9. Regional Co-operation for Capacity Building in Science and Technology

The African Network of Scientific and Technological Institutions (ANSTI) and the Consultative Group for International Agricultural Research (CGIAR)

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Introduction

The promotion and popularisation of science and technology can be done through intervention at the local community level, the primary and secondary school level and at the tertiary education level. However, activities at these different levels are not independent of each other, and interventions at one level influence or are influenced by the other levels.

The emphasis at the tertiary level is to train a pool of scientists and technologists, and this is influenced by how science and technology are promoted in both schools and society, since intakes into tertiary institutions depend on students' interest in science and technology at the lower levels of education. In a similar manner, the output of interventions at the tertiary level influences the effectiveness of science and technology learning at the lower levels. Outputs at the tertiary level are trained scientists and technologists who serve as role models as they engage in activities that facilitate the demystification of science and technology. Thus, high-level human resource capacity building in science and technology is an important activity in their promotion. A critical mass of scientists and science-based professionals who can put science into action for community and national development demonstrates the power of science and technology in improving peoples' quality of life. With a large pool of active, high-level, scientific manpower, society will be better able to appreciate the applications of science

in such sectors as agriculture, health and industry, thus promoting and popularising science and technology.

To produce this pool of scientists and technologists, the countries of sub-Saharan Africa must provide inputs to demystify science and make science-based professions more popular career choices. Thus, the problem of human resource capacity building can be tackled by addressing resource availability and popularisation of science and technology at the lower educational levels and within society. In this chapter we shall concentrate on strategies to optimise the use of available resources. Other chapters have already demonstrated various strategies for demystifying science.

Capacity building is a process involving the input of resources that include staff, laboratory facilities and libraries. In most African countries there are problems with the availability of these resources, and their inadequacy contributes to secondary problems such as inequity in access to science and technology education, and problems of quality assurance and accreditation. An examination of the status of training and research institutions in the region reveals major problems of staff retention, limited financial resources, weak infrastructures, inequity in access to science and technology education, a shortage of university space for the increasing number of students, weak resource endowment of students, an irrelevance of S&T curricula and a scarcity of learning materials.

Faced with such problems, African countries find it difficult to build human resource capacity in S&T. Fortunately, the problems mentioned are not felt to the same degree by all institutions and countries, and the variations across the continent raises a possibility for regional co-operation as a strategy for human resource capacity building in science and technology. Such co-operation could enable students from any part of the continent to be trained in the best institutions particularly at the post-graduate level. Regional co-operation could also provide opportunities for researchers to have access to equipment and other facilities that may not be available in their own institutions. In theory, therefore, regional co-operation is a useful strategy for human resource development, especially at the higher level in specialised disciplines. In practice, however, this may not readily be achieved because of inherent problems that will be discussed in this chapter.

The same regional strategy can also be useful in the popularisation and demystification of science because it enables countries to share experiences on policies and actions that can be used to overcome cultural and other factors inhibiting the promotion of science.

In this chapter we shall examine two examples of regional co-operation in capacity building, the African Network of Scientific and Technological Institutions (ANSTI) and the Consultancy Group for International Agricultural Research (CGIAR), both centres which are based in Africa, to illustrate the programme strategies involved in institutional networking for human resource capacity building. The chapter gives an account of the origin, the participating countries and institutions, the activities and achievements of ANSTI and CGIAR. It describes how they are structured, managed and administered, and the activities they employ to pursue their objectives. The chapter also analyses problems associated with African networks and discusses their prospects for capacity building. Overall, we hope to show that regional co-operation in capacity building in an environment of resource limitation is a useful strategy in Africa for the promotion of science and technology.

Options for Regional Co-operation

Regional co-operation involves pooling resources for the benefit of the region. Thus, for human resource capacity building there are two main types of regional co-operation – regional centres of excellence for training and research, and regional networks. The former is an example of how financial resources can be pooled to establish regional institutions for research and training in highly specialised fields such as those worked on at the CGIAR centres. The latter is shows how physical and human resources available in existing institutions can be pooled for the purpose of research and training as exemplified by ANSTI. Each type of networking has its advantages and disadvantages.

Major advantages of regional centres include that high-quality facilities and opportunities are offered to a selected few, and that major scientific breakthroughs made by regional centres (in contrast to resource sharing networks) have an immediate and significant impact on national economies and the quality of life of countless numbers of Africans. Disadvantages include issues of control and ownership. Non-host countries tend to feel marginalised and may withhold contributions, and this is particularly true for countries whose medium of education is a language different from that used by the regional training centre, though at the level at which they operate most researchers are multilingual. Another disadvantage is that regional centres only provide training in highly specialised areas such as biotechnology, theoretical physics, agriculture and so on, and are not effective for development of human resources across all fields of basic and applied sciences. Finally, the regional centre approach is expensive, requiring construction of new institutions and facilities, though both types of networking are dependent on external funding.

The greatest advantage of institutional networking is its low cost. It does not require new buildings or facilities, but puts those that already exist in individual countries at the disposal of the region. Through networking, postgraduate students requiring specialist training are moved from institutions with low resource endowment to another with better facilities. Because of the low investment required in establishing networks, the financial contribution by members involved in the co-operation is lower. Furthermore, training can be provided in many scientific disciplines. Among the many universities in the region, it will always be possible to find one with the required resources, and because of the wide range of institutions students will be able to receive training in the language with which they are familiar. Networks also enable members to share experiences on policy implementation and the outcomes of various strategies in training and development of science and technology capacity.

A major disadvantage associated with networking is quality control that arises because training takes place in different institutions with different rules and regulations. Sometimes even the system of education and duration of programmes may differ. Under such circumstances it is a challenge to assure quality of the training.

In short, regional centres are more effective at developing Africa's scientific and technological person-power to the highest possible level, and and at producing scientists whose work has a significant and important social impact. However, despite collaboration with national institutions that effectively develop their research capabilities, compared with capacity building networks, centres of excellence affect fewer people.

Regional Institutional Networking

The preceding paragraphs have shown that as far as regional co-operation for capacity building is concerned, institutional networking offers some advantages over regional training centres in that networking emphasises co-operation in terms of sharing resources rather than joint ownership of facilities. Networking is more stable and less prone to civil conflicts such as the unrest in Liberia that forced the West African Rice Association (WARDA) to relocate in Côte d'Ivoire.

We must distinguish institutional from other networks. There are several organisations that engage in regional networking in science and technology. However, most promote networking among individuals, and build or strengthen the capacity of individuals through collaboration and exchange of

information. Networking among individuals is therefore not appropriate for large-scale human capacity development for which institutional networking offers a better alternative. Institutional networks strengthen training institutions not individuals, though the benefits trickle down to individuals. The strengthened institutions are then in a better position to provide training for larger numbers. Institutional networks promote collaboration among member institutions, and facilitate the exchange of staff, students, information and other resources. This enables each member institution to draw on the resources of others in order to enhance its ability to deliver training in certain fields. Furthermore, because institutional networks involve institutions with established facilities for training, they can put a large pool of training facilities at the disposal of the entire region. Networks of individuals on the other hand cannot do so. Institutional networks, by encouraging collective self-reliance in manpower development, promote the full use of the existing institutions.

The African Network of Scientific and Technological Institutions is one of the oldest institutional networks dedicated to human resource capacity building in science and technology in Africa. Indeed, the network is the only regional co-operative activity with a mandate for high-level manpower development in all fields of basic and engineering sciences in Africa. In this chapter we shall use the operation of ANSTI to illustrate the opportunities and problems associated with institutional networks in their drive to foster regional collaboration for human capacity building in Africa. We shall present its history and origins to illustrate how this can affect the success of a network. We shall describe how the programme currently caters for differences in learner abilities and school conditions by fitting learners into different syllabus categories, ranging from the 'hard' or 'pure' sciences to the 'soft' or 'combined' sciences – arrangements that have, to some extent, satisfied the 'science for all' principle. However, current reforms as exemplified by the Swazi project, Linking School Science with Local Industry and Technology (LISSIT), advocate that all learners are exposed to meaningful, applicable and functional school science, at least up to junior secondary school level. Reports on the observation and assessment of classrooms using the contextualised approach indicates that this strategy yields valuable outcomes (Ramsden, 1992; George, 1999) to the extent that it should be regarded as popular school science for all.

The second importance of the context-based teaching strategy emerges as a powerful means to combat Africa's reliance on imported curriculum ideas. A condition for the successful production of context-based material is the necessity for all contributors to be conversant with all vital aspects of the features and culture to be depicted as realities of local S&T in action. If S&T

education should be for everybody, then all requisite resources, physical and human should be aligned to the task of producing the relevant school science. In the LISSIT project, a sample of high-ranking technologists from a variety of local industries collaborated closely with a group of science teachers and educators to develop the contextualised teaching materials.

The History, Structure and Administration of ANSTI

The origin of ANSTI

The African Network of Scientific and Technological Institutions is a regional non-governmental organisation that was established in January 1980 by the United Nations Educational Scientific and Cultural Organisation (UNESCO) with funding from the UNDP and the German government. The network was conceived in response to the resolutions of the Conference of African Ministers of Science and Technology (CASTAFRICA I), held in Dakar, Senegal in January 1974. At that meeting the African ministers present urged UNESCO to help African universities and research organisations engaged in training and research in science and technology to establish linkages to enable them to pool their human and material resources to contribute more effectively to the applications of science and technology.

Although UNESCO initially favoured the idea, the organisation had to be certain there was enough interest in and enthusiasm among African institutions, as well as determining the number and types of institutions that would form the network. Thus, in 1975 they commissioned a consultant to conduct a feasibility study. The consultant visited 19 universities in the region and summarised his reasons for a positive recommendation as follows:

It is difficult to exhaust all the arguments in favour of the creation of the network. The strongest, however, is the fact that practically everybody wants it and everybody is anxious that it should be created, structured, administered, financed and operated in such a manner that it can work to the satisfaction of all.

Thus we can conclude that ANSTI was demand-driven and that the beneficiaries were involved in its development. This is one of the strengths of the Network.

After two expert group meetings on the consultant's report, a project proposal was produced in December 1978 and submitted to the UNDP for funding. The first project document was signed by the UNDP on 4 May 1979 and the Funds-in-Trust Agreement between UNESCO and the Federal Republic of Germany to assist ANSTI was signed on 5 August 1980. ANSTI formally

came into existence on 6 January 1980, the day the first Co-ordinator assumed office.

The aim of ANSTI

ANSTI's original aim, which has remained unchanged, was to develop active collaboration among African scientific institutions to promote research and development in the region. The network's specific objective is to develop and implement progamme activities that will facilitate sharing of resources and an exchange of information and staff to implement high-level training in the relevant fields of science and technology.

ANSTI Membership

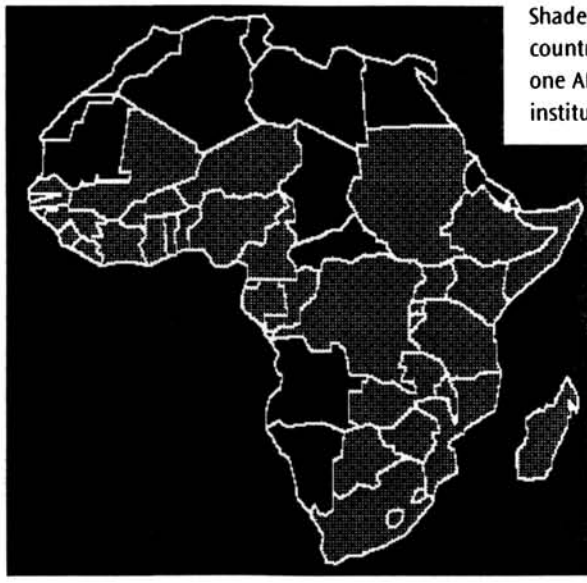
The network's constitution offers membership to:

i. University faculties and schools of basic sciences (physical and biological sciences), and engineering and technology.

ii. University and non-university research institutes devoted to any S&T discipline.

Currently there are 99 member institutions from 33 countries. Figure 9.1 shows the distribution of membership in the region. The size and spread of this network makes it unique. The network is probably the biggest regional scientific network in the world in terms of the number of countries involved and the intensity of its activities. The network's size facilitates dissemination of information and scientific ideas throughout the region.

Figure 9.1

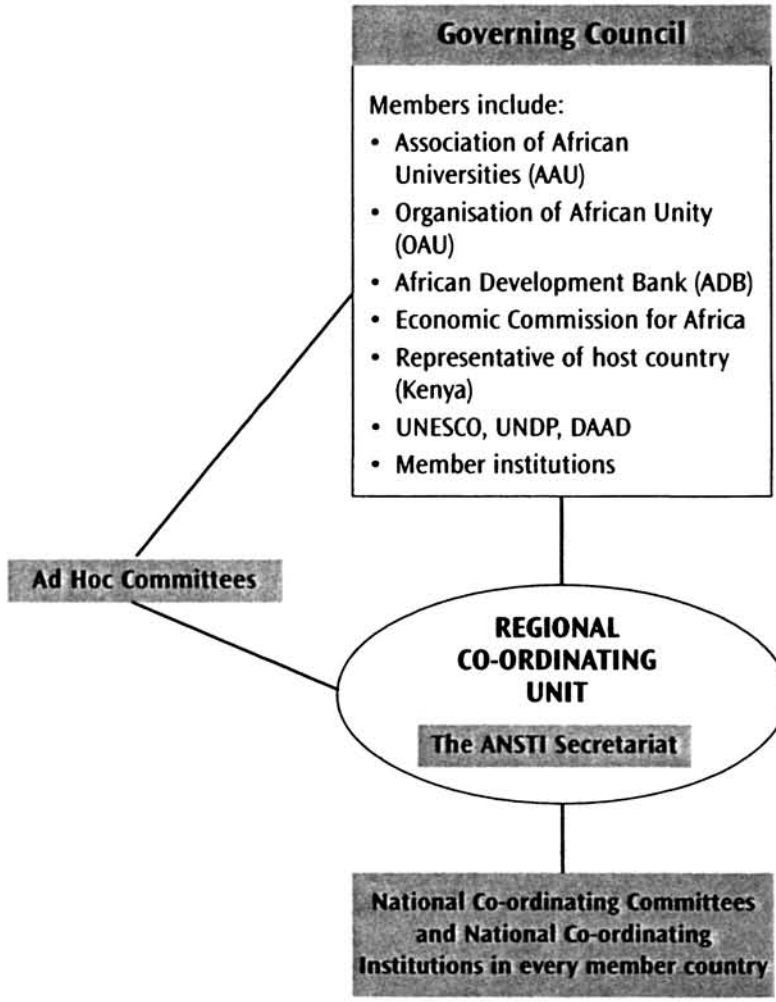


Shaded areas depict countries with at least one ANSTI member institution

ANSTI management structure

The structure of the network has gone through many changes. Over the years it has changed twice to adapt to the size of its programme activities and resource constraints. Currently, ANSTI's policy making organs and administration structure consists of a governing council, national focal points and the regional co-ordinating unit (the secretariat). This structure is depicted in Figure 9.2.

Figure 9.2. ANSTI Management Structure



The Governing Council

ANSTI policies are determined by the Governing Council whose membership includes representatives of the Organisation of African Unity (OAU), UNESCO, United National Economic Commission for Africa (UN-ECA), the Association of African Universities (AAU), deans of the member institutions, the German Academic Exchange Service (DAAD) and other financial sponsors of the network. Although the network's policies on building human resource capacity in science and technology are determined by the Governing Council, the policies relating to its administration are those stipulated under the rules and regulations of UNESCO, a decision that has its origin in the history of the development of the network. At the time of the establishment of the network by UNESCO, it was considered appropriate to integrate the financial management of the network into that of UNESCO to minimise overhead costs. This is why the administrative policies of UNESCO are applied to the Network. To facilitate the work of the Governing Council, some activities are delegated to ad hoc Committees such as the Fellowship Committee.

National Committee and National Co-ordinating Institutions

Each country with a member institution of ANSTI is required to set up an ANSTI National Committee to liaise with the regional co-ordinator to co-ordinate national activities designed to popularise and advance the application of science and technology for sustainable national development.

The Regional Co-ordinating Unit (the Secretariat)

The network's regional operations are planned, co-ordinated and implemented by a regional co-ordinating unit based at the UNESCO office in Nairobi, Kenya. To facilitate in-depth collaborative activities in the relevant areas of science and technology, the regional co-ordinating unit supports sub-networks each of which links several departments across many disciplines in all ANSTI member institutions. Current sub-networks are those in biotechnology, material sciences, renewable energy and water resources engineering. Through these sub-networks ANSTI is able to apply the existing scientific capacity to address regional problems.

Programme and Activities

Rationale

ANSTI must develop and implement programmes that ensure that its members 'pool and share' their available resources for post-graduate training. Thus, opportunities must be offered to potential trainees to travel to other institutions where resources such as appropriate staff and equipment are available. The network must also facilitate the movement of staff so that

institutions that are not well endowed with scientists in a particular discipline can benefit from visits by professors from other institutions. Similarly, to share knowledge, information or research results and experiences, the network must have programmes that facilitate dissemination of scientific information. Indeed, information sharing is crucial in networking for capacity building.

Based on this rationale, ANSTI has developed and is implementing several activities which can be grouped into six programme areas: Training, Staff Exchange, Seminar/Workshops, Information Dissemination, Research Promotion and Capacity Building in production of learning and training materials.

Training

The network awards fellowships to qualified candidates in the basic and engineering sciences to study at member institutions outside the fellow's home country. This has a dual objective of developing manpower resources as well as the research capacity of the fellow's home and host institutions. The network facilitates training at the highest level, that is, postgraduate studies and research. There are several reasons for this. First, previously-mentioned problems associated with the training of scientists are more acute at this level. Second, the impact of interventions at this level is far greater since it trains future trainers who return to their home institutions to train others. Thus, one candidate who qualifies with a PhD or MSc will, over a period of several years, be involved with the training of hundreds of scientists at the undergraduate level in his or her home country. So, whether one's objective is to produce scientists at the undergraduate level or at the postgraduate level, it is cost-effective for regional organisations to intervene at the highest level in order to train potential trainers who will, in turn, engage in large-scale training in their respective countries. Another reason for intervening at the higher level is that nearly all countries in the region now have training facilities at the undergraduate level, and the major problems associated with these facilities, such as infrastructure and finance, are more appropriately handled at the national level. However, in the case of high-level postgraduate training, institutions are fewer, therefore requiring some regional co-operation for exchange of students and staff.

Other ANSTI training activities include awards of short-term training fellowships and organisation of training workshops. Training technicians to manage laboratories to undertake repair and maintenance of scientific equipment is an important aspect of human resource capacity building since improved skills increase the stock of usable laboratory equipment that in turn facilitates research and teaching.

Scientific seminars and conferences

ANSTI promotes communication among scientists through the organising of workshops, scientific seminars and conferences..

Staff exchange programme

The network awards fellowships that cover travel costs and honorariums to facilitate travel of senior academic staff from one member institution to another to undertake research or teaching. This ensures that the training resources in the region are 'pooled' to train high-level scientists.

Promotion of collaborative research

Research is essential for individual professional development. Through research the individual's knowledge is increased and this may have a trickle down effect if the researcher is a university staff member. When funds are available, the network supports applied research activities in member institutions.

The network also searches for funds to sponsor regional studies using investigators in member institutions. Such projects entail comparative studies with inputs from more than one country. Examples include performance testing or diffusion of new technologies in the region and assessment of a pilot programme on new courses in selected institutions.

Dissemination of scientific information

One of the most important programme activities of ANSTI is dissemination of scientific information. There are two categories of S&T information disseminated by the network. The first is general information of S&T activities and includes:

- Descriptions of scientific activities, such as research and training, that are carried out in the various institutions;
- Information on available scientific manpower resources in the region;
- Announcements of meetings, conferences, workshops and seminars;
- Reports on important issues affecting science and technology in the region;
- Information on strategic issues for training in emerging areas of science and technology.

Although such information may appear to be less important than that on scientific research knowledge, the experience at ANSTI indicates that the non-availability of these ancillary types of information gravely affects the success of scientific research and teaching. Access to such information enables

the scientists to overcome their isolation and collaborate meaningfully on important research activities. Table 9.1 sets out the different types of information in this group and also shows how the network collects and disseminates them. The main form of dissemination of this class of information is the publication and distribution in print and electronic form of directories, occasional reports and manuals, and circular letters.

Table 9.1: Collection and Dissemination of Ancillary Information to Enhance S&T Activities

Type of Information	Method of Collection	Method of Dissemination
S&T manpower resources for training and research in the region	Questionnaires to ANSTI member institutions (by e-mail)	Publication of directories in print and on the internet
S&T Research and Training Activities in the region	Questionnaires to ANSTI member institutions	Publication of directories (also put on the internet)
Conferences, seminars and other scientific meetings	Direct communication with the organizers	Circular letters to member institutions (by e-mail)
Important issues affecting S&T in the region	Meetings of expert groups	Occasional reports (in print and electronic form)
Strategic issues in emerging technology problems	Commissioning of consultants	Books, training

The second category of scientific information disseminated by the network is that of research results emanating from member institutions. The network publishes the *African Journal of Science and Technology*, used as a medium to disseminate research results.

Capacity building for preparation of teaching materials

The availability of affordable learning materials in S&T is a constraint on human resource capacity building. One way to overcome this is to develop local capabilities for development of suitable teaching and learning materials. ANSTI has a textbook production programme that utilises staff of its member institutions to develop textbooks that use African examples to illustrate theoretical principles. Through a series of workshops, the materials are harmonised, tested and edited. This programme has led to the production of several undergraduate texts in basic and engineering science using over 30 trained authors from member institutions.

Achievements

The cumulative output of the various programme activities is listed in Table 9.2. Activities implemented since 1994 can also be found in the *Directory of*

ANSTI Grantees published by the network. Other outputs, such as those involving dissemination of information, are more difficult to quantify.

Table 9.2: Output

Description	Quantity (Nos)
Training and capacity building	
Post-graduate Fellowships	27
Visiting Staff Fellowships	79
Short-term International Fellowships	8
Travel Fellowship	5
Fellowships for Technician Training courses	6
Sponsorship for Training courses	16
Seminars and Workshops	
Sub-network (Scientific) Seminars	76
Training Workshops on Maintenance	8
Other Training Workshops	4
Dean's/Director's Conferences	8
Research Promotion	
Grants for Research	20
Publications	
African Journal of Science and Technology (Series A, B and C)	38
Directory of ANSTI Institution	2
Engineering Textbook	8
Science Textbooks	4

The network's achievements should be presented from the viewpoint of the original objective, which is to foster collaboration among African scientific institutions to develop high-level scientific manpower. Thus we shall look at achievements in terms of the number of trainees, the number of ANSTI member staff whose research or teaching ability was strengthened and the level of collaboration among institutions.

Training

In any particular year, some 11 network-supported students graduate with MSc or PhD degrees in basic and engineering science. Over the years, the young graduates trained by ANSTI have joined staff at their own or other universities. Nearly 50 per cent of ANSTI institutions now have at least one member of staff trained by the network. In addition, ANSTI institutions can boast of technicians who have attended one of the training workshops at which 30–50 are trained each year.

Strengthening individual staff

ANSTI has enabled over 80 senior African academics to visit other institutions where they have carried out research that enriched their experience. The beneficiaries of the visiting staff programme have usually returned to their home institutions with increased knowledge and new perspectives. Furthermore, through the network's conference grants, ANSTI institutions' staff have attended meetings that have strengthened their research capacity. Members also use the network's *African Journal of Science and Technology* to disseminate their research results and promote discussion.

Enhancing post-graduate training and research capacity

Programmes such as staff exchange, post-graduate training fellowships and research promotion have effectively contributed to capacity building of African institutions. An outstanding example is that of the water resources engineering programme at the University of Dar es Salaam. Unfortunately, other institutions where similar efforts were made could not sustain the capacity after withdrawal of ANSTI support.

Enhancing inter-university co-operation

Through ANSTI, several faculties and schools of science and engineering in African universities have established contacts where there were none before that have yielded savings in costs of student training, staff recruitment and assessment by external examiners. For instance, more institutions now use external examiners from neighbouring African institutions rather than from traditional sources in Europe and North America. More African professors spend their sabbatical leave in the region, and the network will strengthen this co-operation further when the revised edition of directories and databases is distributed to member institutions, enabling staff to learn about the scientific activities of their colleagues in other countries.

The network disseminates information on S&T activities to 99 faculties of science and engineering in 33 countries. That a significant number of member institutions pay their annual membership fees is a sign of growing confidence in the network's ability to produce results.

Contributing to the identification of science and technology issues

An important part of any capacity building exercise is the identification of strategic issues involved in science and technology education. ANSTI, through meetings of deans and other experts, has in the past identified several issues that affect S&T education in Africa. Some of these findings are published in occasional reports, which are circulated to the deans of member institutions. The most recent include *Strategic Issues in Engineering Education in Africa* (1996), *Quality Assurance and Relevance of Engineering Education in*

Africa (1998) and *Innovative Strategies in the Financing and Management of Engineering Education* (2000).

Building capacity for the production of learning materials

Human resource capacity building in S&T in Africa is constrained by many factors. One is the non-availability of relevant teaching materials. ANSTI has contributed to its alleviation by developing the capacity for preparation of learning materials. The network has provided training and experience to staff of ANSTI member institutions for the preparation of learning materials in basic and engineering sciences. Through this experience several textbooks have been published and distributed to member institutions at very low prices. The books cover mathematics, physics, biology and all first year courses in the three common disciplines of engineering, namely civil, electrical and mechanical engineering. The most significant attribute of the textbook writing programme is that it facilitates the production of textbooks that rely on African examples to illustrate principles.

What has not been Achieved

The network's greatest weakness has been its inability to build women's resource capacity in science and technology. Although participation of women in ANSTI has been in the same proportion to that of their general representation in science and technology, the network should make additional efforts to increase female networking in the sciences because the problem of professional isolation is even more acute for women scientists and engineers. In accordance with the ANSTI programme of thematic sub-networks to address important regional problems such as food production and water supply, a sub-network dedicated to female resource development in science and technology in Africa should be set up. Such sub-networks would be different from existing female networks since it would have access to the training facilities of ANSTI member institutions and the network's other resources such as publication, and fellowships.

Another area of weakness is ANSTI's inability to have a significant impact at the macro-level. Most of the network's achievements have been at the micro-level, that is at the level of the individual and some minor achievements at the institutional level. For the network to have any achievement at the macro-level, the S&T human resources it develops must be used directly in the national development process. At the moment most ANSTI capacity development interventions are in the university environment and contribute to national development through teaching and research. It would also be useful if the sponsored research was oriented towards the solution of national problems and if their results were used in problem solving to enable ANSTI to

have a bigger impact at the macro-level. In addition, capacity utilisation always enhances the capacity building process because it motivates graduates and potential students. Networks should, therefore, engage in programmes such as university–industry partnerships that facilitate the use of the science and technology capacity of member institutions. Such partnerships could be used in many ways, including development of curricula that are relevant to national development so that students can better understand the role science plays in society, and this would further promote the subjects. Such demonstrable applications of S&T know-how to the solution of the societal problems would help to popularise science.

Lessons learned

The experience of the last few years has taught ANSTI several lessons that could be useful for other efforts in capacity building through regional institutional networking.

At its inception, the network was designed and presented as a single project comprised of several activities. Funds for the entire project were provided by three main donors who were also members of the Governing Council. The network was given a lump sum and it was left to the Governing Council to formulate activities for its use. This provided some independence, but experience has shown that to mobilise funds from various sources the network needs to adopt the role of an executing medium for, or work in partnership with, agencies involved with human resource development in science and technology. There are donors that may provide support for specific activities but are unwilling to give grants for the running of a network and all its overheads. Donors may use regional networks just like they do with any project grantee. Under such an arrangement, the network would advertise its nodes as centres for training, research and consultancy, and would present staff of its member institutions as the resource base for different types of activities. The difference between this approach and that of the original ANSTI design is that donors would not be faced with large grants to support major programmes. Rather they would see networks as partners assisting in the implementation of the donor's programmes.

The original structure of the network also posed some problems. It was made up of several committees, including an editorial committee, a programme committee and sub-network committees that met at least once every two years. The unwieldy nature of the management structure made administrative costs high and there was an obvious need for the streamlining that was subsequently carried out.

In connection with the network's programme activities, experiences showed

that implementation of programme activities in research promotion in science is difficult unless the research grant has components for basic equipment, since most ANSTI member institutions are poorly equipped.

In the post-graduate training programme, the biggest problems are variations of admission requirements and a lack of information on the true status of the post-graduate programmes in the member institutions. Basic admission requirements for post-graduate training also vary from one institution to another, and there is an additional problem in establishing the equivalence between French and English qualifications. Some post-graduate training programmes also lack staff and equipment. On one or two occasions this led to the frustration of ANSTI postgraduate fellows and the costly transfer to other institutions.

Finally, one useful lessons is that regional institutional networks are most effective in sharing resources and exchange of experiences in the development and applications of S&T.

Prospects for ANSTI and networking

The prospects for networking as a strategy for capacity building in science and technology remain good for the following reasons:

- The perception of the development problems that led to the founding of ANSTI is still valid. Mechanisms for bringing about regional co-operation and the integration of science and technology into development in Africa are still relevant, especially in a time of deteriorating economies.
- An alternative to networking is the establishment of centres of excellence, such as the CGIAR centres, where specialised research and training are conducted in science and technology. However, though such centres make vital breakthroughs that impact on national economies and the quality of life of countless citizens, the human resource development component is limited to a few top-level researchers. In addition, the autonomous nature of such centres raises problems relating to ownership and control.
- Networks also serve as umbrellas and media for communicating information on training activities supported and organised by other agencies. This is a role which ANSTI has played very well in the past and, through the internet, will do so even better in future. Availability of information is very important for training.
- Institutional networks provide opportunities for sharing experiences on the implementation of policies and strategies relating to science and engineering education that is vital in any effort to promote a science and technology culture in the region.

The CGIAR Centres

The Consultancy Group for International Agricultural Research (CGIAR) provides another example of the power of networking. The 16 centres are distributed worldwide and four are located in Africa, with some others represented by small regional offices. The major CGIAR centres on the continent are the West African Rice Association whose headquarters are in Côte d'Ivoire; the International Institute of Tropical Agriculture (IITA) in Nigeria; the International Centre for Research in Afroforestry (ICRAF) headquartered in Kenya; and the International Livestock Research Institute (ILRI), also located in Kenya. All the centres have representative offices in other countries in the region and elsewhere. With generous budgets – the CGIAR budget for 2000 was US$331 million – all the centres are equipped with the most up-to-date equipment and facilities and can attract an international staff of leading researchers. However, since strengthening national research is a major component of the CGIAR mission, a significant percentage of centre staff are African. Indeed, the CGIAR has done much to keep the best African scientists working in the continent addressing key development problems rather than working elsewhere on issues that have little or no application to Africa.

Established in 1971, CGIAR is an informal association of 58 public and private sector members that supports a network of 16 international agricultural research centres. The World Bank, the Food and Agricultural Organisation of the United Nations (FAO), and the UNDP are co-sponsors of CGIAR, and national governments and many donor agencies and foundations contribute funds.

CGIAR has outlined its aims as follows:

The mission of the CGIAR's centres is to contribute to food security and poverty eradication in developing countries through research, partnership, capacity building, and policy support. The CGIAR promotes sustainable agricultural development based on the environmentally sound management of natural resources.

Challenges posed by the interrelated global issues of poverty, hunger, population growth, and environmental degradation confront the world ... Sustainable agriculture has to be part of the response to these challenges, because agriculture is the cornerstone of development in poor countries, where over 70 per cent of the people depend on the land for their livelihood. Experience shows that agriculture, including forestry and fisheries, is a powerful engine for development, helping to:

- *increase food security and lower food prices*

- *create employment and generate income for the rural poor*
- *alleviate rural and urban poverty*
- *protect and conserve the environment*
- *stimulate development in the rest of the economy, and*
- *ensure overall prosperity through the stimulation of global trade and greater global political stability.*

Agricultural growth has to be achieved with methods that preserve the productivity of natural resources, without further damage to the Earth's precious life support systems – land, water, flora, and fauna – that are already under stress. Research is the means by which the world's knowledge of agriculture is increased and improved. Agricultural research, conducted to help the world's poorest people make lasting improvements in their lives, and in the lives of their children, is, therefore, critical to human progress.

CGIAR centres conduct research programmes in collaboration with a full range of partners in an emerging global agricultural research system. Food productivity in developing countries has increased through the application of research-based technologies. Other results include reduced prices of food, better nutrition, more rational policies, and stronger institutions.

The CGIAR focuses on five major research thrusts:

- Increasing productivity by building into plants greater resistance to insects and diseases that adversely affect productivity and the stability of production in the tropics. While protecting farmers from losses, these improved plants protect the environment because they require little, if any, chemical inputs.
- Protecting the environment by developing farming techniques and systems that reduce the impact of agriculture on the surrounding environment, new research methods to identify long-term trends in major agricultural environments and solutions to pressing environmental problems.
- Saving biodiversity through holding one of the world's largest collections of plant genetic resources that contains over 500,000 accessions of more than 3000 crop, forage and agroforestry species, including farmers' varieties and improved varieties and, in substantial measure, the wild species from which those varieties were created. The germplasm within the in-trust collection is made available to researchers around the world, on the understanding that no intellectual property protection is to be applied to the material.
- Improving policies since producers are heavily influenced by public policy.

The CGIAR's policy research aims to help streamline and improve policies that strongly influence the spread of new technologies and the management and use of natural resources.

- Strengthening national agricultural research by working with colleagues in national programmes, strengthening skills in research administration and management, and formal training programmes for research staff.

The West African Rice Development Association

Founded in 1971 and located in Côte d'Ivoire, WARDA has regional sites in Senegal and Ibadan. Its mission is to

... strengthen sub-Saharan Africa's capability for technology transfer and policy formulation, in order to increase the sustainable productivity of rice-based cropping systems while conserving the natural resource base and contributing to the food security of poor rural and urban households.

(http://www.warda cgiar.org/, p. 2)

WARDA's 17 member states include Benin, Burkina Faso, Cameroon, Chad, Côte d'Ivoire, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone and Togo.

Rice is the staple of more than 240 million people in West Africa and demand is growing, resulting in imports valued at an estimated US$1billion. To meet this crisis, research at WARDA is poised to bring a rice-based green revolution to West and Central Africa through the development of interspecific rices. Cellular biology techniques in interspecific hybridisation can overcome hybrid sterility barriers, leading to their rapid adoption in recent years by over 20,000 farmers in Guinea alone. Such an impact depends not only on 'edge' level scientific research, but also on WARDA's close co-operation with farmers, national research institutions, other centres and advanced level research institutions throughout the world.

WARDA, like other CGIAR centres located in sub-Saharan Africa, provides a dynamic model for pooling Africa's scarce research capacity and limiting the brain-drain of Africa's best scientists and technologists from the continent through provision of good terms of service, high-quality research facilities and professional contacts with science as practised at the highest level throughout the world. WARDA's links with national universities and other research institutions provides national researchers with limited financial support, and a professional challenge and dialogue. As important, through these links WARDA itself benefits from the experience and wisdom of grassroots level farmers.

The International Institute of Tropical Agriculture

The International Institute of Tropical Agriculture was founded in 1967 with a mandate for improving food production in the humid tropics and to develop sustainable production systems. IITA is staffed by approximately 80 scientists and other professionals from over 30 countries, and approximately 1300 support staff. Staff are located at the Ibadan campus, and also at stations in other parts of Nigeria, and in Benin, Cameroon, Côte d'Ivoire and Uganda. Others are located at work sites in several other countries throughout sub-Saharan Africa.

IITA's mission is to enhance the food security, income and well-being of resource-poor people primarily in the humid and sub-humid zones of sub-Saharan Africa by conducting research and related activities to increase agricultural production, improve food systems and sustainably manage natural resources, in partnership with national and international stakeholders.

IITA conducts research, germplasm conservation, training and information exchange activities in partnership with regional bodies and national programmes, including universities, NGOs and the private sector. The research agenda addresses crop improvement, plant health, and resource and crop management within a food systems framework and is targeted at the identified needs of four major agroecological zones – dry savanna, moist savanna, humid forests and mid-altitude savanna. Research focuses on smallholder cropping and postharvest systems and on the following food crops – cassava, cowpea, maize, plantain and banana, soybean and yam.

The International Livestock Research Institute

The International Livestock Research Institute works to improve the well-being of people in developing countries by enhancing the diverse and essential contributions livestock make to smallholder farming. Two-thirds of the world's domestic animals are kept in developing countries, where over 90 per cent are owned by rural smallholders. Ruminant animals provide poor farmers with the resources they need most – high-quality food, animal traction and transport, manure to fertilise croplands, a daily income through dairying and insurance against disaster. ILRI research products are helping to solve the severe problems that hold back animal agriculture, sustainable food production and economic development in the tropics.

ILRI, whose headquarters are in Nairobi, Kenya, is a non-profit institution governed by an international Board of Trustees. The institute belongs to the CGIAR. ILRI began operations in 1995 with consolidation of staff and facilities of two former CGIAR livestock centres: the International Laboratory for

Research on Animal Diseases (ILRAD), based in Nairobi, Kenya and the International Livestock Centre for Africa (ILCA), based in Addis Ababa, Ethiopia.

Feeding an extra 90 million people a year, most of them in developing countries, while preserving the earth's land, water and biodiversity, will challenge the world well into the first century of the new millennium. To help meet that challenge, ILRI supports Future Harvest, a CGIAR public awareness campaign that builds understanding of the critical role international agricultural research plays in forestalling a food and environmental crisis of the first order in the twenty-first century.

ILRI addresses these problems in seven programmes. Six programmes conduct research primarily to develop technologies that enhance tropical livestock enterprises. Three of the programmes focus on improving livestock nutrition, health and genetics – the traditional pillars of enhanced livestock productivity. (ILRI's animal health research is also applied in human health research with collaborating institutions.) Two programmes analyse policy instruments and interactions among people, livestock and the environment to isolate enabling agents for sustainable and equitable development of livestock agro-ecosystems. The sixth research programme integrates information from the other five programmes in systems models that help ILRI set priorities and assess the impacts of its research.

Work in a seventh programme helps to strengthen capacity for livestock research in developing countries. ILRI staff co-ordinate research networks, train technical staff in laboratory and field techniques, supervise and mentor graduate students, and provide information products and services to research, development and government workers. The programme helps organisations deliver the products of livestock research to farmers who need them most. ILRI also leads multi-partner research projects conducted largely in the field. These production-to-consumption projects target four systems: dairy production (Africa, Asia, Latin America), meat and milk enterprises that transect regions and economies (West Africa), mixed crop-and-livestock farming in the highlands (South America, Central Asia, East Africa), and rainfed crop-and-livestock farming (Southeast Asia).

ILRI also conducts research within a Systemwide Livestock Programme. This programme awards competitive grants to research projects submitted by ILRI and other Future Harvest centres of CGIAR, most of which work to improve production of staple food crops. The Systemwide Livestock Programme is co-ordinated by ILRI and representatives from 10 participating CGIAR centres. The projects funded by the programme aim to improve food and

natural resource management through research products that refine the integration of crop and livestock processes on small farms. ILRI supports livestock-related research in more than a dozen other initiatives and consortia of CGIAR and its partners.

The impacts of ILRI's work benefit the developing world. The main benefits are more income, food and natural resources for poor people. The end-users of ILRI's research-based technologies are predominately smallholder crop-and-livestock farmers in humid, sub-humid and semi-arid regions of the tropics and subtropics. The first users of ILRI's products, information and expertise generally are development agencies and the national agricultural research systems of developing countries.

Regardless of discipline or research topic, ILRI staff and their partners attend to issues spanning livestock agro-ecosystems as a whole – from environment to farm to market to consumption. They think through issues across the research continuum – from discovery to delivery to impact. Without worldwide partnerships with organisations that possess complementary expertise and resources, ILRI could fulfill none of its development objectives. ILRI offers opportunities for outsiders to collaborate not only in ILRI's research work but also in multi-institutional projects funded by the CGIAR Systemwide Livestock Programme. ILRI scientists leverage the institute's resources to form partnerships with other CGIAR centres and advanced research institutes around the world, with national and regional agricultural research centres in developing countries, with international research and development organisations, with non-governmental organisations and with the private sector. ILRI's collaborators thus gain entry into a global mega-network of livestock research for the poor.

The International Centre for Research in Agroforestry

Established in Nairobi in 1977, the International Centre for Research in Agroforestry is an autonomous, non-profit research body supported by CGIAR. ICRAF aims to improve human welfare by alleviating poverty, improving food security and enhancing environmental resilience in the tropics. ICRAF conducts strategic and applied research, in partnership with national agricultural research systems, for more sustainable and productive land use. It has five research and development themes: diversification and intensification of land use through domestication of agroforestry trees; soil fertility replenishment in nutrient-depleted lands with agroforestry and other nutrient inputs; socio-economic and policy research to allow policies that will benefit smallholders; acceleration of impact on farms by ensuring that research results are used; and capacity and institutional strengthening through training and the dissemination of information.

ICRAF works mainly in six ecologically distinct regions: the sub-humid highlands of Eastern and Central Africa; the sub-humid plateau of Southern Africa; the semi-arid lowlands of West Africa; the humid tropics of Latin America; the humid tropics of Southeast Asia; and the humid tropics of West Africa. These regions were chosen because they allow ICRAF to simultaneously tackle major poverty and environmental problems that can be addressed by agroforestry, with benefits in both areas. The first three eco-regions tackle the issue of overcoming exacerbated land degradation in areas of Africa with decreasing per capita food production. In the humid tropics, ICRAF is looking for alternatives to slash-and-burn agriculture at the margins of the world's tropical moist forests, where major global environmental damage is being done in the midst of rural poverty.

Conclusions

Ideally, capacity building should be a national effort. However, because of the high costs of training and the non-availability of staff and other training resources in some scientific disciplines in some countries, regional co-operation and centres of excellence for high-level manpower development remain viable alternatives. Both forms of networking make important contributions. Institutional networking as a concept for regional co-operation, as described in the Lagos Plan of Action, stressed that co-operation and collective self-reliance can only be effective when African states pool their resources to strengthen and make full use of the existing institutions. This, indeed, is the basis of networking.

The ANSTI model is an example of an institutional network for capacity building in science and technology that has produced results in the face of resource limitations. It has contributed to staff development in ANSTI institutions through training, research promotion, dissemination of science and technology information, and production of learning materials.

The CGIAR model as an example of networking has produced different, but equally important, results. Major breakthroughs have made, and are making, significant differences to national economies and peoples' quality of life. The centres retain Africa's best scientists to work on critical development problems, and through partnerships inspire many scientists working in national institutions. Unlike the ANSTI model, however, fewer personnel are involved and costs are much higher.