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Developing Mechanisms to Promote South-South Research in Science and Technology: the Case of the Southern African Development Community

Abstract:

The African continent has struggled to develop an indigenous agenda for science and technology research and development. Despite efforts since the 1960s, the results have been less than satisfactory. In the southern region, the Southern African Development Community (SADC) has attempted to play a coordinating role for science and technology, but is widely regarded to have been unsuccessful in this venture. Although many countries in the SADC region have elevated the science and technology (S&T) function to Ministerial level, the linkages between S&T, government, industry and higher education are tenuous at best. There has been much talk of policy driven development, but little in the way of action. This paper will sketch the history of S&T development in the SADC region and in particular the interplay between the local agenda and that of the advanced industrial countries. It will highlight the difficulties of conducting research against imbalances in resources and expertise by considering an initiative of the Department of Arts, Culture, Science and Technology that seeks to foster research cooperation between South Africa and the SADC region. The paper will explore the relations between and among state research institutions, higher education and industry in SADC and considers possibilities for local research co-operation.

Introduction

The return of South Africa to the community of nations has opened its borders and institutions to interaction with the African continent and beyond. Historically South Africa has been a magnetic pole for many of the peoples of Southern Africa, for the migrant workers who would work beneath the earth in the gold mines of Gauteng and for the migrant students who in many cases later came to inherit their homeland earth. The stream of mineworkers has slowed as the mines have closed, whereas the flow of students that was interrupted during the apartheid years has swelled, and is likely to surge as the consequences of an open immigration policy take effect.

Within the Southern African Development Community (SADC), South Africa is arguably the state with the most advanced science and technology (S&T) capacity and industrial activity. Given historic antagonisms of the apartheid era this leadership position conveys a responsibility toward the SADC to exchange expertise in these areas, foster innovation and develop capacity amongst its neighbours. This responsibility is both altruistic and necessary, in that strong regional economies will be to mutual benefit. Currently South Africa's major international collaborators are with scientists in the European Union (40%) and the United States (29%), clinical medicine being the main arena. For Africa the figure is a mere 4%. It is imperative to shift this balance to enable meaningful South-South cooperation. Without such, noble ideas of the 'African Renaissance' will remain empty.

The South African Department of Arts, Culture, Science and Technology (DACST), in support of the national system of innovation (NSI), launched two large multi-year programmes. These were the Innovation Fund, and the S & T Lead Programme. While the Innovation Fund seeks to promote domestic innovation partnerships that involve all players, the Lead Programme stretches abroad and involves only the domestic Science Councils. Their partners may be drawn from any region, and are mostly institutions in the North. Such developments must be seen in the context of burgeoning bi-lateral science and technology agreements. In the five years after 1994 no fewer than 33 new agreements were in force or close to finalisation, of which one third were with African countries. Arguably this is a suite of thrusts that promote knowledge development and transfer, but the historical bias away from the SADC region remains.

DACST accordingly commissioned a project[1] intended to strengthen technological capability in the SADC member states through a framework for cooperation. A small team of researchers was commissioned to seek ways to give substance to the cooperation at project level. On the South African side the Science Councils would coordinate higher education and other partners as needed. To open the possibilities of accessing European Union funding, possible 1 + 2 models were also to be explored with SADC partner institutions. The project therefore had to determine the extent of SADC capacity to engage in common projects and establish the constraints that might hinder such work.

Science and Technology in SADC

Following the independence of Namibia in 1990 and the legalisation of the liberation movements of South Africa, the SADCC in 1992 through the Windhoek Declaration transformed itself into the Southern African Development Community (SADC). The founding nine states have since been joined by Namibia, Mauritius, Seychelles, South Africa and the Democratic Republic of the Congo, making up a bloc of States with population of around 185m, all essential natural resources and a GDP (1998) of USD 182bn. SADC includes some of the poorest countries on the globe with the widest intra-communal disparities.

In their efforts to build the modern state, the governments of SADC have established institutions of higher education and other S &T organs. Together these comprise around two hundred entities that support and promote research and development in S&T. By and large these institutions are staffed with highly qualified nationals many with higher degrees earned in North America, Western and Eastern Europe. A significant investment in high-level skill has been made. While there has been some brain drain out of SADC to the West, a significant number of scientists, engineers and technologists remain in SADC, including those who have entered state administration, in research and technology organisations and in higher education. A regional 'brain gain' is also evident, with migration to greener pastures a common feature, one that is likely to be pulled southward through the new open door policy of the Mbeki government.

At policy level a useful overview is that of Ogbu, Oyeyinka and Mlawa[2]. Their main argument is that technology drives development. 'African economies require deep technological revolutions to bring about rapid structural shifts ... (within) an enabling macroeconomic environment and the ways that environment interacts with an effective technology policy' (ibid.5). They argue that technological capability is not an automatic outcome of capital accumulation and investment, but that successful technology transfer involves and requires time, skills of adaptation and continuous learning for which investment must be provided. Technological learning is not automatic and not necessarily expensive. But it must be managed and allowed for.

Accordingly the consequences of a '... lack of capacity for domestic capital-goods and machinery production is a singular characteristic of underdevelopment. ... SSA (Sub-Saharan Africa) is extremely weak, lacking the capacity to produce even the most basic tools for manufacturing ... (and) maintain the systems'(ibid. 9). One of the additional factors that contribute to this weakness is the lack of, or impossibility for interaction among a network of firms. When there is no domestic capital-goods sector, linkages with firms cannot emerge. Technological learning is limited and little technical change will occur. Turnkey projects generate forex (at least for a while), but the factory in a box does not stimulate local manufacturing, human resource development or R & D. Despite such turnkey projects the gap between the G- 8 countries and the rest widens. Accordingly what is argued for is a set of state-driven national systems of innovation that enable participation in the global knowledge economy.

Various studies[3 4 5] concur that critical obstacles to project implementation include poor physical infrastructure, lack of financial resources, inadequate management, planning and use of physical, financial and human resources, and weak or non-existent information systems.

A key policy instrument intended to promote regional cooperation is the *Protocol on Education and Training in the SADC.* In particular Article 8 of the Protocol lays out guidelines for cooperation in R & D. The protocol makes provision for higher education and R & D resource sharing, and recommends that within ten years all states should have their national S&T policy in place. This will serve as the basis for formulation of S&T Policy for SADC as a whole. Cooperation among the various R & D role players including the establishment of professional associations is urged, through which information might be exchanged and R&D quality enhanced. Overall there is a call for the promotion of mobility of researchers through relaxation of immigration regulations for the purposes of 'research, consultancy work and related pursuits' (ibid. 20). This might easily be interpreted as a device to promote elite activity.

Historically speaking, the S & T function in SADC, like gender, is a cross cutting activity, but is dealt with under human resource development, the function that is assigned to Swaziland. This had long been recognised as inadequate, and in May 1999 the SADC Secretariat declared S&T as a priority area and agreed to find means for the popularisation of S&T. The hanging question, not yet resolved, turns on the role that South Africa might play in this. As in other spheres of interaction, there are political sensitivities and fears of undue influence, as well as inter-State rivalries. As the interviewers were told on more than one occasion, so-called 'SADC' projects were often nothing more than national programmes marketed in the name of SADC. Strangely however, this did not appear to apply in the energy, transport and trade spheres.

A positive step taken by SADC was the establishment of a Gender Unit in the Secretariat. This followed the 1997 adoption of a policy framework for mainstreaming gender. A set of policies[6] has been published to serve as the basis for the work of this Unit. This is a timely move given the dominance of males in the R&D institutions of the SADC States.

In seeking to keep abreast with the impact of the unfolding knowledge society, the theme of the 1999 SADC Consultative Conference was Information Technology. Conference took a sanguine view of the benefits that a networked region might bring, echoing the World Bank Internet Report[7]: 'Countries which are able to seize the opportunities these technologies present will be able to leapfrog into the future, even though they lack a developed communications infrastructure today. In fact, countries with little existing infrastructure ... can proceed directly to the use of wireless technologies and fibre' (14). A Southern African Information Society would be a natural environment enabling R & D cooperation across the region and with the rest of the world. South Africa has since emerged as a major African player in rolling out communications networks of various kinds, ranging from cellular telephony to pay television.

Role of the Science Councils

South Africa is the southernmost member of the SADC, which it joined in 1994 after the inception of democracy and majority rule. It is the most developed economy in SADC, with a GDP of USD129bn, of which manufacturing is the major factor. The GNP/capita is USD 3200 but is marked with an exceptionally high Gini coefficient[8]. The country is rich in natural resources and self-sufficient in food, but like many developing countries is a net importer of technology.

The formulation of S&T policy and its coordination is the responsibility of the Ministry of Arts, Culture, Science and Technology. South Africa has chosen to conceptualise the broad functioning of its scientific organisations and institutions through the model of a national system of innovation (NSI). The NSI consists of the institutions and relationships among them as well as the policy and regulatory regime and infrastructure supporting their work.

Historically speaking the state-supported parts of the NSI operated largely in the interests of the minority through supporting industry and agri-business. Since the early 60s a large military industrial complex was spawned, that is today able to compete on the world market. Most recently[9], urgency has been given to refocusing the national S & T agenda in support of biotechnology, for which a national strategy is to be developed by July 2001. Other parallel initiatives are underway to strengthen the country's human resources. These include the reform of higher education[10], the tabling of a human resource development strategy, the bolstering of school science and mathematics education[11], and a high level push to engage with the issues that globalisation and the knowledge economy are bringing. Changes in immigration policy will allow for a more tolerant flow of skilled personnel into the country, especially from Africa. This will apply both to students and professionals, a move whose broader consequences cannot be fully anticipated. This shift in policy has acquired great urgency, given the impact that HIV/AIDS is expected to have on the economy and society.

Across all sectors government spends in the order of USD 1bn. on R&D, or about 0,8% of GDP. Industry is a relatively poor investor in R & D. Of the nine science councils, six may be regarded as performers of R&D, namely the Agriculture Research Council (ARC), Council for Geosciences (CGS), CSIR, Human Sciences Research Council (HSRC), Council for Mineral Technology (Mintek), and South Africa Bureau of Standards (SABS).

The ARC has projects with all SADC States through the Southern African Centre for Cooperation in Agricultural Research. However only around 2% of the ARC budget is spent with co-operating countries, and probably as few as 5% of their staff are involved in this at any one time. The Council for Geosciences co-operates with all SADC countries and spends about 8% of its total budget on this. The work typically involves local geological surveys, departments of mines, and departments of hydrology.

The CSIR regards itself as a funnel that brings technologies from all over the world, adapts them to suit local conditions, and deploys them where needed, thus acting as a bridge to transfer these capabilities into Africa. The CSIR has a strategic focus on Africa and at present has interaction and collaborative projects with 19 countries in Africa. These include collaboration with institutions in all the SADC countries, albeit with varying levels of activity. The CSIR's largest involvement in the international arena is in the field of environmental impact assessment and natural resource management. Currently less than 10% of the CSIR income from countries outside South Africa arises from SADC projects.

At the time of the study the HSRC had no agreements at institutional level with any SADC state.

Mintek's main interaction with SADC states is via commercial projects exercised in the private sector. Work of this nature is effected in Botswana, Malawi, Mozambique, Namibia, Tanzania and Zimbabwe. Much of this work is at the level of feasibility studies into mining, ore processing, instrumentation and process control, and recovery of metals from slag.

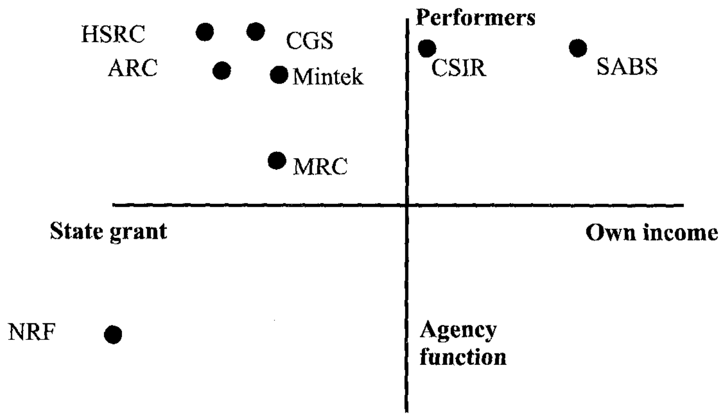
The MRC has had a number of projects relating to malaria with Angola, Botswana, Mozambique, Namibia, Swaziland, Tanzania and Zimbabwe. Trauma research is carried out with Malawi, Mozambique and Zimbabwe, while infectious diseases, drug resistance and AIDS research is carried out with many of the SADC states. Collaborators are the various ministries of health, universities and some specialist institutions.

SABS has had commercial contact with many of the SADC states, and is also active in training towards common standards.

Mention must be made of the National Research Foundation (NRF) that is both a grantmaker and manager of national research facilities that include a cyclotron, observatories and a fisheries research centre. These national facilities are available to countries in the region for training and collaborative projects. At present scientists from Namibia, Malawi, Zimbabwe and Zambia use the facility to train with observatory staff for extended periods (more than one month). Both the Southern African Large Telescope (SALT) and observatory are in the process of being established as African facilities. Grantholder-linked NRF bursaries have enabled other African students to study in South Africa. Ten percent of the total budget for these bursaries could be utilised for international students, with a strong contingent coming from other African countries.

As to the future, the provisions of the SADC Education and Training Protocol for students from SADC countries, coupled with the availability of bursaries, could lead to greater utilisation of NRF facilities than in the past.

Diagram 1: Taxonomy of the Science Councils



The activities of the science councils in the SADC states are wide ranging, from "public goods" through to strictly commercial, as would be expected from their domestic mode of operation. In a previous study[12] the Science Councils were categorised according to the schema of Diagram 1, that indicates the extent to which the organizations are self-financing as opposed to operating on the Science Vote alone. The various Science Councils are plotted out with reference to their role as performers or agents and the extent to which they earn income as opposed to disbursing grants. The point of introducing this schema is that it helps demarcate the type of projects that Councils might tend to engage in. A performer that has a large earned income stream may tend to seek contracts of a commercial nature. On the other hand a performer that works more in the public goods domain is more likely to seek donor-funded projects.

A broad overview of S & T performance in SADC

A starting point for an analysis of S & T activity in SADC begins with some comparisons across the different states.

The data in Table 1 summarise some of the main socio-economic indicators for the various states. Unfortunately the problems of social instability and inadequate information gathering systems mean that these figures are unreliable and can only be used for very broad comparisons. Where data are highly uncertain or unknown, this is depicted with '?'. In addition, the data for economic activity do not characterise the informal sector very well. Literacy is averaged across male and female, and this can be misleading for some countries.

The countries divide up into three main economic groupings:

- Lower income (GNP/capita < $785): Angola, Democratic Republic of Congo, Lesotho, Malawi, Mozambique, Tanzania, Zambia and Zimbabwe

- Lower middle income ($785 < GNP/capita < $1500) Namibia, Swaziland
- Upper middle income ($3125 < GNP/capita < $9655) – Botswana, Mauritius, Seychelles and South Africa. Except for Seychelles, the other three countries are at the bottom end of this range.

Table 1: Some basic indicators

Country	GDP (USD) bn.	GNP/ Capita (USD)	Service: agric	Population (m)	Income status	Urban/ rural %	Adult Literacy %	H.E. (R&D) Inst	Phone lines/ 1000	NRDCB	ISI pubs	S&T policy
Angola	7,7	260	3 (oil)	12	Lower	32	40	2 (?)	5	No	11	No
Botswana	5,0	3310	15	2	Upper mid.	65	75	2 (4)	56	BOTEC	104	Yes
D.R. Congo	6,1	110	0,5	47	Lower	29	?	16(?)	1	No	49	No
Lesotho	0,95	680	4	2	Lower	26	80	2 (2)	11	MNR	14	No
Malawi	2,5	210	1,2	10	Lower	14	40	5 (5)	4	NRCM	106	Yes
Mauritius	4,4	3970	6,5	1	Upper mid.	41	83	3 (5)	195	MRC	31	1999
Mozambique	2,8	140	1,4	17	Lower	23	28	5 (10)	4	No	33	No
Namibia	3,3	2110	2	2	Lower mid.	38	78	2 (6)	58	MHEST &VT	43	Yes
Seychelles	0,5	6910	17	0,08	Upper mid.	56	88	0 (2)	196	No	7	No
South Africa	129	3210	13	41	Upper mid.	55	84	36 (30)	107	DACST	4739	Yes
Swaziland	1,3	1520	2	1,0	Lower mid.	33	77	2 (2)	24	No	83	No
Tanzania	6,9	210	0,6	31	Lower	26	72	7 (25)	3	COST-EC H	283	Yes
Zambia	3,9	370	3	9	Lower	44	75	3 (5)	9	NCSR	107	Yes
Zimbabwe	8,9	720	3	11	Lower	33	91	5 (10)	17	SIRDC	272	1999

Sources: World Bank (1997) *World Development Indicators;* SADC (1999) *SADC in the Next Millennium;* International Association of Universities (1999) *Guide to Higher Education in Africa* London: Macmillan Reference; ISI data are counts of SCI, SSCI and A&HCI for 1997.

Among the four most prosperous states Seychelles has the highest GNP/capita. The other three are at the lower end of the upper middle income range, the unusual case in this group being Botswana whose social composition is unusually homogeneous with a minute expatriate and settler population. Arguably in terms of GNP/capita, infrastructure and composition of GDP, the three settler 'islands' have most in common with each other.

South Africa and Botswana are members of the Southern African Customs Union (SACU). Both countries in the lower middle income group are members of SACU, and have 'marched together'. The remaining member of SACU, Lesotho lies in the lower income group and is the country least endowed with agricultural potential or mineral resources. Until the completion of the Lesotho Highlands Water Scheme, its main income derived from migrant labour remissions. As a water and energy exporter one may expect Lesotho's GDP to rise dramatically from 1998 onward.

Two members of the lower income group are the former Portuguese colonies of Mozambique and Angola, whose economies were largely destroyed during and after independence. The former Belgian colony of the Democratic Republic of Congo has since independence struggled to establish state infrastructure. This leaves the former British possessions of Malawi, Tanzania, Zambia and Zimbabwe. All have a leading University, and in some cases, more than one. While Tanzania and Malawi have predominantly agriculture-led economies, both Zambia and Zimbabwe have through their mining industries an associated manufacturing sector. In the latter case this sector developed strong self-reliance during the period of sanctions from 1965 to 1980. The literacy figures for Zimbabwe are apparently very high, but given the post independence commitment to basic education are probably correct.

Unfortunately the conventional indicators for S&T activity, government expenditure on R&D (GERD), number of scientists and engineers, and scientific output are largely unavailable for the SADC states. South Africa is credited with some 17000 scientists and engineers active in R&D, while for Malawi the figure in their S& T policy documents is around 400. Even such crude data are unavailable for most states. Figures for elsewhere in Africa are equally unreliable especially as the number of research-active scientists is hard to quantify. In Table 1 therefore a number of indicators and proxies serve to describe the infrastructure needed for the conduct of science and technology. The basic elements of national systems of innovation exist in a number of states, but the linkage with any industrial sector is tenuous.

Over the period 1992 – 1996 SA was ranked 27th in the world by citations of papers produced[13], being slightly behind Argentina and ahead of Hong Kong, Mexico and Brazil. No other African country ranked among the top 30 scientifically active nations. Within SADC, of those countries for whom data were available, South Africa in 1997 produced 4739 papers, Zimbabwe 272 and Tanzania 283. From the ISI data in Table 1 it may be calculated that South Africa accounts for 80% of the SADC output. According to FRD statistics[14], South Africa, within Africa as a whole contributed 37% of the output, ahead of Egypt and Nigeria. This confirms yet again that South Africa plays a special role in the SADC region. That was the very reason driving the original establishment of SADCC as a defensive mechanism.

In the case of South Africa it is known[15] that 75% of journal publications are produced by the university sector. It is also the case in many countries that much competent research remains in reports that are not translated into peer-reviewed articles. Such practice may explain why Mauritius has an apparently low publication score in spite of having a well-developed agricultural research sector.

Among the upper middle income countries, Mauritius and Botswana are currently making strides in reconfiguring their S&T systems toward national goals. Both have well-functioning economies and well-established universities.

The two lower middle income countries, Namibia and Swaziland have very small S&T systems and are heavily dependent upon expatriate researchers. However both have particular strengths that may be engaged with.

Among the lower income countries Zimbabwe, given its huge investment in human resource development, and the developments around the National University of Science and Technology, may be expected to achieve greater levels of scientific output over the next decade or so.

Fundamentally, it would be inappropriate to slice up the states into those with whom cooperation should be effected on the grounds that the research infrastructure is already in place.

Through the project DACST sought to understand the potential for and constraints limiting cooperation in R&D with institutions in the SADC states, in other words a South-South cooperation. It is instructive to consider the findings of a previous study[16] commissioned to investigate the scope for targeted cooperation of South African R & D organs with institutions in the European Union, i.e. South-North. That study sought to identify world-class institutions and researchers in South Africa who could engage in collaboration with European Union peers with the aim of achieving added value outcomes and industrial spin-offs. The major findings of that study were that such potential existed, though the main concern of those surveyed was 'lack of funding and high costs of research'. External contacts among the local researchers were found to be quite strong – of publications surveyed 19% had foreign co-authors. Most existing cooperation was with Germany, the United Kingdom and France.

Four areas of common interest between South Africa and the then Framework Programme IV where collaboration already existed and could have been extended were found to be in: biotechnology, agriculture and fisheries, biomedicine and health, and sustainable management of renewable natural resources. That study also recommended that in order to maximise participation in Framework Programme V some institutional learning on the South African side would be needed, including networking, conference attendance and to actually participate in projects. It was further suggested that comparative studies of countries 'in a similar position' (Israel, Hungary, Canada, Australia and Switzerland) should be effected.

Those findings have clear relevance to any framework for South-South cooperation at two levels. First in terms of understanding the constraints to project work between parties whose economic strengths are widely divergent, and secondly through pinpointing areas of world class research taking place in

South Africa. It would be logical to hope that this research could be applied and extended in the SADC region.

How the SADC researchers see cooperation

It is difficult to present a uniform view of how previous experience with international S&T has transpired for the other SADC states. Some institutions that could form the basis for national systems of innovation are in place, but the impact of war; political instability, the imposition of structural adjustment policies and the disastrous falls in commodity prices mean the S&T systems in many states have all but collapsed. While the S&T institutions are today largely populated with nationals, many units are moribund with demoralised staff and ageing equipment. Funds for transport are limited and many scientists are performing largely administrative functions.

At the same time many of the lower and lower middle income countries have become dependent upon donors for the continued functioning of their S & T research systems. This raises the very real concern of who is in control of the S & T research agenda. Where relationships are so unbalanced, the existence of an official S & T policy in and of itself is no safeguard against usurpation of the research agenda.

On the other hand, some country economies have blossomed, S&T institutions have grown and are performing world class research and development. A network of SADC Centres of Excellence has been established, and are actively training a new generation of scientists and carrying out relevant research.

The concerns that scientists and administrators raise in regard to international cooperation must therefore be understood in the context of decline, dependence and loss of control. Broadly these concerns are:

1. In many countries the fear was expressed that donor-funded projects create well-resourced islands that lead to further fragmentation within institutions.
2. The imbalances of power had made some researchers feel as if 'we have moved from being hunter-gatherers to data gatherers' who performed basic tasks that would accrue to the benefit of academics in the North.
3. Researchers were concerned that donor technical assistance that was built into projects consumed a disproportionate share of the funds, that this amounted to 'recycling of money to and from the North', and was frequently of a nature that could well have been performed by a local researcher.
4. The devaluation of local currencies and erosion of income of highly qualified scientists has led many to turn to consulting as a survival activity. That many donor projects did not recruit local consultants is thus a further source of concern and fuels distrust of motives.

5. At the level of country experience there was generally movement of researchers from North to South and students from South to North. This also made for a feeling of inequality, and was further exacerbated where projects were made to fit into the northern partner timetable.
6. It was claimed by many researchers that cooperation with external partners who had access to greater resources led to 'swamping' within projects, such that the local voice was all but lost.
7. Perhaps the greatest concern related to intellectual property rights. It was frequently alleged that external researchers had appropriated data or specimens. This theme was a constant background in discussions and has become an urgent issue in the age of biotechnology and genetic engineering.
8. There were claims that the absence of ethical regimes for experimentation laid the SADC states open to the unscrupulous testing of humans, animals and crops by foreign parties within their borders.
9. Scientists face the very real prospect of becoming de-skilled since they lack the necessary equipment and other resources to work in their fields of specialisation. Put simply, scientific human capital has a finite shelf life.
10. There were many forms of brain drain and brain gain in operation, with scientists moving within the region and out of the region.
11. Researchers in many states were frustrated that politicians had not grasped the importance of funding research and building S&T systems. They felt that leadership was only interested in activities with a high likelihood of delivering immediate results. There was a problem of managing expectations.
12. Fears of dominance frequently arose, directed toward the rich countries of the North, South Africa and even East Africa.
13. Some government departments felt a strong need to control research especially where this intruded on sensitive issues such as threatened first peoples.
14. A caution was frequently offered that individual researchers were prone to advocate narrow interests to attract funds toward their own areas or institutions.
15. Appropriate technology was to be encouraged; appropriation of technology would be resisted.

These concerns illustrate sensitivity toward matters such as power relations, self esteem, mobility and intellectual survival.

Framework

Traditional socio-economic data as presented in Table 1 do not capture the whole story, particularly as this relates to the knowledge industries. Measuring the number of main lines per 100 of population tells one something of what the telephone infrastructure looked like a decade ago, but in the age of cellular telephony this is quite misleading. Virtually all SADC countries now have a cellular network in their capital cities. In some cases there is now more than one network provider and coverage extends to other major population centres as well. The top layers of government, industry and academe are in therefore in touch, mobile and independent of unreliable fixed line services. With the benefit of local wireless loop and the deployment of satellite channels for Internet access, researchers are now in contact with colleagues around the world.

Over the last five years universities and research institutes have to varying degrees become 'wired' and this trend can but accelerate. Such linkage has the potential to improve the sharing of information, broaden participation, and reduce isolation of researchers. While the Internet cannot substitute for direct hands-on experimentation, its deployment offers cost reductions and speed of data exchange that were unimaginable just a few years back. Infrastructure or not, provided a PC and phone line are in place, scientists can work together.

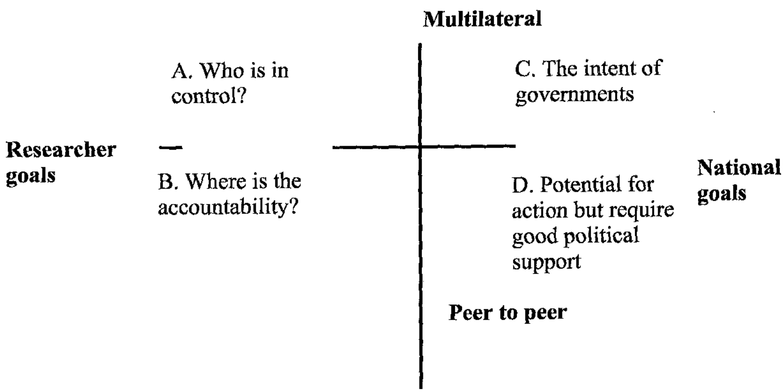
At one extreme one might argue that formal nation to nation bi-lateral agreements are needed. However the time and effort required to effect such agreements is an obstacle. Where such bi-laterals exist they may be used for setting up collaboration, but where they do not exist, other mechanisms must do.

At the other extreme might be a totally *laissez faire* approach that relies upon peer to peer or institution to institution networking. The argument would be that competent scientists know one another, will make contact and will get on with the job. Sadly, where the resources available to the different scientists are highly unequal, the emergent relationship may be flawed. Somewhere between the two is where funding is channelled through the appropriate national research and development co-ordinating bodies. Where such bodies do not exist the national university could assume the position of facilitator.

To the relations between individuals or nations must be added the purpose behind the relations and that brings one to the question of goals. All countries grapple with the problem of deciding where the self-interest of researchers both national and foreign ends and linkage to national interest begins.

Diagram 2 explores the four types of dynamics that such considerations produce. Where researchers determine the goals various forms of lack of accountability to local goals may arise. However this lack of 'goal' accountability does not necessarily preclude funds becoming available from sources external to the state. In an attempt to keep track of such relationships some SADC governments have or are drafting legislation that requires the registration of research. Turning to the diagram, in quadrant A. there is possible tension between researcher goals and what the other national parties are prepared to fund. Given the strong multilateral dimension such cooperation frequently involves significant numbers of expatriate researchers being on local ground. This serves to provide additional intellectual capital and project experience for local researchers, but it does tend to feed into many of the concerns that were listed above. The combination represented in quadrant B. arises from time to time where researchers are able to access their own funds. Typical cases are where a national retains links with the foreign university where they obtained their doctorate, or with the donor agency that made this possible. Fruitful work may arise out of such relationships, but these are often felt to threaten the national agenda.

Diagram 2: Goals and partners



Quadrant C. is appealing to governments – they feel in control and would believe that their national goals will be addressed. The limitation here is in persuading multilateral agencies that projects in support of the national goals are what they should fund. Another difficulty lies in getting all the parties onto the same timeline. Quadrant D. is certainly viable but depends on charismatic leadership that is able to marshall resources and sustain political support. Research activities that fit into these four possibilities were in evidence in many of the states.

With the above considerations in mind the following was proposed as a framework for cooperation:

1. Promotion of trans-national peer to peer interaction aligned with national goals and effected in cooperation with NRDCBs where such exist.
2. Concentration on activities that are squarely in the public goods domain. There are a number of reasons for this position that arise from direct historic relations as well as the general experience of the region. The primary goal must be to establish a relationship of trust with partner organisations. This may best be done through research where the fear of unilateral exploitation is kept to a minimum. By removing commercial gain from the equation along with its concomitant contractual aspects one goes some way toward this.

3. As the relationships mature and all parties become secure, more commercial benefit might be sought. Accordingly those agencies that are primarily seeking contractual work should at this stage do so outside the framework of the DACST SADC project.
4. Linkage with the productive sector must be a longer-term goal of the cooperation.
5. Well-defined projects that address immediate needs and fit national goals should be selected. Project identification could be based on goal directed needs, through an expression of interest, or where an existing project is recognised as having mutual benefit. Project plans should specify work breakdown structure; activity cost breakdown, intended deliverables, roles, responsibilities and the agreed mechanisms for decision-making and conflict resolution.
6. Where potential projects involve direct social impact it would be expected that stakeholder consultation will be effected as early as possible.
7. Given the public goods orientation, charges for goods and services would normally be levied at cost.
8. Where feasible the projects should involve postgraduate student development.
9. Intellectual property rights arising from the project work will primarily be dealt with through joint publication. A memorandum of understanding (MoU) would normally suffice to protect pre-existing rights.
10. A Steering Committee should monitor the projects in terms of ethical compliance, and gender balance, and be responsible for formative and summative project evaluation. The evaluation criteria should be built into the project design at the outset.

In addition a list of possible areas for research cooperation was identified.

Immediate outcome

The framework proposed through this research was adopted in early 2000, with the decision taken that peer-to-peer collaboration would serve as the mechanism for collaboration. A public call for proposals was placed across six SADC states and elicited 83 immediate responses. This would seem to indicate an enthusiasm for collaboration.

The eight projects that were supported range across development of a nutraceutical supplement, investigation of nitrate contamination of groundwater, marine policy harmonization, ethno-veterinary studies, establishing a database on land-cover, a development geographic information system, the role of legumes in soil improvement, and lastly, studies on cross-border air pollution.

On the South African side the players span CSIR, SABS, HSRC, ARC, UCT and Peninsula Technikon. On the SADC side the participants in the six countries include eleven parastatal agencies, five government departments and two SADC organs. Universities are notable by their absence, an explanation for which is yet to be forthcoming.

The 'Regional S & T Programme' is modest, with some $0,5m of funds awarded in the third quarter of 2000as a kick-off. The programme sits squarely in the public goods domain, where fees are low, since state subsidies operate.

Cross-country collaboration is complex, the more so where many parties are involved. Public funding demands public accountability, with the necessity for proper contracts and monitoring. At the time of writing the contracts had been signed, but no financial transfers had been effected.

For the moment then the jury is out. The framework exists, the parties are willing, the funds are available, a start has been made.

But there is perhaps another subtlety at work here. The eight projects all sit close to the resource exploitation and management domain, and by their very nature do not interact with the local industrial base where competitive interest dominates.

This is in sharp contrast with the project set of the Lead Programme that includes ground-breaking work on vaccines for animal heartwater disease and tuberculosis, the development of superalloys, and novel extraction metallurgy. It may be the case that no southern partners exist for cooperation in these fields and that is why northern groups were chosen. However the fact remains that 'Lead is North'.

The project fields that were identified (Appendix I) as viable and essential for south-south collaboration included high technology areas such as biotechnology and the ICTs, but these are essentially absent from this first round of funding for south-south collaboration.

It will be important to ratchet up the level of high-tech projects in the next round in order to dispel any sense that south-south means low tech.

Notes

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1. South Africa. *A Study on the Potential for Regional Co-operation in Science and Technology*, DACST, Pretoria 2000.
2. O.M. Ogbu, B.O. Oyeyinka and H.M. Mlawa (1995). *Technology Policy on Africa*. IDRC: Ottawa.
3. Chisholm e.a., (1998) SADC Initiative in Education Policy Development, Planning and Management.
4. Chipeta e.a. (1997) Review and Rationalisation of the SADC Programme of Action.
5. NUFFIC (1996) Feasibility study of a SADC Initiative for cooperation in mathematics and science education.

6. SADC (1999) Gender mainstreaming at SADC: Policies, Plans and Activities. Gaborone: SADC.
7. Knight, P. and Boostrom, E. (1995) Increasing Internet Connectivity in Sub-Saharan Africa: Issues, Options and World Bank group Role. Washington: Online World Bank Publications.
8. Nattrass, N. and Seekings, J. (2001) "Two Nations"? Race and Economic Inequality in South Africa Today. *Daedalus* Vol. 130, No. 1.
9. Mbeki,T. State of the Nation Address, 9 February 2001.
10. National Plan for Higher Education, Ministry of Education, Pretoria 2001.
11. Strategy for Science, Mathematics and Technology Education, Department of Education, Pretoria, 2000.
12. Performance Indicators for the Science Councils, Department of Arts, Culture, Science and Technology, Pretoria, 1998.
13. (ISI, 1999) National Science Indicators.
14. (FRD, 1998) South African Science and Technology Data Overview.
15. National Research and Technology Audit, Department of Arts, Culture, Science and Technology, Pretoria, 1997.
16. Segal Quince Wicksteed, CSIR and FRD (1998) Exploring the prospects for greater RTD cooperation between the European Union and South Africa. Final report to the Commission of the European Communities, DG XII.

Appendix I : Some possible projects and agents

Project area	*Science Council*
Agriculture and food security	
Crops: sweet potato, sugar	ARC, universities
Food technology	CSIR
Forestation	CSIR
Peri-urban agriculture	
Post harvest processing of crops	ARC
Soil management	ARC
Vermiculture/earthworms	
Water management	ARC
Environmental management	
Environmental impact	CSIR
Renewable energy (biogas)	CSIR
Zero Emissions Research Initiative	
Appropriate technology	
Cross border pollution	CSIR

Affordable shelter	CSIR
Effluent studies	Mintek
Marine/inland fisheries	
Marine biotechnology	
Fisheries	
Health	
Micro-nutrients	MRC
Weaning foods	CSIR
HIV/AIDs treatment, avoidance, education	MRC
Burn treatment	MRC
Tuberculosis treatment	MRC
Malaria prevention, diagnosis, treatment, management. (Also Bilharzia and other schistosomes.)	MRC
Medicinal plants (identification, sustainable propagation, processing)	CSIR
Biomedicine	MRC
Applied Science	
Biotechnology	CSIR
Remote sensing	CSIR, ARC
Forensic science	
Information and communication technologies including GIS and EMIS	CSIR
Geological mapping; GIS	CGS
Natural products research (e.g. Cassava as a feedstock for chemical industry)	CSIR
Policy research and social sciences	
Legal and policy work on intellectual property rights; information technology	
Social impact studies (e.g. Social Fabric of Mauritius)	HSRC
Development of common standards (commodity release legislation, seed quality standards, ethics governing biotechnology and animal experimentation)	ARC; SABS MRC
Capturing, strengthening and protecting indigenous knowledge	CSIR

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