Mapping research systems in developing countries

Country report: The Science and Technology system of Tanzania

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THE UNITED REPUBLIC OF TANZANIA

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Section 1: The political environment[1]

The United Republic of Tanzania was formed out of the union of two sovereign states namely Tanganyika and Zanzibar. Tanganyika became a sovereign state on 1961 and became a Republic the following year. Zanzibar became independent on 1963 and the People's Republic of Zanzibar was established after the revolution 1964. The two sovereign republics formed the United Republic of Tanzania in 1964.

From independence in 1961 until the mid-1980s, Tanzania was a one-party state, with a socialist model of economic development. Beginning in the mid-1980s, Tanzania undertook a number of political and economic reforms. In January/February 1992, the government decided to adopt multiparty democracy. Legal and constitutional changes led to the registration of 11 political parties. Two parliamentary by-elections (won by CCM, The Chama Cha Mapinduzi) in early 1994 were the first-ever multiparty elections in Tanzanian history.

In October 2000, Tanzania held its second multi-party general elections. The ruling CCM won the presidential and parliamentary elections. The elections were marked by irregularities, especially in Zanzibar, and subsequent political violence claimed at least 23 lives in January 2001.

In October 2001, the CCM and the CUF (the Civic United Front) parties signed a reconciliation agreement which called for electoral reforms on Zanzibar and set up a Commission of Inquiry to investigate the deaths that occurred in January 2001. The agreement also led to the presidential appointment of an additional CUF official to become a member of the Union Parliament. Changes to the Zanzibar Constitution in April 2002 allowed both the CCM and CUF parties to nominate members to the Zanzibar Electoral Commission. In May 2003, the Zanzibar Electoral Commission conducted by-elections to fill vacant seats in the parliament, including those seats vacated by the CUF boycott. Observers considered these by-elections, the first major test of the reconciliation agreement, to be free, fair, and peaceful.

In December 2005, presidential and parliamentary elections took place, with the Zanzibar poles once again marred by violence and intimidation. Elections in mainland Tanzania proceeded with few problems, and the ruling party won by over 80% of the vote and secured additional parliamentary

[1] U.S. Department of State, http://www.state.gov/r/pa/ei/bgn/2843.htm

seats. Elected President Kikwete and his party members will serve until the next general elections in 2010. Similarly, Zanzibar President Karume and members of the Zanzibar House of Representatives also will complete their terms of office in 2010.

Section 2: Country characteristics

2.1 Basic economic outlook[2]

Since 1986, the Government of Tanzania initiated an adjustment program to dismantle state economic controls and encourage more active participation of the private sector in the economy. The program included a comprehensive package of policies which reduced the budget deficit and improved monetary control, substantially depreciated the overvalued exchange rate, liberalized the trade regime, removed most price controls, eased restrictions on the marketing of food crops, freed interest rates, and initiated a restructuring of the financial sector. The World Bank, the International Monetary Fund, and bilateral donors have provided funds to rehabilitate Tanzania's outdated economic infrastructure and to alleviate poverty. These measures have lead to an average overall GDP growth rate of 6% a year over the past seven years. This is higher than the annual average growth of less than 5% in the late 1990s, but not enough to improve the lives of average Tanzanians. The economy remains overwhelmingly donor-dependent.

Agriculture seems to have dominated the economy until recently, providing about 42% of GDP in 2005. In 2008, this figure dropped to only 27%. The services sector (with 50.3% in 2008) now provides the largest contribution to GDP. The industry sector is also growing (17.2% of GDP in 2004 to 22.7% in 2008). The main industrial activities (90%) are dominated by small and medium sized enterprises (SMEs) specializing in food processing including dairy products, meat packing, preserving fruits and vegetables, production of textile and apparel, leather tanning and plastics. A few larger factories (10%) manufacture cement, rolled steel, corrugated iron, aluminium sheets, cigarettes, beer and bottling beverages, fruit juices and mineral water. Other factories produce raw materials, import substitutes, and processed agricultural products. Poor infrastructure in water and electricity supply systems continues to hinder factory production. In general, Tanzania's manufacturing sector targets primarily the domestic market with limited exports of manufactured goods. Most of the industry is concentrated in Dar es Salaam.

Despite Tanzania's past record of political stability, an unattractive investment climate has discouraged foreign investment. Government steps to improve the business climate include redrawing tax codes, floating the exchange rate, licensing foreign banks, and creating an investment promotion centre to reduce bureaucracy.

Zanzibar's economy is based primarily on the production of cloves (90% grown on the island of Pemba), the principal foreign exchange earner. Exports have suffered with the downturn in the clove market. Tourism is a promising sector with a number of new hotels and resorts have been built in recent years. The Government of Zanzibar legalized foreign exchange bureaus on the islands before the mainland Tanzania moved to do so. The effect was to increase the availability of consumer commodities. Furthermore, with external funding, the Government of Zanzibar plans to make the port of Zanzibar a free port. In 2007, the rehabilitation of Zanzibar's port facilities commenced with assistance from European donors. The island's manufacturing sector is limited mainly to import substitution industries, such as cigarettes, shoes, and process agricultural products. In 1992, the

[2] CIA Fact Sheet; U.S. Department of State, http://www.state.gov/r/pa/ei/bgn/2843.htm

government designated two export-producing zones and encouraged the development of offshore financial services. Zanzibar still imports much of its staple requirements, petroleum products, and manufactured articles.

Some of the basic economic indicators are summarized in Table 1.

Table 1: Selected economic Indicators of Tanzania

BASIC ECONOMIC DATA	
GDP	$56.22 billion (2008 est.)
GDP-Growth	7.1% (2008 est.)
GDP per capita	$1.400 (2008 est.)
Inflation Rate	9.3% (2008 est.)
GDP composition per sector agriculture industry services	 27% 22.7% 50.3% (2008 est.)

Source: CIA Fact Sheet and US Department of State

2.2 Demographic characteristics

The following table is a summary of the geopolitical characteristics of Tanzania.

Table 2: Summary of geographic and demographic characteristics of Tanzania

GEOGRAPHY	
Area	Mainland 945 000sq m, Zanzibar 1658 sq m
Cities	Capital –Dar es Salaam, Major metropolises –Arusha, Mwanza, Dodoma, Mtwara, Stonetown, Zanzibar
Climate	Varies from tropical to arid to temperate

Table 2 Continued

DEMOGRAPHY	
Nationality	Tanzanian(s) Zanzibar (s)
Population	40 213 160, Mainland-39.3m, Zanzibar 1m (2008 est.)
Religions	Muslim 35%, Christian 30%, Indigenous beliefs 35%, Zanzibar – more than 99% Muslim
Language	Kiswahili (official), English
Education	Literacy: 69.4% (2003 est.)
Health	Infant mortality rate-70 deaths/1000 live births HIV/Aids adult prevalence rate: 6.5% (2003 est.)
Workforce	Agriculture-80%, Industry and services-20%

Source: CIA Fact Sheet, US Department of State and UNICEF

Section 3: Science and technology system

3.1 Governance of science and technology

3.1.1 The National Science and Technology Policy of Tanzania

The Ministry of Higher Education, Science and Technology (MHEST) published the National Science and Technology Policy for Tanzania in 1996. The formulation of a national policy on science and technology arose out of the recognition that the country needed a suitable policy instrument to guide it in sourcing and applying new technologies and creating endogenous technological capacity. The major thrust of this policy is to establish relative priorities and programmes for generating new knowledge and to determine strategies for the application of science and technology development.

The main areas of emphasis are agriculture and livestock. The policy document asserts that science and technology should be applied to improve and sustain agricultural production in the country. Another salient feature of the Tanzanian science and technology policy is its emphasis on proper management of natural resources. The policy document states that the aim shall be the maximization of rational exploitation and utilization of the country's natural resources based on proper scientific understanding of the nature and dynamics of the resources.

The broad objectives of the Science and Technology Policy for Tanzania are therefore to:

- Promote science and technology as tools for economic development, the improvement of human. Physical and social well-being and for the protection of national sovereignty.
- Promote scientific and technological self-reliance in support of economic activities through the upgrading of R&D capabilities.
- Promoting and encouraging the public and private productive sectors in developing science and technology.

- Promote active participation of women in science and technology.
- Establish and/or strengthen national science and technology institutions.

The policy is currently under review.

3.1.2 Ministry of Higher Education, Science and Technology[3]

The Ministry of Higher Education, Science and Technology is the government ministry that is charged with formulating the science policy. The ministry's vision is to transform Tanzania into a competitive, knowledgeable, scientific and technologically anchored society among the community of Nations.

The role of the ministry is to develop policies on the development and promotion of Science and Technology and to ensure provision of Technical, Vocational and Higher Education. The ministry is responsible for:

- Science and Technology policy and programmes.
- Acquisition and application of Technology.
- The development of local expertise in Science and Technology.
- The dissemination of research findings regarding the development of Science and Technology.
- Higher and Technical Education policies (Universities, Technology Institutes and Technical Colleges).
- Working with international organisation such as UNESCO.
- The development of human resources under the Ministry.
- Extra-ministerial departments, para-statal organisations and projects under the Ministry.
- Government agencies falling under the Ministry.

The following table summarises the main research and higher education policy bodies.

[3] MHEST website, http://www.MHEST.go.tz/

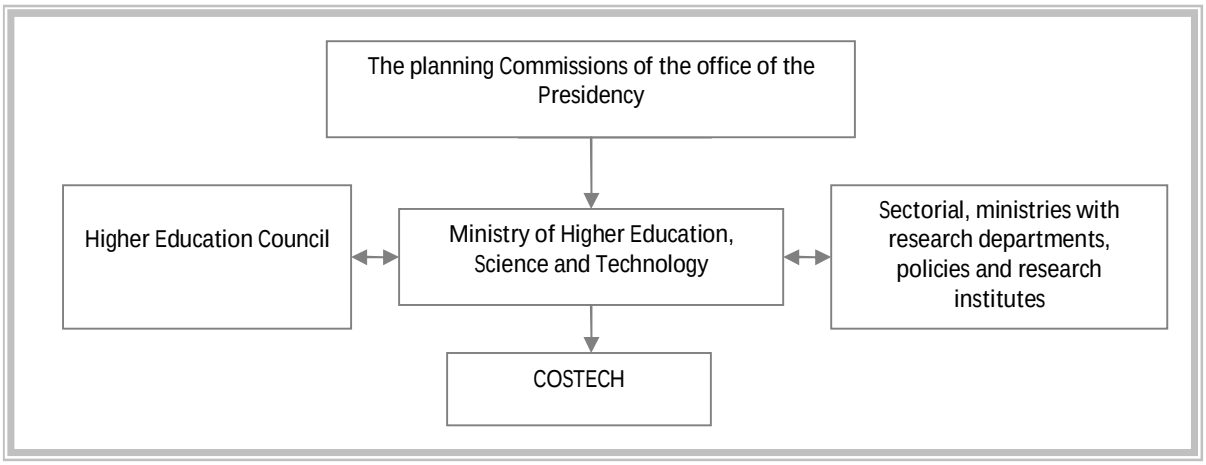
Table 3: Stakeholders in the National S&T system of Tanzania

INSTITUTION	KEY TASK /RESPONSIBILITIES
The planning Commission of the office of the Presidency	Coordinates national sectorial policies and plans
Ministry of Higher Education, Science and Technology (MHEST)	Responsible for the operation of Tanzania's three universities 14 technical colleges and COSTECH
Higher Education Council	Established in 1994 to coordinate the development and planning of higher education
INSTITUTION	**KEY TASK /RESPONSIBILITIES**
Sectorial, ministries with research departments , policies and research institutes	agriculture and health, coordinate sector specific research activities that are aligned with national priorities and plans
COSTECH (Tanzania Commission for Science and Technology)	Advise the MHEST and coordinates policy

Source: Adopted from Gaillard, 2001

The institutional arrangement and linkages among the departments and key agencies are presented schematically in the following diagram.

Figure 1: Simplified illustration of the institutional arrangements in S&T



Source: Adopted from Gaillard, 2001

3.1.3 Tanzania Commission for Science and Technology (COSTECH)[4]

[4] COSTECH website

Tanzania Commission for Science and Technology was established in 1986 as a successor to the Tanzania National Scientific Research Council (UTAFITI) and became operational in 1988. COSTECH is a parastatal organisation with the responsibility of co-ordinating and promoting research and technology development activities in the country. It is the chief advisor to the Government on all matters pertaining to science and technology and their application to the socio-economic development of the country. The Commission coordinates and promotes all research activities in the country and all national Research and Development (R&D) institutions are affiliated to COSTECH.

COSTECH's core mission is to seek appropriate means of:

- utilising selected research results;
- to promote technology development;
- to co-ordinate research endeavours;
- to mobilise financial and academic support in favour of research; in order to implement/advise the government on the most efficient methods of achieving sustainable socio-economic development in Tanzania.

3.1.4 Science and Technology Priorities

As one of its first tasks, COSTECH developed a document on priority areas for research in Tanzania that was reviewed in 1998. It is the duty of COSTECH to set out research priority areas in order to assist Government in its planning process and research fund allocation. The Commission meets this obligation through assistance from its R&D advisory committees. These research priority areas cover a wide range of research topics including:

- agriculture and livestock,
- natural resources,
- environment,
- medicine and public health and industry
- energy,
- basic sciences
- social sciences.

3.2 Science and technology landscape

3.2.1 R& D Performing Institutes and Centres of Excellence

Tanzania has an extensive science and technology infrastructure with various R&D institutions in most sectors of the economy. These institutions are also responsible for producing the science and technology workforce. The research and development performing institutions in Tanzania consists mainly of public universities and research institutions. The following table indicates the main educational and research institutions that contribute to the science and technology infrastructure in Tanzania.

Table 4: Present Science and Technology infrastructure

NAME OF INSTITUTION	Research area
Educational Institutions:	
University of Dar es Salaam	
Sokoine University of Agriculture	
Ardhi University (ARU)[5]	
Muhimbili University of Health and Applied Sciences[6]	
Rwegalulira Water Resources Institute	
National College of Mbeya, Arusha	
Dar es Salaam Institute of Technology	
Open University of Tanzania	
Mzumbe University	
Tumaini University / Kilimanjaro Christian Medical College	
Mikocheni International University of Health Science Programmes	
Institutions affiliated to COSTECH:	
Agricultural Research Institute Mikocheni	Food and agricultural research
Centre for Agricultural Mechanization and Rural Technology	Food and agricultural research
National Environmental Management Council	Environmental research
National Housing and Building Research Agency	Industrial research
National Institute of Medical Research (NIMR)	Health and medical research
National Social Welfare and Training Institute	Social sciences research
Tanzania Automotive Technology Centre	Industrial research
Tanzania Atomic Energy Commission	Energy research
Tanzania Bureau of Standards	Industrial research
Tanzania Engineering Manufacture and Design Organisation	Industrial research
Tanzania Fisheries Research Institute (TAFIRI)	Food and agricultural research
Tanzania Food and Nutrition Centre	Food and agricultural research
Tanzania Forestry Research Institute (TAFORI)	Natural resources research
Tanzania Industrial Research and Development Organisation	Industrial research
Tanzania Industrial Studies and Consulting Organisation	Industrial research
Tanzania Wildlife Research Institute (TAWIRI)	Natural resources research
Technology Development and Transfer Centre (TDTC)	Industrial research
Tropical Pesticides Research Institute	Food and agricultural research

[5] Previously known as the University College of Lands and Architectural studies

[6] Previously known as Muhimbili University College of Health Sciences (MUCHS)

Table 4 Continued

NAME OF INSTITUTION	Research area
Other government institutions	
Directorate of Research and Development (DRD)	Food and agricultural research
Tsetse & Trypanosomiasis Research Institute (TTRI)	Animal health
Non-profit organisations	
Tanzania Coffee Research Institute (TACRI)	Food and agricultural research
Tea Research Institute of Tanzania (TRIR)	Food and agricultural research
Private	
Ifakara Health Research and Development Centre	Health and medical research
Primary Health Care Institute, Iringa	Health and medical research
Centre for Education and Development in Health (CEDHA)	Health and medical research

Source: MHEST and COSTECH websites

ASTI Country Briefs, March 2003

3.2.1.1 Higher Education Sector

The higher education institutions play a key role in research and development in Tanzania and production of scientists and technologists. At present, the two main R&D performers in this sector are the University of Dar es Salaam (UDSM), Sokoine University of Agriculture (SUA). Table 5 lists the public higher education institutions that offer postgraduate training, their faculties and associated institutes.

Table 5: Profile of the key Public Universities in Tanzania

UNIVERSITY	FACULTIES AND INSTITUTES
University of Dar es Salaam (UDSM)	FACULTIES Informatics and Virtual Education, Law, Arts and Social Sciences, Commerce and Management, Education, Science, Aquatic Science and Technology INSTITUTES Institute of Development Studies Institute of Kiswahili Research Institute of Marine Sciences Institute of Journalism and Mass Communication Institute of Resource Assessment CENTRES Centre for Entrepreneurship Development Centre for the Study of Forced Migration (CSFM) Centre for Environmental Studies (CES) Technology Development and Transfer Centre (TDTC) UDSM Gender Centre
Sokoine University of Agriculture	FACULTIES Agriculture, Forestry and Nature Conservation, Science, Veterinary Medicine INSTITUTES Institute of Containing Education Pest Management Centre Development Studies Institute Centre for Sustainable Rural Development
Open University of Tanzania	FACULTIES Arts and Social Sciences, Science Technology and Environmental Studies, Business Management, Law, Education. INSTITUTES Institute of Continuing Learning Institute of Educational Technology

Table 5 Continued

UNIVERSITY	FACULTIES AND INSTITUTES
Ardhi University (ARU)[7]	SCHOOLS Architecture and Design, Construction Economics and Management, Geospatial Science and Technology, Real Estate Studies, Urban and Regional Planning, Environmental Science and Technology INSTITUTES Institute of Human Settlement Studies
Mzumbe University	FACULTIES Commerce, Science and Technology, Law, Social Sciences, Public Administration and Management INSTITUTES Institute of Public Administration Institute of Development Studies Institute of Continuing Education
Muhimbili University of Health and Applied Sciences[8]	FACULTIES School of Dentistry, School of Medicine, School of Nursing, School of Pharmacy, School of Public Health and Social Sciences. INSTITUTES Institute of Allied Health Sciences Institute of Traditional Medicine

Source: MHEST and University websites

The University of Dar es Salaam (UDSM)[9]is the oldest and biggest public university in Tanzania and was established in 1970. Prior to this it was an affiliated college of the University of London. In 2007, two of the universities constituent colleges namely the University College of Lands and Architectural Studies (UCLAS) and Muhimbili University College of Health Sciences (MUCHS) were transformed into public universities. They are now known as Ardhi University (ARU) and as the Muhimbili University of Health and Allied Sciences (MUHAS).

The university has seven faculties, three colleges, five institutes and various support centres. There has been an increase in the number of programmes from 159 in 2003/04 to 242 in 2006/07. With the departure of MUCHS and UCLAS the number of programmes has remained at 150.

7 Previously known as the University College of Lands and Architectural studies
8 Previously known as Muhimbili University College of Health Sciences (MUCHS)
9 UDSM website

Generally, the number of students admitted to UDSM (excluding MUCHS and UCLAS) has maintained a growing trend over the past five years. Between 2003/04 and 2006/07 the number of students registered increased by 178%. In 2003/04 UDSM had 2410 registered students and in 2007/08 registration stood at 5775. The undergraduate student enrolments ranged from 12,492 in 2003/04 to 17,098 in 2007/08. During the same timeframe the proportion of female students increased from 31% to 37%.In 2007/08 there were 2552 postgraduate students registered at USDM.

The student-staff ratio is a reasonable indicator of the workload of the academic staff. It fluctuated between 15 in 2003/04 and 19 in 2007/08.The current year has excluded MUCHS and UCLAS.

The number of research projects at the University increased from 360 in 2003/04 to 402 in 2006/07. In 2007/08 the number dropped to 258, partly due to the departure of MUCHS and UCLAS.

Research at UDSM has received marginal funding from the government and this is a significant constraint to the R&D effort. In his report of 2001, Gaillard estimated that the government was allocating about $30,000 annually to the UDSM for research activities for several years, out of a total budget of slightly more than $10 million. To fund its research activities the university has to rely on support from international donors.

The Sokoine University of Agriculture (SUA)[10]was established on the 1st July 1984. The University is currently made up of four campuses and one constituent college. The University has four Faculties and six Directorates/Institutes, excluding those in the constituent college. The University also offers postgraduate training leading to the award of Master of Science and PhD in the respective fields of Agriculture, Agricultural Economics and Agribusiness, Food Science, Human Nutrition, Forestry, Management of Natural Resources and Sustainable Agriculture (MNRSA), Veterinary Medicine, Preventive Veterinary Medicine (MPVM), and Rural Development.

The mission of the University in the field of research is to initiate and conduct basic and applied research in the fields of land use, crop and livestock production, fisheries, natural resources and allied sciences, mechanical arts and technology and to promote the integration of the research with training and agricultural extension services.

Currently, the University has about 175 researchers trained at PhD level in all fields of agriculture, forestry and veterinary medicine. Also, SUA has the comparative advantage over other research institutions as it uses students in conducting some research Programmes. Furthermore, there are about 45 signed agreements on research collaboration with a number of research institutions inside and outside Tanzania.

The **Open University of Tanzania (OUT)**[11]is an open and distance learning institution offering certificates, diplomas, degrees and postgraduate courses. The Open University of Tanzania was established in 1992. The university currently consists of five faculties, two institutes and a number of directorates supporting the institution. The Open University of Tanzania conducts its operations through Regional Centres and Study Centres. Currently there are 25 Regional Centres and 69 Study

10 http://en.wikipedia.org/wiki/Sokoine_University_of_Agriculture

11 OUT website

Centres. In February 2004, OUT requested SIDA to support its efforts to strengthen the University and has been engaged in an institutional transformation process since July 2004.

In 2008 there were 3506 undergraduate enrolments and 609 postgraduate enrolments (of these 15 where PhD enrolments). There has been a doubling of postgraduate programmes in a four years period from 13 programmes in 2004 to 27 programmes in 2008. This increase reflects change of mindset for postgraduate studies through the OUT. The trend has been a steady growth in various programmes from 159 graduates in 1999 during the first graduation of the OUT to 1101 graduates in the 2008. The growth of the institution is also reflected in the increase of academic staff from 76 in 2003 to 207 in 2008.

University College of Lands and Architectural Studies (ARU)[12]starting from 2007, is one of the new public Universities in Tanzania formed from the transformation of the then University College of Lands and Architectural Studies (UCLAS), which was a constituent College of the University of Dar es Salaam. Ardhi University has six schools, one Institute and four Centres, through which it offers a range of both Undergraduate and Postgraduate Programmes. In total, the University has 26 academic programmes of which 20 undergraduate and 6 postgraduate programmes plus many more short courses.

Mzumbe Universitywas established in December 2006. The university has five faculties, 19 departments, three institutes and a number of directorates that support the management of the institution. No further information on this institution is currently available.

The **Muhimbili University of Health and Applied Sciences**[13] is a successor to the Muhimbili University College of Health Sciences (MUCHS), which was a constituent College of the University of Dar es Salaam. MUCHS was established in 1991, when the then Faculty of Medicine was upgraded to a College. The Faculty of Medicine originated from the Dar es Salaam School of Medicine, which was established in 1963 by the Ministry of Health with the primary aim of training clinical health staff. . The Parliament Act that established MUCHS was repealed in 2005. Subsequently, in the year 2007, MUHAS was established in line with the recommendations of the Tanzania Commission of Universities. The university currently runs 71 academic programmes, and in 2007/08 six specialized programmes were established in the areas of Neurology, Pulmonary Medicine, Parasitology/Medical Entomology, Applied Epidemiology, Epidemiology and Laboratory Management and Clinical Pharmacology.

During 2007/08, 723 students were admitted in various MUHAS diploma, undergraduate and postgraduate Programmes. This represent an increase of 25% compared to 578 students admitted in the year 2006/2007. The number of students admitted during 2007/08 into all undergraduate programs was 310 out of 913 applicants this is only 34% of all the applicants. The majority (66%) of the applicants who were qualifying to enter into the MUHAS programs were not admitted due to limited capacity. Inadequate physical facilities, financial and human resources are the mitigating factors against the MUHAS enrolment expansion program, which will reach its target with acquisition of adequate teaching facilities and other resources. The number of graduating undergraduates has been rising steadily for the past six years from 83 in 2001/02 to 294 in 2007/08.

12 ARU website

13 Muhimbili University website and 2007/08 Annual Report

This increasing trend is attributable to the student enrolment expansion program, improved retention and decreased attrition rates.

The number of postgraduate students has been consistently increasing from 2003/04 to 2007/08. During 2007/08, 99 students were admitted in various postgraduate programs. Unlike undergraduate students the admissions of postgraduates has been consistently low. However, during the period under review there was a 73.7% increase over the previous year (2006/2007) during which 57 students were admitted. This is a significant increase, which may be due to the increased awareness of the programs and popularity of the newly introduced programs. The postgraduate students output has been consistently low due to small numbers of candidates admitted in the postgraduate programs over the years During 2007/08, 50 students graduated. There is an improvement compared to the previous year where only 37 students graduated.

The student academic staff ratio also improved from 1:8 in the 2006/07 to 1:7 during 2007/08 and this is attributable to additional staff completing their PhD, Masters Degrees and 21 new recruitments in various units. Staff development has been maintained and 41 academic staff is registered for PhD and some administrative and technical staff is supported by the institution to acquire additional qualifications and skills for competence in the performance of their activities. The age profiles for both academic and technical staff indicate that more than 40% of the staff are aged more than 50 years and have less than 10 years to reach the retirement age of 60 years.

Research is an integral core function of the University. The university has recently updated its research policy defining research priorities to ensure that research conducted in the University is in line with national policies and priorities. Currently the University has more than 65 research projects established through the existing and new collaborations. Research funding has been largely dependent on donors and does not receive funding for the government for research development.

3.2.1.2 Agricultural research institutes

Tanzania has a strong tradition in agricultural research with agricultural institutions spread all over the country. The basic philosophy of this sector is to undertake client-oriented, demand-driven and cost-effective research. Agricultural research under the ministry comprises of crop research; farming systems and socio-economic research; and special programmes research. Tanzania has also been divided into seven agricultural zones, each with their own areas of specialisation. The majority of these institutes are managed by the Ministry of Agriculture, Food and Cooperatives.

Table 6 is a summary of some of the key institutions that are main R&D performers in this sector.

Table 6: Major agricultural research institutions

CATEGORY	SUPERVISING AGENCY	NAME OF INSTITUTE	RESEARCH FOCUS
Government	Ministry of Agriculture, Food and Cooperatives	Animal Diseases Research Institute (ADRI) - Temeke	Animal Diseases
		ARI - Uyole	Food crops, livestock, agricultural engineering, food technology and agricultural economics Headquarters for the Southern Highlands Zone
		Chollima (Dakawa) Agro-Scientific Research Centre	Maize, rice and vegetables
		Ifakara Research Centre	Rice research
		Kibaha Sugarcane Research Institute (SRI)	Sugar
		Makutupora Viticulture Research and training Centre (VRTC)	Vine research, planting material
		Maruku Research Centre	Banana research
		Mikocheni Agricultural Research Institute	Coconut development
		Mlingano Research Institute	Soil and water conservation
		Mpawapwa Livestock Production Research Institute	Livestock
		Naliendele Agricultural Research Institute	Oilseed and cashew nut research Southern Zone Agricultural Research and Training Institute
		Selian Agricultural Research Institute (SARI)	Headquarters for Agriculture and Livestock Research for the Northern Zone
		Tengeru Horticultural Research and Training Institute (HORTI)	Horticulture and pest control
		Tropical Pesticides Research Institute (TPRI)	Pesticides
		Tsetse & Trypanosomiasis Research Institute (TTRI)	Animal health

Table 6 Continued

CATEGORY	SUPERVISING AGENCY	NAME OF INSTITUTE	RESEARCH FOCUS
Government	Ministry of Agriculture, Food and Cooperatives	Tumbi Research Institute	Headquarters for the Western Zone Research Institute
		Ukiriguru Agricultural Research Institute	Cotton research
		West Kilimanjaro Livestock Research Centre(GeneBank)	Livestock
	Ministry of Natural Resources and Tourism	Tanzania Forestry Research Institute (TAFORI)	Forestry, natural resources
		Tanzania Fisheries Research Institute (TAFIRI)	Fisheries
		Tanzania Wildlife Research Institute (TAWIRI)	Wildlife
Non-profit		Tanzania Coffee Research Institute (TACRI)	Coffee
		Tea Research Institute of Tanzania (TRIR)	Tea

Source: ASTI Country Briefs, March 2003, http://www.agriculture.go.tz/Research-Training/research%20zones.html

3.2.1.3 Medical and Health Research Institutes

The three bodies that are responsible for setting priorities and co-coordinating health research in Tanzania are the Ministry of Health and Social Welfare (MoHSW), COSTECH, and the National Institute of Medical Research (NIMR). The National Institute for Medical Research is a parastatal service organization under the Ministry of Health. The functions of the NIMR include the coordination, facilitation and evaluation of all medical research within Tanzania; and with a specific interest is disease control and traditional medical practices and herbal medicine. NIMR is also responsible for keeping a register of all medical research undertaken in Tanzania and to promote the practical application of the findings for the purpose of improving the general health of the people of Tanzania. NIMR also manages ten research centres spread across Tanzania.

Main institutions involved in medical and health research

The main institutions that are responsible for Health research in Tanzania are cantered around three categories of institutions: governmental health research institutions, universities (public and private), and private health research institutions.

Table 7: Major health research institutions

CATEGORY	NAME OF INSTITUTION	RESEARCH FOCUS
Government	Ministry of Health and Social Welfare	Research in decision making and policy implementation
	National Institute of Medical Research	Contagious diseases – mainly medical research NIMR has ordered its research priorities as follows: Malaria, Filariasis, Trypanosomiasis, Onchocerciasis, Schistosomiasis and sexually transmitted diseases including AIDS
	Tanzania Food and Nutrition Centre	Food and Nutrition issues
Universities	Muhimbili University of Health and Applied Sciences	Contagious and non-contagious diseases
	Tumaini University / Kilimanjaro Christian Medical College	Reproductive Health, HIV/Aids, Maternal and child health, malaria
	Mikocheni International University of Health Science Programmes	New university in the process of identifying its research programme
Private	Ifakara Health Research and Development Centre	Entomology, malaria, schistosomiasis, socioeconomic studies and traditional medicine
	Primary Health Care Institute, Iringa	Continuing education for health workers. Not primarily involved in health research.
	Centre for Education and Development in Health, Arusha (CEDHA)	Continuing education for health workers. Not primarily involved in health research.

Source: Adopted from Gaillard, 2001

3.3 Human capital for S&T

Through COSTECH, the MHEST has attempted to collect data on its science and technology unsuccessfully. At present they are in the process of developing capacity to carry out this task (R, Kingamkono, personal communication).

3.3.1 Higher Education enrolment

Tanzania has about 30 universities of which 11 are public while the remaining is private. The student population was appallingly low, but this situation has improved as reflected in table 8. From this table, the public institutions have the overwhelming share of the student population largely because the cost of private education is inhibitory. The increase in student population has been a result of a concerted effort to expand and institutional reform. By December 2006 this growth trend was illustrated once more with 35821 students enrolling in public universities and 5275 students

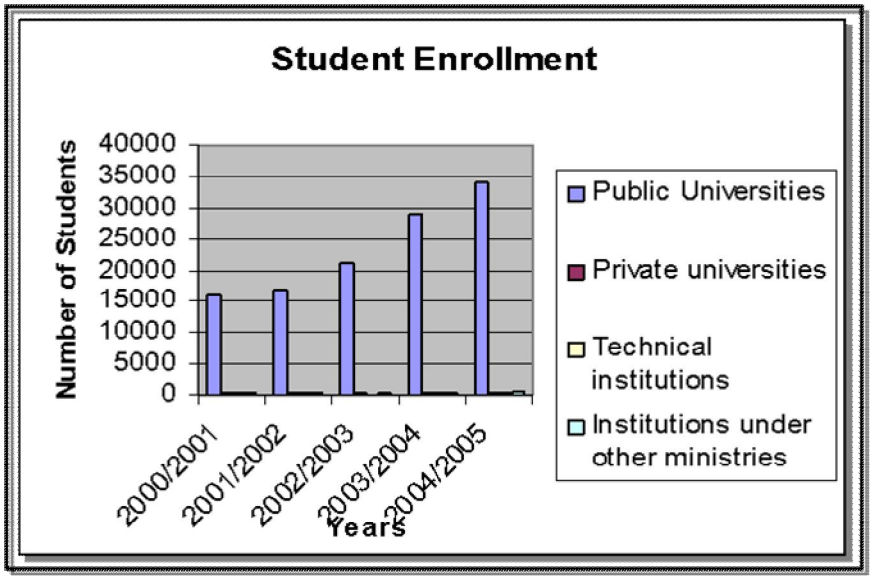
enrolling in private universities[14]. New universities have opened, and existing ones have increased their student intake. From the statistics provided by the MHEST, the student enrolment by discipline could not be determined. Figure 2 illustrates the trend in the number of student enrolment in public, private, technical and institutions that are under other ministries.

Table 8: Student enrolment in HEI for YEARS 2000-2005

Institutions	2000/2001	2001/2002	2002/2003	2003/2004	2004/2005
Public Universities	16107	16895	21334	28910	34113
Private universities	319	272	317	366	422
Technical institutions	178	190	164	502	247
Institutions under other ministries	268	226	285	422	515
Total	16 872	17 583	22 100	32 454	48 236

Source: MHEST website

Figure 2: Student enrolment in Higher Education Sector and Institutions under ministries



Source: MHEST website

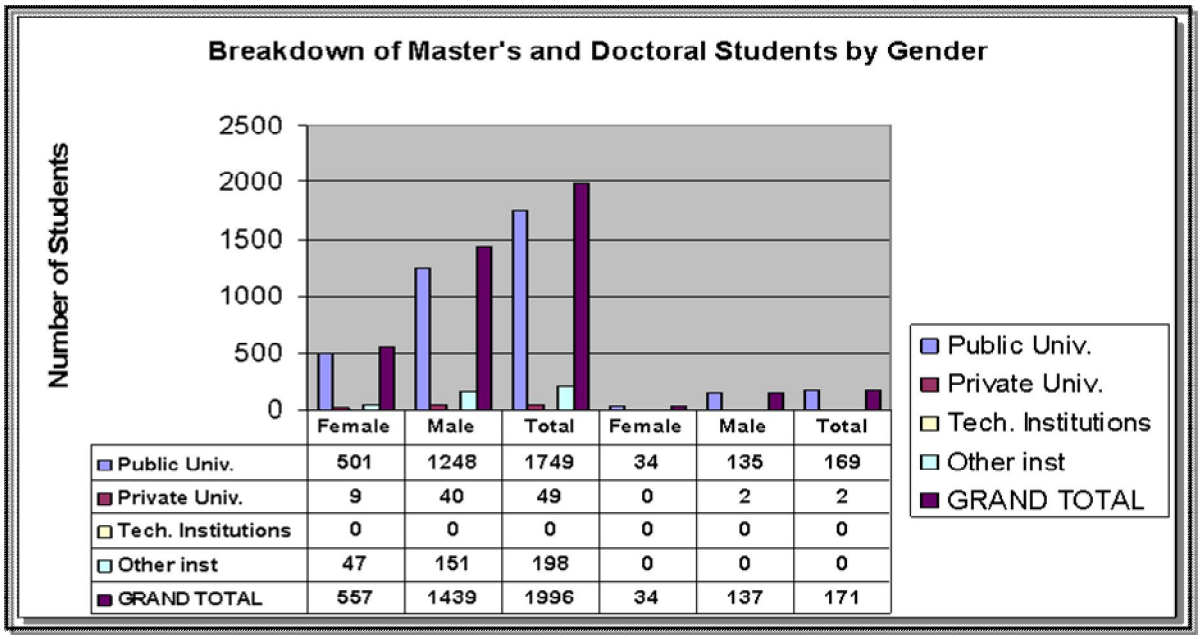
[14] Issues of Higher Education in Tanzania, by Prof Peter Msolla (MHEST), www.siteresources.worldbank.org/INTWBISFP/Resources/0_Prof_Msolla.pdf

3.3.2 *Master's and doctoral enrolments*

The head count of master's and doctoral enrolment in 2004/5 is shown in Figure 3. This illustrates that the number of postgraduate students is very low given the size of the total student enrolment. This is largely due to the high cost of education with many students relying on government and foreign funding.

A common feature of the enrolment at postgraduate level is the low number of female students. Figure 3 highlights this by comparing the number of female and male students.

Figure 3: Master's and Doctoral Students in 2003-4



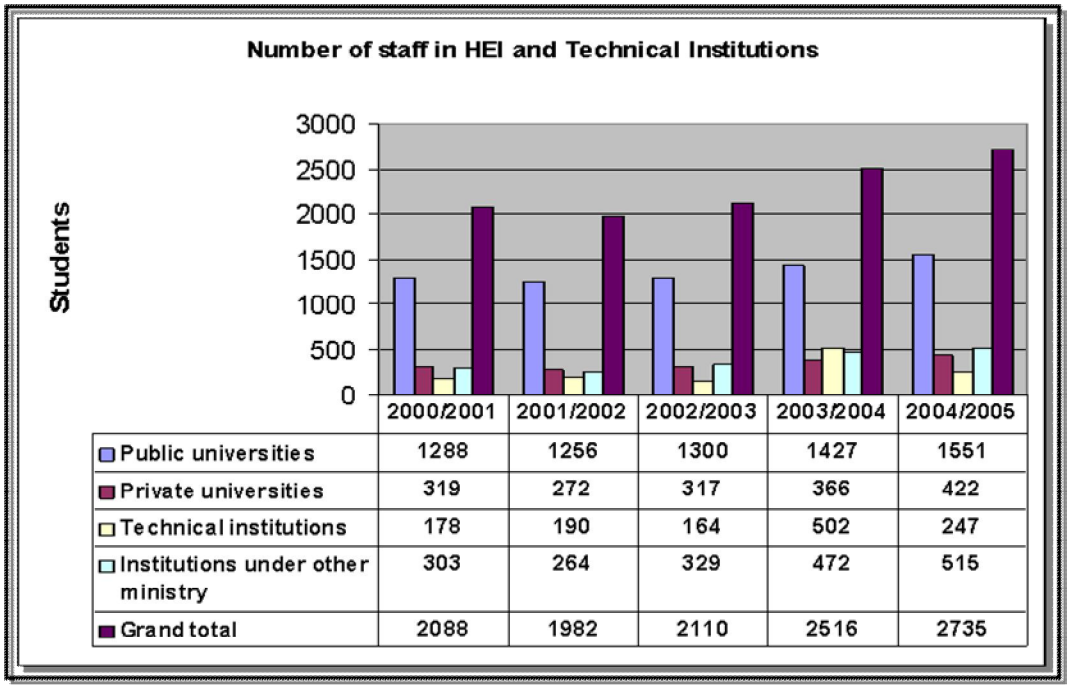
	Female	Male	Total	Female	Male	Total
Public Univ.	501	1248	1749	34	135	169
Private Univ.	9	40	49	0	2	2
Tech. Institutions	0	0	0	0	0	0
Other inst	47	151	198	0	0	0
GRAND TOTAL	557	1439	1996	34	137	171

Source: MHEST website

3.3.3 *Size of the University Workforce*

The size of the university workforce (educators, tutorial assistants) has increased steadily from 2088 in 2000/1 to 2 735 in 2004/5. The public sector accounted for 56% of the total headcount in 2004/5. According to Gaillard's report, a common feature of the public university staff is the lack of financial resources that results in underpaid staff. Another important characteristic is the ageing academic staff population. Due to lack of scholarships for postgraduate degrees, and the unfavourable terms of employment, the academic degrees are awarded at a relatively late stage. The distribution of the academic staff is presented graphically in Figure 4.

Figure 4: Trends in academic staff in Higher Education Institutions



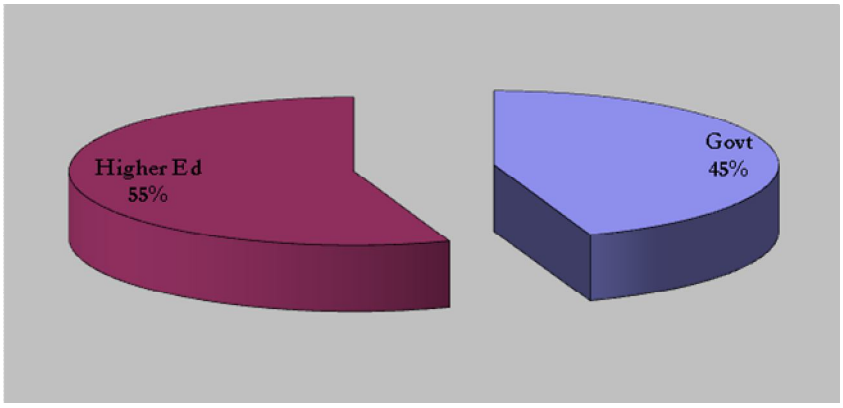
	2000/2001	2001/2002	2002/2003	2003/2004	2004/2005
Public universities	1288	1256	1300	1427	1551
Private universities	319	272	317	366	422
Technical institutions	178	190	164	502	247
Institutions under other ministry	303	264	329	472	515
Grand total	2088	1982	2110	2516	2735

Source: MHEST

3.3.3.1 R&D Personnel Head Count (HC), 30 June 2004

In 2005, a survey of R&D and Human Resource inputs in Tanzania was commissioned by COSTECH (Masanja, V. G). The study covered a nine-year period (1993-2004). Unfortunately, all the institutions that responded to the survey could only provide data for the year 2003/2004. The presented data therefore are approximations, not actual numbers. Even then, these numbers can still shed some light on the distribution of personnel in R&D institutions. From Figure 5, the data show that the Higher education sector has 55% personnel head count while the Government R&D institutions have 45%.

Figure 5: Distribution of R&D Personnel HC by Performance Sector, 30 June 2004



3.3.4 Human and institutional capacity development strategies

One of the goals of Tanzania's Development vision is a well-educated and learning society. The key issues of Higher Education in Tanzania revolve around the following:

- The financing of Higher Education
- Expansion and accessibility
- Quality assurance and relevance
- Information and Communication Technology
- Building a skilled human capital
- Need for research.[15]

A number of strategies have been proposed to address these focus areas. For example, higher enrolments can be achieved by expanding public facilities and encouraging private universities, cost sharing, affirmative action to expand female participation, more places that are non-residential, efficiency gains and distance education. The Government has also been implementing the Primary Education Development Plan (PEDP, 2002-2007) and the Secondary Development Plan (SEDP, 2004-2009), both of which have been successful in increasing student enrolments and outputs. The outcome of the PEDP and SEDP is to provide a pool of students to join the higher education institutions in the country.

Higher education curricula should be geared towards the changing world of science and technology and the corresponding ever-changing needs of the people, their government, industry, commerce and the surrounding environment in general. As agriculture will continue to be the backbone of the economy, agricultural-related disciplines and technologies shall be given priority.

Training and research objectives should target the development and promotion of a strong indigenous base of science and technology to enable Tanzanians to solve their development problems.

The Tanzanian government is to fund a highly successful initiative to increase the number of women studying science subjects at university.[16] The 'pre-entry programme' - which gives a six-week 'booster' course to women who initially fail to meet the entry requirements of science courses — has increased the proportion of women studying science at the University of Dar es Salaam from 3 to 28%. Students enrolled through the pre-entry programme can be admitted to various degrees in the faculties of science, engineering and education at the University of Dar es Salaam, the Muhimbili University College of Health Sciences, and the University College of Lands and Architectural Studies.

[15] Issues of Higher Education in Tanzania, by Prof Peter Msolla (MHEST), www.siteresources.worldbank.org/INTWBISFP/Resources/0_Prof_Msolla.pdf

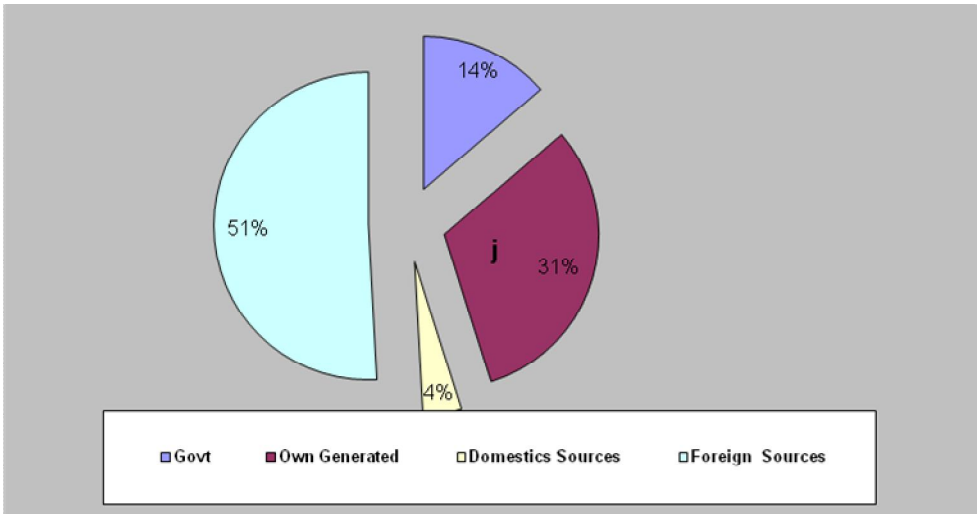
[16] SciDev

3.4 Research and development funding

3.4.1 Gross expenditure on R&D

As stated in the previous section, the survey by COSTECH included an estimation of the R&D expenditure. Figure 6 shows the total contributions by sources of funding over the entire 9-year period. Form the figure it is evident that foreign donor contribution to R&D expenditure is the largest; contributing nearly half (51%) of the total funds followed by own generate funds (31%), then government funding (14%) and the smallest proportion is from domestic donors (4%). Contribution from government funding being so small has an indication that R&D agenda are driven by others and not by the government policy and plans or researchers' quest for search for knowledge, innovation and discovery.

Figure 6: Proportions of source of funds to total 1995-04 funds flow to R&D programs



The survey shows a rather dismal state in the direction of Tanzania's commitment towards R&D investment with the aim to attain a target of 1.0% of its GDP by year 2008. The current state of below 0.24% just a few years from the deadline calls for immediate action and concerted efforts.

This low figure is hardly enough to pay salaries and other personnel costs. To overcome this funding shortage, the development of research and higher education institutions in Tanzania, foreign support has become necessary at each stage of research capacity building including PhD studies. The Tanzanian system is surviving because it attracts external financial support. Without these major subsidies, very little research would be conducted in Tanzania. The government policy of science for the development of the country has, however set a target of 1% of the GDP should be allocated to science and technology. From available information, very little private sector funding is available.

3.4.2 International Donor Funding

Foreign donor funding in Tanzania contributes approximately 70% of the R&D expenditure in Tanzania.[17] Foreign funding agencies concentrate on particular institutions or faculties (notably the two main universities: University of Dar es Salaam–UDSM; and Sokoine University of Agriculture –

[17] Kingamkono R, personal communication (COSTECH)

SUA). The table below, taken from Gaillard shows the most important and long-term aid between 1980 and 2000. The table lists the donor country and the Tanzanian beneficiary.

Table 9*:* **Long-term aid to Tanzanian research**

AGENCY AND COUNTRY	TANZANIAN BENEFICIARY
NORAD ,Norway	SUA Faculty of Forestry
NORAD ,Norway	UDSM Department of Chemistry
NORAD, Norway	UDSM Department of Chemical and Process Engineering
FINNIDA, Finland	UDSM Department of Geology
DANIDA ,Denmark	SUA Department of Animal Science
SDC ,Switzerland	UDSM Departments of Mathematics and Physics
GTZ, Germany	UDSM Faculty of Engineering
NUFFIC ,The Netherlands	UDSM Department of Microbiology
SAREC-ISP, Sweden	UDSM Department of Seismology
Sweden	UDSM University Library
World Bank ,International	MoAC Rehabilitation of Agricultural Research Centres

Source: Adopted from Gaillard, 2001

3.5 Research outputs

3.5.1 Publications[18]

The total number of articles published in Tanzania as indexed in the international database ISI between 1990 and 2007 was 4815. The table below presents Tanzania's publication output over a six-year window period and from this it is evident that their publication output has increased steadily, especially for the 2002-2007 period.

Table 10: Tanzania ISI-output by six-year window (1990 – 2007)

Country	1990-1995	1996-2001	2002-2007
Tanzania	1132	1435	2248

Source: SARUA, *The state of public science in the SADC region*, produced by CREST, 2008

[18] SARUA, *The state of public science in the SADC region*, produced by CREST, 2008.

Tanzania is currently the second most productive contributor to the total publication output for the SADC region. In a recent study comparing the ISI-output of 14 SADC countries, Tanzania moved up from position 3 to 2 from the 1990-1995 to the 2002-2007 period.

Table 11: Rankings of SADC countries by ISI-output (1990-1995 vs. 2002- 2007)

Country	1990-1995	Rank	2002-2007	Rank	Gain
South Africa	22515	**1**	29225	**1**	■
Zimbabwe	1458	**2**	1460	**3**	▼
Tanzania	**1132**	**3**	**2248**	**2**	▲
Zambia	510	**4**	696	**6**	▼
Malawi	424	**5**	922	**5**	■
Botswana	280	**6**	948	**4**	▲
DRC	264	**7**	242	**11**	▼
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**	▼
Swaziland	71	**13**	93	**12**	▲
Angola	44	**14**	81	**13**	▲
Total	**27439**		**37760**		

Source: SARUA, *The state of public science in the SADC region*, produced by CREST, 2008

3.5.1.1 Institutional collaboration in 2004

Tanzanian institutions have a significant number of internationally co-authored papers in many countries. Analyzing the data of publications from Tanzania for 2004 showed extensive international collaboration. The number of co-authored articles from Tanzanian institutions showed they mainly collaborate with the USA (50), England and Denmark (25). The number of co-authored articles with African countries reveals that the main collaborations are with Kenya (16) Uganda (7) and South Africa (4). Overall, Tanzania's main collaborative partners are the EU countries and the US. On the other hand, there is very limited collaboration among the Tanzanian institutions probably due to limited resources and institutional weaknesses.

3.5.2 Patents

Internationally, Tanzania is a member of the Paris and Berne Conventions and joined WIPO in 1993. In 1999, it became a member of the Patent Cooperation Treaty and the World Trade Organization, which automatically makes Tanzania a member of the trade related aspects of IP referred to as TRIPS Agreement.

Tanzania is also a member of the African Regional Intellectual Property Organization (ARIPO) based in Harare, Zimbabwe, and has established a Business Registration and Licensing Agency (BRELA).

Although trademarks, copyright and patent laws are in the statute books, the mechanisms for enforcement are nonexistent.

3.6 Concluding remarks

The Tanzanian S&T system has a relatively long history of scientific activities, which have resulted in a fairly elaborate and well-articulated S&T infrastructure (large number of research institutions). The country has a fairly strong HR capacity in S&T and has extensive international collaboration networks. However, government expenditure on R&D is very low which, together with the dependency on international funding for S&T, has meant that there is no real growth in the S&T capacity in the country. Most S&T equipment and laboratories are outdated and in dire need of restoration and replacement. In general, the system needs a major revitalization and there is promise in the revision of the current S&T policy.

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