THE UNITED REPUBLIC OF TANZANIA

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Section 1: The political environment

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.

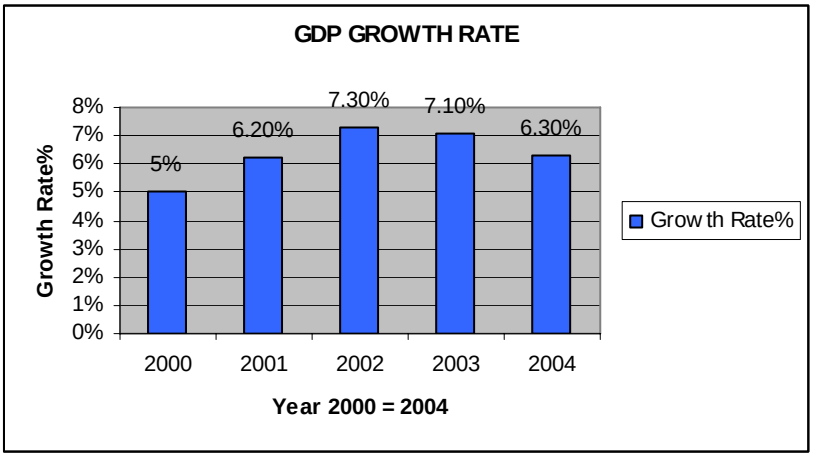
Tanzania was a one party state with a socialist model of economic development. A number of political and economic reforms led to an adoption of multiparty democracy resulting in the first democratic elections in early 1994. The elections were won by the Chama Cha Mapinduzi (CCM) and in the second multi-party general elections in 2000.

Section 2: Country characteristics

2.1 Basic economic outlook

Since the 1990s, the per capita GDP in Tanzania has been increasing and Tanzania's growth trend has been impressive. The annual GDP growth has averaged 6.4 percent between 2000 and 2004 and exceeded seven percent in 2002 and 2003 (Figure 2, Real GDP Growth). Tanzania's growth rate of 6.3 percent in 2004 was well above the rate achieved in South Africa (3.7 percent). This strong growth performance reflects the fruits of responsible monetary and fiscal policy, concerted reforms, rapid export growth, and significant debt relief.

Figure 2: Recent economic data of Tanzania



Source; USAID Report 2005, Tanzania Economic Assessment

The economy of Tanzania depends heavily on agriculture, which accounts for almost half of GDP, provides 85% of exports, and employs 80% of the work force. Industry traditionally featured the processing of agricultural products and light consumer goods. The World Bank, the International Monetary Fund, and bilateral donors have provided funds to rehabilitate Tanzania's outdated economic infrastructure and to alleviate poverty. Long-term growth through 2005 featured an improvement in industrial production and a substantial increase in output of minerals, led by gold. Recent banking reforms have helped increase private-sector growth and investment. Some of the basic economic indicators are summarized in Table 1.

Table 1: Selected economic Indicators of Tanzania

BASIC ECONOMIC DATA	
GDP	$27.07 billion (2005 est.)
GDP-Growth	6% (2005)
GDP per capita	$700
Inflation Rate	4.3% est. 2005
GDP composition per sector agriculture industry services	 45.2% 17.2% 39.6% (2004 est.)

Source: Compiled from CIA Fact Sheet and US PolitInfo Websites

In 1986, the Government of Tanzania embarked on 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.

Accounting for only about 10% of GDP[1], Tanzania's industrial sector is one of the smallest in Africa.

The main industrial activities include producing raw materials, import substitutes, and processed agricultural products. Foreign exchange shortages and mismanagement continue to deprive factories of much-needed spare parts and have reduced factory capacity to less than 30%.

The Government of Zanzibar has been more aggressive than its mainland counterpart in instituting economic reforms and has legalized foreign exchange bureaus on the islands. This has liberated the economy and dramatically increased the availability of consumer commodities. The island's manufacturing sector is limited mainly to import substitution industries, such as cigarettes, shoes, and process agricultural products. Zanzibar still imports much of its staple requirements, petroleum products, and manufactured articles.

[1] USPolitInfo.com

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
PEOPLE	
Nationality	Tanzanian(s) Zanzibar (s)
Population	Mainland-32m, Zanzibar 1m (est)
Religions	Muslim 45%, Christian 45%, Indigenous beliefs 10%
Language	Kiswahili (official), English
Education	Attendance-74% (primary) literacy -67%
Health	Infant mortality rate-98/1000;
Workforce	Agriculture-80%, Industry, commerce, government-20%

Source: CIA Fact Sheet and Tanzania Government website

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 Science, Technology and Higher Education (MSTHE) 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.

3.1.2 Ministry of Science, Technology and Higher Education

The Ministry of Science, Technology and Higher Education[2]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[3].

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. Its responsibilities include the following:

- Science and Technology policy and programmes.
- Acquisition and application of Technology.
- Development of local expertise in Science and Technology.
- Dissemination of Research Findings regarding the Development of Science and Technology.
- Higher and Technical Education policies (Universities, Technology Institutes and Technical Colleges).
- Work with International Organisation such as UNESCO.
- Development of Human Resources under the Ministry.
- Extra-Ministerial Departments, Para-statal Organizations and Projects under the Ministry.
- Government Agencies falling under the Ministry.

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

[2] The name of the Ministry has been changed to the Ministry of Higher Education, Science and Technology)
[3] Ministry of Science, Technology and Higher Education

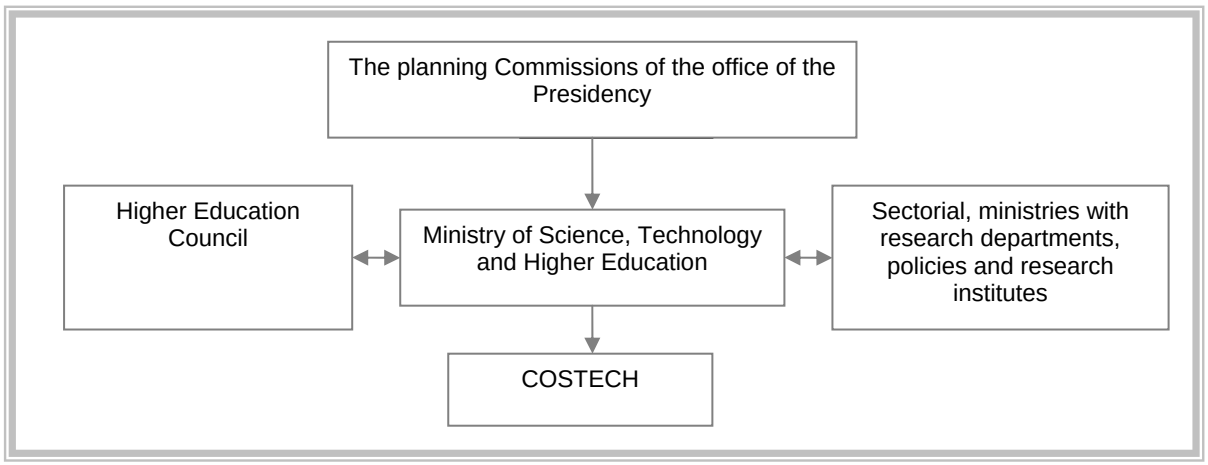
Table 3: Stakeholders in the National S&T system of Tanzania

INSTITUTION	KEY TASK /RESPONSIBILITIES
The planning Commission of the office of the presidency	Co ordinates national sectorial policies and plans
Ministry of Science, Technology and Higher Education	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
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	Advise the MSTHE and coordinate 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 3: Simplified illustration of the institutional arrangements in S&T



3.1.3 Tanzania Commission for Science and Technology (COSTECH)

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. Among others, its mandate includes advising the Government on all matters relating to scientific research and technology development. It also coordinates and promotes all research activities in the country.[4]

[4] COSTECH website

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 Ministry of Agriculture

Agriculture is a very important sector in Tanzania and the role of this ministry is crucial in economic development and food security. Science and Technology play a key role in improving agricultural production. Within this Ministry, the Department of Research and Development (DRD) is responsible for research and technology development activities. The functions of the [5]the DRD are

- To coordinate research programmes in Tanzania in accordance with the national policies and priorities for agricultural research;
- To recommend the use of research findings and in collaboration with extension services, make sure that the research recommendations reach farmers;
- To coordinate and integrate agricultural and livestock research work with that of other sectors through the Tanzania Commission for Science and Technology
- To draw-up plans for training agricultural experts and manage the running of training courses for such experts in the country.

3.1.5 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 [6]and Centres of Excellence

Tanzania has and extensive science and technology infrastructure and 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 University of Dar es Salaam (UDSM) is by far the largest and oldest, with a student population of about

[5] Gaillard 2001, MSTHE website and COSTECH

12 144 in 2005 which is more than 70% of the total population of university students in the country. The other important universities are Sokione University of Agriculture and Open University of Agriculture (long distance education). The following table indicates the composition of the S&T system (from data collected from MSTHE website and COSTECH websites and publications)

Table 4: Present Science and Technology infrastructure

NAME OF INSTITUTION	NAME OF INSTITUTION
Educational Institutions University of Dar es Salaam Sokione University of Agriculture University College of Lands and Architectural studies Muhimbili University College of Health Science Rwegalulira Water Resources Institute National College of Mbeya, Arusha Dar es Salaam Institute of Technology.	**Some of these Centres of R&D and S&T service Institutions are**: Centre for Agricultural Mechanization and Rural Technology National Institute of Medical Research (NIMR) Serengeti Wildlife Research Institute Tanzania Bureau of Standards Tanzania Engineering Manufacture and Design Organisation Tanzania Forestry Research Institute Tanzania Industrial Research and Development Organisation Tanzania Industrial Studies and Consulting Organisation Tropical Pesticides Research Institute Research

Source: MSTHE

3.2.2 Centres of Excellence in Tanzania

Tanzania has established a number of Centres of Excellence (CoEs are highly reputed / world-renowned centres of science and technologies) and several are listed in Table 6. These institutions will be used to provide the leading role in their respective areas of specialization.

Table 5: List of Centres of Excellence in Tanzania

Centre of Excellence	Area of Specialisation
Tanzania Industrial Research and Development Organisation (TIRDO)	Research/Technology development/Technology brokerage, technical services to industry
Located at University of Dar es Salaam	Sustainable development related scientific and technological research, part of the Centres of Excellence for Technological Innovation for Sustainability in Africa (CETISA network)
Muhimbili Medical College	Health Care Systems
Ocean Road Cancer Institute (ORCI)	Cancer Therapy –to be established by International Atomic Energy Agency

Sources: Compiled from Websites of CETISA, IAEA and personal communication (COSTECH)

The CoEs are supported by international organizations and will form part of a network of leading institutions in their respective fields.

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), Sokione University of Agriculture (SUA). Below is a list of these universities, their faculties and associated institutes (Open University of Tanzania does not conduct research)

Table 6: Profile of the key Public Universities in Tanzania

UNIVERSITY	FACULTIES AND INSTITUTES
University of Dar es Salaam (UDSM)	FACULTIES (Arts and Social Sciences, Commerce and Management, Education, Engineering, Law. Science. INSTITUTES Institute of Development Studies, Institute of Kiswahili Research, Institute of Marine Sciences, Institute of Production Innovation, Institute of Resource Assessment
Sokione University of Agriculture	FACULTIES –Agriculture, Forestry, Veterinary Medicine) INSTITUTES Institute of Continuing Education Development Studies Institute
Open University of Tanzania	FACULTIES Arts, Arts with Ed, ,Commerce, Law, Science, Science with Education-long distance education institution

The University of Dar es Salaam (UDSM)

Besides the academic faculties, the University of Dar es Salaam also houses important institutes such as the institutes of Development Studies, Kiswahili Research, Marine Sciences, Production Innovation, and Resource Assessment. Previously UDSM suffered from low student enrolment given its present physical facilities and the number of teaching and supporting staff. The university embarked on a Transformation Programme to expand the undergraduate student enrolment from slightly more than 5,000 in 2001 to 8,000 by the year 2,000 and 13,000 by the year 2008.

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 Sokione University of Agriculture (SUA)

Sokione University of Agriculture (SUA) is the main University of Agriculture. The university offers undergraduate training leading to the award of degrees in Agriculture, Horticulture, Animal Science, Home Economics and Nutrition, Food Science and Technology, Agronomy, Agricultural Engineering, Forestry and Veterinary Medicine. The university also offers training leading to awards of master and doctoral degrees in the respective fields of Agriculture, Forestry and Veterinary Medicine. A general feature of the public universities is the lack of financial resources that results in under-paid staff, low number of scholarships, overcrowded and deteriorating facilities, marginal activities in the field of research and insufficient science equipment. Another important characteristic is the ageing of the academic staff population. Despite affirmative action policies, women continue to be a small fraction of the workforce.

3.2.1.2 Research institutes Affiliated to COSTECH

Tanzania has a large number of research institutes, that are either affiliated to COSTECH and/or to the sectorial ministries of which Agriculture and Health are the main ones. Below is a brief presentation of the main institutes that are associated with COSTECH (from the different economic sectors)

Institutions affiliated to COSTECH

- Industrial Research
    - Tanzania Industrial Research and Development Organisation (TIRDO)
    - Tanzania Engineering Manufacturing and Design Organisation (TEMDO)
    - Tanzania Bureau of Standards (TBS)
    - Building Research Unit (BRU) National Construction Council (NCC)
    - Tanzania Industrial Studies and Consulting Organisation (TISCO)
    - Tanzania Automotive Technology Centre (TATC)
    - Institute of Production Innovation of the University of Dar es Salaam (IPI)
- Health and Medical Research
    - National Institute for Medical Research (NIMR)
- Food and Agricultural Research
    - Centre for Agriculture Mechanisation and Rural Technology (CAMARTEC) Tropical Pesticides and Research Institute (TPRI)
    - Tanzania Food and Nutrition Centre (TFNC)
    - Tanzania Fisheries Research Institute (TAFIRI)
- Natural Resources Research
    - Tanzania Forestry Research Institute (TAFORI)
    - Tanzania Wildlife Research Institute (TAWIRI)
- Energy Research
    - Tanzania National Radiation Commission (NRC)
- Social Sciences Research
    - National Social Welfare and Training Institute
- Environmental Research
    - National Environmental Management Council

3.2.1.3 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 four research programmes, namely, crops, livestock, special programmes, farming systems research and socioeconomics.

The following table is a summary of some of the key institutions that are main R&D performers in this sector.

Table 7: Major agricultural research institutions

CATEGORY	SUPERVISING AGENCY	NAME OF INSTITUTE	RESEARCH FOCUS
Government	Ministry of Agriculture and Food Security (MAFS)	Directorate of Research and Development (DRD)	Crops, livestock, natural resources, socio-economics
		Tropical Pesticides Research Institute (TPRI)	Pesticides
		Tsetse & Trypanosomiasis Research Institute (TTRI)	Animal health
	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

3.2.1.4 Medical and Health Research Institutes

The three bodies that are responsible for setting priorities and co-ordinating health research in Tanzania are the Ministry of Health (MoH), COSTECH, and the National Institute of Medical Research (NIMR). By tradition, the division of labour between the MoH and NIMR was that NIMR was responsible for medical research and the Ministry for purely operational health systems research. This is about to change, as NIMR is also moving into research on health systems and services and getting operational. COSTECH and the Ministry of Science, Technology and Higher Education are formulating the priorities for health research in general: the primary focus is placed on communicable diseases, in addition to maternal and child health.

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 8: Major health research institutions

CATEGORY	SUPERVISING AGENCY	NAME OF INSTITUTION	RESEARCH FOCUS
Government	Research in decision making and policy implementation	Ministry of Health	Research in decision making and policy implementation
	Contagious diseases - mainly medical research NIMR has ordered its research priorities as follows: Malaria, Filariasis, Trypanosomiasis, Onchocerciasis, Schistosomiasis and sexually transmitted diseases including AIDS	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
	Food and Nutrition issues	Tanzania Food and Nutrition Centre	Food and Nutrition issues
Universities		Muhimbili University College of Medical Science (MUCHS)	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 MSTHE 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 21 universities of which 8 are public while the remaining are private. The student population was appallingly low, but this situation has improved as reflected in table 7. 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. New universities have opened, and existing ones have increased their student intake. The growth in student enrolment in technical institutions declined sharply from 502 in 2003/4 to 247 in 2004/5. Technical students accounted for only 0.51% in 2005. From the statistics provided by the MSTHE, the student enrolment by discipline could not be determined.

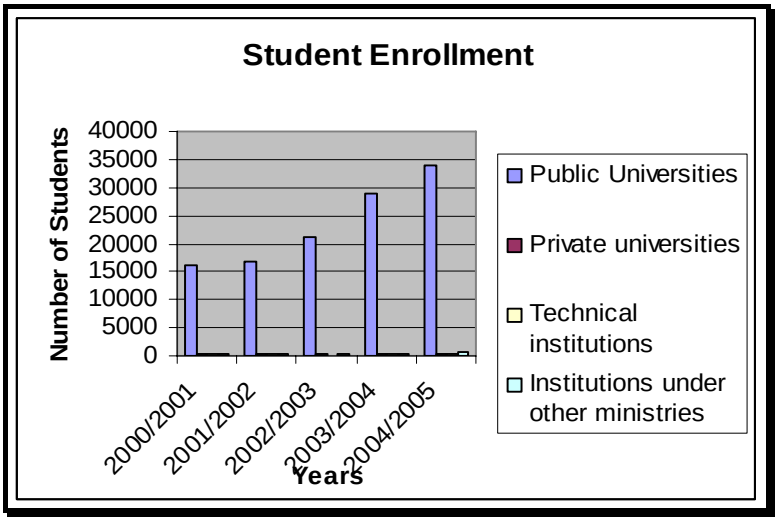
Table 10: Student enrolment in HEI for YEARS 2000-2005

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: MSTHE website

Figure 3 illustrates the trend in the number of student enrolment in public, private, technical and institutions that are under other ministries.

Figure 3: Student enrolment in Higher Education Sector and Institutions under ministries

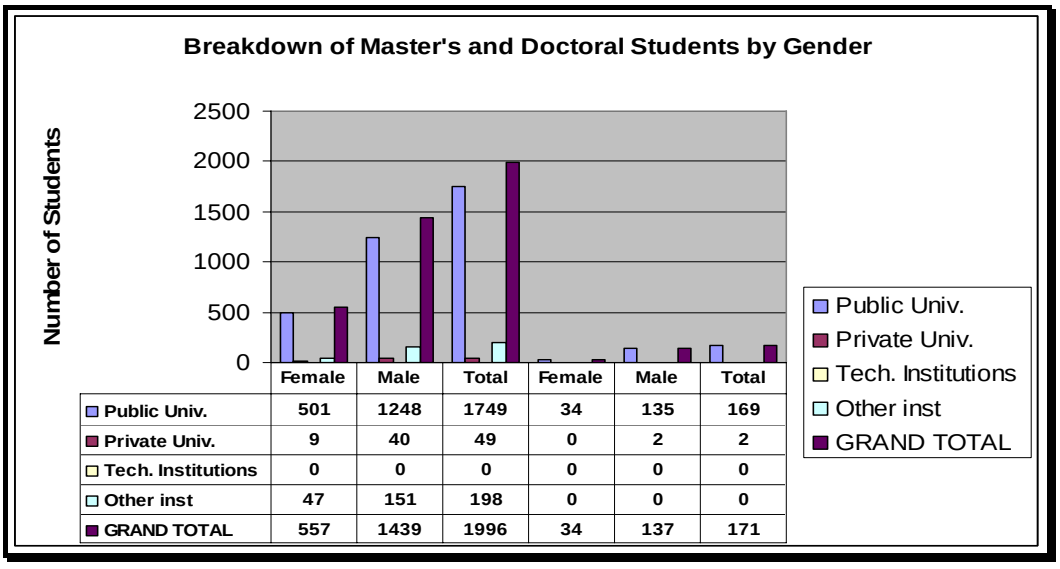


3.3.2 Masters and doctoral enrolments

The head count of masters and doctoral enrolment in 2004/5 is shown in Figure 4. This illustrates that the number of postgraduate students is very low give 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 4 highlights this by comparing the number of female and male students.

Figure 4: Masters 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: MSTHE website

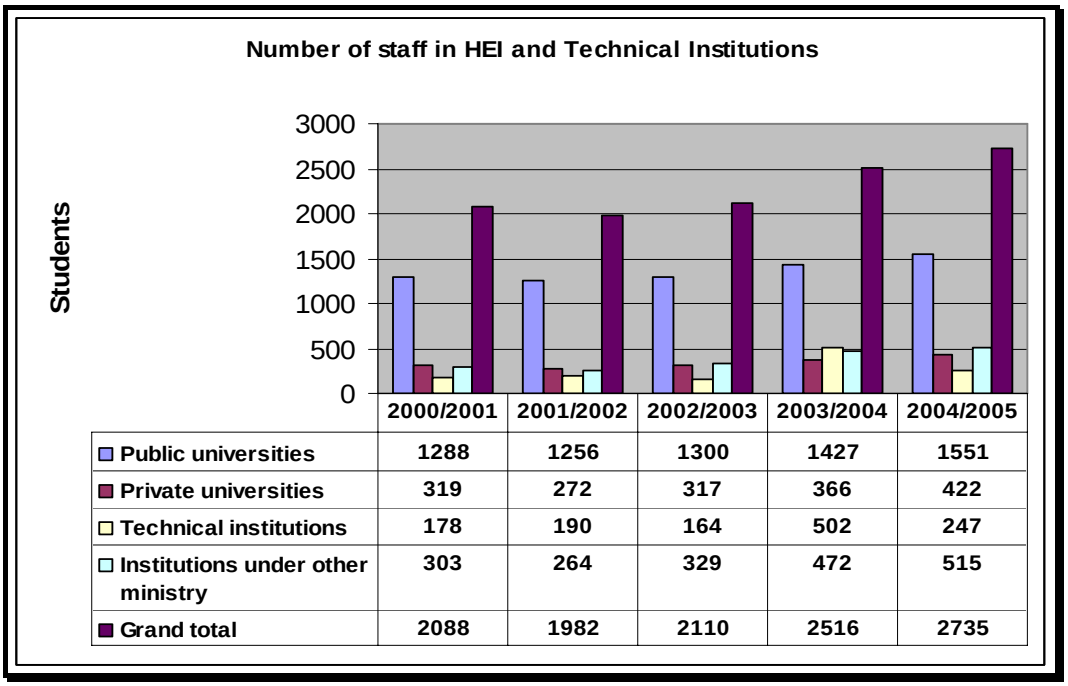
3.3.3 Size of the University Workforce

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 5.

Figure 5: 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

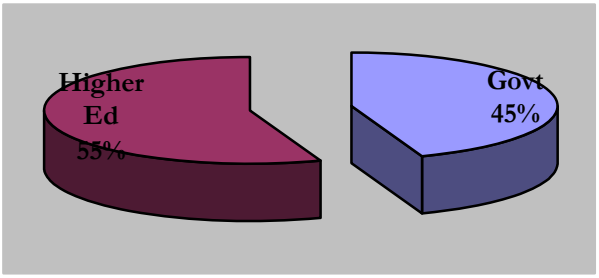
Source: MSTHE

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 Fig 6, the data show that the Higher education sector has 55% personnel head count while the Government R&D institutions have 45%.

Fig 6: 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 major challenges that face higher education in Tanzania are:

- Very low student enrolment;
- Gross imbalance in science relative to liberal arts;
- Gender imbalance;
- Poor financing;
- Unregulated, uncontrolled proliferation of tertiary training institutions;
- A tendency to distort the real worth of academic programs.

A number of strategies have been proposed to address these problems. 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.

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 shall 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.[7] 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 percent. 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.

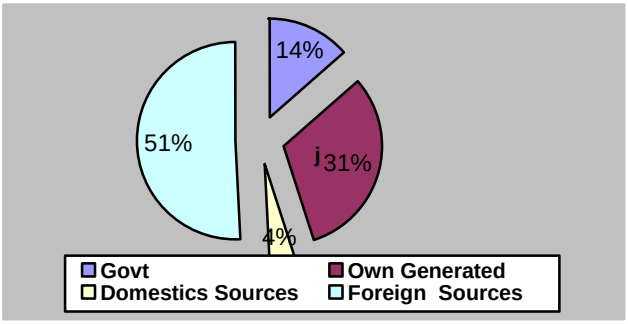
3.4 Research and development funding

3.4.1 Gross expenditure on R&D

[7] SciDev

As stated in the previous section, the survey by COSTECH included an estimation of the R&D expenditure. Fig 8 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.

Fig. 7: 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 attaint 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.[8] Foreign funding agencies concentrate on particular institutions or faculties (notably the two main universities: University of Dar es Salaam–UDSM; and Sokione University of Agriculture –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.

8 Kingamkono R, personal communication (COSTECH)

Table 11*:* **Long-term aid to Tanzanian research**

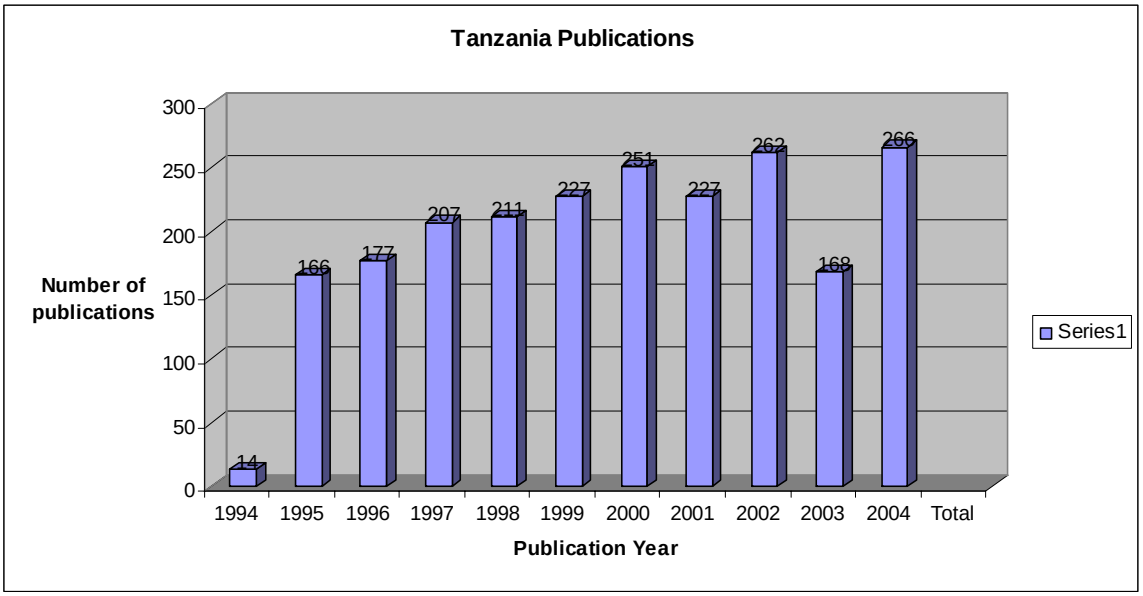
AGENCY AND COUNTRY	TANZANIAN BENEFICIARY
NORAD ,Norway	SUA Faculty of Forestry
NORAD ,Norway	UDSM Department of Chemistry
NORAD, Norway	UDSM Department of Chemical and Process Engineering
FINNIDA, Finland	UDSM Department of Geology
DANIDA ,Denmark	SUA Department of Animal Science
SDC ,Switzerland	UDSM 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

3.5 Research outputs

3.5.1 Publications

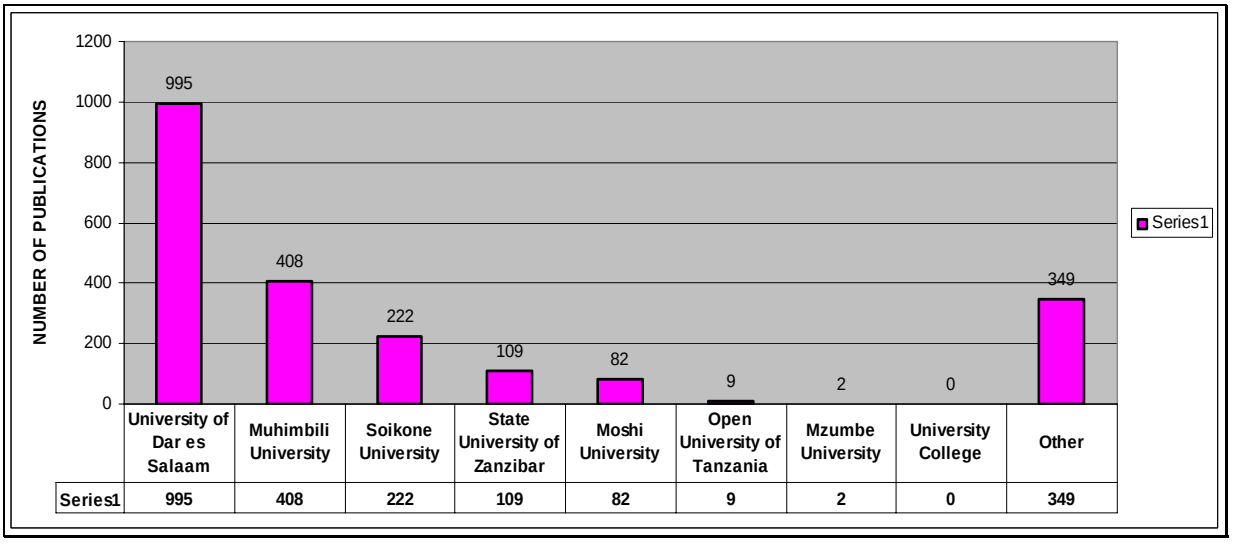
The total number of articles published in Tanzania as indexed in the international database ISI between 1994 and 2004 was 2176. With a yearly average of about 200, the publication output is very low. Except for the decline in 2003, the publication output has however increased steadily over the last 10 years.

Figure 8: Number of publications between 2004 -2004



The top four universities in terms of scientific output are the University of Dar es Salaam, Muhimbili University College, Sokione University of Agriculture and State University of Zanzibar (Figure 8). The high ranking of Sokione University of Agriculture demonstrates the strong research tradition in agriculture.

Figure 9: Main producers of publications (1994-2004)



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 because of limited resources and institutional weaknesses.

3.5.2 Patents

The following table displays technology classes and counts of associated patents, as distributed by the year of patent grant. From this table, it is evident that intellectual property production in Tanzania as measured by USPTO patents is insignificant**.**

Table 12: Patents granted to Tanzania

Class Title	2000	2001	2002	2003	2004	Total
Chemistry: Molecular Biology and Microbiology	**0**	**0**	**0**	**1**	**0**	**1**
Chemistry: Analytical and Immunological Testing	**0**	**1**	**0**	**1**	**0**	**1**
ALL CLASSES	**0**	**1**	**0**	**10**		**2**

Source: USPTO

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

To assess Tanzania's ability to participate in the knowledge economy, the Technology Achievement Index was used (TAI). The Technology Achievement index aims to capture how well a country is creating and diffusing technology and building a human skill base. Technology incorporates elements such as the number of utility patents, gross tertiary enrolment, company spending on R&D, firm-level technology absorption, and the availability of mobile phone.

The index was developed by the United nations Development Programme (UNDP: 2001) is used since it allows the country to be compared to other countries in terms of technology achievement.

3.8.1 Comparative analysis

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.

4. References

Diyamett, B and Wangwe S, *Measuring innovation in OECD and non-OECD countries, Innovation indicators*.

Gaillard. Country Report, Tanzania Stockholm IFS & Paris: IRD, December 2001

Kingamkono, R, COSTECH, personal communication

Masanja, V Grace, (2005) *A Survey Of R&D Funds Flow In Tanzania Government R&D Institutions 1995/96-2003/04*

Msuya, R A, COSTECH, personal communication

Mwamila, B LM and Diyamett, B, D: College of Engineering and Technology University of Dar es Salaam, Tanzania *The Position of Higher Education in the National System of Innovation: The Case of Tanzania* Paper presented at UNIVERSIDAD 2006" 5th International Congress on Higher Education Cuba, 13-17 February, 2006

Information sources

CIA fact Sheet

COSTECH

MSTHE

SciDev

UNDP

USAID

USPolitifno

USPTO

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