

THE REPUBLIC OF ZAMBIA

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Introduction

This report looks at the science, technology and innovation system of the Republic of Zambia. Section 1 briefly deals with the national political environment; Section 2 looks at the key country characteristics including the economic, demographic and health, education and information and communication technology infrastructure. Finally, Section 3, which forms the main part of the report, gives overview and analysis of the science technology system. This section is subdivided into seven thematic subsections covering the governance of science and technology, science and technology landscape, S&T human resources, funding, research outputs, technological innovation and lastly international co-operation and networks activities.



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Section 1: The political environment

Zambia, a landlocked country covering an area of 752,612 sq. kilometres lies in a tropical belt on a high plateau averaging about 1,300 metres above sea level. Zambia is centrally located in Southern Africa and shares borders with the Democratic Republic of Congo and United Republic of Tanzania in the north, Malawi and Mozambique in the east, Botswana, Namibia and Zimbabwe in the south and Angola in the west. (http://www.sadcreview.com/country_profiles/zambia/zambia.htm)

European settlers created Zambia's borders, notably Cecil Rhodes who's British South Africa Company laid claim to this part of Africa in the 1890s. In 1911, the country became the British colony of Northern Rhodesia, with Livingstone as its capital. (http://www.sadcreview.com/country_profiles/zambia/zambia.htm) The colony came under direct British rule in 1924. In response to pressure from European settlers, the Federation of Northern Rhodesia, Southern Rhodesia and Nyasaland came into existence on 3 September 1953. It only lasted 10 years in the face of nationalist movements in all three territories. The Federation was dissolved on 31 December 1963. Northern Rhodesia formally became the Independent Republic of Zambia on 24 October 1964. (http://www.sadcreview.com/country_profiles/zambia/zambia.htm)

In 1972, Zambia was declared a one-party State, but reverted back to multiparty democracy in December 1990 and with the general elections held in October 1991, the Movement for Multiparty Democracy came to power. The election in 2001 was marked by administrative problems with three parties filing a legal petition challenging the election of ruling party candidate Levy Mwanawasa. The new president launched an anti-corruption campaign in 2002, which resulted in the prosecution of former President Frederick Chiluba and some officials of his administration.

Section 2: Country characteristics

2.1 Basic economic outlook

Zambia is richly endowed with various minerals such as copper, cobalt, gold and various precious stones including amethyst, blue stones, emeralds, and many others. Zambia holds six percent of the world's known copper reserves. Mining and quarrying account for a large proportion of Zambia's merchandise exports and have traditionally contributed the largest proportion of the country's total Gross Domestic Product (GDP). (SADC Trade and Investment Review 2006)

The country also has extensive arable land, forests, woodlands and water resources. The agricultural sector has great potential for further development since only about 15 percent of the available arable land is currently under cultivation. The rise in the proportion of non-traditional exports to total exports in the past few years has led to the government placing special emphasis on the development of the agricultural sector. (SADC Trade and Investment Review 2006)

Despite the challenge of the escalating oil prices, preliminary figures for 2004 show that real Gross Domestic Product grew by 5.0 percent compared to a target of 3.5 percent. Furthermore, domestic financing was within the budget target of 2.2 percent of GDP. Gross International Reserves (GIR) was equivalent to 1.2 months of import cover. Annual inflation was 17.5 percent, which was 2.5 percentage points above the target, largely because of high input costs arising from the increased oil prices. (SADC Trade and Investment Review 2006)

Table 1: Gross Domestic Product (constant 1994 prices)

	2000	2001	2002	2003	2004
Total (ZK bn) at market prices	2,499.0	2,621.3	2,707.9	2,846.7	2,988.9
Real change (%)	3.6	4.9	3.3	5.1	5.0
Per capita (ZK)	242,626	248,531	250,723	257,398	269,518

Source: Central Statistical Office

After more than two decades of stagnation, Zambia's¹ economy has recently grown robustly, according to the IMF's latest economic review. During 2000-05, real GDP growth averaged 4.5 percent a year, as mining recovered and construction picked up because of a surge in housing demand. Nevertheless, poverty remains widespread, and the economy is still vulnerable to shocks. (IMF Survey, 2006)

Growth slowed in 2005, owing to a drought-related shortfall in maize production and disruptions in mining activity. Inflation was in the high teens during most of 2005, and moderated at year-end, partly in response to the sharp appreciation of the Zambian kwacha, but remains high. The appreciation was driven by strengthened market sentiment stemming from record-high world copper prices, a perceived commitment to prudent fiscal and monetary policies, and Zambia's improved debt sustainability outlook. Through improved fiscal management, Zambia has reduced its overall deficit (including grants) while allowing for increased spending for poverty reduction. It is also implementing structural reforms to increase the efficiency and effectiveness of the public sector, improve debt management, deepen the financial sector, and promote private sector development. (IMF Survey, 2006)

¹ Currency = Zambian Kwacha

Zambia's debt burden remains high and the total foreign debt stock as at the end of December 2004 was US\$6.8 billion having risen from US\$6.38 billion in 2003. The debt rose over this period due to positive net flows on existing and new loans minus amortisation payments as well as exchange rate variations. In 2004, a total of US\$129.0 million was spent on foreign debt service of which US\$92.9 million was principal repayment and US\$36.0 million was interest repayment. Zambia's large and unsustainable foreign debt has caused the country to seek international intervention for its resolution. Since December 2000, the country is under the Heavily Indebted Poor Countries (HIPC) Initiative, which is a global initiative to try to reduce debts of developing countries to sustainable levels. (SADC Trade and Investment Review 2006)

2.2 Demographic and health characteristics

Table 2: Summary of various demographic statistics for Zambia

Indicator	Statistic	Year	Source
<i>General demographical statistics</i>			
Total Population (millions)	11.3	2003	Human Development Report, 2005
Population aged 15 -64	51.1% (male 2,848,402 / female 2,904,376)	2005	http://en.wikipedia.org/wiki/Demographics_of_Zambia
Annual population growth (%)	2.12	2005	http://en.wikipedia.org/wiki/Demographics_of_Zambia
Percentage of urban population	35.9	2003	Human Development Report, 2005
<i>Health</i>			
Life expectancy at birth (years)	37.4	2000-2005	Human Development Report, 2005
Total fertility rate	5.47 children born / woman	2005	http://en.wikipedia.org/wiki/Demographics_of_Zambia
Infant mortality rate (per 1000)	88.29	2005	http://en.wikipedia.org/wiki/Demographics_of_Zambia
HIV/AIDS – adult prevalence rate	16.5%	2003	http://en.wikipedia.org/wiki/Demographics_of_Zambia
Doctors	693	2004	Ministry of Finance and Planning
Clinical officers	1165	2004	Ministry of Finance and Planning

Table 2 Continued

Indicator	Statistic	Year	Source
<i>Health</i>			
Nurses	8356	2004	Ministry of Finance and Planning
Laboratory	454	2004	Ministry of Finance and Planning
Pharmacists	24	2004	Ministry of Finance and Planning
Other paramedics	840	2004	Ministry of Finance and Planning
<i>Education</i>			
Total Enrolment (Grade 10-12)	159339	2004	World Bank Report, 2006
GER at High school (Grades 10-12)	16%	2004	World Bank Report, 2006
Adult literacy	80.6%	2003	CIA Fact book
<i>Information & Communication Technology (ICT)</i>			
Telephone mainlines (per 1000 people)	8	2003	Human Development Report 2005
Cellular subscribers (per 1000 people)	22	2003	Human Development Report 2005
Internet users (per 1000 people)	6	2003	Human Development Report 2005

Section 3: Science and Technology system

Despite the implementation of various macro-economic and development strategies, from 1964 to 1991, there was deterioration in the economic and industrial performance in Zambia. The transformation of Zambia's economic policy framework, in 1992 from a Central State controlled to a free market and liberalized economy, with greater emphasis on private sector participation in the economy, brought some beneficial results in some sectors of economy and some negative results in other sectors, such as manufacturing industry, which faced stiff competition from imported goods and services. (MSTVT, 1996)

A major contributing factor to the poor performance of the industry has been the lack of application of science and technology, which has resulted in industries becoming uncompetitive with declining productivity under global trade environment. In view of the above, the Government has realized that sustainable socio-economic development can only be achieved through a strong well co-ordinated and monitored Science and Technology System. Hence, the government decided to formulate a National Science and Technology Policy. (MSTVT, 1996)

It is imperative that Zambia on the advent of the new millennium takes audit of its scientific and technological needs and makes the right choices to enhance and create capacities for a sustained competitive productive base, which is technology-based. A consultative process among stakeholders has culminated in the development of the Science and Technology Development Programme (STDP),

vision. This vision is one where, on one hand Zambia charts a course through which it uses science and technology (S&T) to become economically competitive on the global market and provide essential goods and services to meet local needs and export the surplus. (MSTVT, 2002)

The science and technology development programme aims at providing a working mechanism for the government and stakeholders to plan and map out strategies to create capacities and promote the development and application of science and technology. This programme aims at rekindling the national productive potential through the judicious utilization of available resources based on transparency and accountability to the people. The STDP will enhance the overall national science and technology delivery system for the socio-economic well being of the Zambian people. (MSTVT, 2002)

The STDP spells out strategies for creating wealth and improving the quality of life of the people by integrating Science and Technology into the national development process in all sectors of the economy. The STDP in a broader context proposes establishment of a foresighted Science and Technology Development initiative; the purpose of which is to promote application and utilisation of Science and Technology in national development by creating a framework for development. The programme also aims at identifying sector specific initiatives that will form an integral part of the government strategy for industrial development. (MSTVT, 2002)

Science and technology creates conditions for economic and social development. To achieve this, it is essential to ensure that science and technology outputs are transferred into viable products and services. The National Science & Technology Policy framework provides for the establishment of key institutions for the promotion and marketing R&D products and their commercialisation. The overall objective is to foster innovation that is strongly allied to facilitating the up scaling, diffusion and commercialisation of indigenously developed and imported technologies to promote national capabilities for the development of contemporary and novel products and services. The primary responsibility of government is to ensure and stimulate such diffusion between the medium and small-scale industries to raise national industrial production and create jobs. (STDP, MSTVT, 2002)

3.1 Governance of Science and Technology

In Zambia, Science and Technology work is carried out largely by the National Council for Scientific Research (NCSR), University of Zambia (UNZA), line Ministries principally, Agriculture Food and Fisheries, Environment and Natural Resources, Mines and Minerals Development and Health and with funding predominantly from Government. However, funding for research and development by both Government and private sector has been limited and has greatly contributed to the poor performance of the application of Science and Technology in national development. The weak linkages between the Research System, Government and Industry are another contributing factor.

3.1.1 Ministry of Science, Technology and Vocational Training

The Ministry of Science, Technology and Vocational Training (MSTVT) is one of the Government Institutions, that is expected to play a major role in the socio-economic recovery programme of the country aimed at achieving sustainable economic growth and improving the well-being of the people of Zambia. MSTVT is expected to provide an enabling environment for active participation of both the public and private sectors in the development and application of science and technology and the provision of technical education, vocational and entrepreneurship training. (MSTVT, 2002)

In line with the Government's general policy framework and according to Government Gazette Notice Number 46 of 24th January 1992, MSTVT is responsible for the following portfolio functions:

- Policy and administration of Technical Education and Vocational Training;
- Trade Training Institutes;

- Technical Colleges;
- Technologist Training;
- Art Training and Promotion;
- Secondary Technical Teacher Training;
- Curriculum Development; and
- Co-ordination of Technical Training.

In addition, MSTVT is also responsible for the following statutory bodies and institutions:

- Technical Education, Vocational and Entrepreneurship Training Authority (TEVETA);
- National Institute for Scientific and Industrial Research (NISIR);
- National Science and Technology Council (NSTC); and
- National Technology Business Centre (NTBC). (MSTV, 2002)

Since 1995, when the Strategic Plan for MSTVT was developed, some developments have taken place in the country and key policy decisions have been made by Government, which have had a bearing on the structure and operations of the Ministry. These include:

- Enactment of the Science and Technology Act No. 27 of 1997.
- The transformation of the National Council for Scientific Research into the National Institute for Scientific and Industrial Research in 1998.
- Enactment of the Technical Education, Vocational and Entrepreneurship Training Act No. 13 of 1998.
- Creation of the Department of Vocational Education and Training in 1999.
- Establishment of Management Boards in Training Institutions in the Year 2000.
- Creation of the Technical Education, Vocational and Entrepreneurship Training Authority (TEVETA) in the Year 2000.
- Establishment of the National Science and Technology Council in the Year 2000.
- Formulation of the Technical Education Vocational and Entrepreneurship Training (TEVET) Development Programme in 2001.
- Establishment of the National Technology Business Centre in 2001.

3.1.2 *Ministry of Education (MoE)*

The Ministry of Education (MoE) is responsible for overseeing basic schools, high schools, and the fourteen Teacher Colleges. The two universities - the University of Zambia and Copperbelt University - are self-governing para-statal bodies, whose GRZ budgetary support is included within the MoE budget. Responsibility for oversight of technical education, entrepreneurship, and vocational training (TEVET) lies with the Ministry of Science, Technology, and Vocational Training (MSTVT), and the TEVET Authority (TEVETA). (Education Sector Public Expenditure Review, 2006)

3.1.3 *Ministry of Agriculture, Food and Fisheries (MAFF)*

From 1995 to 2001, the main vehicle for the implementation of the policy objectives in agriculture was the Agriculture Sector Investment Program (ASIP) under the Ministry of Agriculture, Food and Fisheries (MAFF). ASIP adopted a holistic approach to provide improved and sustainable services to the sector through efficient use of resources. The major underlying assumption was that all government and donor resources would be pooled into “basket funding” for the various ASIP activities. The strategies for achieving the objectives of ASIP focused on enhancing production through free market development, reduction of government role in commercial activities, and provision of efficient public services. (Muna Hantuba)

The interventions of ASIP were organized around the following sub-programs: Extension, Irrigation, Research, Agriculture Training, Animal Production and Health, Agriculture Finance, Marketing and Trade, Seeds, New Product Development, Farm Power and Mechanization, Policy and Planning, Standards, and the Rural Investment Fund. These sub-programs set the outline of the Ministry of Agriculture, Food and Fisheries (MAFF) during the last five years. Consequently, the ministry was restructured to meet the objectives of the program. During this period, the program scored a number of successes and recorded some failures. (These are outlined in the GRZ/MAFF ACP document of November 2001). (Muna Hantuba)

3.1.4 *Science and technology priorities*

Innovation is an encompassing notion that is based on the continuous production of new knowledge and its creative applications in a number of spheres. Therefore, the promotion of research, both applied and basic, in the natural sciences and in the social sciences, is crucial to innovation and hence to both social and economic development. (NSTC, 2005)

From a study that the National Science and Technology council, commissioned involving stakeholders inputs, the following priority areas were established:

- Agriculture, Fisheries and Forestry
- Health services
- Information, Communication and Technology
- Energy and Environment
- Education
- Engineering and Manufacturing
- Industry, excluding Mining
- Tourism
- Housing and Construction
- Transport, and
- Mining and quarrying.

Using the above priority ranking of sectors, R&D programmes can be developed, whose research findings can be used to find solutions to problems facing the nation and such programmes or proposals can be used for resource mobilization. The development of such a problem-based “Scientific and Technological Priorities” plan is illustrated below for four sectors: Agriculture forestry and fisheries, health services and nutrition, industry/manufacturing and Education in S&T. (NSTC, 2005)

Table 3: Scientific and Technological Priorities plan

<p>Scientific and Technological Priorities for Agriculture, Forestry and Fisheries:</p> <p>Intensified R&D work in such areas as drought-resistant and disease-resistant crops (maize, sorghum, cassava, rice)</p> <p>Livestock production, livestock disease control, and manufacture of vaccines and antibiotics</p> <p>Biotechnology research in plant tissue culture, nitrogen fixation and fermentation</p> <p>Increased production of cotton, groundnuts, and high-value crops such as paprika and coffee as well as horticulture for export</p> <p>Increased fish production through fish farming</p> <p>Honey and beeswax for export</p> <p>Value addition/ Processing of Agricultural produce</p>	<p>Scientific and Technological Priorities for Industry Manufacturing</p> <p>Manufacturing: chemicals and oil products; wood processing; construction and building materials; fertilizers; agro-processing</p> <p>Technology upgrading through the introduction of modern efficient technology in the manufacturing and physical development of existing and new products/processes with a view to enhancing the competitiveness level of firms. Enhanced R&D work in quality control and standards</p> <p>For export- orientated agro-food products, the production and marketing systems require the development of high level technology application, well trained human resource and competitive marketing management</p>
<p>Scientific and Technological Priorities for Health and Nutrition</p> <p>Nutrition enhancement through locally grown cassava and rice both bred with protein</p> <p>Nutrition Food Promotion Community-based Programme. The main objectives of such a programme will be to promote the production of adequate and nutritious food for family consumption; to encourage the rural community to make effective use of locally produced food products; and to increase the rural populations awareness of locally available nutritious foods for an improved diet</p>	<p>Scientific and Technological Priorities for Education</p> <p>Education and training of human resources in S&T including Design Engineering deserve the highest possible attention of S&T policy makers.</p> <p>There is a need to create a more efficient system of education geared towards the science and technology requirements of this century and rooted in the local culture.</p>

3.1.4.1 ICTs

The Communications Authority of Zambia (CAZ) was established by the 1994 Telecommunications Act, the same Act that divide the then-Posts and Telecommunications Corporation (PTC) into the Zambia Telecommunications Company (ZAMTEL) and the Zambia Postal Services Corporation (ZAMPOST). The creation of the policy is the responsibility of the Ministry of Communications and Transport. (Munsaka, J; Habeenzu, S; & Mulusa, N; 2004)

As the regulatory body, CAZ has encouraged local ownership of the market players that exist within the sector, in that there must be at least a 30% share holding by Zambians in any of the operators. CAZ has rigorously been following this approach. (Munsaka, J; Habeenzu, S; & Mulusa, N; 2004)

The beginnings of liberalization of the mobile sector in the early 1990's saw greater competition. Telecel entered the market, quickly followed by Zamcell, which subsequently changed its name to Celtel. The incumbent Zamtel's Cell Z service then became the third operator in the mobile sector. (Munsaka, J; Habeenzu, S; & Mulusa, N; 2004)

The Internet service provider (ISP) sector is liberalized, to the extent that one can set up an ISP as long as one pays the license fee to operate such a service. The operators all piggyback on the national carrier, ZAMTEL. The Internet has grown in Zambia since its inception in 1994 by ZAMNET. There are 6 active players in the market, out of the 9, which are registered. ZAMNET is the pioneer of

Internet services within Zambia and was established by the University of Zambia. Currently ZAMTEL has about 38% of the market share, followed by the incumbent fixed-line operator ZAMTEL's service at 34% and CopperNET with 19%. Three of the six main ISP's have foreign shareholding. According to available reports (ITU, COMESA) there are nearly 12 000 Internet subscriptions in Zambia, with the number of Internet users between 40 000 and 50 000. A number of the subscriptions are corporate, or are used by collective access points by cyber cafes and internet cafes. (Munsaka, J; Habeenzu, S; & Mulusa, N; 2004)

3.2 Science and Technology landscape

The Department of Science and Technology developed the National Policy on Science and Technology in 1996 and facilitated the enactment of the Science and Technology Act No. 26 of 1997. The Department also facilitated the transformation of the National Council for Scientific Research from the National Institute for Scientific and Industrial Research (NISIR) in 1998 and established the National Science and Technology Council in 2000 and the National Technology Business Centre (NTBC) in 2001. In addition, the Department undertook studies and spearheaded plans to establish training Cum Production Centre for Gemstone processing for small-scale miners, and the National Remote Sensing Centre (NRSC) in 2001.

Table 4: Highlights of Institutions Development

1959	Agricultural Research Council of Rhodesia and Nyasaland
1967	Agricultural Research Council of Zambia
1967	The National Council for Scientific Research
1997	Science and Technology Act No. 26
	Golden Valley Agricultural Research Trust (GART) established
1998	National Institute for Scientific and Industrial Research
1998	Technical Education, Vocational and Entrepreneurship Training Act No. 13
1999	National Technology Business Centre
	Cotton Development Trust (CDT) established
2000	National Science and Technology Council
2000	Technical Education, Vocational and Entrepreneurship Training Authority (TEVETA)
2001	National Technology Business Centre (NTBC)
	National Biotechnology and Biosafety Policy
2002	Livestock Development Trust (LDT) established
	Lyambai Agricultural Development Trust (LADT) was established focusing on livestock training and breeding improvement
2003	Draft Information Technology and Communications Policy released

3.2.1 S&T agencies

The institutional landscape defining the Science and Technology landscape of the country is comprised of research funding, training, performing and utilizing organizations.

Table 5: S&T agencies

Name	Date Established	Function
National Science and Technology Council	2000	Enhance Zambia's capacity for scientific research and technological development
Science and Technology Fund	To be established	
National Technology Business Centre	2000	Linking developed and proven technologies from various local and international sources with the business community and entrepreneurs

3.2.1.1 National Science and Technology Council

The national science and technology council is a statutory body through which the Government of the Republic of Zambia directs policy on the development and application of science and technology in the country. An Act of Parliament, the Science and Technology Act, No 26 of 1997 established it. The council was inaugurated on the 10th of August 1999 and the Secretariat was established on 1st April 2000.

The mission of the Council is to enhance Zambia's capacity for scientific research and technological development, in order to create wealth and improve the quality of life, by promoting the development and application of science and technology.

The overall function of the council is to promote science and technology to create wealth and improve the quality of life in Zambia. Specific functions of the Council include:

- Promoting: the development of indigenous technological capacity, the use of science and technology in industry, the integration of gender concerns in science and technology development, and broad national priorities in science and technology.
- Regulating research in science and technology including the registration of research and research and development institutions and initiating special projects.
- Advising the government on: science and technology related policies, the establishment of any new research and development institutions, and national research and development priorities in science and technology.
- Mobilizing and making available financial, human and other resources including science and technology information to research and development institutions.

The major source of funds for the Council is Parliamentary appropriation. The council is however, allowed by law to accept money by way of grants or donations from any source in Zambia and, with the approval of the Minister of Science, Technology and Vocational Training, from any source outside Zambia.

3.2.1.2 *Science and Technology Fund*

Successful implementation of the Science and Technology Policy depends on the availability of adequate financial resources. Hence, the following sources of funds have been proposed: Government allocation of 3% of GDP to scientific and technological activities; public, private and donor contribution to the Science and Technology Fund, which will be created; research institutions' internal generation of funds through commercialisation of technologies, contract research and collaborative research; and Creation of Technology Venture Capital by the private sector. (MSTVT, 1996)

The creation of a Science and Technology Fund was proposed with the promulgation of the Science and Technology policy in 1996; however, yet there it does not exist. Within the National Science and Technology Council there are plans for the creation and development of the fund, but these plans are in it infancy.

The Ministry of Science, Technology and Vocational Training set aside money in the 2006 budget for the establishment of the Science and Technology Venture Capital and Innovation Fund.

3.2.1.3 *National Technology Business Centre*

The National Technology Business Centre (NTBC) Is a Corporate body created by the Science and Technology Act No 26 of 1997 and Statutory Instrument No 136 of 1999. NTBC became operational from 1st April 2000, with the main objective of linking developed and proven technologies from various local and international sources with the business community and entrepreneurs for the production of goods and services.

NTBC was established with the main objective of linking developed and proven technologies from various local and international sources with the business community and entrepreneurs for the production of goods and services. The NTBC's mission is to promote and assist entrepreneurs and business in the acquisition and adoption of technology, provision of technology information And related consultancy services The NTBC is regulated by the Board of Directors and is managed by a team of experts in Administration Engineering, Finance / Accounting and the Information technology ministry.

3.2.2 *R& D performing institutes*

The R&D performing institutions in Zambia may be categorized into the higher education sector institutions, public sector research and technology institutes as well as private sector research institutes.

3.2.2.1 *Higher Education Sector*

There are two universities in Zambia, both public: the University of Zambia, with about 8000 students, and Copperbelt University, with about 3000 students.

Staffing levels within the two universities increased from 598 to 815, from 2003 to 2004. At the University of Zambia the number of lecturers increased from 438 in 2003 to 552 in 2004, and in the case of Copperbelt University and increase of more than 100 lecturers is noted for the same period.

Table 6: Number of lecturers at the two universities, 2003/2004

Year	Copperbelt University	University of Zambia
2003	160	438
2004	263	552

Source: Economic Review 2004, Ministry of Finance and Planning

3.2.2.1.2 Public Universities

University of Zambia

The idea of creating a Zambian university was first proposed at the UNESCO sponsored Conference on the Development of Higher Education in Africa convened in 1962 in Tananarive, Madagascar. In late 1964, the new Zambian government, then barely two months old proceeded to appoint a provisional council. The birth of the University of Zambia, in the absence of a higher education tradition, went remarkably smoothly. (Lulat, Y. G-M, 2003)

The university opened in 1966 with a mere 312 students. The Committee had recommended that within five years this number should be doubled. Instead, the figure had already reached more than 1,000 students by 1970. Four years later, this number had more than doubled to 2,500 students. In 1980, it stood at a little under 4,000, and today the enrolment is approximately 5,000 students. (Lulat, Y. G-M, 2003)

The few expatriate personnel who can still be found at the university are there because some teaching fields (such as medicine) still lack sufficient Zambian applicants and because of the university's policy that at least 10% of teaching positions should be reserved for foreign teachers (to ensure the university's linkage with the international university community). Approximately 12% of the current faculty is female. The brain-drain problem threatens to become severe, given the deteriorating economic situation in the country and the resultant impoverishment of the university itself. (Lulat, Y. G-M, 2003)

Some research is taking place, but faculty productivity is pathetically low. Much of the research being undertaken today by individual faculty is done at the behest of external development aid agencies, which have their own specific agendas. The result is that such research remains uncoordinated; even worse, findings are often restricted to the archives of the sponsor. (Lulat, Y. G-M, 2003)

Copperbelt University

The Copperbelt University was established as a public University by an act of Parliament No. 19 of 1987 1st December 1987. Before then, the institution fell under the University of Zambia Federal system which comprised of three consistent institutions; namely

- University of Zambia, Lusaka
- University of Zambia, Ndola and
- University of Zambia, Solowezi.

In 1987, the Government recognised the University of Zambia at Ndola into Copperbelt University while the University of Zambia at Lusaka became the University of Zambia

The University has enjoyed significant growth in recent years, with major expansion in the Programmes offered. It now has four Faculties after the incorporation of the Zambia Institute of Technology into the University as the School of Technology in 1989, and the creation of the School of Forestry and Wood Science in 1995 later renamed School of Natural Resources in 2001.

The University has been active in fostering external linkages and is a member of the following Associations:

- The Association of African Universities
- The Association of Commonwealth Universities
- Eastern and Southern African Universities
- Founder member of the African Council for Distance Education.

The University has four main schools:

<p>School of Business</p> <p>The school offers three under-graduate degree programmes, namely;</p> <p>Bachelor of Accountancy (BAcc)</p> <p>Bachelor of Business Administration (BBA)</p> <p>Bachelor of Science in Production Management (BSc)</p> <p>The School also offers a Master Degree in Business Administration (MBA)</p>	<p>School of the Built Environment</p> <p>The School offers the following Degree programmes:</p> <p>Bachelor of Architecture (BArch.)</p> <p>Bachelor of Science in Building (BSc. Building)</p> <p>Bachelor of Science in Urban & Regional Planning (BSc. URP)</p> <p>Bachelor of Science in Quantity Surveying (BSc. QS)</p> <p>Bachelor of Science in Land Economy (BSc. Land Economy)</p> <p>Bachelor of Science in Civil Engineering (BSc. Civil Engineering)</p> <p>These degrees are awarded after five (5) years of successful study.</p>
<p>School of Natural Resources</p> <p>The school offers a Bachelor of Science degree in Forestry</p>	<p>School of Technology</p> <p>The School offers the following Degree programmes:</p> <p>Chemical Engineering (Being)</p> <p>Computer Science (BSc. Comp. Sc.)</p> <p>Electrical/Mechanical Engineering (B. Eng)</p> <p>Electrical/Electronics Engineering (B. Eng)</p> <p>Metallurgy Engineering (B. Met Eng.)</p>

3.2.2.2 Public Research Institutes

3.2.2.2.1 Tropical Diseases Research Centre

The World Health Organisation (WHO) in collaboration with the Zambian Government initiated the Tropical Diseases Research Centre (TDRC). This was in response to a resolution of the World Health Assembly (Resolution No. WHO 27.52) of 1974 that called for the intensification of research into tropical diseases and stipulated that, as far as possible, the work should be done in developing countries where these diseases are endemic.

The Zambian Government generously offered space at Ndola Central Hospital to accommodate the Centre. In January 1981, the TDRC became a National Institution for research, training, and service in diseases of public health importance in Zambia. To this effect, the TDRC must be seen primarily as a national resource dedicated to priority health problems in Zambia and as a facility for training national and regional health service personnel. It is a statutory body under the Ministry of Health with the mandate to conduct epidemiological and clinical research.

Despite the budgetary constraints, the Government of Zambia continues to recognise the value of applied research to support disease control programmes. Most of the research at the Centre is supported by competitive grants from external donor agencies and collaborating institutions such as WHO, UNICEF, U.S. Centre for Disease Control and Prevention (CDC), Duke University, Boston University, Institute of Tropical Medicine (Belgium), Wellcome Research Laboratory, (UK), the Irish Government, USAID, WAF, etc.

The centre has laboratories with basic equipment and tools to perform meaningful research. The centre's research focus areas are malaria, HIV/AIDS, schistosomiasis and nutrition deficiency disorders. TDRC has developed new drugs against malaria that have already been tested and are currently in use. It has also been involved in a programme of distributing Vitamin A capsules to all children, and in so doing has helped reduce vitamin A deficiency. (NSTC, 2002)

3.2.2.2 National Institute for Scientific and Industrial Research

An Act of Parliament (Act 236) to replace the then Agricultural Research Council of Central Africa created the National Council for Scientific Research (NCSR) in 1967. The NCSR was mandated to advise the Government on matters of Science and Technology (S&T); to enhance local capacity in S&T by recommending or undertaking research and development work in national priority areas to promote the application of S&T in national socio-economic development. The name changed to National Institute for Scientific and Industrial Research (NISIR) following the repeal of the NCSR Act and replacing it with the Science and Technology Act number 26 of 1997.

The institute is mandated to undertake Research and Development activities as follows:

- Carry-out research in civil engineering, mechanical engineering; electrical engineering; nuclear science; textile technology; energy resources; water resources; chemical engineering; electronic engineering; industrial chemistry; food science; material science; livestock and plant science; natural products; information science; cartographic and location analysis.
- Liaise with other research bodies within and outside Zambia conducting similar research;
- Cooperate with other organisations and institutions of higher learning in training programmes and other matters relevant to research;
- Disseminate research findings;
- Cooperate with the Ministry responsible for S&T, the Council and other relevant institutions in matters pertaining to research policies and priorities;
- Cooperate and liaise with industry;
- Develop and maintain a vibrant relation with the business sector;
- Mobilise financial and other resources for the purpose of carrying-out technical research under this regulation; and
- Do all such acts and things as are connected with or incidental to the foregoing.

It undertakes research and development activities in various areas, including agriculture, natural resources and products, environment and water resources, minerals and industrial raw materials, peaceful application of nuclear science and technology, electrical and electronic power conditioning and protection, textile testing and services, information and communications technology and the information system.

3.2.2.2.3 The Soils and Crops Research Branch (SCRB)

The Soils and Crops Research Branch (SCRB) of the Department of Research and Specialist Services (DRSS), which in turn falls under the Ministry of Agriculture, Food and Fisheries (MAFF), is the main agricultural research agency in Zambia. (Beintema, N.M.; Castelo-Magalhaes, E.; Elliot, H. & Mwala, M., 2004)

In 2000, SCRB accounted for over half the country's total agricultural R&D spending and FTE researchers. Its mandate is to generate and adapt soil and crop technologies to increase the sustainability of agricultural production and serve the needs of poor farmers. SCRB consists of four technical divisions— Crop Improvement and Agronomy, Soils and Water Management, Plant Protection and Quarantine, and Farming Systems and Social Sciences—with research activities divided across 20 programs. The branch is headquartered in Chilanga and has nine zonal agricultural research stations (ZARSSs) located throughout three broad agro-ecological zones (SCRB 2001; Elliott and Perrault 2001). Currently SCRB is in transition to become the Zambia Agriculture Research Institute (ZARI), which will be an autonomous department under the Ministry of Agriculture and Cooperatives. (Beintema, N.M.; Castelo-Magalhaes, E.; Elliot, H. & Mwala, M., 2004)

3.2.2.2.4 Central Veterinary Research Institute (CVRI) & Central Fisheries Research Institute (CFRI)

These two agencies: the Central Veterinary Research Institute (CVRI) and Central Fisheries Research Institute (CFRI) fall under the Ministry of Agriculture, Food and Fisheries (MAFF).

The Central Veterinary Research Institute (CVRI), diagnoses animal diseases and provides other laboratory services related to research on animal health, and the Central Fisheries Research Institute (CFRI), provides information on technologies in support of sustainable fisheries resource management and increased productivity in aquaculture. (Beintema, N.M.; Castelo-Magalhaes, E.; Elliot, H. & Mwala, M., 2004)

3.2.2.2.6 Forestry Research Branch (FRB)

The Forestry Research Branch (FRB) is administered by the Ministry of Environment and Natural Resources and was created in 1997 through a merger of the former Forestry Research and Forestry Products divisions. FRB's mandate includes the development of appropriate technologies to promote efficient use of the country's forestry resources. (Beintema, N.M.; Castelo-Magalhaes, E.; Elliot, H. & Mwala, M., 2004)

3.2.2.3 Private Research Institutes

3.2.2.3.1 Macha Malaria Research Institute

The Macha Malaria Research Institute, Inc., (MMRI) was incorporated as a non-profit (501(c) 3) organization in the State of Pennsylvania, U.S.A. in 1997. The Zambia Office of MMRI was formally established in 1998, although prior to this date malaria research had been conducted in Zambia under the direction of Doctors Victor Gordeuk and Philip Thuma for a number of years. The Zambia Office of MMRI consists of a field site located at the Macha Mission Hospital, where various malaria research projects are carried out. As of 2003, this is now incorporated in the Malaria Institute at Macha (MIAM), a collaborative effort between the Johns Hopkins Malaria Research Institute, MMRI, the Zambian government and the Macha Mission Hospital/Zambian Brethren in Christ Church.

The Malaria Institute at Macha (MIAM) is a joint collaborative effort - to develop a centre of excellence in rural Zambia that will carry out state-of-the-art malaria research - including molecular biology, entomology, epidemiology and clinical studies.

The hospital is located in the Southern province of Zambia, 80 kilometres from the nearest town of Choma. It is accessible by an all weather gravel road, and has 24-hour electricity available from the national grid with a back-up generator available. Communication is available by a radio link with Choma, and a VSAT-based full broadband system with email and Internet access.

3.2.2.3.2 The Centre for Policy Research and Analysis

The Centre for Policy Research and Analysis (CePRA) in Lusaka, Zambia is an independent, non-partisan and not-for-profit organization whose aim is to contribute to the sustenance of an enabling socio-economic environment and democratic practices in Zambia through public policy research and advocacy. It was established in November 1997. CePRA's focus areas are economic policy with emphasis on private sector development, democratic governance and multi-party democracy and the environment.

CePRA is conducting a three-phased research, publication and advocacy project to contribute to increased transparency, timely consultation, and more effective decision making in Zambia's budgetary process. As part of their project, CePRA will conduct surveys, write reports, and hold workshops.

3.2.2.3.3 ZamSeed, Maize Research Institute & Dunavant

Unlike many African countries, private-sector research is active in Zambia. Three private enterprises involved in agricultural research in Zambia were identified representing 14 percent of agricultural research spending in 2000. ZamSeed and the Maize Research Institute (MRI) conduct mainly maize research while Dunavant focuses on cotton research. While research activities at all three agencies focus on seeds, they cover a range of other issues, such as crop improvement, pesticides, and fertilizers, as well as some post harvest activities. Dunavant and until recently ZamSeed are largely controlled by foreign capital, while MRI is a Zambian owned enterprise. (Beintema, N.M.; Castelo-Magalhaes, E.; Elliot, H. & Mwala, M., 2004)

"ZAMSEED has introduced a new wheat variety that would enhance yields by at least 10 percent, managing director Ben Zulu has disclosed. The new variety comes as farmers prepare for this year's wheat cultivation season. Zulu has also disclosed that the company would spend at least K20 million on exploring the expansion of irrigation at its research farm so that more crop seeds could be developed." Lusaka, Apr 19, 2006 (The Post/All Africa Global Media via COMTEX)

"In an interview, Zulu said the new wheat variety, dubbed Pungwa, would supplement the already existing Loerie II variety. He said Pungwa's introduction was aimed at boosting farmers' yields especially that the country had limited irrigation capacity. "Being a winter crop, wheat is grown through irrigation. But as you may be aware the country has limited irrigation capacity so the challenge is to develop varieties that boost output despite this constraint," Zulu explained." Lusaka, Apr 19, 2006 (The Post/All Africa Global Media via COMTEX)

3.2.2.4 Trusts

Since the late 1990s, the Government of Zambia has focused on increasing the role of the private sector in the performance of agricultural research. With this in mind, four research trusts were created: the Golden Valley Agricultural Research Trust (GART, established in 1997), the Cotton Development Trust (CDT, established in 1999), and the Livestock Development Trust (LDT, established in 2002), and the Lyambai Agricultural Development Trust (LADT, established in 2002). The primary rationale for the trusts is to increase flexibility in the financing and management of both physical assets and

human resources, ultimately promoting efficiency and cost-effectiveness while developing public-private partnerships (Elliott and Perrault 2004). GART and CDT have become trustees of some former SCRB stations, with a significant level of autonomy; they remain linked to SCRB, however, in the joint conduct of complementary research activities. To enhance this relationship, the director of DRSS serves on GART's board, and SCRB's deputy director is a member of CDT's board. (Beintema, N.M.; Castelo-Magalhaes, E.; Elliot, H. & Mwala, M., 2004)

3.2.2.4.1 Golden Valley Agricultural Research Trust (GART)

The Government of the Republic of Zambia (GRZ) in partnership with the Zambia National Farmers Union (ZNFU) created the Golden Valley Agricultural Trust (GART) as a substantially self-sustaining part of the National Agricultural Research and Extension System (NARES). The broad objectives of GART are translated into four broad strategic themes.

GART professional staff has regional and international exposure. GART has written collaboration agreements with key regional institutions as well as with CG Centres. These arrangements have and continue to enrich the GART programs. GART is a recognized centre of excellence for Conservation Agriculture and smallholder dairy systems in Southern Africa. GART has signed professional enrichment agreements with the Wageningen University and Agricultural Research System in the Netherlands, the University of Nebraska in the USA and has a working arrangement with the University of Maryland Eastern Shore in the USA.

GART currently raises about 55 - 60% of its annual budget through commercial farming and contract research. With further capital investment, the internally generated resources could perhaps reach 80%. The donors and the Government of the Republic of Zambia support the balance of the budget. The Government currently contributes about 1-2% of GART's annual budget.

The Golden Valley Agricultural Research Trusts' research, development and commercial activities are organized in four strategic themes:

<p>Theme I: Research, development and promotion of conservation farming</p> <p><i>Areas of concentration</i></p> <p>Conservation tillage research</p> <p>Green water technologies</p> <p>Farm implement testing and development</p> <p>Soil quality improvement</p> <p>Livestock-crop integration</p> <p>Knowledge and technology transfer</p> <p>Foresight programme</p>	<p>Theme II: Engage in contract research and scientific technical partnerships</p> <p><i>Areas of concentration</i></p> <p>Testing of crop varieties from seed companies</p> <p>Testing of agricultural chemicals from chemical companies</p> <p>Ad-hoc research contracts with private industry, e.g. agricultural manufacturers and dealers</p> <p>Research contracts from Zambia National Farmers Union</p> <p>Seeking scientific and technical partnerships with local and foreign scientific institutions.</p>
<p>Theme III: Development and promotion of smallholder livestock systems</p> <p><i>Areas of concentration</i></p> <p>Development of a dual-purpose dairy animal suitable for smallholder situations</p> <p>Adaptive research in dual-purpose dairy production management systems</p> <p>Research in improved management systems of meat</p>	<p>Theme IV: Engage in innovative and commercial agriculture</p> <p><i>Areas of concentration</i></p> <p>Test and generate competitive and value adding technologies</p> <p>Generate farm management information</p> <p>Conduct large-scale demonstrations of proven and promising technologies</p>

goats	Income generation through commercial farming
Provide at cost improved goat breeds to smallholder farmers	Soil quality improvement
Knowledge and technology transfer	Livestock-crop integration
Foresight programme	Knowledge and technology transfer

3.2.2.4.2 *The Cotton Development and Livestock Development Trusts*

The Cotton Development Trust's (CDT) research focuses on developing and disseminating technologies and for cotton farmers (MAFF 2001; Elliott and Perrault 2001). The Livestock Development Trust is involved in training and commercial activities. The trust provides training in dairy, beef rearing and piggery. Training is also offered on animal draught power technologies, where farmers are taught to handle animals for land preparations among others. The commercial component focuses on dairy farming including an outreach facility involving trained farmers. The sale of trained animal (oxen and donkeys) for animal draught is another source of revenue. (Beintema, N.M.; Castelo-Magalhaes, E.; Elliot, H. & Mwala, M., 2004)

3.3 *Human capital for S&T*

The National Science and Technology Council commissioned a project to develop science and technology indicators at the beginning of 2005. The overall objective of the project was to develop indicators that can be used to assess Zambia's performance in science and technological development. These indicators will provide information on scientific and technological growth and the utilization of public funds in the science and technology sector. (NSTC, 2005)

The collection of data was done using questionnaires and discussion with various stakeholders. This data was collected from six provinces of Zambia that have a high index of scientific and technological activity. The survey covered all the research institutions and some industries conducting research and development as part of their operations in Zambia. (NSTC, 2005)

The information includes R&D investment, research facilities, total R&D expenditures, costs and financing and outputs of science and technology in Zambia over the past 4 years. The report is not exhaustive and it is hoped that more information may be included in future reports. (NSTC, 2005)

The version of indicators in this project report focused on "input" and "output" indicators. The "input" indicators included financial resources and corresponding involvement of qualified personnel (usually scientists and engineers) in Research and Development work. The "output" indicators included results of R&D such as patents and number of scientific publications. (NSTC, 2005)

3.3.1 *Size and structure of the R&D workforce*

According to the NSTC indicator report, the number of researchers per 100,000 inhabitants within the Zambian Science and Technology system has increased from 1.2 in 2002 to 2.1 in 2005. The R&D expenditure per researcher has also increased over the same period, from K 3,464,136 to K 4,741,794. From these indicators it is evident that the pool of researchers within the S&T has grown and so has the financial resources required to perform R&D within the Zambian system.

Table 7: S&T human resources

	2002	2003	2004	2005
Number of Researchers per 100,00 inhabitants	1.2	1.3	1.9	2.1
R&D Expenditure per Researcher	K 3,464,136	K 4,063,136	K 4,999,324	K 4,741,794

Source: National Science and Technology Council, S&T Indicator Report, 2005

When assessing the age distribution of the researchers within the S&T system one realises that a large proportion (43.9%) of the staff are between the ages of 35 and 44. Only a small proportion (23.4%) of the researchers are younger than 34. The distribution in age groups may not currently be a problem within the Zambian context, however, the Zambian government needs to ensure that a sufficient number of young researchers enter its research institutions continually, so as to avoid an ageing researcher population.

Table 8: Percentage of Researcher Staff by Age group in 2005

	29 and below	30-34	35-39	40-44	45-49	50-54	55 and above
Percentage of Researcher Staff by Age group	9.9	13.5	23.3	20.6	16.6	10.4	5.7

Source: National Science and Technology Council, S&T Indicator Report, 2005

The table below indicates the proportion of R&D staff by occupation, according to researchers, technicians and support staff. The proportion of researchers has decreased from 35% in 2002 to 31% in 2005. In the case of the technicians however, there has been an increase in proportion of 8%, from 29% in 2002 to 37% in 2005. The support staff has followed a similar trend in proportion as the researchers where a decrease in proportion (4%) has occurred over the period 2002-2005.

Table 9: Proportion of Research and Development Staff by Occupation

	2002	2003	2004	2005
Researchers	35%	32%	35%	31%
Technicians	29%	31%	32%	37%
Support Staff	36%	37%	33%	32%

Source: National Science and Technology Council, S&T Indicator Report, 2005

When looking at the distribution of the R&D staff across the different fields of S&T, the fields where the most staff occurred in 2002 was Engineering & Technology and Agriculture with Veterinary and Other fields (Pharmaceutical, Environmental, Information Technology & Forestry) making up very small proportions. In 2005, the proportion of R&D staff has hardly changed with respect to the veterinary and other fields, whereas Engineering & Technology and Agriculture now have the same proportion of R&D staff (40.6%). The R&D staff proportion within the field of Engineering and Technology has decreased over the period examined, from 43.3% to 40.6%. In the case of the field of Agriculture, its R&D staff proportion has increased over the same period from 36.7% to 40.6%. It needs to be mentioned that respondents did not provide data for the fields of Natural Science and Medicine, if that data had been provided the field proportions might have looked very different.

Table 10: Proportion of Research and Development Staff by Fields of Science and Technology

Year	2002	2003	2004	2005
Engineering and Technology	43.3	43.3	46.4	40.6
Agriculture	36.7	36.7	39.3	40.6
Veterinary	6.7	6.7	7.1	6.3
Other fields*	13.3	13.3	7.2	12.5

*Other fields were Pharmaceutical, Environmental, Information Technology & Forestry

** None of the respondents provided data for Natural Sciences and Medicine.

Source: National Science and Technology Council, S&T Indicator Report, 2005

3.3.2 *Masters and doctoral graduate output*

The School of Graduate Studies coordinates the graduate studies program at the university. All the schools within the university now offer Masters level degrees, but not in all programs, very few offer a doctorate. Graduate education places special demands on an institution, ranging from the hiring of graduate-level teaching staff to the provision of research facilities, including a library with extensive and continual updated holdings. (Lulat, Y. G-M, 2003)

3.3.3 *Human and institutional capacity development strategies*

There are three types of monetary flows from the Zambian government budget to the universities: their annual Grant; bursaries for university students (which are passed on to the universities); and "Poverty Reduction Program" grants for rehabilitation. In most years, the size of grants requested by the universities in their budget proposals has been reduced by

30-50%, to help the Ministry of Education budget fit within ceilings. However, in some years the size of the grant was then increased through a Supplementary Estimate. Close to 70% of students are entitled to the bursary scheme. The MoE Strategic Plan foresees the creation of a student loan scheme for students "who are not so disadvantaged". (Education Sector Public Expenditure Review, 2006)

Table 11: University enrolment by Gender, 2003/2004

Year	Copperbelt University			University of Zambia		
	Male	Female	Total	Male	Female	Total
2003	2039	495	2534	4993	2565	7558
2004	2465	625	3090	5488	2983	8471

Source: Economic Review 2004, Ministry of Finance and Planning

Total enrolment within the two universities increased by 15% in 2004 to 11 561 from 10 092 in 2003. The increases in enrolments are clearly seen in both universities in the table below. The increase in enrolments can be attributed to a greater number of self-sponsored students, following the government's policy on allowing an increase in university access by self-sponsored students.

3.4 Financial resources (funding)

Success for implementation of the Science and Technology Policy depends not only on the adequate allocation of financial resources for research and development and other activities but also for the development and expansion of small, new technology oriented business ventures. Hence, the need to develop a funding mechanism for both scientific and technological research and development, which shall facilitate the development and promotion of appropriate technology. (MSTVT, 1996)

3.4.1 National Financial Resources

Funding to science and technology caters for all costs involved in work performed in the science and technology sector including the actually scientific research and technological development. The data that were used were GDP for a particular year and Government expenditure on S&T. Government expenditure on S&T was derived from all S&T line ministries' expenditure on R&D, S&T training and other scientific and technological services. The latter services include for example, S&T activities of libraries and museums, translation and editing of S&T literature, surveying and prospecting, data collection on socio-economic phenomena, testing, standardization and quality control, client counselling and advisory services, patent and licensing activities by public bodies. (National Science and Technology Council, 2005)

From the S&T Indicator report, it is shown that the Zambian gross expenditure on science and technology has increased from 0.19 in 2002 to 0.72 in 2005 as a percentage of GDP.

Table 12: Gross expenditure on Science and Technology as a percentage of GDP

Year	2002	2003	2004	2005
Percentage	0.19	0.29	0.66	0.72

Source: National Science and Technology Council, S&T Indicator Report, 2005

In the table below the data that were used are GDP for a particular year and Government expenditure on R&D. Government expenditure was derived from all S&T line ministries on R&D projects and R&D institutions themselves. The Zambian gross expenditure on research and development (GERD) as a percentage of GDP has increased from 0.02 in 2002 to 0.10 in 2005.

Table 13: Gross expenditure on Research and Development as a percentage of GDP (GERD)

Year	2002	2003	2004	2005
Percentage	0.02	0.03	0.08	0.10

Source: National Science and Technology Council, S&T Indicator Report, 2005

The data that were used in the table below are GDP for that particular year and the expenditures of funding from government by R&D institutions on R&D projects. This information was analyzed as group data. Only 14 of the 26-targeted R&D institutions provided information on funding to R&D institutions. Therefore, the index for this indicator is slightly lower than expected. Here too there was an increase in the public expenditure on R&D as a percentage of GDP from 0.002 in 2002 and 0.005 in 2005.

Table 14: Public Expenditure on R&D as a percentage of GDP

Year	2002	2003	2004	2005
Percentage	0.002	0.003	0.003	0.005

Source: National Science and Technology Council, S&T Indicator Report, 2005

Even though there were increases in expenditure across the period assessed, the government planned to allocate a minimum of 3% of its GDP to scientific and technological activities in its National Science and Technology Policy in 1996. Now 10 years on, this has not been achieved; therefore the Zambian government needs to address this issue.

3.4.2 International donor funding

A large proportion of the Zambian S&T total expenditure on R&D was through external funds in the year 2004. Almost 90% (89.98%) of the total expenditure on R&D was externally funding, which indicates extremely high donor participation in R&D compared to Government's involvement. (NSTC, 2005)

3.5 Research output

It is standard practice to measure research output in country studies in terms of peer-reviewed article output. Information on other forms of research outputs (books, conference proceedings, chapter in books and so on) is usually neither available in standard form nor always readily available at country level. In cross-country comparisons, it has also become standard practice to use output in one of the ISI-indexes (SCI, SSCI, or AHI) as sole source. This inevitably introduces various kinds of biases into such comparisons, as the ISI-indexes do not cover all countries, languages and disciplines equally well. It is a well-established fact that the coverage of those countries on the margin of world science-, which is true for most if not all of Africa-, is particularly poor.

Results of work done in science and technology are tangible and can be in the form of goods and or services. Examples are documents, processes and or methods of doing work, patented technologies, equipments, crop varieties etc. All these are normally produced to improve the quality of life.

In the table below the proportion of research and development publications produced by field is represented, for 2004. The largest percentage of publications was produced in the field of Agricultural sciences (83.7%) with the fields of Medical sciences and Engineering & Technology trailing far behind in second and third place respectively, with very small proportions. The fields with the smallest contribution to the research and development publications of Zambia were the Natural Sciences and Social Sciences.

Table 15: Proportion of Research and Development Publications by fields of Science and Technology for 2004

Fields	Natural Sciences	Engineering & Technology	Agricultural Sciences	Medical Sciences	Social Sciences	Humanities	Others
Percentages	1.5	5.9	83.7	7.4	1.5	0	0

Source: National Science and Technology Council, S&T Indicator Report, 2005

The ISI-data for Zambia was analyzed to produce institution level data (see diagram below), as well as a profile of scientific collaboration both within and outside of the country. The profile presented on the next page reveals some interesting trends:

- The University of Zambia and the University Teaching Hospital as institutions are the main contributor's scientific article production. Interestingly, Copperbelt University has not produced any scientific articles
- The National Council for Scientific Research only produced two scientific journals in the period evaluated, raising concern as why an institution of its nature is not producing a greater number of scientific articles.
- There is no evidence of collaborations between the universities and the research institutes that exist within Zambia.
- The University of Zambia, the University Teaching Hospital and the Ndola City Council have all collaborated with research institutions outside of Zambia, either within Africa or within the rest of the World. They are the only institutions that are involved in collaborative publications with research institutions outside of Zambia.

3.6 International co-operation and networks

Zambia is a member of international bodies such as the Southern African Development Community (SADC), Common Market for Eastern and Southern Africa (COMESA), African Union (AU), Commonwealth, United Nations, World Trade Organisation (WTO), African Development Bank (ADB) and World Bank. (SADC, 2006)

Zambia's main trading partners are European countries, such as Germany and the United Kingdom, Japan, India, Saudi Arabia, Egypt and Thailand. Within Southern Africa, South Africa, Malawi, Zimbabwe, United Republic of Tanzania and more recently, the Democratic Republic of Congo, are the leading trading partners. (SADC, 2006)

3.7 Conclusion

The broad Zambian science and technology policy objective is to embed science and technology as part of the culture of the key sectors. By creating this S&T culture within the relevant sectors, it would then promote competitiveness in the production of a wider range of quality goods and services. (NSTP, MSTVT, 1996)

The strategies for achieving this broad policy objective include recognizing gender concern; changing institutional structure; ensuring that research is guided by national developmental goals; establishing a mechanism for increased innovation, transfer, diffusion and commercialisation of technology, especially for small and medium scale industries, with emphasis on indigenous technology. (NSTP, MSTVT, 1996) Putting in place efficient facilities to formulate and enforce standards and undertake quality control testing and assessment of industrial products; developing appropriate training which imparts practical skills and application of knowledge to develop prototype, products and processes in changing environment of market technology; establishing a comprehensive data bank which is easily accessible at strategic locations by scientific, management and industrial users; and providing incentives and high targeted promotions on the importance of science and technology to economic development in the key sectors. (NSTP, MSTVT, 1996)

The Zambian S&T policy embodies all the right elements to make the system function and operate in the manner in which it was intended. New institutions have been and are in the process of being established, so that the S&T system can work optimally. The country has the natural resources to enrich the kinds of research and development that could take place and meet world standards. In addition, the people are willing to work at their science and technology development, given the opportunity. The government needs to go back to their initial policy objectives and follow through with them, so that the Zambian science and technology system can be what it was set out to be.

