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STUDY GOALS AND RESEARCH METHODOLOGY



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- To describe and understand the nature and state of scientific institutions in the region.
- To describe in some detail the modes of knowledge production (basic research, contract research, consultancy research and so on) prevalent in the region.
- To document the nature and extent of international funding agencies in their support of research in the region.
- To analyse and describe the nature and extent of scientific collaboration within the region.
- To describe and understand the main forms of dissemination of scientific information in the region and specifically the role of local and indigenous journals in this regard.

Study design and methodology

A mixed-methodology phased research design was followed with 4 main components:

- Desktop study of existing documents and statistics
- A web-based survey of the most productive scientists in the region
- Country field visits (11 of the 14 countries)
- Bibliometric analysis of ISI-papers



Centre for Research on Science and Technology Complete dataset per country

Country	Target number of respondents	Number of questionnaires completed	Number of interviews conducted	Total nr of questionnaires and interviews	Coverage of target
Angola	25	2		2	8%
Botswana	50	50	8	58	116%
DRC	30	28	2	30	100%
Lesotho	25	8	6	14	56%
Madagascar	50	37	10	47	94%
Malawi	50	49	25	74	148%
Mauritius	35	13	13	26	74%
Mozambique	40	20	2	22	55%
Namibia	40	36	17	53	133%
South Africa	200	244		244	122%
Swaziland	25	16	8	24	96%
Tanzania	100	55		55	55%
Zambia	50	24	11	35	70%
Zimbabwe	80	52	11	63	79%
Total	800	634	113	747	93%



THE DE-INSTITUTIONALISATION OF SCIENCE IN THE SADC REGION



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Numerous studies have been conducted over the past 10 – 15 years that demonstrate quite convincingly that research at former well-resourced and supported institutions in sub-Saharan Africa (such as Makerere University in Uganda, Ibadan in Nigeria and University of Dar es Salaam in Tanzania) have deteriorated; that research infrastructure and the general state of laboratories at many institutions have suffered from a lack of maintenance and timely replacement of old equipment. In addition the generally poor quality of library resources has not improved significantly with many university libraries not even using automated management systems; the demand for sufficient research funding for ongoing research and scholarship continues as does the need for proper research management and support at most of these institutions.

The cumulative effect of the funding policies of the last two decades of the previous millennium – especially of the World Bank, the huge growth in student enrolments in higher education institutions, combined with continuing political instability in many African countries have created a state of affairs which is best described as the "de-institutionalization" of science.



Science systems in developed and highly industrialized countries have a certain number of clear and evident features which together produce what could be termed the <u>national mode of</u> <u>scientific production</u>:

• <u>Density</u>: Such systems are well-populated with a diversity of scientific institutions. "Scientific institution" is defined as any formal organization or entity which is dedicated to the pursuit of scientific knowledge production, dissemination and utilization. This definition includes bodies that perform R&D such as university centers, laboratories and institutes as well as knowledge production entities outside the higher education sector. But it also includes scientific publishing houses, journals, conferences, workshops and seminars which are "organizations" for the dissemination of scientific knowledge. And it also includes bodies such as technology incubators, technology transfer offices, patenting offices and so on that promote the utilization and commercialization of scientific knowledge.

• <u>Articulation:</u> In a modern science system there are typically a multitude of institutions that perform clearly articulated functions and roles and together constitute the national system of science and innovation. In addition to the institutions listed above, there are bodies tasked with governance and oversight (A Ministry of S&T), with policy advice (NACI), with a funding agency role and other lobbying and advocacy bodies.

• <u>Social inscription of science</u>: In such systems science is well-inscribed in the social system with high degree of legitimacy, consistent support by the national government, healthy and critical public interest in matters of science and so on.



Few of the features of modern science system apply to many countries in the SADC region.

- <u>Fragility</u>: Many of the scientific institutions in these countries are fragile and susceptible to the vagaries of political and military events and are severely underresourced and suffer because of a lack of clarity and articulation of science governance issues (demonstrated by constant shifts in ministerial responsibility for science). In fact, one could even refer to some of these science systems and the associated institutions as operating in a "<u>subsistence</u>" mode where they struggle to even reproduce themselves. A "subsistence mode" refers to a system that basically produces knowledge for its own use only and does not export knowledge. In fact it does not make a significant contribution in the global game of knowledge production.
- <u>Individualism</u>: Under these circumstance individual scientists are often forced to only focus on the promotion of their own careers and CV's (as a survival strategy).
- <u>Assemblage</u>: It is debatable whether one can talk of a science "<u>system</u>" in many of these countries as they do not exhibit typical "systemic" characteristics. Institutions are not typically aligned through input, process and output flows and there is no typical systemic behavior in response to external changes and demands. Rather, the image of an "<u>assemblage</u>" of fragile, somewhat disconnected and constantly under-resourced institutions is perhaps a more apt metaphor to describe the science arrangements in some of these countries.



THE GOVERNANCE OF SCIENCE



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Centre for Research on Science and Technology Governance of science overview

Country	Science Policy Document	Date issued	Ministry of Science & Technology	Date of establishment
Angola	No	-	Yes	1997
Botswana	Yes	1998	Yes	2002
DRC	No	-	Yes	2003
Lesotho	Yes	2003	Yes	-
Madagascar	No	-	-	-
Malawi	Yes	1991 (revised 2002)	Yes	2004
Mauritius	No	-	Yes	-
Mozambique	Yes	2003	Yes	2000
Namibia	Yes	1999	No	-
South Africa	Yes		Yes	
Swaziland	No	-	No	-
Tanzania	Yes	1996	Yes	1990
Zambia	Yes	-	Yes	1992
Zimbabwe	Yes	2002	Yes	2002

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- As far as science policy development is concerned, our study suggests that it is possible to discern at least three very different trajectories:
- The first trajectory refers to those countries which have gone through two waves of science policy development: during the first wave (not too long after acquiring independence) a first S&T policy was developed but during the subsequent years was allowed to become dormant and ineffectual. A second wave of policy revision was instigated more recently (1990's and after) in order to recapture the essence of the science policy goals (examples of South Africa and possibly Zimbabwe).
- The second category consists of countries that established their first S&T policy documents in the 1990's and even more recently (after 2000): These include countries such as Botswana, Lesotho, Malawi, Mozambique, Namibia and Tanzania.
- A third and small category of countries in the region still does not have a S&T policy, viz. Angola, DRC, Madagascar, Mauritius and Swaziland.



R&D INTENSITY



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Country	GERD/ % GDP	Headcount of academic staff	Headcount of researchers in public sector	Total nr of FTE researchers	Nr of FTE researchers per million of pop
Angola	N/a	1329 (2006)	Est. 20 (2002)	167?	8?
Botswana	0.43% (2005)	827 (2006)	Est. 100	265	139
DRC	0.4% (2004)	9092	664 (2004)	2500	38
Lesotho	0.1% (2004)	370 (2007)	24 (Khalil,2000)	69?	33?
Madagascar	0.12% (2000)	900	260	440	23
Malawi	N/a	747 (2007)	Est. 240 (1999)	389	29
Mauritius	0.29% (1997)	Est. 500	Est. 80	180	150



Country	GERD/ % GDP	Headcount of academic staff	Headcount of researchers in public sector	Total nr of FTE researchers	Nr of FTE researchers per million of pop
Mozambique	0.58% (2005)	2109 (2004)	468/ FTE 374 (2002)	795	38
Namibia	N/a	86 (2006)	Est. 67 (1998)	84	42
South Africa	0.87% (2004/5)	18270	2823 (2005)	6329	135
Swaziland	N/a	328	n/a	60	55
Tanzania	0.35%	2735 (2005)	Est. 500	1047	27
Zambia	0.1% (2004)	815 (2004)	Est. 100	263	23
Zimbabwe	-	1100	300	520	42



SCIENTIFIC OUTPUT IN THE SADC REGION



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Crest Centre for Research on Science and Technology Figure 2: ISI Output by country (excl. RSA) [1990-2007]





Country	1990-1995	Rank	2002-2007	Rank	Gain
South Africa	22515	1	29225	1	•
Zimbabwe	1458	2	1460	3	V
Tanzania	1132	3	2248	2	
Zambia	510	4	696	6	V
Malawi	424	5	922	5	
Botswana	280	6	948	4	
DRC	264	7	242	11	V
Madagascar	235	8	675	7	
Namibia	197	9	423	8	
Mozambique	134	10	366	9	
Mauritius	96	11	313	10	
Lesotho	79	12	68	14	V
Swaziland	71	13	93	12	
Angola	44	14	81	13	
Total	27439		37760		



- South Africa is the most prolific and productive producer of scientific output in the region. It dominates scientific production by producing on average 80% of all output for the period 1990 – 2007 and being about 4 times more productive than the average for the region (119 papers per million of the population compared to the average of 29 papers per million of the population in the region)
- In terms of absolute output, Tanzania is ranked second behind South Africa having pushed Zimbabwe into the third position over the past five years.
- Botswana is the second most productive country with 96 papers per million of the population. The only other countries that have above average productivity scores are Mauritius and Namibia.
- Scientific output in the region is dominated by the biodiversity of the eco-systems and the very strategic demand for medical research in such fields as infectious diseases and tropical diseases.



THE FUNDING OF SCIENCE



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The state of national and institutional funding agencies



Country	National Funding Agency	Central co-ordinating office for research funding at main universities?
Angola	No	No
Botswana	Yes [Botswana Research Science and Technology Funding Agency] (BRSTFA)	University of Botswana Research Department
DRC	No information	No information
Lesotho	No	Director, Research and Graduate Studies, National University of Lesotho
Madagascar	No	No information
Malawi	Yes [National Research Council of Malawi] (NRCM)	Research and Publications Committee (University of Malawi)
Mauritius	No	No information
Mozambique	Yes [National Research Fund (Fundo Nacional de Investigação – FNI)]	No information



The state of national and institutional funding agencies



Country	National Funding Agency	Central co-ordinating office for research funding at main universities?
Namibia	No	No information
South Africa	Yes (National Research Foundation)	Yes (The majority of South African universities as a central Research Office which manages external flows of research funding)
Swaziland	No	UNISWA Research Centre (URC)
Tanzania	Yes [COSTECH (Tanzania Commission for Science and Technology)]	Research and Post-Graduate Studies Office, UDSM (University of Dar es Salaam)
Zambia	Yes [National Science and Technology Council (NSTC) - Science and Technology Development Fund]	Directorate of Research and Post- Graduate Studies (UZ)
Zimbabwe	Yes [Scientific Industrial Research and Development Centre (SIRDC)]	No information

Crest Intre for Research on Ence and Technology Funding of science: Salient points

- The lack of national government commitment to the stated ideals of expending 1% of GDP on R&D
- The lack of a central infrastructure for co-ordinating and facilitating science funding (and its alignment with national research goals)
- The huge dependence on foreign funding for S&T in the majority of countries and most of the universities in SADC (with the exception of South Africa) – 6% of survey respondents in South Africa said that more than 70% of their total research funding comes from international funding organisations; the comparative figure for the other SADC countries is 42%.
- The relative lack of institutional research offices for coordinating and facilitating research funding within universities.



THE ROBUSTNESS OF THE INSTITUTIONS OF SCIENCE



UNIVERSITEIT•STELLENBOSCH•UNIVERSITY jou kennisvennoot • your knowledge partner **Dimensions of robustness in science**

- Degree of dependency on external (international) funding (slides above)
- Building science through (long-term) research
 programmes rather than individual projects
- Extent and nature of scientific collaboration
- Size of project funding
- Extent of consultancy work
- Dependency of PG-students on external universities
- Disposition to emigrate (brain drain)
- Academic societies

Centre for Research on Science and Technology Standalone vs. "programmatic" projects

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Is your project part of a broader re	R	RSA versus rest			
programme of your institution?		RSA	Other SADC	Total	
Yes	Count	82	177	259	
	%	31.7%	68.3%	100.0%	
No – my research is my own stand-	Count	127	93	220	
alone project	%	57.7%	42.3%	100.0%	
No – but my research forms part of a	Count	18	34	52	
programme of another institution in my country	%	34.6%	65.4%	100.0%	
No – but my research forms part of a	Count	13	62	75	
programme of an institution outside my country	%	17.3%	82.7%	100.0%	
Total	Count	240	366	606	
	%	39.6%	60.4%	100.0%	



- Our study provides strong evidence for collaboration in most fields of science in the region. But intra-regional collaboration amongst countries in the SADC region is evidently less than extra-regional collaboration. Collaboration is mostly with countries in the North – whether such collaboration is driven by well-established networks based on mutual interest or by the availability of funding from donor agencies in the North (which often make collaborations with scientists in the donor country easier), is not clear.
- Moreover, scientists and scholars from South Africa are involved in less joint activities across the whole spectrum of the research process (from conceptualisation and writing of proposals to execution and publication) than their counterparts in the other SADC countries. We would suggest that this collaboration is a correlate of the fact that scientists in the other SADC countries cooperate more internationally because of their greater reliance on overseas funding.

<u>*CVESt*</u> Kinds of research activities that are performed jointly with other scientists/researchers

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Research activity	South Africa	Other SADC
Joint writing of funding proposals	38.6%	61.4%
Joint conceptualisation/ planning of research	43.3%	56.7%
Joint execution of research	39.6%	60.4%
Joint publication of research (e.g. writing reports, articles)	41.4%	58.6%

<u>Crest</u> Centre for Research on Science and Technology Size of project funding (RSA vs. SADC Rest)





- The picture about involvement in research projects is a complex one. On the one hand, our respondents on average are involved in more than 2 projects at any given time and in many fields this increases to 3 or 4. Significant percentages of our respondents indicated that they are involved in research that is jointly done with foreign collaborators but it is also clear that South African scientists overall have more money for projects which is a likely explanation for the fact that they engage in more standalone projects. South African scientists also seem to access the big funding as they are more likely to have projects with funding in excess of \$250 000 than their counterparts in other SADC countries.
- But the personal interviews also paint a picture of huge teaching loads, lack of research interest in many institutions and a general lack of funding for the average scientist.



- As far as the extent of consultancy work is concerned, the majority of our survey respondents (62%) indicated that they are involved in consultancy of some kind. The proportions of respondents by country that indicated that they engage in consultancy range from 50% (Lesotho) to 72% (Malawi and Zimbabwe).
- What types of consultancy are the respondents involved in?
 - 21% indicated that they do consultancy for academics in their country
 - 8% said that they consult for academics in other African countries
 - 7% do consultancy for academics in non-African countries
 - 36% consult for their governments
 - 8% consult for governments of other African governments
 - 30% consult for the industry sector in their country
 - 4% consult for industry in other African countries







; International flow of students at the tertiary level - 2004

Country	Students from a given country studying abroad			Top five destinations for outbound mobile	Nr of students	Net flow of mobile students	
	Total	Outbound mobility rate (%)	Gross outbound enrolment ratio	students	from abroad studying in given country	Total	New flow ratio (%)
Angola	5942	45.9	0.4	Portugal (3367) ⁻ , South Africa (839), USA (442), Namibia (354), France (205)	50	-5892	-45.4
Botswana	9471	71.6	4.5	South Africa(7012), Australia (792), UK (700), USA (488), Malaysia (152) ⁻	n/a	n/a	n/a
DRC	3956	6.6	0.1	Belgium (1271),France (816), South Africa (378),USA (340), Burundi (276)	n/a	n/a	n/a
Lesotho	4537	74.3	2.0	South Africa (4366), UK(42), USA (39), Australia (15)	116	-4421	-72.4
Mada- gascar	3995	9.5	0.2	France (3487), USA (109), Germany (100), Switzerland (80), Canada (41) ⁻	1219	-2776	-6.6
Malawi	1438	28.3	0.1	South Africa (417), UK (404), USA (399), Australia (77), Canada (22)	n/a	n/a	n/a
Mauritius	7224	40.6	7.0	France (1893), South Africa (1732), UK (1646), Australia (860), India (366)	75	-7149	-40.2



International flow of students at the tertiary level - 2004

Country	Students from a given country studying abroad			Top five destinations for outbound mobile students	Nr of students	Net flow of mobile students	
	Total	Outbound mobility rate (%)	Gross outbound enrolment ratio		from abroad studying in given country	Total	New flow ratio (%)
Mozam- bique	2366	10.6	0.1	Portugal (1066 ⁾⁻¹ , South Africa (815) ⁻¹ , USA (93), UK (71), Australia (67)	n/a	n/a	n/a
Namibia	6847	58.1	3.5	South Africa (6530) ⁻¹ , USA (95), UK (74), Australia (24), Germany (16)	1026	-5821	-49.4
South Africa	5619	0.8	0.1	USA (1971), UK(1408), Australia(643), Cuba (340), Germany (196)	49979	44360	6.2
Swaziland	2106	31.9	1.7	South Africa (1882 ⁾⁻¹ , USA(86), UK(67), Lesotho(17), Australia(13)	127	-1979	-30.0
Tanzania	3907	9.1	0.1	USA(1471), UK(1053), South Africa (283) ⁻¹ , Australia (119), Germany (115)	275	-3632	-8.5
Zambia	3610	14.7	0.3	South Africa (1363) ⁻¹ , USA (859), UK (541), Australia (317), Namibia(228) ⁻¹	n/a	n/a	n/a
Zimbabwe	16669	29.9	1.1	South Africa (10586) ⁻¹ , UK(2741), USA (1999), Australia (892), Namibia (71) ⁻¹	n/a	n/a	n/a



	RSA ve	rsus rest	Frequency	Percent	Valid Percent
South	Valid	Yes	33	13.5	14.0
Africa		No	202	82.8	86.0
		Total	235	96.3	100.0
	Missing	System	9	3.7	
	Total		244	100.0	
Other	Valid	Yes	93	23.8	24.8
SADC		No	282	72.3	75.2
		Total	375	96.2	100.0
	Missing	System	15	3.8	
	Total		390	100.0	

<u>Crest</u> Centre for Research on Science and Technology Membership of academic societies







THE VISIBILITY OF SCIENCE IN THE REGION



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- atterns of scientific tists in all countries
- Our study demonstrates the complex patterns of scientific publishing in the region. Although scientists in all countries appreciate that publishing in foreign journals is preferable because of their high visibility and scholarly quality, lack of opportunity to publish in such journals acts as a constraint to many.
- But there are many other constraints: lack of funding for proper equipment that impacts on experimental results, lack of scientific writing skills, perceived unfair competition even for local journals and so on. These constraints force many scholars and scientists to publish in local journals even if they are not peer-reviewed as the pressure to publish is a pervasive criterion in all performance appraisal systems.
- The lack of a culture of publishing in certain very applied environments (such as engineering) coupled with the need and practice of consultancy and technical service-delivery also impact negatively on scientific publication. Language is an issue as was evidenced from our interviews in Francophone countries and the de facto dominance of English as the international publishing language is seen as a serious constraint and challenge.



NATIONAL DEVELOPMENT GOALS AND SCIENTIFIC RESEARCH



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To what extent is science in the region addressing or attempting to address the most important development goals of the respective countries? Do scientists pursue research topics and projects that are consistent and supportive of national socio-economic priorities in the country or are these of secondary concern?

The results show that scientists in all countries are primarily driven by their own interests and preferences but with an interesting difference of 15% between RSA and the rest of SADC respondents. Respondents across all countries are motivated by the availability of international funding but this is more the case (not surprising given our previous results) of scientists from other SADC countries. Perhaps the most significant result is the fact that a much bigger proportion of respondents from other SADC countries (89% compared to 67% of RSA respondents) are motivated by a concern for the development agenda of the country.

Crest Centre for Research on Science and Technology National development goals and scientific research





RECOMMENDATIONS



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Recommendation 1

Improving Intra-regional research collaboration



Scientific collaboration in the SADC region is mainly a function of traditional (in some cases colonial) linkages as well as available international funding support. This has led to a situation where South-North collaboration is the norm rather than collaboration with countries in the region. It is desirable to increase intra-regional collaboration, not only because of the positive effect it would have on strengthening regional institutions, but also because of significant commonalities in scientific priorities in such areas as infectious diseases, astronomy, water and marine resources, environmental biodiversity, social cohesion, regional history, democracy and citizenship.

<u>Recommendation</u>: That SARUA considers various mechanisms to improve intra-regional scientific collaboration especially amongst university researchers in the region. In addition to the strengthening of scientific journals and regional networking, the development of a regional knowledgebase of scientific projects and scholars in the region could be utilized to support various regional collaborative ventures.



Recommendation 2 Increase funding of research



Our study shows that the lack of sufficient funding for research is the most often cited reason that constrains research in the region. This is mainly due to the fact that the majority of governments in the region do not allocate sufficient national funds for R&D which results in the huge dependence on international funding sources.

<u>Recommendation</u>: That SARUA considers the following three mechanisms to address this problem:

• To embark on a deliberate advocacy and lobbying campaign to persuade national governments to make true on their commitments to allocate 1% of GDP to R&D;

• To assist universities in the region to gain access to international funding sources through such services as Research Africa;

• To conduct workshops with researchers on developing funding proposals so as to increase their success rate in application for overseas funding.



The field visits that were conducted as part of our country visits confirmed that most universities, including the most research active, do not have adequate research management infrastructures in place. Most universities in the region do not have well-developed and well-functioning research directorates in place. Crucial functions such as gathering research and postgraduate statistics, developing and implementing research capacity building programmes and advising on matters related to the integrity of research, intellectual property and knowledge transfer are not always done.

<u>Recommendation:</u> That SARUA collaborates with organizations such as SARIMA (Southern African Research and Information Management Association), ACU (Association for Commonwealth Universities) and the SRA (Society for Research Administrators) in strengthening the research management capacity of universities and other research organizations in the region. These organizations have for some years now been involved in developing and conducting courses for research directors and officers in African countries in order to strengthen the institutional capacity in research management.





Although our study did not aim to focus on brain drain in any detail, the findings from our survey show that this remains a major issue. The fact that academic salaries are poor and working conditions in many universities are not conducive to research, force many academics into consultancy and/or considering leaving their countries. Similarly, the lack of sufficient Masters and especially Doctoral programmes at many universities force post-graduate students to consider studying at great costs elsewhere. Although it is unlikely that SARUA can directly address brain drain from the region, it can make a positive impact on student and staff mobility rates within the region.

<u>Recommendation:</u> That SARUA considers a number of initiatives that would make it more attractive for post-graduate students in the region to study and stay here rather than consider studying abroad:

- First, that SARUA uses its own communication media to provide doctoral students in the region with information on doctoral programmes offered in the region;
- Second, that SARUA gets involved in regional initiatives which aim to prepare and train post-graduate students better for doctoral studies;
- Third, that SARUA considers conducting workshops for academics in the design and implementation of new doctoral programmes.



African science in general and science in the SADC region suffers from a lack of international recognition. One of the reasons for this state of affairs relates to the lack of sufficient high-quality scientific journals in the region as well as lack of sufficient resources for efficient peer review and editorial practices.

<u>Recommendation:</u> That SARUA considers initiatives that would strengthen regional journals with regard to quality and editorial management. We would also recommend that consideration be given to the establishment of one or two regional journals of high quality that would serve the needs of local researchers. In these efforts SARUA should consult with the Academy of Science of South Africa (ASsaf) who is currently involved in such a venture in South Africa as well as the work of African Journals Online (AJOL) housed at Grahamstown.



Various bodies and organizations (international and African) are involved in some way in promoting and supporting research in the SADC region. These bodies would include the AU, NEPAD, ICSU, SARIMA, OECD, UNESCO, ACU, EU and many more. International funding agencies such as the World Bank, USAID, the Bill Gates Foundation, SIDA/Sarec, DFID, NORAD, DANIDA, the Ford Foundation, Carnegie Corporation of New York, the Kellog Foundation and many more all active the region. There are a few organizations – such as Research Africa and SciDevNet – that gather systematic information on scientific activities in the region. However, there is no central database or study of all of these initiatives as they apply to SADC. Our survey has begun to identify the main role players and agencies, but further follow-up work is required in order to produce a more comprehensive and definite picture of these initiatives.

<u>Recommendation:</u> That SARUA considers commissioning a study that would map existing actors and initiatives (funding, training and information gathering) in the SADC that would provide stakeholders with a more comprehensive picture of the state of research in the region. Such a study would be a useful resource to support many of the actions proposed under the recommendations above.



Thank you



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