the case of the FARA programmes they appear to have been deliberately separated.

Overall, it is difficult to definitively categorise the various initiatives on the basis of participant profiles, contents and approaches to capacity building/strengthening, reflecting perhaps the complexity of agricultural science policy. In addition it is also clear that there is considerable overlap involved and there is need for some rationalisation at regional level. This point has already emerged and will be re-visited in the final section below.

6. Conclusions and Recommendations

As a result of this investigation it is my considered view that capacity building to enhance agricultural science in Africa is an area to which the NEPAD should give high priority. The reasons are contained at various points in the text but 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. As we have seen 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 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 has been used as a shorthand 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 of this report are 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. In this context NEPAD is encouraged to pay attention to the conclusions on pedagogy summarised in Section 4 (ii) (c) above. 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. *Degree Programmes* 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. However, an approach is also needed that will address the need to raise the quality of undergraduate training of whole cadres of graduates because the present reliance on strengthening training in single departments of individual institutions does not address the human capacity requirement for African agricultural development. In this context the BASIC project of FARA is encouraged to include modules that highlight science and innovation policy topics.

6. *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.

7. *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

Deleted: 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.

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"Inventing a better future: A strategy for building worldwide capacities in science and technology", and some of the other programmes summarised in Section 5, above.

8. *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

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9. *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.

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10. *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.

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11. *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.

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This "needs assessment" study has inevitably been more constrained than perhaps is necessary due to a relatively short time-scale for completion. However, enough information has been gained to indicate 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. The analysis in this report suggests that emphasis ought to 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.

Appendix

A List of People/Organisations Contacted in the Course of the Enquiry

- Prof. O Oyelaran-Oyeyinka, United Nations University/ Institute for New Technologies (UNU/INTECH), Keizer Karelplein 19, 6211 TC Maastricht, The Netherlands, Tel: +31 43 350 6342, Fax: +31 43 350 6399, E-mail: oyeyinka@intech.unu.edu, www.intech.unu.edu
- Dr. Andy Hall, United Nations University/ Institute for New Technologies (UNU/INTECH), Keizer Karelplein 19, 6211 TC Maastricht, The Netherlands Tel: +31 43 350 6345, Fax: +31 43 350 6399, E-mail: hall@intech.unu.edu, www.intech.unu.edu
- Prof. Isa Baud, University of Amsterdam, Nieuwe Prinsengracht 130, 1018 VZ Amsterdam, The Netherlands, Tel.: +31(0) 20 525 4067, Fax: +31(0)20 525 4051, E-mail: i.s.a.baud@uva.nl, www.english.uva.nl
- Prof. Jan Douwe van der Ploeg, University of Wageningen, Hollandseweg 1, 6701 KN Wageningen, The Netherlands, Tel: +31 317 483253. Fax: +31 317 485475, E-mail: jandouwe.vanderploeg@wur.nl, www.wur.nl
- Dr. Theo van de Sande, Dutch Ministry of Foreign Affairs, Directorate-General for International Co-operation (DGIS), Bezuidenhoutseweg 67, 2594 AC Den Haag, The Netherlands/ Postal address: Postbus 20061, 2500 EB Den Haag, The Netherlands, Tel: +31 70 3486486, E-mail: theo.sande@minbuza.nl, www.minbuza.nl/english/homepage.asp
- Mr. John Komen, BIO-EARN/ PBS, Duinoordstraat 69, 2023 WC Haarlem, The Netherlands, Tel: +31 23 5263125, Fax: +31 84 7247818, E-mail: jce.komen@planet.nl, j.komen@cgiar.org
- Ms. Ethel Brooks, U.S. Agency for International Development (USAID), Economic Growth, Agriculture & Trade (EGAT) / Education Office1300 Pennsylvania Ave., NW Room 3.09, Washington, D.C. 20523-3901, United States, Tel (202) 712-0496, Fax (202) 216-3229, E-mail: ebrooks@usaid.gov, URL: www.usaidtraining.net
- Ms. Valerie Rhoe, International Food Policy Research Institute (IFPRI), Training and Capacity Strengthening Programme, 2033 K Street, NW Washington, DC 20006-1002, USA, Tel: +1-202-862-5600, Fax: +1-202-467-4439, Email: v.rhoe@cgiar.org, URL: www.ifpri.org
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- Dr. Michael Waithaka, ASARECA/ ECAPAPA, P.O. Box 765, Entebbe, Uganda, Tel: +256 41 321751, Fax: +256 41 321777, E-mail: m.waithaka@asareca.org, URL: www.w1.co.ug/asareca/htdocs/ecapapa/index.php
- Dr. Suma Kaare, Economic and Social Research Foundation, 51 Uporoto Street, Ursino Estates, P.O. Box 31226, Dar es Salaam, Tanzania, Tel: +255 22 2760260, Fax: +255 741 324508, E-mail: skaare@esrf.or.tz, URL: www.esrftz.org/index.asp
- Dr. Ruerd Ruben, University of Wageningen, De Leeuwenborch, room 514, Wageningen, The Netherlands, Tel: +31 317482486, Fax: +31 317484037, E-mail: ruerd.ruben@alg.oe.wag-ur.nl, URL: www.wur.nl
- Sustainable Food Security in Central West Africa (SADAOC), Place de l'Atlas, Villa No. L01, Ouaga 2000; Ouagadougou 06, Burkina Faso. Tel: +226 374035, Fax: +226 374037, E-mail: sadaoc.se@fasonet.bf, fsadsaoc@cenatrin.bf, URL: www.sadaoc.bf
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B Bibliographical Material Consulted

Bernal J D (1969) *Science in History* (Harmondsworth, Pelican). Volume 3.

Biggs, S.D., (1990). "A multiple source of innovation model of agricultural research and technology promotion" *World Development 18* (11), pp 1481-1499.

Biggs, S.D. (1995) "Farming Systems Research and Rural Poverty: Relationships between context and content", *Agricultural Systems 47*, pp.161-174.

Biggs, S.D., and Smith, G., (1998): "Beyond Methodologies: Coalition – Building for Participatory Technology Development", *World Development Vol. 26*, No.2, pp. 239-248.

CGIAR (2001) "Challenge Program Concept Note: Improving livelihoods and natural resource management in sub-Saharan Africa" Mimeo, Washington DC

Chambers R & Ghildyal, B P (1985). "Agricultural Research For Resource-Poor Farmers: The Farmer First And Last Model". *Agricultural Administration* vol. 20

Clark N G, K Stokes and J Mugabe (2002) "Biotechnology and Development: Threats and Promises for the 21st Century" *Futures*, Vol. 34 (12).

Clark N G (2002) "Innovation Systems, Technology Assessment and the New Knowledge Market: Implication for Third World Development" *Economics of Innovation and New Technology, Vol. XI*, Nos. 1 & 2, July.

Clark N G, A Hall, R Sulaiman and G Naik (2003) "Research as Capacity Building: The Case of an NGO Facilitated Post-Harvest Innovation System for the Himalayan Hills" *World Development Vol. 31*, No. 11, November.

Clark N G and J Mugabe (2004) Strengthening Science and Technology Policy in the Field of Environment and Development: The Case of the African Centre for Technology Studies Capacity Development Programme, in Hall A J (ed) 2004, pp 163-175, op. cit.

Daane, J. & R. Booth (2003) "Developing Capacity in Agricultural Research for Development: The ICRA Initiative". Paper prepared for the 2nd Meeting of the ACP Informal Working Group on Science and Technology, November 28-December3, 2003. Wageningen, The Netherlands

DFID (2004) *The Use of Science in UK International Development Policy*, House of Commons Science and Technology Committee, Thirteenth Report of Session 2003-2004, The Stationery Office, 26th October.

Eponou S (1993) “Integrating Agricultural Research and Technology Transfer” *Public Administration & Development, Vol. 13*, No. 3 August, (RIPA International Ltd., London, and John Wiley & Sons Ltd), pp 307-318.

Eyzaguirre E and O Okello (1993) “Agricultural Research Systems in Developing Countries: Implications for Public Policy and Administration” *Public Administration & Development, Vol. 13,* No. 3 August, (RIPA International Ltd., London, and John Wiley & Sons Ltd), pp 233-247.

Francis, J.A. (2004) *Workshop Conclusions: 3rd Meeting of the Advisory Committee on Science and Technology for ACP Agricultural and Rural Development*. Mimeo CTA: Wageningen

Gibbons M (ed) (1994) *The New Production of Knowledge,* Sage, London.

Hall, A., and Nahdy, S., (1999) “New Methods and Old Institutions: The ‘Systems Context’ of Farmer Participatory Research in National Agricultural Research Systems. The Case of Uganda”, *Overseas Development Institute (AgRen), Agricultural Research & Extension Network, Network Paper no. 93*, January

Hall A J et al (2000) “New Policy Agendas for Agricultural Research: Implications for Institutional Arrangements” *Knowledge**,** Technology and Policy 13* (1) Spring

Hall A J et al (2001) Why Research Partnerships Really Matter: Innovation Theory, Institutional Arrangements and Implications for Developing New Technology for the Poor” *World Development**,*** 29 (5) May

Hall A J et al (2004) “The Evolving Culture of Science in the Consultative Group of International Agricultural Research: Concepts for Building a New Architecture of Innovation in Agri-Biotechnology”, in Hall A J (ed) 2004, pp135-162, op. cit.

Hall A J (ed) (2004), *Innovations in Innovation*, ICRISAT, Patancheru India

Harwood R R & A H Kassam (2003) *Research towards Integrated Natural Resource Management: Examples of Research problems, Approaches and Partnerships in Action in the CGIAR*, Interim Science Council, FAO, Rome.

IFPRI (2003) The CGIAR Initiative for a Global Open Agriculture and Food University (GO-AFU), Program Proposal presented to the CG Centres, Washington, December.

Jones, M. (2004) ”Strengthening Agricultural Research in Africa”. *2020 Africa Conference Brief No. 9,* Washington, D.C., IFPRI

von Kaufmann, R. & A Temu (2004) ”Building African Scientific and Institutional Capacity (BASIC)”. Paper prepared for the CTA/AFSTD/ATPS Africa Regional S&T Meeting on Enhancing the Science and Technology Dialogue – Innovation for Development. Sept. 14-16 Nairobi, Kenya.

von Kaufmann, R. (2004) ”BASIC: A proposal for action”. Presentation given at the 3rd Annual Meeting of the Science and Technology Advisory Committee of the CTA. November 2004. Wageningen, The Netherlands.

May R (2004) Presidential Address to the Royal Society of London, London, UK, December.

Millennium Project (2004) *Interim Report of Task Force 10 on Science, Technology and Innovation,* Commissioned by the UN Secretary General and the UN

Lipton, M & R Longhurst (1989), *New Seeds and Poor People*. Unwin Hyman, London, U.K.

NEPAD, 2001: *The New Partnership for Africa's Development,* Government Printer, Pretoria.

NEPAD (2003) *Outline of Science and Technology Plan of Action Adopted by the 1st African Ministerial Conference on Science and Technology* November 6-7, Johannesburg, South Africa.

Pardey P G, J Roseboom and N M Beintema (1997) "Investments in African Agricultural Research" *World Development, Vol. 25*, No. 3, pp 409-423.

Porter G and K Phillips-Howard (1997) "Comparing Contracts: An Evaluation of Contract farming Schemes in Africa" *World Development, Vol. 25*, No. 2, pp 227-238.

Roseboom, J. and H Ruttan (1998) "The Transformation of the Dutch Agricultural Research System: An Unfinished Agenda", *World Development Vol. 26*, No.6, pp.1113-1126, 1998

Snow C P (1963) *Science and Government*, Penguin, London.

Tripp R (1993) "Invisible Hands, Indigenous Knowledge and Inevitable Fads: Challenges to Public Sector Agricultural Research in Ghana" *World Development, Vol. 21*, No. 12, pp 2003-2016.

Wambugu F, M Karembu, M Njuguna and S W Wanyangu (2001) "Biotechnology to Benefit Small-Scale Banana Producers in Kenya", Mimeo UNU/INTECH, Maastricht, Netherlands.

Wiskerke J D and J D van der Ploeg (eds.) (2004), *Seeds of Transition* (Royal van Gorcum, Assen Netherlands.

C. Curriculum Vitae

Norman Clark is Vice Chancellor of Kabarak University, Nakuru, Kenya. Previously he was Professor of Environmental Studies and Director of the Graduate School of Environmental Studies at the University of Strathclyde, Glasgow, UK. He is a development economist specialising in science, technology and environmental policy issues with particular relevance to Third World problems, a field in which he has published extensively. He has lived and worked in many countries with particular concentration on Kenya, Nigeria and India. Previously he held academic posts at the Universities of Glasgow and Sussex. While at Sussex he acted as the Founding Director of Graduate Studies at the Science Policy Research Unit (SPRU) where he worked for some 15 years and now holds the post of Honorary Professor. He has also acted as Founding Director of the Technology Planning and Development Unit, University of Ife, Nigeria; Visiting Professor, Institute for Advanced Studies, University of Sao Paulo, Brazil; and Director of the Capacity Development Programme at the African Centre for Technology Studies (ACTS), Nairobi, Kenya. In addition to normal academic activities he has had some 30 years experience as an adviser and consultant to governments, international agencies and NGOs including the World Bank, UNCTAD, IDRC, DFID, ITDG, CGIAR, UN-Habitat, UNU and UNDP. He acted also as an adviser to the UK House of Commons Select Committee on Overseas Development on ODA's [now DFID's] Special Units (i.e. TPI, COPR, LRDC etc.). He is a member of Task Force 10 of the UN MDG Project and is currently acting as an adviser to the NEPAD.

D. Needs Assessment Questionnaire

The New Partnership for Africa's Development (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 initiative is stimulated by the three main factors. *First*, scientific advances and related technological innovations (particularly in areas such as biotechnology and information technology) are changing the focus and conduct of agricultural research in very profound ways. *Second*, the process of globalisation is changing the locus of agricultural research not only in a geographical trading sense but also with respect to relationships with the private sector and associated issues concerned with intellectual property rights and impacts on rural poverty. *Third*, public agricultural research organizations are faced with fundamental questions about their relevance, performance and accountability. There is increasing consensus that current configurations of public agricultural research are not responsive to growing demands 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 the generation and application of new knowledge and innovations for food and agricultural production. It deals with policy and institutional measures to improve effectiveness of agricultural research. NEPAD intends to facilitate efforts aimed at raising awareness and building the capacity of agricultural scientists and managers to handle emerging science policy and related issues of institutional change. The questionnaire outlined below is designed help NEPAD's Office of Science and Technology and the African Ministerial Council for Science and Technology to develop a comprehensive programme on science policy. We would be most grateful therefore if you would please answer the following questions: ***[Note: Unless otherwise specified, when using the tables please adopt the ranking scheme of 1 to 5 with 5 being the most important and 1 being the least important]***

A Emerging issues in the domain of agricultural science and technology

Table 1 [For questions 1-3 below]

Policy goals	Importance rank	Research contribution (strong, mediocre, weak)	Reasons for strong or weak contribution
Agricultural productivity			
Food security			
Poverty reduction			
Environmental sustainability			
Export promotion			
Import substitution			
Employment generation			
Coping with HIV/AIDS			
Millennium development goals			
Other (please specify and elaborate below)			

1. In the context of today's development scenario what do you see as the main goals of agricultural research?

2. How effective has research been in contributing towards these goals?

3. Has the contribution of agricultural research been less than expected in any area? And why do you think that might be?

4. Please rank the reasons for weak contribution in Table 2 below

Table 2

Reasons for weak contribution of R&D	Rank
Poor research/extension infrastructure	
Inadequate training of professional scientists	
Lack of resources	
Misallocation of resources	

5. The changing technological and development environment means that agricultural research needs to adapt to a new set of conditions and demands. What are the major changes taking place that affect agricultural research in your country? What are the challenges that this presents to you? And how are you responding to this challenge?

Table 3

Changing context	Importance rank	Challenges	Responses
Biotechnology			
Information technology			
Public private sector partnerships			
HIV/AIDS			
International trade rules			
Competition in domestic and international markets			
IPR			
Decentralisation/ participation and new norms of governance and accountability			

6. What are the main policy tools that you use to make decisions about the orientation and organisation of agricultural research?

7. Do you find these tools useful in the light of the changing and increasingly complex context of agricultural research what are the shortcomings?

Table 4

Policy tools	Often used/rarely used/never used	Decision making domain	Relevance/ shortcomings
Monitoring and evaluation			
Economic impact assessment			
Priority setting by commodity			
Priority setting by research theme			
Priority setting socio-economic relevance			

Collection and analysis of science and technology indicators			
Stakeholder consultations			
Foresight exercises			
Scenario analysis			

8. Of those in your organisation who are involved in policy activities, please specify their disciplinary background in terms of the following categories

Table 5

Discipline	Numbers
Natural sciences/ engineering	
Social scientists	
Agricultural economists	
Science policy specialists	
Public administration	

B Institutional Context

An increasingly important aspect of science policy in the contemporary context concerns decisions and strategies about building and sustaining relationships with other organisations?

1. How have these patterns changed in recent years? What difficulties have you encountered in building and sustaining relationships?

2. What types of institutional reform would you recommend for R&D in your organisation?
3. What sorts of organisation do you partner with?

Table 6.

Organisation Type	Importance
Private sector	
Other agricultural research institutes	
Other scientific institutes	
Universities	
NGO	
Other (please specify and elaborate below)	

4. What sort relationships are most common with other agencies (contractual, informal based on trust, subservient, collaborative)?

Table 7

Organisation Type	Relationship Type
Private sector	
Other agricultural research institutes	
Other scientific institutes	
Universities	
NGO	

5. Have you engaged in public debates about biotechnology and the issues it raises? Yes/No

6. What types of institutional reform would you recommend for agricultural R&D in your country's national research system as a whole?

7. Do you agree with the proposition that most publicly funded R&D organisations need now to engage with the private sector? Yes/No

If No please go to the next question. If Yes,

8. How can you reconcile this need with the imperatives of poverty-oriented impacts?

C Training needs

1. What capacity building programmes do you have that meet or address the science policy capacity needs of African scientists and research managers?

2. Please specify

   a) The main areas that are covered

   b) Their duration and frequency

   c) Target group trained. (Note it would help if you could also supply an outline of these programmes; or even better give us a contact person we could telephone).

3. If you have none please indicate why not below (using the same scale as before to indicate relative importance)

Table 8.

Reasons	Scale
Unnecessary	
Lack of resources	
Lack of trained training staff	
Not part of our specified activities	
Other (please specify)	

4. Is your organisation involved in wider capacity building programmes in the policy area? Yes/No

If Yes please indicate how these may be contacted and also specify if these programmes are:

- National
- Regional
- International

5. Are you aware of other capacity building programmes with these broad objectives? If yes please indicate how these may be contacted

6. Please specify which of the following general training needs in the science policy analysis field are of importance in your organisation (using the same scale as before to indicate relative importance; If none indicate this)

Table 9.

Types of training	Scale
Research proposal writing	
The handling of intellectual property rights	
International best practice in organisational change	
Partnerships with other bodies (NGO, public and private sector)	
How to interface with economic production activity	
Funding policy analysis	
Monitoring and evaluation	
Other (please specify)	

7. In the context of any of the above needs, please elaborate on what it is that you most need and why.

8. For the following types of capacity building programme that members of your organization have attended over the last 3 years, please give the frequency of attendance in numbers of personnel.

Table 10.

Types of capacity building programme	Number of personnel
Scientific	
Policy interaction with stakeholder groups	
Internal project organisation	
Other	

9. Do you believe that higher education training for agriculture needs to be changed? If yes please specify in what broad directions these changes should proceed

D Future Agendas

1. What are the 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? Please elaborate giving reasons why you have given this answer.

2. Please also elaborate on any other relevant points that you believe this questionnaire has omitted to highlight

E Focus Group

Capacity Development Programme on Rural Innovation with Special Emphasis on the Post-Harvest Sector- A Brief Review.

This brief review reflects a small focus group discussion with a selected group of participants held in the middle of an 8-day workshop. The workshop was held between November 21st and 29th 2004. It was designed to provide researchers, research managers and rural sector specialists with the analytical skills needed to tackle innovation in this more holistic and embedded way. The programme gave candidates a thorough grounding in a conceptual framework that situates research and associated efforts in the relationships and institutional contexts that have been found be important for successful innovation. The following were the main points that emerged:

- The use of an inductive pedagogy was clearly the correct one. All participants felt they had benefited from this approach and as a result had grasped the fundamental issues fairly well.
- The balance between formal presentations by resource persons and participant activity was not quite achieved, however. This was especially felt on Day 2 which was `seen to be too "academic". As a result slight amendments were made during the workshop. But in future the greater use of group/team sessions is to be advised. In addition more "break" time is needed to review and digest material.
- More prior written information (guidelines) should have been provided to participants. This would have given them a better starting point to absorb later material. Such guidelines might include examples of standard case study reports.
- Abbreviated write-ups of presentational cases should also have been made available

- The group was slightly too heterogeneous, some felt. However, most believed that was an advantage in a workshop designed to bring out the importance of innovation partnerships. Contacts were made between different professional groups that might not otherwise be achieved.
- Some felt there should be short sessions to improve presentational skills, report writing and conflict resolution skills. These could be built into the practical sessions.
- The presented case studies were not carefully enough chosen. They did not allow adequately for comparative discussion. In addition more visual material should have been included in the presentations
- Workshops should be targeted also at senior professionals. This is because however much the participants may wish to adapt their professional behaviour as a result of the training, their organisations need to be sensitised as well. This must take place at the top.
- More could be done to bring out how “science” can be enhanced through a systems approach.

F. Summary Interview Transcripts

Uganda.

A] Research system challenges and implication for STIP capability.

Like many countries Uganda’s expertise in the area of biotechnology began with tissue culture in the early 1990’s. This involved 3 major crops (i) Sweet potato, a food crop important for poor households; (ii) Banana, an important staple food crop widely traded in the domestic market and (iii) coffee, Uganda’s main export crop. In the case of the first two crops efforts have focused on the development of disease free planting material. In the case of coffee concentration has been on the clonal planting material of improved cultivars. Work on banana is now proceeding towards genetic transformation techniques (for female sterility). Much of this work has been supported by donors, often through the CGIAR system. Technologically the research appears to have been successful, but has encountered problems in relating to the wider systems that could make effective use of the technologies. The clonal coffee programme was originally set up under EU funding in 1991. Scientists were trained in the UK. A laboratory was built at the Kwanda Agricultural Research Institute research station (KARI) near Kampala but the cloning protocols did not work for the Uganda material and new techniques had to be devised. Material was eventually produced and distributed through various public networks. However plans for the commercialisation of the clonal coffee production facility failed to take place. In a related development, a link with a German coffee company IBERO began promisingly but later fell apart. Initially the company was just buying coffee, but then went into its own production and approached KARI for clones. The company’s technicians were trained in the production of clones. However the company wanted to take (clonal) material out of the country for evaluation. Under regulations in place at the time this could not be allowed. However, for whatever reason the company felt compelled to do this and smuggled material out of the country. This led to a break down in the relationship with the public facility at KARI.

The banana programme at KARI faces similar problems. It has difficulties in producing the amount of material that is potentially required in the country (as it is obviously a research facility not a production unit). However, even though a private tissue culture organisation exists, a form of collaboration has yet to be found. The recently established biotechnology facility at KARI will continue to build technical capability in the area of biotechnology. It will focus on three areas: diagnostics; marker assisted selection and genetic modification. At the time of writing a draft policy on biosafety is waiting to be approved. However it is anticipated that this will soon be forthcoming and that the way will be open to the use of GMOs. There has been concern voiced by consumer groups about GMOs in Uganda, but there has not been a process of inclusive public debate on these issues. Currently GMO material cannot be brought into the country even for testing. Uganda therefore certainly has the technical capabilities for transformation work, but currently not the legal framework

These points illustrate the way many countries like Uganda are moving into an era where the use and application of agricultural science is forced to deal with wider issues than those of biological science. One is the need for and difficulty in, building relationships with the private sector. But there is also need to engage constructively with the issue of public perceptions of safety if indeed GMO-based research becomes a major strategy in Uganda. What STIP capability exists to deal with this? In Uganda there is a national coordinator for biotechnology and biosafety. She is a professional research manger having been a director of Namalongue Agricultural Research Institute -- one of three institutes in the country. Her background is in a technical discipline. Training in biotechnology disciplines for the programmes at KARI and elsewhere has been in straight biotechnology. At KARI where the banana and coffee programmes are centred (and where the biotechnology unit has been established) there are two social scientists. One is a senior scientist attached to the banana programme and the other a more junior scientist attached to the post-harvest programme. Both are agricultural economists and neither has training in contemporary science policy issues.

A number of conclusions arise from interviews with the biotechnology scientific community in the agricultural research stations. Firstly the number of social scientists working along side technologists needs to be increased dramatically. These social scientists should be equipped with the concepts necessary to challenge biologists to think beyond science and reflect on how it can impinge more effectively on the development process. Secondly scientists at all levels need to be given the skills to help them understand and deal with the wider context of their work. Skills here need to be at two levels – the level of understanding innovation as a systems phenomenon, and the level of specific skills to allow them to operate in this way, i.e. skills relating to building partnerships, IPR, participation. This will involve both curriculum development in universities, as well in-service training. Thirdly the wider environment in which scientists are operating needs to be conducive to their working in a systems mode. Again this needs both a general understanding at the policy level of the systemic nature of innovation as well as specific policy instruments such as biosafety and IPR.

B Policy system challenges and its implications for STIP capability

The Uganda biosafety policy has been developed by a task force established by the National Council for Science and Technology (NCST). This task force includes representatives from the health sector and the private sector. The NCST is a very small unit with less than 6 professional staff. While not formally trained in contemporary STIP, approaches many of its staff have a systems perspective on the issue they are dealing with. Staff at NCST have a clear understanding that innovation needs the support of a number of policies across different ministries and departments. However it recognises that existing bureaucratic arrangements create difficulties for this integration. So for example, the national plan for modernisation (PMA) suggests dealing with agriculture in a more holistic sense. However as it is under the Ministry of Agriculture, support is mainly to NARO and NAADS and not to the health and transport infrastructure that would be needed to build up agriculture in a more general sense.

Ministries are not surprisingly reluctant to support and report activities that could be seen as falling under other ministries. However, they do report on macroeconomic contributions to the Poverty Implementation Plan (PIP). Whereas the PMA is a sectoral national plan the PIP is a combination of sectoral plans under the Ministry of Financial Planning and Economic Development (MFPED). The MFPED has different sector desks, but again this means that policy is dealt with in a narrow sectoral sense. Usually an agricultural economist deals with agriculture with a similar situation for health and so forth. Science and Technology (S&T) is viewed as one component of each sector's responsibility rather than a cross cutting issue where there is both technical convergence across different sectors and where there is complementarity between different policy instruments under different ministerial mandates that provides the incentives and capabilities to promote innovation. In addition most training is in economics. Only one course unit has been about S&T and then only about S&T as a factor of economic production.

One could argue that this is bureaucratic arrangement, which prevents a more holistic treatment of STIP. However the problem is really at a more fundamental level because with the exception of those in the NCST there is limited understanding of the need to deal with STIP in a more holistic way. To address this, policy actors at both operational and strategic levels need to be equipped with practical analytical tools that will allow them to understand their sectoral responsibilities in a wider context. This does not mean that ministerial or sectoral distinctions should be removed; rather it means that policy actors should have the analytical tools to recognise the scope of policy instruments needed to make the most of science, technology and innovation in achieving the policy goals in different sectors. Such perspectives would feed through into bureaucratic and other institutional changes in the policy making process in the long term. Currently there is no provision in Uganda for training policy level staff in these wider perspectives

Ethiopia

(A) Research system challenges and implication for STIP capability

Agriculture science and technology have a particularly important role in Ethiopia due to five main reasons. Firstly there is the unique nature of major crops found in the country, e.g. teff, cultivated nowhere else. Secondly, Ethiopia has a high degree of biodiversity as the centre of origin for major commodities of economic importance, notably coffee and barley. And thirdly there is significant economic value of germplasm in a general sense due to property right protection combined with the specific interest of developing countries in accessing traits and commodities to address lifestyle concerns of the Western World, e.g. teff for gluten free diets and decaffeinated coffee. Accompanying these interests is the much greater involvement of private sector companies. Fourthly there is a continuing need to improve crop and livestock production in ways that ensure both food and livelihood security and the realisation that poverty reduction in inextricably linked to upgrading of the agricultural sector. And fifthly the opportunities presented by the temperate nature of the Ethiopian climate for export crops including vegetables fruits and cut flowers. This last area of export development has been given considerable emphasis by the government and has grown remarkably in the past decade.

Following the establishment of a new government in 1991 the research systems was decentralised to each region of the country[55]. There are currently 13 federal research centres coordinated by EARO. In addition there are 5 regional research Institutes. EARO is organised into 5 directorates: crops, livestock, natural resource management, dry land and forestry. Major support for the development of EARO has come from the World Bank (notably the World Bank Agricultural Research Training Programme between 1997 and 2005) as well as assistance channelled through the NEPAD. The former programme has trained large numbers of scientists in classic agricultural science disciplines by sending them to India and Thailand for short course and masters and PhD degrees. It is worth noting that training had to take place in other developing countries because in cases where students are sent to UK or USA, 80% do not return.

Contrasting to this pattern of capacity development the director of EARO related a number of challenges that clearly were pushing the boundaries of what traditionally trained agricultural scientists were prepared to deal with. Three interesting examples were as follows. One concerned arguments over the ownership of decaffeinated coffee germplasm, which the Brazilians were trying to claim, but which were a naturally occurring part of Ethiopian diversity. IPRs were unclear and the EARO scientists were unprepared to deal with this. Furthermore the Ethiopian expert on these issues was located in another organisation, the Ethiopian Environmental Protection Agency.

Secondly, on GMOs the government position is relatively moderate and open, mainly because the major GMOs on the international market are not native species to Ethiopia. So it is felt that chances of inserted genes spreading to wild relatives are thought to be quite low. Public perceptions of GMOs are thought to be generally positive, but it is not clear the extent to which a public debate about this topic has been conducted. EARO suggests that it wishes to demonstrate the advantages of using GMOs but appears to regard this as mainly a

[55] From interview with the director of the Ethiopian Agricultural Research Organisation (EARO)

technical issue. A third case is the negotiation of an agreement with a Dutch company for the supply of teff of a specific variety for the production of gluten free bread in Europe. This case was particularly interesting as the agreement gave the company exclusive rights to buy this specific variety (developed by EARO) from farmers. For this concession the company had to pay the government of Ethiopia 10 Euros per hectare.

Each of these illustrations are typical of the way the utilisation of agricultural science is becomes embedded in a range of new relationships and policy and institutional contexts. While IPR and underpinning biological skills for the development regimes and biosafety protocols are almost certainly available within Ethiopia, understanding these in the broader sense understood in contemporary STIP is not so apparent. Social science skills are relatively well represented in EARO with each centre having a social science division. These however are mainly agricultural economists and this is reflected in the four main research themes:

- Adoption and impact assessment;
- Characterisation of farming systems
- Production economics
- Agricultural marketing and policy

Discussion with the director of socio-economics Department of EARO however revealed a more nuanced understanding of the relationship between S&T and innovation and the role of science in this process. He felt that the extension system was so totally ineffective that EARO had to take matters into its own hands, even if only on a pilot scale. An example of this was the case of durum wheat. EARO has developed over 40 varieties, but millers (still public enterprises) are importing durum wheat from Italy since farmers are not growing the new EARO varieties (because of “weak extension). A similar situation exists with barley and the brewing industry. In the case of durum wheat EARO held a meeting with all the Ethiopian millers and negotiated that they would pay a premium for locally produced EARO durum varieties. This in turn has led to the establishment of contract arrangements between millers and farmers. In the case of the brewing industry, it established its own task force to explore linkages with EARO and farmers and now has a mechanism for demanding varieties.

The interesting part of these illustrations is that EARO is starting to recognise that it needs to engage directly a series of activities that go beyond the normal remit of a classical agricultural research organisation. But paradoxically this perspective has not reached the agenda for staff training and instead seems to be the pragmatic response of some scientists to systems failure in the institutional setting in which they work. These sorts of institutional innovations would make excellent case study material in capacity development programmes for other Ethiopian scientists

(B) Policy system challenges and its implications for STIP capability[56]

The Ethiopian Commission for Science and Technology (ECST) is a large organisation with professional staff of 120 (working across all sectors). It is organised as a number of councils: Manufacturing, National Resources and Health with apparently good connections to line ministries. Agriculture is mainly dealt with by EARO, but there is an agriculture department within the commission, as well as a small grants programme. There is recognition of the need to move away from broad policy issues and instruments, to dealing with more complex (and diverse issues) and where engaging with people (rather than dictating to them) is paramount. It is less clear how these laudable objectives will be achieved. The organisation was established in the 1970, but had its main phase of growth in the early 1990s. This also involved considerable overseas training at PhD level in both the UK and Sweden. No overseas training has been conducted since that period, which is interesting as contemporary STIP has only fully developed its distinctiveness recently. One senses perhaps unfairly, that ECST is an important policy resource that would benefit enormously from refresher course for staff trained a decade or so ago and a stream of younger staff equipped with contemporary STIP skills. In the specific context of agriculture the on-going ILRI/ISNAR research and capability interest in STIP and the anticipated involvement of INTECH with this regional hub

[56] This section derives mainly from an interview with the Commissioner, Ethiopian Commission for Science and Technology (ECST)

would make a good focus for developing the STIP capability of the Ethiopian policy and research system.

Netherlands Interviews

Interviewee [A]
According to [A] a challenge facing agriculture in the South is the absence of a conducive agricultural innovation environment. Barriers to this have included lack of good governance in research organisations and lack of institutional synergy. As a result, only limited co-operation takes place between agricultural practitioners. Past capacity strengthening initiatives have focused on training more scientists, and little or no attention has been given to the context in which they are expected to operate. Consequently, returns on investment in capacity building have been disappointing. There is therefore a need to approach capacity strengthening from an "institutional perspective". It is not sufficient merely to build up a critical mass of scientists; rather, they must be provided with an "enabling environment" in which they can realise their "innovative potential". A change of mindset is needed – more institutional analysis is required as to what the major stumbling blocks are that are preventing co-operation. In other words, it is necessary to begin with tearing down the 'ivory towers' of research. This analysis or willingness to scrutinise activities, must come from within organisations themselves. Similarly, it is important that initiatives designed to correct the situation be demand-driven, as opposed to being imposed externally. An example of an approach that focused on changing the mindset is the DGIS Special Programme for Biotechnology, as realised in Andhra Pradesh, India.[57]

Another area of particular concern to interviewee [A] are the contradictory pressures under which many NARS find themselves. On the one hand, it is often taken for granted that NARS focus on public-goods research. On the other hand, these systems are facing increasing demands to commercialise their research results and become more financially self-sustaining. Broad-based training, which includes components in poverty-alleviation, is therefore paramount to ensuring that scientists understand the impact that their work can have in the public arena (in addition to ensuring, among others, provide better wages and more financial resources to NARS). However, providing 'non-scientific' modules (for instance, in participatory research methods) during university training is not sufficient – these are merely a means of grounding innovative capacity in the social, political and economic context of research. Instead, there is a need to target "all layers" in an effort to establish an enabling, collaborative environment. This is exemplified in the field of biotechnology, which is itself an 'interdisciplinary' activity. Co-operation, which extends beyond the confines of the scientific community, is required to undertake biotechnology-related research. For instance, indigenous knowledge, international trade, environmental safety, etc. come into play as well, indicating the need for partnerships amongst a broad range of participants. With increased co-operation also come checks and balances, which act to ensure better governance.

Policy training programmes do play a role in capacity strengthening, but they must be broad enough in their scope to cover institutional issues, and all capacity strengthening efforts must be locally based. Capacity in specific policy issues, such as IPR management, technology transfer arrangements and biosafety, is important. The manner in which these policies are even formulated needs to be founded on national research priorities, which in turn must be based on multi-stakeholder platforms and national debates. In other words, it is necessary to ensure that the constituency involved in such issues is varied – otherwise identifying needs for capacity strengthening becomes 'myopic'. [A] expressed the concern that NEPAD may be embracing 'high' science and technology for the sake of status and prestige, particularly with biotechnology, without being clear about public benefits.

Interviewee [B]
According to [B] one of the challenges facing agricultural R&D in the South is the lack of capacity in science, technology and innovation policy, specifically from the modern perspective of innovation as a systemic and holistic process. This is a problem not only in research organisations, but also in government ministries. [B] cited the example of Uganda,

[57] See Clark et al (2002)

where according to his experiences, biotechnology training is confined to 'the science', with little or no regard for the management of the science and society interface, specifically on issues such as biosafety and IPRs. This results in the formation of two 'streams' of experts – natural and social scientists – situated in separate locations. Overall, what is needed is a paradigm shift in conceptualising innovation, a move away from a linear view on technology development. Innovation systems-theory can provide a set of principles for this (but not strict recommendations, due to the importance of local context in innovation), as well as a tool that reveals the character of a context (for instance, why policies or institutions do not do what is expected). The task at hand is to translate what academics have developed into training courses for practitioners.

There is considerable need to both raise awareness of innovation systems thinking, as well as build capacity in specific science policy issues. Specific policies, such as IPRs and biosafety, represent a set of *rules* that govern *how knowledge is used* in a given environment, while innovation systems thinking *locates these rules* within a broader context. The policy arena must provide a nurturing context where the holistic, systems nature of the innovation process is recognised. As with [A], [B] also feels that it is necessary to target all 'layers' of practitioners involved in agricultural innovation, although he suggests that it may be useful to equip practitioners at different levels with different skills. For instance, senior managers could be provided with short executive programmes; more junior research managers with slightly longer programmes having a specific emphasis; and general policy-awareness raising programmes for individuals who might not be using the skills immediately, but who still need to have an understanding of them.

Interviewee [C]
[C] discussed his experiences in agricultural innovation mainly from the perspective of a comparative international study carried out in Spain, South Africa, Italy and the Netherlands.[58] According to [C], an issue facing agricultural innovation today is the inability of institutionalised R&D to generate innovations responsive to the needs of farmers. As a consequence, a range of new practices and insights are emerging from farmer innovativeness at the grassroots level. However, these novelties run counter to the reigning regimes (a range of paradigms, laws and policies governing agriculture) found at the macro-level of institutionalised agricultural R&D. Consequently, many of these novelties 'die' at inception, or remain 'alive' at the lower, micro-levels of individual farmers. The challenge facing agriculture, therefore, is how to bridge the gap between farmer innovativeness and institutionalised agricultural R&D. This is complicated by the differences in the knowledge systems used by these actors. In general, agricultural sciences are segmented as a result of a high degree of specialisation. It is very difficult to combine the various strands – they all deal with isolated research paradigms. This is in contrast to farmers' knowledge, which is more interactive, including an understanding of, for instance, the relationship between soil quality, livestock and availability of forage crops.

What is required is a new type of cooperation between researchers and farmers that transcends the current *modus operandi*, and that is conducive to the development of new trajectories for agricultural innovation. He refers to this as "strategic niche management". Strategic niche management entails a search for autonomy, creation of agency and building of coherence within an agricultural innovation environment. Knowledge is a crucial dimension of this.[59] How might this new form of co-operation be realised in practice? Local knowledge should be taken as a basis for problem identification. From this, specific needs for further scientific research should be derived. Eventually, research and local knowledge should be integrated into an 'arabesque'. Three additional elements are important – firstly, a farmers' council should be convened to govern the research/innovation process, including the scientific components. Secondly, it should be ensured that participants are not working in isolation, but rather recognise that they are part of a broader whole. Thirdly, there should be a shared conviction that scientific research is never finished – often, scientists work on the presumption

58 Wiskerke & van der Ploeg (2004)

59 A doctoral thesis on strategic niche management will be defended at the University of Perugia in December 2004. The topic will also be dealt with further in Prof. van der Ploeg's forthcoming book. Strategic niche management is also discussed in Wageningen Journal of Life Sciences, vol. 51. 1-2, Sept. 2003.

that there exists a fixed body of knowledge according to which the physical world should be organised.

Additionally, a new breed of agricultural scientist is needed. Current university training is not equipping future scientists with the necessary skills to function effectively within an agricultural innovation environment based on cooperation. More emphasis has to be placed on the ability to get in touch with specific agricultural realities, the ability to understand the heterogeneity of agriculture, as well as the ability to explore promising novelties that stem from farmers' innovativeness. Modern technologies and institutionalised organisation of agricultural innovation exclude adaptation and experimentation on the part of farmers.

Interviewee [D]
According to *Interviewee [D]* there is a considerable need to build capacity in science, technology and innovation policy amongst scientists at all levels. Policy-makers, such as directors of research and policy organisations, see science, technology and innovation from a very narrow perspective. There is little understanding of wider contextual issues – much focus is placed on science for the sake of science, with little attention given to demand-driven activities. There is also a lack of individuals who are able to analyse and design science, technology and innovation policy. Interviewee [D] referred to ATPS training activities as an example of capacity strengthening initiatives addressing this need. These focus on providing policy-makers and scientists with information on 'broad' issues affecting science, technology and innovation (such as the impact of technological capabilities for development, and innovation-systems thinking), as well as specific issues arising, for instance, from biotechnology and ICTs. Such programmes should be made more widely available, specifically in such a manner that individuals are able to graduate from a general to a specific level.