NAMIBIA'S NATIONAL SYSTEM OF INNOVATION

A REVIEW OF POLICY REGIMES AND THE INSTITUTIONAL LANDSCAPE | AUGUST 2016

NCRST
NATIONAL COMMISSION ON RESEARCH, SCIENCE & TECHNOLOGY

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NAMIBIA's NATIONAL SYSTEM OF INNOVATION: A Review of Policy Regimes and the Institutional Landscape

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EXECUTIVE SUMMARY

Namibia has a wide range of opportunities available to attain its Vision 2030 – to become an industrialised, prosperous and high growth economy. Firstly, the country experiences political stability and relatively good governance. Since gaining independence in 1990, the nation has adopted a progressive Constitution and held peaceful presidential and parliamentary elections.

Secondly, Namibia is classified as an upper middle-income country with good macroeconomic conditions. The economy has performed relatively well over the past two decades despite various shocks and a slowdown attributed to the global economic crisis of the past decade.

Thirdly, Namibia has deepened its participation in the Southern Africa Development Community (SADC), the African Union (AU) and the United Nations (UN). It has also established numerous bilateral arrangements with numerous countries around the world. The country's trade and economic relations have grown considerably and Foreign Direct Investment (FDI) inflows have increased over the past two decades. This has exposed Namibia's economy to a global pool of scientific knowledge and new technologies, and has widened possibilities of spurring industrialisation and export-led development.

Lastly, there has been a resurgence of attention to Science, Technology and Innovation (STI) as critical factors in national economic change and development. The Government of Namibia recognises that Vision 2030 will not be attained without investments in STI. This is manifested in the integration of STI considerations into Vision 2030 and the National Development Plan (NDP) 4, as well as organisational developments associated with the establishment of the National Commission on Research, Science and Technology (NCRST) in 2013 and other institutions such as the Business and Intellectual Property Authority (BIPA) and the Namibia University of Science and Technology (NUST) in 2015.

The NCRST has embarked on a process of reforming the country's national policies for STI and strengthening the National System of Innovation (NSI). It has created the National Research, Science and Technology Fund (NRSTF) and developed the National Programme on Research, Science, Technology and Innovation (NPRSTI). The Commission is also investing in a wide range of other measures, including conducting the first national Research and Development (R&D) survey. A national process has been launched to conduct a comprehensive review of the National Policy on Research, Science and Technology (NPRST) of 1999 and to identify strengths and weaknesses of the NSI.

This is the report of the review exercise. The overall aim of the exercise was to critically review the relevance, adequacy and implementation of the NPRST of 1999 and to provide an indicative assessment of the strengths and weaknesses of the country's NSI. The review was conducted between January and February 2016. It involved a desktop study of relevant reports, interviews and focused group discussions, and a national workshop of stakeholders in Namibia.

Namibia is investing in policy learning and there are deliberate efforts by the government to draw lessons from peer countries in the SADC region and internationally, in order to grow the NSI. The country is participating in regional STI initiatives such as the African Science, Technology and Innovation Indicators Initiatives (ASTII) of the New Partnership for Africa's Development (NEPAD) and the Southern Africa Innovation Support Programme (SAIS) funded by the Government of Finland. It has bilateral STI cooperation agreements with several countries including South Africa. Through these initiatives and other collaborations Namibia has been involved in benchmarking its NSI. Outcomes of these efforts show that the NSI is not performing as well as those of its neighbouring countries, particularly Botswana and South Africa, and international partners such as Finland and Germany.

On the whole, there is a general consensus on the need to modernise Namibia's STI policy and invest more proactively in policy implementation. Several prior review initiatives (including 2005 review of the national science and technology system by the United Nations Educational, Scientific and Cultural Organization (UNESCO), a draft framework policy on innovation in 2011 and a gap analysis of the NSI by the NCRST in 2015) also provides the basis for developing a new national STI policy.

Key findings and recommendations of the review are outlined below:

FINDINGS	RECOMMENDATIONS
The NPRST of 1999 invokes the concept of NSI. However, it is founded on the conventional approach of linear linkages between R&D and innovation, and lacks a clear conceptual framework of NSI. It is largely a regime for R&D, and has inadequate attention to technology development and innovation considerations.	A new national policy that adequately focuses on all aspects of STI should be developed guided by a well-articulated conceptual framework. The new NSTI policy should contain explicit measures for promoting endogenous technology development and technological innovation. It should also articulate specific actions for growing the NSI.
Despite recent efforts by the NCRST and other agencies to promote STI for the attainment of Vision 2030, there is weak alignment of R&D within national development priorities, as outlined in Vision 2030. In general, there is a significant mismatch between the NPRST of 1999 and Vision 2030.	The proposed NSTI policy and related implementation instruments (e.g. the NPRSTI) should promote R&D and innovation activities that deliberately focus on national development challenges and priorities such as those in Vision 2030 and NDP4. They should be backed by funding mechanisms for mission-oriented problem-focused R&D.
The NPRST of 1999 has not been effectively implemented. There is a relatively long policy gestation, of approximately 10 years from the adoption of the NPRST of 1999 to the establishment of policy implementation structures and instruments. The slow pace of policy implementation is largely accounted for by factors such as weak executive and political leadership for STI, low levels of STI policy literacy within government, and limited civil society/public engagement in STI policy processes.	The development of a new NSTI policy should be accompanied by programmes for securing broad-based political and civil constituencies for STI. In particular, the NCRST should design and implement a programme for strengthening the national legislatures and regional authorities' awareness of STI policy issues and related implementation programmes. It should actively engage parliamentary portfolio committees in the STI policy process and also promote public participation in and ownership of STI policy processes. This should be done through stakeholders' workshops and use of media to sensitise the public about STI policy.
Namibia's NSI has grown in the past two decades. New R&D programmes, educational institutions, and enterprises have been established. Funding for R&D has generally increased, the number of researchers and engineers, and outputs also increased. However, the country's Gross Expenditure on R&D (GERD) and scientific output are below or less than those of its peer countries such as Botswana and South Africa in the SADC region.	The country needs to implement policy measures and programmes for strengthening its NSI. There is a need to increase levels and diversity of funding dedicated to STI programmes. The executive and parliament should set a specific annual budget allocation target for the NPRSTI and ensure the sustainability of the NRSTF. This should be accompanied by the implementation of measures that will link funding of R&D and innovation activities to specific performance benchmarks.
The NSI is characterised by relatively weak links between R&D institutions and private enterprises. The country lacks explicit policies and programmes for promoting university-industry linkages.	There is need for a national platform and programme for promoting inter-institutional R&D and innovation projects. Such a platform could include an annual national summit on science and innovation at which universities and enterprises are encouraged to explore and develop potential joint programmes. The NCRST and the Ministry of Industrialisation, Trade & SME Development should also explore the possibility of establishing various incentive schemes, such as innovation vouchers, that stimulate industry-university collaboration.
There is a scarcity of reliable up-to-date data/statistics on R&D and innovation activities, investments and outputs. There are many varying data/statistics on R&D expenditure, number of registered patents, number of full-time researchers, etc.	The NCRST's efforts of conducting an R&D census in the country should be institutionalised and a national programme for STI indicators developed. This will require building NCRST's capacities in STI statistics, dedicating specific budgetary resources for the programme, and having a clear mechanism for ensuring that high quality reliable data are collected and used in STI policy making.
The country's efforts at technology development and innovation are not well coordinated and strategic. This is because there is a lack of explicit policy measures and programmes for promoting technological development and innovation.	The country needs NSTI policy regime with deliberate policies for promoting technology development and innovation. Such measures should promote investments in technology prospecting, acquisition and technology commercialisation. The proposed NSTI policy should build on other innovation policy instruments such as the "Growth-at-Home" strategy and the national industrial policy.
The NCRST's location within the Ministry of Higher Education, Training and Innovation may be undermining its authority and reducing its influence across the NSI. Some of the sectorial ministries and departments have a limited understanding of the NCRST's role of coordinating STI policy and programmes. In general, the NCRST has not articulated its authority of coordinating STI policy and influencing sectorial STI programmes.	To enhance NCRST's authority and enlarge its influence across sectors and institutions within the NSI, it should be located within a higher-level non-sectorial office of government. It should be at par with the National Planning Commission and be an authoritative body within the Presidency or Office of the Prime Minister. Locating the NCRST in either the Presidency or the Office of the Prime Minister will give it adequate authority to coordinate STI policies and promote policy coherence across the institutional terrain.
There is a general consensus that despite the relatively high expenditure on education, the education system is not adequately configured to explicitly respond to national (including industry's) economic needs for skills in sciences, technology, engineering and mathematics. Educational and training institutions are not producing enough graduates with the necessary skills to spur industrialisation.	The NCRST, the National Planning Commission, the Namibia Training Authority, the Ministry of Labour and Social Welfare and other agencies of government should conducted a comprehensive assessment of the country's skills needs and revise the Human Resource Plan (and ensure its implementation) with a clear focus on strengthening universities' and vocational training institutions' base for producing skilled graduates in science, technology, engineering and mathematics disciplines.

INTRODUCTION

Namibia aspires to be a prosperous, industrialised and high growth economy that is driven by manufacturing of high value exports by 2030. This aspiration is articulated in the country's Vision 2030.[1] National development plans and a wide range of policy documents formulated after 2004 also articulate the national vision. Attaining the vision will involve making a transition from a resource-based raw commodity exporter to an efficient and innovation-driven economy. *Making that transition is critically dependent on how well Namibia harnesses and deploys STI.*

The country's development policies and plans *make explicit reference to the role of STI in the realisation of Vision 2030.* The Vision 2030 document devotes attention to education, scientific research and technological innovation, and clearly considers them to be key drivers of economic growth, human (social) development and industrialisation. The current National Development Plan (NDP4) also emphasises that the country will not industrialise, be economically competitive and be integrated into the global knowledge economy without making strategic investments in STI.[2]

Namibia has formulated and adopted several explicit and implicit policies for promoting STI. These include the National Policy on Research, Science and Technology (NPRST) of 1999, the Research, Science and Technology Act of 2004 (RST Act no. 23 of 2004), the Research, Science and Technology (RST) Regulations of 2011, Industrial Policy of 2012 and a wide range of implicit research, technology and innovation related sectorial policies for agriculture, health and education.

The NPRST of 1999 *is the current overarching policy framework for STI.* It is the regime on which other policy instruments, particularly the sectorial ones, should find their expression and conceptual guidance. The NPRST of 1999 was adopted before 2004 and does not embody all the principles and priorities expressed in the Vision 2030. Since its adoption, many changes have taken place within the nation's socio-economic and political fabric, as well as in the global geopolitical setup. Rapid irreversible scientific and technological developments of the past two decades or so have caused changes in 'the research enterprise' across the world, and there is now demand for new norms and rules of organising and conducting research, technology development and innovation. New forms of governing STI have emerged.

This review is guided by Terms of Reference (TOR) and based on documents provided by the NCRST as well as consultations with NCRST staff and stakeholders from universities, research institutions, non-governmental organisations and state ministries in the country.[3] Key aspects of the TORs on which emphasis is placed in the review are: (a) the relevance and adequacy of the NPRST of 1999 (b) effectiveness of the NPRST in terms of its implementation (c) strengths and weakness of Namibia's NSI, and (d) identification of specific policy measures and institutional changes that should be considered by the Government of Namibia and all stakeholders in order to strengthen the NSI through a new NSTI policy.

1 Government of the Republic of Namibia (2004). *Namibia Vision 2030: Policy Framework for Long-term National Development.* National Planning Commission, Windhoek, Namibia.
2 Government of the Republic of Namibia (2012). Namibia's Fourth National Development Plan, NDP4 2012/23-2016/17. National Planning Commission, Windhoek, Namibia.
3 Terms of Reference are annex 1 of the report.

1

The next section of the report is a brief description of Namibia's political economy. It focuses the country's economic activities and growth trends over the past decade. This section shows that Namibia's economy is largely natural resource-based with agriculture, tourism and mining as the main economic activities. These sectors are dependent on the ecology and the natural endowment of the country. Maintaining ecological integrity through conservation and sustainable use of natural resources is thus critical to fostering economic growth and sustainable development of Namibia. The section also shows that Namibia has political stability and favourable macroeconomic conditions for promoting science, technology and innovation for the attainment of Vision 2030.

2

The second section lays out a conceptual framework for the review. It defines key concepts of STI policy and NSI, and then suggests a framework for assessing the effectiveness of the NPRST of 1999, and for reviewing the dynamism of the NSI. A methodological approach and limitations of the review are also outlined in this section.

3

Section three provides a profile of some of the institutional components of Namibia's NSI. It focuses on the education and training system, public research and development (R&D) institutions, the industrial landscape, financing mechanisms, and policy and regulatory agencies. The section shows that over the past two decades Namibia has established various institutions - both normative and agency types - for the promotion of R&D.

4

The fourth section outlines key objectives, features and provisions of the NPRST of 1999. Emphasis is placed on the relevance of the NPRST in terms of its alignment with Vision 2030 objectives. The review also examines the adequacy of the policy regime - whether it has explicit and adequate focus on all domains of a good STI policy regime, and whether it is framed in such ways as to ensure the implementation of its specific measures or courses of actions.

5

Section five is an indicative assessment of the implementation of the NPRST of 1999. It provides a general assessment of trends in funding of R&D, status of human resources with focus on the number of researchers in the country, innovation activities and outputs, and institutional developments since the adoption of the policy regime (NPRST of 1999). This section also examines whether the NPRST has coherence (or is in coherence) with other policy instruments. It outlines factors that influence the implementation of the NPRST of 1999.

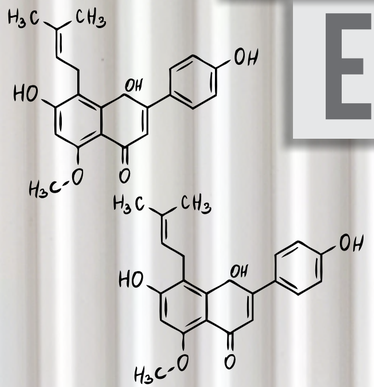
6

The sixth section focuses on policy learning and benchmarking as two interrelated aspects of building good national policy regimes for the promotion of STI and the growth of NSI. In this section an initial attempt is made to identify Namibia's policy learning potential and to benchmark the country's policy processes and NSI to a number of selected countries (particularly Botswana, South Africa, Mozambique, Malaysia, Singapore, China, Germany and Finland).

7

The last section of this report provides a synthesis of the review and makes recommendations.

1 THE POLITICAL ECONOMY OF NAMIBIA



1.1 GEOGRAPHY & ECOLOGY

Namibia, with a population of about 2.3 million people, is on the southwest region of the African continent.

It has five distinct geographic areas or regions: the Central Plateau, the Namib Desert, the Great Escarpment, the Bushveld and the Kalahari Desert. Each of these regions has unique vegetation and climatic conditions.

The country's economy is heavily dependent on the ecological and climatic conditions. It comprises agriculture, tourism, mining and fisheries - natural resource-based sectors or activities. These activities are vulnerable to ecological destruction and climate variability. Environmental challenges associated with drought and desertification, loss of biological diversity, water insecurity, and climate change undermine the country's long-term economic prospects.

1.2 ECONOMIC GROWTH TRENDS

Namibia has a relatively strong economy compared to many African economies.

Namibia is classified by the World Bank and the International Monetary Fund (IMF) as an upper-middle income country. Since independence in 1990, the economy has performed well, with an average annual Gross Domestic Product (GDP) growth rate of 4%[4]. The economy grew at 6.4% in 2014 from 5.7% in 2013[5]. The GDP growth is projected to be approximately 6.4% in 2016 and forecasted to be an average of 5% 2015-20[6]. The good economic performance is largely accounted for by good governance and political stability, fiscal discipline and favourable macroeconomic conditions.

The main economic activities or sectors in Namibia are agriculture, tourism, mining and fisheries. These sectors constitute or contributes about 60% of the country's GDP. The agricultural sector comprises of livestock production and employs at least 25% of the population. Mining and construction are also major sources of employment and contribute significantly to the country's GDP. The mining sector generates about N$22 billion in revenue[7] (about 12% of GDP) and employees about 20 000 people.[8] Namibia exports diamonds, uranium ores and concentrates, and zinc to countries such as South Africa, the United Kingdom (UK), Spain and the United States of America (USA).

Despite the good economic performance, Namibia imports many processed goods including petroleum oils, pharmaceutical products, fruits, textiles, grain, and a wide range of other products. Its imports are higher than exports. In 2010 imports as a percentage of GDP were estimated at 60.7% in 2010 and 63.16% in 2014 while exports as percentage of GDP were 47.8% in 2010 and 39.61% in 2014.[9] The total value of exports declined while imports increased between 2008 and 2013 (see figure 1).

4 Namibia's industrial policy, Ministry of Trade and Industry
5 Annual National Book 2014
6 http://country.eiu.com/namibia
7 Chamber of Mines statistics
8 Namibia Statistics Agency (NSA)
9 http://www.theglobaleconomy.com/indicators_data_export.php

ECONOMIC GROWTH TRENDS (CONTINUED)

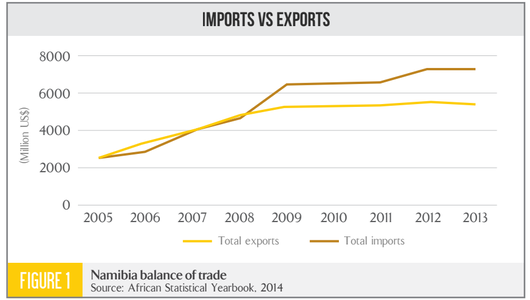


FIGURE 1 Namibia balance of trade
Source: African Statistical Yearbook, 2014

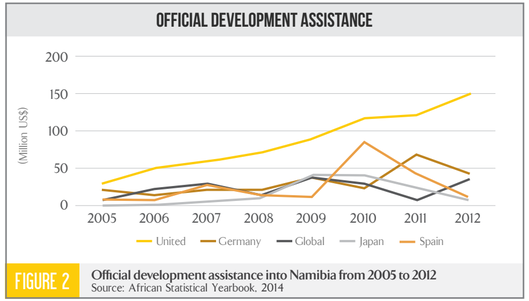


FIGURE 2 Official development assistance into Namibia from 2005 to 2012
Source: African Statistical Yearbook, 2014

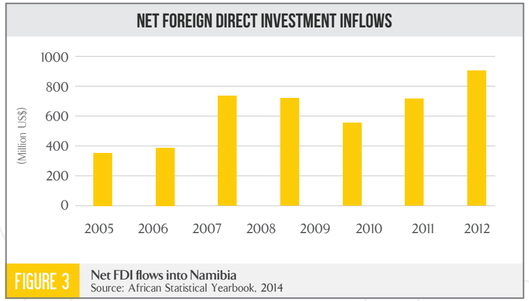


FIGURE 3 Net FDI flows into Namibia
Source: African Statistical Yearbook, 2014

Namibia is a recipient of Overseas Development Assistance (ODA). From 2005, the total ODA has grown from $125m to c$300m in 2012. Leading sources of ODA to Namibia are the USA and Germany.

Foreign Direct Investment (FDI) inflows into Namibia have also increased over the past two decades (See figure 3 below). As a percentage of GDP, FDI grew from 6.8% in 2010 to 8.42% in 2012.[10] For the year 2011, the net FDI inflow was approximately US$1billion. Germany is the biggest net foreign investor in Namibia, followed by Spain and Italy.

10 http://www.theglobaleconomy.com/indicators_data_export.php

SOCIAL DEVELOPMENT & ENVIRONMENTAL CONSIDERATIONS

Namibia is confronted with an array of social, economic and environmental problems.

Poverty, malnutrition, loss of biological diversity, drought, water scarcity, and unemployment are persistent sustainable developmental challenges faced by the country. They undermine social and political stability as well as prospects for higher levels of economic growth and the attainment of Vision 2030.

Social and economic disparities are key development challenges for Namibia. One-third of the country's population lives in poverty on a monthly consumption of less than N$380 (see figure 4 below). Women constitute at least 30% of the poor population. Poverty is more pronounced in rural areas. Inequality is high in urban areas than in rural areas. Namibia is ranked 128 out of 186 countries on the Human Development Index (HDI) with a rating of 0.608, (a negative shift from 2011 when it was ranked 120 out of 187 countries at 0.625). This is largely because of high unemployment and inequality.[11]

Despite the poverty and inequalities, major strides have been made in the past two decades. Access to social assets such as basic education, primary health care services, and safe water has improved and gender inequality narrowed. Life expectancy increased from 62.48 in 2010 to 64.34 in 2013.[12] Health spending as a percentage of GDP is estimated at 7.5%; this is one of the highest in the SADC region. At least 80% of the rural population has access to clean drinking water.

Namibia is well endowed with biological diversity and is a leader in the area of conservation. About 45% of its total land is under conservation and the country's entire 1,570 km coastline has protected status. However, the country is largely arid with pronounced water scarcity. It also faces challenges associated desertification, deforestation, as well the challenges of managing its living aquatic resources sustainably and at the same time promoting the economic development of the fisheries' sector.

11 United Nations Partnership Framework (UNPAF) 2014-2018 —A Partnership for Growth, Job Creation and Equity
12 http://www.theglobaleconomy.com/indicators_data_export.php

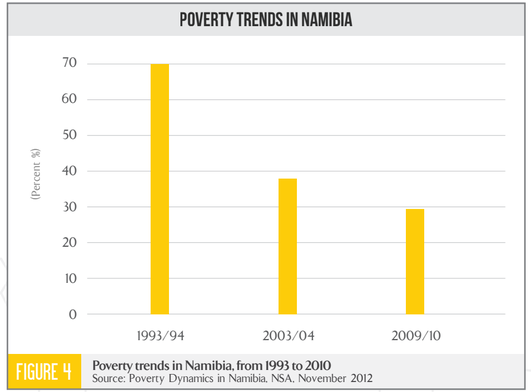


FIGURE 4 Poverty trends in Namibia, from 1993 to 2010
Source: Poverty Dynamics in Namibia, NSA, November 2012

NATIONAL DEVELOPMENT POLICY FRAMEWORK & PRIORITES

To address the various challenges and to build a stronger economy, Namibia has developed different development policy frameworks and plans.

In 2004 **Vision 2030** was adopted as the overall national development policy framework.13 Vision 2030 is articulated as: "a prosperous and industrialised Namibia, developed by her human resources, enjoying peace, harmony and political stability."14 It is a unifying broad vision on which five-year national development plans are founded.

Some of the key benchmarks set by Vision 2030 are: by 2030 Namibia's economy should be highly industrialised with manufacturing contributing to 80% of the GDP; processed goods accounting for at least 70% of exports; the country has a critical mass of knowledge workers; small and medium scale enterprises contribute to not less than 30% of GDP; and less than 5% of the workforce is unemployed.

The Vision 2030 document emphasises the role of STI in the achievement of the nation's aspirations or goals. It states that by 2030 Namibia will have an education and training system that is geared to developing relevant skills in fields of science, mathematics and engineering; and having highly skilled technical workforce to drive industrialisation. The development framework also outlines a range of measures that will be instituted to build a strong research and innovation system. The measures include increased financing of research in national institutions, incentives for enterprises to engage in technological innovation, and strengthening of regional and international cooperation in science and technology.

National Development Plans (NDPs) have focused on promoting the realisation of Vision 2030. The current NDP4 articulates the importance of innovation-driven industrialisation. It states: "Industrialisation in Namibia, driven by innovation and respect for the sustainability of ... [the] environment, will ensure the expansion of the country's capacity to produce secondary goods and services."[15]

The plan focuses on three interrelated goals: "faster and sustainable economic growth, the creation of employment opportunities, and enhanced income equality."[16] It outlines three foundations or priorities – logistics, tourism, manufacturing and agriculture – for the transition to Vision 2030. The NDP4 stresses that without "the development and retention of superior skills needed by both the private and public sectors" and the development of capacity to conduct R&D, the country will not be able to achieve industrialisation. It puts emphasis on strengthening vocational education and training in order to produce the necessary skilled workforce for the economy.

The NDP4 states: "R&D, too, is underdeveloped in Namibia, with few institutions carrying out R&D on a significant scale, resulting in low levels of product development. Moreover, there is limited tracking of funds spent on R&D in the country. Conversely, for example, our neighbours Botswana and South Africa spend approximately 0.5 and 0.76%, respectively, of GDP on R&D."[17] The Plan sets a target of spending on R&D to at least 0.3% of GDP by 2017.[18]

To strengthen economic growth and spur industrialisation, the Government of Namibia is putting a lot of emphasis on improving logistics and infrastructure. Logistics, including transport, courier and freight services, and have grown considerably in the past decade or so. In 2014 they experienced a growth rate of 6.6%.[19] The Government is boosting transport infrastructure around Walvis Bay by building a new container terminal and undertaking a regional railway project. The container terminal is estimated to cost about NAD 3.5 billion and the 1 900km Trans-Kalahari Railway Line Project is estimated to cost at least NAD 50 billion in the next ten years or so.

13 Republic of Namibia (2004). *Namibia Vision 2030: Policy Framework for Long-Term National Development*. Office of the President, Windhoek, Namibia.
14 Republic of Namibia (2004). *Namibia Vision 2030: Policy Framework for Long-Term National Development*. Office of the President, Windhoek, Namibia.
15 Republic of Namibia (2012). *Namibia's Fourth National Development Plan 2012/2013 to 2016/17*. p.xvii. Office of the President, National Planning Commission, Windhoek, Namibia.
16 Republic of Namibia (2012). *Namibia's Fourth National Development Plan 2012/2013 to 2016/17*. Office of the President, National Planning Commission, Windhoek, Namibia.
17 Republic of Namibia (2012). *Namibia's Fourth National Development Plan 2012/2013 to 2016/17*. p. 47. Office of the President, National Planning Commission, Windhoek, Namibia.
18 Republic of Namibia (2012). *Namibia's Fourth National Development Plan 2012/2013 to 2016/17*. p. 51. Office of the President, National Planning Commission, Windhoek, Namibia.
19 NSA, Acting Statistician General: Namibia Statistics Agency, Windhoek – 09 September 2015

NATIONAL POLITICAL GOVERNANCE

Namibia's relatively good economic performance and future development prospects are, to a large measure, due to political stability and good governance. The country enjoys peace and has a wide range of political liberties.[20] Since attaining independence from South Africa in 1990, the country has grown a wide range of legal and political institutions. It adopted a Constitution in 1990, and has had peaceful, fair and free legislative and presidential elections in which at least 10 political parties have participated.

20 See KPMG (2012). *Namibia—Country Profile*.

1.5

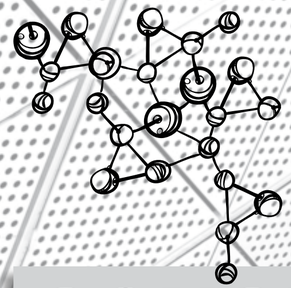
BILATERAL COOPERATION & PARTICIPATION IN REGIONAL & INTERNATIONAL AFFAIRS

Namibia has established diplomatic or foreign relationships with many countries around the world.

Namibia has established diplomatic or foreign relationships with many countries around the world. It has political, trade, economic and other cooperation agreements with neighbouring countries such as Botswana, Angola, South Africa and Zambia, and European countries particularly Finland and Germany, as well as with the Asian countries (mainly China, India and Malaysia).

Namibia is an active member of the Southern Africa Development Community (SADC), the African Union (AU), the United Nations (UN) system and a range of regional and international organisations and conventions. Within SADC and AU the country is engaged in science and technology processes. It has subscribed to the SADC Science and Technology Protocol and is engaged in the African Science, Technology and Innovation Indicators Initiative (ASTII) of the AU and its New Partnership for Africa's Development (NEPAD). Through its membership in SADC and bilateral cooperation with Finland, Namibia participates in the dialogues on science and technology and programmes such as the Southern Africa Innovation Support Programme (SAIS).

Within the UN system, Namibia participates in programmes of the United Nations Educational, Scientific and Cultural Organisation (UNESCO), the United Nations Industrial Development Organisation (UNIDO) and the United Nations Conference on Trade and Development (UNCTAD). UNESCO supported Namibia to undertake a review of the science and technology system in 2005.



2 CONCEPTUAL ISSUES & METHODOLOGY

2.1 WHAT CONSTITUTES A NATIONAL SCIENCE, TECHNOLOGY & INNOVATION POLICY

A national Science, Technology and Innovation (STI) policy is a regime of many policies (courses of actions or decisions that are agreed upon by government) that cover three interrelated domains: science policy, technology policy and innovation policy.

SCIENCE POLICY is about measures (courses of actions) that a government adopts in order to: guide or determine the choice of Research and Development (R&D) priorities; establish rationales and mechanisms for funding R&D; set R&D funding and research productivity targets; establish scientific (R&D) institutes/agencies and regulate their activities; and guide the procurement and use of science in policy processes. On the whole, science policy encompasses policies for scientific research (or policy for science) and science for policy.

TECHNOLOGY POLICY deals with the range of actions or policy measures that are used to promote the development (the translation of scientific knowledge into hardware and/or software), prospecting, choice, procurement, diffusion, transfer, regulation, use and management of technologies. Technology policy instruments largely focus on specific technologies e.g. biotechnology, nanotechnology, and Information and Communication Technologies (ITCs). They are thus often aimed at promoting or governing a particular technology or a cluster of technologies. While science policy is concerned with R&D, technology policy aims at fostering technological change.

INNOVATION POLICY includes a range of actions or decisions that promote the introduction or implementation of a new or significantly improved product or process or practice into an economy or enterprise/firm. An innovation policy is largely aimed at enabling the entry of technology or knowledge embodied in practices into an economy or market. It creates linkages between and among knowledge and technology producers with the consumers (market). A good innovation policy aims at improving a country's abilities to harness and utilise the existing or available pool of scientific knowledge.

Although governments around the world have been formulating and implementing innovation policies, often through indirect measures, there has been a surge of interest and focus on direct or explicit innovation policies since the 1980s. This interest is stimulated by the growing realisation or recognition that traditional Science and Technology (S&T) policies (focusing mainly on financing R&D) are not adequate in promoting sustainable development in general and economic transformation of developing countries.[21] While many countries are exposed to a huge pool of scientific knowledge and technologies, they have been unable to exploit them because of limited innovation capacities.

It is now well accepted that in addition to S&T policies, countries require specific measures for promoting innovation, both technological and organisational. The latter type of innovation relates to the introduction of new management norms and practices into enterprises or institutions. Technological and organisational innovations co-evolve. Technological innovation tends to cause organisational change, and the converse is also true: organisational change often stimulates the introduction of new products, processes and techniques.

A national STI policy is thus about measures and/or decisions that national authorities take in order to promote the production of scientific knowledge, utilisation of the knowledge to develop technologies, and the procurement and introduction as well as the spread of both knowledge and technologies into an economy. STI policy has evolved over the past six decades or so, particularly from the pre-Second World War era when the emphasis by nations was on how to stimulate scientific discovery to the 1940s epoch of 'The Endless Frontier' associated with Vannevar Bush when governments got more concerned with the social and economic values of R&D.[22] Vannear Bush's Science: The Endless Frontier stimulated attention to why governments should fund R&D for purposes of technological development. Science and technology policy emerged in the mid-1940s/early 1950s as a convergence of 'science policy' and 'technology policy', and STI policy has evolved since the 1980s.

On the whole, there are at least two clusters of issues that STI policy is concerned with. The first pertains to setting national priorities for R&D and directing resources to the attainment of specific goals within or linked to the priorities. This involves establishing funding targets, mechanisms and institutions for the R&D. Second; STI policy is concerned with financing of technology development and the creation of configurations of institutions for introducing and diffusing technologies and related knowledge into an economy.

21 Aubert, J. (2005). 'Promoting Innovation in Developing Countries: A Conceptual Framework'. World Bank Policy Research Working Paper 3554, Washington, DC.
22 Geuna, A., Salter, A., and Steinmueller, W. eds. (2003). *Science and Innovation: Rethinking the Rationales for Funding and Governance*. Edward Elgar Publishing, UK.

NATIONAL SYSTEMS OF INNOVATION (NSI) APPROACH[23]

23 This section draws on Mugabe, J. (2009). 'Knowledge and Innovation in Africa: Priorities, Policies and Programmes'. Paper prepared for the World Bank Institute, Washington, DC.

The effectiveness of national STI policy is assessed or measured on the basis of the dynamism and productivity of a country's 'national system of innovation'.

A National System of Innovation (NSI) is a network of public and private institutions that are organised through linkages to relate to each other as elements of a collective system of knowledge creation and utilisation, technology development and innovation (introduction and diffusion of technology).[24]

The main institutional actors in the NSI are universities, public R&D institutes, policy-making bodies, private enterprises, financial institutions such as commercial banks, and technology support agencies such as bureaus of standards. The NSI is supposed to be an open system characterised by inflow and outflow of knowledge, information, skills and machinery.

Linkages in a NSI usually take different forms including joint research projects among public institutes, and joint technology development and transfer activities between public and private sector institutions, exchange and mobility of scientists and engineers, technology licensing agreements, and sharing of information and technology infrastructure. Assessing the performance of a national system of innovation entails tracing the various institutional links and measuring the intensity of the interactions among various knowledge producers and economic actors. The interactions are supposed to be continuous and characterised by positive feedback.

The feedback takes place between economic firms and consumers; between R&D institutions and industry; between R&D institutions and financial ones; between policy-making bodies and R&D institutions; between policy-making institutions and private firms; and between education and training institutions and industrial firms.

The performance of NSI is also influenced by political, economic and social conditions. Open and democratic political systems are likely to encourage the search for new information, introduction of new knowledge and tend to promote learning capabilities. Institutional linkages and interactions, including positive feedback and generally the exchange of information, tend to flourish in countries where policies and political practices encourage open dialogue and debate. They flourish in countries or societies with high trust levels and strong social capital. [25]

The capacity of countries or economies to innovate is also dependent on existing physical infrastructure and how that infrastructure is used. Infrastructure defined to include laboratories for scientific research or R&D, electricity, and telecommunications and connectivity is critical for industrial firms in countries to design and develop new products and processes or even to use existing technologies. The state of infrastructure influences the quality of institutions for producing and applying knowledge.

24 See Edquist, C., ed. (1997). *Systems of Innovation: Technologies, Institutions and Organizations*. Pinter, London.

25 Fukuyama, F. (1995). *Trust: The Social Virtues and the Creation of Prosperity*. Free Press Paperbacks, New York.

TERMS OF REFERENCE & METHODOLOGY OF THE REVIEW

This review is based on TORs that were developed by the National Commission on Research, Science and Technology (NCRST).

The TORs outline the main aim of the exercise as: "To conduct a review of the National Policy on Research, Science and Technology (NPRST) of 1999 and to develop a National, Science, Technology and Innovation Policy (NSTIP)." The review's major aims are:

> "to enable the STI stakeholders to establish a diagnosis of our National Innovation System (NIS) and to assess the extent to which existing STI policies promote its functioning and development";
>
> "to raise awareness and to stimulate a policy dialogue among stakeholders about the role of STI in national development and to encourage the emergence of stronger linkages among the STI players"; and
>
> "to identify practical actions that favour technological capacity building and the strengthening of their innovation capabilities".

Before conducting this review an initiation meeting with officials of the NCRST was held in early 2016 to discuss and establish a common or shared interpretation of the TORs. After the meeting a thorough review of documents provided by NCRST was conducted. The documents included a range of national policy and legal reports, the NPRST of 1999, the RST Act of 2004, the RST Regulations of 2011, the Industrial Policy 2012, Vision 2030 document, the National Development Plan 4, and other reports of previous reviews of science and technology.

To adequately address the TORs, a review of academic literature on science, technology and innovation policy and NSI was done. This formed the basis for developing a conceptual approach that is proposed above. Our critical reviews of the NPRST of 1999 and the NSI in sections 4 and 5 are also guided by the conceptual framework/approach.

The main sources of data for R&D expenditure, innovation outputs and human resources are the African Innovation Outlook (AIO)-2014 of ASTII/NEPAD and NCRST's draft Namibia National Survey of Research and Experimental Development: Statistical Report 2013-14; intellectual property protection data from the World Intellectual Property Organization (WIPO) and the European Patent Office (EPO), the Ministry of Industrialisation, Trade & SME Development and World Bank reports on enterprise surveys and support. Data from the UNESCO Institute of Statistics, the World Economic Forum (WEF) and the African Development Bank (AfDB) were also analysed and used.

In February 2016 interviews and group discussions were conducted in Namibia involving more than 60 persons from the universities, ministries of Industrialisation, Trade & SME Development, Higher Education, Training and Innovation, the NCRST, the Namibia Training Authority (NTA), the National Planning Commission (NPC), and Non-Governmental Organisations (NGOs). The interviews and discussions focused on the following issues or aspects of the review. The first was to build some sense of interviewees' and group discussions participants' knowledge and understanding of the NPRST of 1999 and get their views on the adequacy and relevancy of the policy regime. The second aspect was to get views on the effectiveness of the NPRST of 1999 in promoting STI in general and growing the country's NSI. In addition, the interviews and discussions focused on what are the strengths and weaknesses of Namibia's NSI, and what specific measures should be instituted in order to grow or strengthen the NSI.

3 NATIONAL SCIENCE TECHNOLOGY & INNOVATION SYSTEM

Namibia's NSI comprises public and private educational and training institutions, public R&D institutes, technology support agencies, for example, bureau of standards, private industrial companies (foreign large firms or multinational corporations, and small and medium enterprises), policy and regulatory agencies, development banks and financing agencies. This section provides an overview of Namibia's NSI with emphasis on institutional actors from higher education institutions, public research institutions, the industrial landscape, policy and regulatory agencies, and financial institutions.

3.1

EDUCATION & TRAINING SYSTEM

The education system - including both public and private institutions of primary, secondary and tertiary education - plays a major in the economic development and attainment of Namibia's Vision 2030. Government has identified the strengthening of education and skills as one of the core priorities to attain Vision 2030. The NDP4 states that education "is the single most aspect of human development and a critical success factor for economic advancement and increased equality." The country's education challenges include a mismatch between supply of and demand for skilled labour associated with low quality of primary and secondary schooling, limited vocational training opportunities and limited access to university education. To address these challenges, the Government is committed to increasing the national budget for education. In the 2013/2014 financial year, the allocation to education was approximately 23% of the total national budget. This represents 7% of Namibia's total GDP.

PRIMARY EDUCATION

The country's education system has expanded considerably in the past two decades. There are now more than 2000 primary schools and primary education is compulsory for 10 years between the ages of 6 and 16. About 95 percent of school age children attend primary school and the number of teachers has increased considerably since the 1990s. This is mainly due to the Government's considerable investment/budget. The relatively high budget expenditure on education is because the Constitution requires the government to provide free primary education.

SECONDARY EDUCATION

Secondary education is also expanding in Namibia. It covers a period of 5 years from Grade 8 to Grade 12. Children are presented with a Junior Secondary School Certificate after successful completion of Grade 10. After Grade 12 learners are presented with a Namibia Senior Secondary Education Certificate.

TERTIARY EDUCATION

Namibia has two public tertiary institutions. These are the University of Namibia (UNAM) and the Namibia University of Science and Technology (NUST). There is one private university -the International University of Management (IUM). - and a number of specialised tertiary educational institutions such as the Windhoek College of the Arts , the Namibia Maritime and Fisheries Institute (NAMFI) in Walvis Bay, and the Namibia Institute of Mining and Technology (NIMT) in Arandis.

The University of Namibia (UNAM), with the main campus in Windhoek and ten campuses throughout Namibia, is the country's oldest and biggest institution of higher learning which was established in 1992. It is a teaching and research institution with faculties of agriculture and natural sciences, economic and management sciences, engineering and ICT, law, humanities and social sciences, and medicine. The University enrolled about 20,000 students in 2014. Less than 10% of these were enrolled in post-graduate science and engineering courses.

The Namibian University of Science and Technology (NUST) was until 2014 a polytechnic that was established as an independent educational institution in 1996. It has faculties of engineering, business and management studies, and centres for entrepreneurial development, applied research and technology, business innovation, and energy research.

Educational institutions in Namibia are accredited by the Namibia Qualifications Authority (NQA). NQA evaluates and accredits national institutions and degrees while the Namibia Training Authority (NTA) controls seven vocational centres. These institutions are supposed to ensure that all educational and training institutions in the country provide high quality education and training based on approved curriculum and respond to national skills needs.

3.2

PUBLIC RESEARCH & DEVELOPMENT (R&D) INSTITUTIONS

The main national public R&D institutions in Namibia are UNAM and NUST.

UNAM has a number of centres and initiatives dedicated to scientific research. These include the Multidisciplinary Research Centre (MRC), the Sam Nujoma Marine and Coastal Resources Centre and faculties or schools of agriculture and natural sciences, medicine and pharmacy, and engineering and Information Technology (IT).

NUST has centres dedicated to R&D. They include the Renewable Energy and Energy Efficiency Institute (REEEI) that focus on the establishment of a national information resource base for renewable energy, sustainable energy use and its management.[26]

Other national public R&D institutions are the National Botanical Research Institute (NBRI), the Habitat Research and Development Centre, the National Forestry Research Centre, the Namibia Institute of Mining and Technology, and the Central Veterinary Laboratory, and the Desert Research Foundation of Namibia (DRFN). The DRFN is a non-governmental organisation that aims to enhance decision making for sustainable development through research, training and consultancy.

In addition to the R&D institutions, the Namibia Standards Institution (NSI) is another important actor in the NSI. It was created in 2005 under the Standards Act (Act No. 18 of 2005) to be responsible for promoting standard and quality assurance in industry, commerce and public sector. It deals with certification systems, inspection and testing of products, and metrology. For example, the NSI carries out inspection of fish and meat products and administers standards to ensure that products meet international standards for export.

26 www.reeei.org.na

3.3

INDUSTRIAL LANDSCAPE & ENTERPRISES

Namibia's industrial landscape has grown over the past two decades.

Namibia's industrial landscape has grown over the past two decades. Enterprises, particularly Small and Medium enterprises (SMEs) and large firms, are engaged in a range of economic activities in the country. Large foreign enterprises or firms are dominant in the mining sector where they own at least 75% of the activities. There are also several state-owned enterprises that have been created over the past decades. These enterprises play important roles in STI. Some of them are key actors in R&D and technological innovation. Foreign firms or enterprises located in the country can be sources of new scientific knowledge and technologies for manufacturing and industrialisation in line with Vision 2030. However, most of the foreign enterprises have their R&D activities in their home countries. They do not adequately invest in R&D in Namibia.

One of the key state-owned enterprises with roles in R&D and innovation include NamPower. NamPower is the national power utility of Namibia whose remit includes the generation and transmission of electricity in the country. The parastatal has a wide range of R&D and innovation activities in the energy sector.[27] It has developed a number of renewable energy technology initiatives such as the Tsumkwe Hybrid Energy project and Combating Bush Electricity for Namibia Development (CBEND) project.

27 Data on NamPower's investments in R&D and technology development programmes will be sought.

In addition to state-owned enterprises, there are several associations that have direct and indirect roles in the NSI. These include the Namibian Manufacturers' Association, the Engineering Professions' Association, and the Namibia Chamber of Commerce and Industry (NCCI). These associations play key roles in building platforms for innovation and influence national policies for R&D and technology development. The Namibia Manufacturers Association is an association of manufacturers that mobilises and represents enterprises in lobbying and advocacy for manufacturing in the country. The association has a critical role in ensuring the attainment of Vision 2030 through increased investment in manufacturing. It has been instrumental in the development of the Industrial Policy.

The Engineering Professions' Association is a voluntary membership association of engineering and related professionals in Namibia. It promotes excellence in the field of engineering by spearheading the development of curriculum and training programmes. Its membership comprises engineers from all engineering disciplines that play a pivotal role in the development of infrastructure in Namibia.

With 2500 members, the Namibia Chamber of Commerce and Industry (NCCI)[28] is the leading business representative and support organisation in Namibia. Its membership comprises companies across all economic sectors, including large multinational companies as well as SMEs. The NCCI also offers enterprise development services. It is a key player in technology procurement for SMEs.

28 http://ncci.org.na/index.php/2-uncategorised/53-the-role-of-business-namibia-in-industrializing

3.4

POLICY & REGULATORY AGENCIES

The main institutional authority for STI policy formulation and coordination is the NCRST.

There are several public agencies with policy and regulatory responsibilities that impinge on the growth and functioning of the NSI. The main institutional authority for STI policy formulation and coordination is the NCRST. The NCRST was established in 2013 under the RST Act no. 23 of 2004 as the key national agency for promoting, coordinating, monitoring and developing of research, science, technology and innovation in Namibia. In accordance with section 18 subsection 3 of the RST Act of 2004), the NCRST is responsible for preparing national programmes for research, science and technology as well as coordinating the implementation of the NPRST of 1999. The NCRST is under the Ministry of Education, Training and Innovation.

Ministry of Industrialisation, Trade and SME Development is responsible for the formulation and implementation of industrial policies, and policies and regulations pertaining to manufacturing, FDI and enterprise development in the country. It deals with issues such as the implementation of policies for tax incentives for enterprises, procurement of technologies for SMEs, and training in entrepreneurship. Ministry of Industrialisation, Trade and SME Development is also responsible for matters pertaining to intellectual property protection through the Business and Intellectual Property Authority (BIPA) as well as the implementation of the Competition Law of Namibia. BIPA is an autonomous entity currently established in terms of Section 21 of the Companies Act, pending the enactment of the enabling legislation to transform it into a fully-fledged autonomous agency.

Other sectorial ministries such as the Ministry of Agriculture, Water and Forestry, the Ministry of Environment and Tourism, the Ministry of Finance (National Treasury), and the Ministry of Health and Social Services are also key actors in the NSI as they deal with various aspects of STI policy and some of them host/have R&D centres. For example, the Ministry of Health and Social Services is responsible for formulating and coordinating the implementation of the national health research policy while that for agriculture handles policies for agricultural R&D.

3.5

FINANCING MECHANISMS & AGENCIES

There are three main national institutional mechanisms or channels for financing STI activities in Namibia.

The first institutional mechanism is the National Research, Science and Technology Fund (the Fund) established in accordance with sections 23 and 24 of the RST Act of 2004 and located in as well as administered by the NCRST. The second mechanism or channel is through sectorial ministries responsible for agriculture, education, environment and tourism, health, trade and industry and others. The third national mechanism is through development and commercial banks and related micro-finance institutions. The Fund and sectorial ministries responsible for agriculture, education and health are the known mechanisms for funding R&D while ministries responsible for trade and industry and the banks as well as micro-finance institutions tend to support technology procurement and innovation related activities.

The Development Bank of Namibia (DBN) is the main provider of development financing in Namibia. It funds a range of enterprise development initiatives including the financing of start-up companies in the private sector. The Bank also deals with equity financing, bridging finance, enterprise development finance, trade finance, small and medium enterprises, public private partnerships, public sector infrastructure, local authorities, and bulk finance to various micro-finance institutions. Through its financing of enterprises, the DBN is a critical agency for technology procurement and innovation activities.

STI activities, particularly R&D, are also funded by international agencies and bilateral donors. Through bilateral cooperation agreements, Finland and Germany and several other countries fund R&D projects for Namibian institutions, particularly UNAM and NUST as well as research centres such as those for water, fisheries and desert research. The European Union (EU), through its funding programmes such as Horizon 2020 and Framework Programmes, may fund R&D projects in Namibia.

4 NATIONAL SCIENCE TECHNOLOGY & INNOVATION POLICY REGIME

4.1

THE NATIONAL POLICY ON RESEARCH, SCIENCE & TECHNOLOGY (NPRST) 1999

Over the past two decades Namibia has adopted a wide range of explicit and implicit policies that impinge on the evolution or growth of its NSI. The country has policies that are deliberately aimed at promoting R&D. It also has adopted policies that, though not designed as STI policy measures, have considerable implications for scientific research and technological innovation in the country. This section provides a succinct overview of both explicit and implicit policies for STI. The review is based on the premise that both explicit and implicit policies are critical for the growth of the country's NSI. Often implicit STI policies are not given attention in the assessment of NSI.

The review focused on three interrelated aspects of policy evaluation:

RELEVANCE + ADEQUACY + EFFECTIVENESS

Emphasis is placed on whether both explicit and implicit policy instruments and their specific measures are relevant, adequate and effective in promoting STI (scientific research, technological change and technological innovation) to attain Namibia's Vision 2030.

The NPRST of 1999 was adopted in May 1999 to "guide the nation on how it generates, contributes to, and benefits from scientific knowledge and technology."[29] The overall objectives of the Policy are to:[30]

> **"foster a culture of partnership and strategic purpose among S&T training, research and employer institutions, and to link their services to S&T providers, purchasers, users and consumers for meaningful added value goods and services, greater job opportunities, sustainable earnings and rising living standards."**
>
> **"promote a sense of commitment in public and private sector institutions and individuals toward research and technological innovations as basis for human development, business success, national wealth creation and international competitiveness."**
>
> **"secure an appropriate mix of resources and that steady funding and priority are devoted to research, and for the engagement of science and technology in both public and private sectors."**
>
> **"facilitate the development of Namibian citizens and enterprises through the provision of up-to-date technical advice, business support and S&T extension services and maintenance of a critical core of technical competencies in the country with skills and know-how needed by the society for efficient management of … S&T resources and assets."**
>
> Source: Republic of Namibia (1999), *National Policy on Research, Science and Technology*, p.9.

The Policy deals with a broad array of R&D and innovation issues such as science and technology education, sustainable funding of R&D in both public and private institutions, environmental considerations, commercialisation of S&T innovations, "S&T innovation system to support entrepreneurial activities", S&T strategies for sectorial development, ... and "protection of S&T property, rights and traditions, especially community-based knowledge systems. ...."[31]

29 Republic of Namibia (1999), *National Policy on Research, Science and Technology*, p.1. Ministry of Higher Education, Vocational Training, Science and Technology, Windhoek, Namibia.
30 Republic of Namibia (1999), op. cit.p.9.
31 Republic of Namibia (1999), op. cit.p.1.

The NPRST invokes the NSI approach. It states:

"In promoting this S&T policy, Government development objectives will be achieved through a national system of innovation. Essentially, this system will define the critical cluster of scientific institutions, technical organisations in public and private sector and set an enlightened framework for S&T policies and institutions to interact in pursuit of agreed goals and objectives deemed to be strategic and important to national development."[32]

The NPRST document further asserts:

"The system of innovation will put explicit emphasis on the design of market-based policies, to stimulate public inputs and responses that are necessary to produce, support and sustain an innovative and competitive economy giving due regard and access to all active stakeholders."[33]

It is commendable that Namibia embraced the NSI approach in the 1990s and in its first main S&T policy document at a time when the conceptual approach was relatively young and was just being introduced in countries of the Organisation for Economic Cooperation and Development (OECD) such as Finland, Sweden and Denmark. As stated earlier, the NSI started receiving attention and usage in policy circles in the 1980s in the OECD.

The NPRST covers the main aspects or elements of growing a NSI. The aspects are: resources (funding and human resources), institutional articulation or linkages (collaboration and cooperation), infrastructure (facilities, equipment and laboratories), and overall macro-economic environment and political stability.

32 Republic of Namibia (1999), op. cit.p.14.
33 Republic of Namibia (1999), op. cit.p.14.

In terms of resource inputs into the NSI, the NPRST contains a range of measures. First, in the preamble the Policy document states that at least 1% of national GDP should be devoted "to research and *innovation* and S&T education".[34] A national funding or investment target is set to encompass R&D, education in science and technology, and technological innovation activities. It is important to stress that unlike in most countries where the target is limited to gross expenditure on R&D as a percentage of GDP, the Namibian '1% of GDP' policy target covers funding of educational and innovation activities as part of building NSI.

Second, the NPRST establishes an institutional mechanism for funding STI. It provides for the creation of the Fund for Innovation in Science and Technology (FIST) to be a mechanism for funding R&D, technology development and innovation activities in both public and private sector institutions. It is important to emphasise that the Policy *does not restrain FIST from funding innovation activities as well as directing funding to private sector R&D and innovation activities*. In addition, the Policy document sometimes uses the phrase "innovation fund" to refer to FIST and this can be interpreted to mean that FIST is dedicated to funding innovation, including in private enterprises. The Policy states: "Through the Fund for Innovation in Science and Technology (FIST), Government will support and promote a well-managed and focused "public good" research programme. Such a programme will be the product of joint dialogue between the various partners representing public, private sector interests and the Non-governmental sector."[35]

There are also explicit measures articulated by the NPRST to address challenges of human resource deficits. The Policy recognises that the country does not possess adequate human resources in science, engineering and technical fields. It also notes that the education system is not well configured and equipped to develop the necessarily skilled human resource base for a STI-driven economy.

34 Republic of Namibia (1999), op. cit.p.1. Emphasis in italics is ours.
35 Republic of Namibia (1999), op. cit.p.18.

THE NATIONAL RESEARCH, SCIENCE & TECHNOLOGY POLICY 1999 (CONTINUED)

Specific policy measures that are outlined in the NPRST document to address the human resource development challenges include:

(a) reforming "the educational system to give greater emphasis on science and mathematics and to provide for their full integration in school curricula, from basic levels through to tertiary level institutions"[36];
(b) introducing "quality teaching, experiments, in-school and after-school work experience"[37]; and
(c) encouraging "research activities in approved tertiary level teaching and research institutions, private laboratories and Regional Innovations Centres".[38]

Regarding the aspect or element of institutional articulation or linkages, the NPRST recognises that there is weak "coordination and communication between and among public and private sector institutions" and also there is "wasteful duplication of economic activities". To address these limitations or deficiencies of Namibia's NSI, the NPRST puts emphasis on the promotion of institutional linkages or collaboration, within the public R&D system, between public and private sector institutions, and particularly R&D collaboration between academic and industry agencies.

The NPRST outlines general measures (or at least statements of intent) for promoting institutional linkages or collaboration. They include the following:

> "Advance to the extent of possible indigenous small and medium scale enterprises (SMEs) and help them to link with larger farmers nationally and regionally so that both groups can develop synergy and a new culture of efficient production of high value added goods and services and sustained thrust towards continuous innovation".[39]

39 Republic of Namibia (1999), op. cit.p.11.

> "... the capacity of the economy to support improvements in the standard of living of citizens will be greatly affected by the works and collaboration of professionals - scientists, engineers and technologists. Such a collective solution obligates the public and private sector to work closely to avoid unproductive duplications of resources and repetition of efforts".[40]

Source: Republic of Namibia (1999), *National Policy on Research, Science and Technology*

40 Republic of Namibia (1999), op. cit.p.10.

Lastly, the NPRST aims at improving infrastructure and macro-economic policy conditions for scientific research and technological innovation. For infrastructure, the Policy puts emphasis on funding for the improvement of laboratories in R&D institutes, promoting the use of ICT in research and educational institutions, and developing databases of scientific and technical information. The Policy also recognises the country's overall physical infrastructure of energy, water and roads will greatly influence scientific and technological development.

The implementation of the Policy is dependent on the extent to which sectorial policies for agriculture, trade and industry, health, environmental management, education and training, foreign affairs and international cooperation, immigration and labour and national budgeting. In this regard, the NPRST stresses the importance of integrating STI considerations into sectorial policies and programmes. The Policy regime is complemented by a range of other explicit and implicit STI policies such as the National Industrial Policy, the National Biotechnology Policy, the National Environmental Action Plan and related legislation and numerous policy statements contained in FDI regulations issued by Ministry of Industrialisation, Trade and SME Development and the annual budgets issued by the Ministry of Finance. The NDP4, as shown above, has policy measures that can be used to promote STI.

36 Republic of Namibia (1999), op. cit.p.15.
37 Republic of Namibia (1999), op. cit.p.15.
38 Republic of Namibia (1999), op. cit.p.15.

OTHER EXPLICIT NATIONAL POLICY INSTRUMENTS

Namibia has other policies that explicitly or deliberately aim at promoting STI. They are explicit in the sense that they contain provisions that are intended to promote scientific research and/or technological innovation activities.

The explicit STI policy instruments include: 'Namibia's Industrial Policy'[41], 'Growth at Home: Namibia's Execution Strategy for Industrialisation'[42], 'Enabling the Safe Use of Biotechnology Policy of 1999', 'ICT Policy for Education', the Ministry of Health Research Policy of 2002, and the 'National Human Resources Development Plan 2010-2025'. Sectorial policies for agriculture, mining, forestry, fisheries, and environment and natural resource management have explicit policies for promoting scientific research.

Namibia's Industrial Policy is a framework instrument with general principles and policy statements that largely focus on promoting the industrialisation of the country in line with Vision 2030. It is "a policy statement about the intentions of the State with respect to industrialisation."[43] Specific industrial policy measures are deposited or expressed in the 'Growth at Home' document. The overall goal of the country's industrial policy is to transform the economy from low value resource-based to high-value manufacturing through technological innovation and entrepreneurship. Using the policy, the Government of Namibia intends to create fiscal and legal incentives for the emergence and growth of local industrial enterprises. Specific STI policy measures articulated by the Policy are: (a) promotion of the development of vocational and technical training institutions to generate skilled manpower in industrial fields and (b) increasing "R&D expenditure within the next five years in order to enhance ... capacity for innovation"[44].

41 Republic of Namibia (2012). *Namibia's Industrial Policy*. Ministry of Trade and Industry, Windhoek, Namibia.
42 Republic of Namibia (2013). *Growth at Home: Namibia's Execution Strategy for Industrialization*. Ministry of Trade and Industry, Windhoek, Namibia.
43 Forward by Hon. Hagen Giangos, Minister of Trade and Industry, in *Namibia's Industrial Policy*, p. iv.
44 Republic of Namibia (2012). *Namibia's Industrial Policy*, p. 11. Ministry of Trade and Industry, Windhoek, Namibia.

The Industrial Policy document outlines a range of STI related initiatives that the Ministry of Industrialization, Trade and SMEs Development will spearhead in collaboration with other line ministries. The initiatives include:

- Promoting "an innovation agenda focused on strategic R&D in the areas of resource efficiency, energy, transport, climate change, environmentally friendly production methods, land management, etc.";
- Improving "the framework conditions for business to innovate, including through modernising the framework of copyright and trademark protection, improved access to SMEs to intellectual property protection, improved access to capital, and full use of demand-side policies through public procurement and smart regulation";
- Launching "nationwide innovation partnerships to speed up the development and deployment of technologies to meet identified challenges;"
- Strengthening "and further developing existing innovation programmes through closer collaboration with development finance institutions, and streamline administrative procedures to facilitate access to funding, particularly for SMEs, and to bring in an innovation incentive mechanism for fast movers";
- Promoting "knowledge partnerships and strengthen links between education, business, research and innovation, and promote entrepreneurship by supporting young innovative companies";
- Ensuring "a sufficient supply of science, mathematics and engineering graduates, and focus school curricula on creativity, innovation and entrepreneurship"; and
- Prioritising "knowledge expenditure, including by way of tax incentives and other financial instruments to promote greater R&D investment."

Source: Ministry of Trade and Industry, *Namibia's Industrial Policy*, p. 11.

OTHER EXPLICIT NATIONAL POLICY INSTRUMENTS (CONTINUED)

The Industrial Policy document, though containing the above STI policy statements, makes no reference to the NPRST of 1999. However, *there is significant convergence* between its policy statements and those contained in the NPRST of 1999.

The other important policy instrument is the 'Enabling of Safe Use of Biotechnology', the national biotechnology policy of 1999.[45] This is an example of a technology (and environmental) policy that is largely focused on technology regulation and management. It was developed and adopted by the Government of Namibia in order to domestic the United Nations Convention on Biological Diversity and its protocol on biosafety. The policy aims at supporting the development of research and industrial capacity to safely apply biotechnology techniques and build regulatory capacity to assess, test and monitor biotechnology applications. This is one policy that can either promote or hinder R&D in biosciences. Its implementation should be governed in such ways that enable the country to harness the technology for development while at the same time managing or reducing any potential technology risks.

45 Republic of Namibia (1999). *Enabling Safe Use of Biotechnology*. Ministry of Education, Vocational Training, Science and Technology. Windhoek, Namibia.

IMPLICIT STI POLICY INSTRUMENTS

As stated earlier, Namibia has a wide range of implicit national policies for STI.

These are policies that are not deliberately intended to promote or govern STI but impinge on scientific research and technological innovation in the country. They can either promote or hinder scientific research and/or technological innovation. Such policy regimes or instruments include those covering defence and security policies, tax and foreign exchange regulations, immigration and labour laws, environmental impact assessment regulations, competitive policy and legislation, and foreign direct investment policy and regulations. Competition and foreign direct investment policy regimes can stifle scientific research and technological development, for example by restricting mergers and acquisition of firms or companies thereby denying the country the opportunity of consolidating scarce scientific and technological assets such as human skills and machinery. On the other hand, these regimes may also contain policy measures that enable the country to attract foreign technology and scientific knowledge through pro-technology FDI incentives.

4.3

NPRST IMPLEMENTATION LEGISLATION, PROGRAMMES & AGENCIES

The main instruments for implementing the NPRST are the Research, Science and Technology Act of 2004 (Act no.23 of 2004), the RST Regulations of 2011, and the National Programme for Research, Science and Technology (NPRST).

The RST Act of 2004 (Act no.23 of 2004) was promulgated almost five years after the adoption of the NPRST and largely focuses on structural and procedural issues or aspects of promoting, coordinating and developing R&D in the country. The aim of the Act is to "provide for the promotion, co-ordination and development of research, science and technology in Namibia; to establish the National Commission on Research, Science and Technology and the National Research, Science and Technology Fund; and to provide for incidental matters".[46]

The Act's specific objectives are outlined in Section 2 and include the following: ensuring that there is: "co-ordination, monitoring and supervision of research, science and technology in Namibia" (Article 2(1a); and "dedicated, prioritised and systemic funding for research, science and technology application and development in Namibia" (Article 2(1e)). For purposes of realising the two objectives the legislation provides (in Articles 5-17) for the creation and governance of the NCRST, and the establishment of the National Research, Science and Technology Fund (Articles 23-14).

The NCRST's functions and powers are specified in Article 5 and include: providing "direction and policy guidance to the research, science and technology innovation systems in Namibia" (Article 5(1c)); promoting "the application of research, science and technology to the development and improvement of industrial and commercial outputs, designs and productivity" (Article 5(1h)) and "to undertake, in cooperation with the appropriate institutions and other bodies, the development and exploitation of any research, science and technology invention, and to provide advice and assistance to innovators and inventors in the registration and protection of their innovations and inventions" (Article 5(1o)). *It should be noted that these provisions should be interpreted to emphasise the role of the NCRST in promoting or spearheading innovation and generally playing a coordinating role in the NSI.*

For this review, there are a number of pertinent issues worthy giving attention to. The first pertains to convergence between the NPRST of 1999 and the RST Act of 2004. It is surprising that Act does not make any reference to the NPRST and does not invoke any specific provisions of the NPRST. The Act is supposed to be the policy implementation instrument but is silent on the existence of the NPRST of 1999. The second issue relates to the interpretation or articulation of specific policy decisions/measures in the Act. The Article seems to have created or caused the creation of an institutional arrangement different from that envisaged in the NPRST of 1999. While in the NPRST of 1999 Government committed itself to create an elaborate institutional mechanism including the Council for Science and Technical Education (CSTE), the Science and Technology Information Centre (STIC), the Council for Research and Industrial Innovations (CRII) and the Foundation for Research, Science and Technology (FRST) all under the NCRST, the Act only enables the creation of the National Research, Science and Technology Fund (NRSTF). The NRSTF is perhaps the FRST envisaged in the NPRST of 1999.

46 Republic of Namibia (2004). *Research, Science and Technology Act, 2004*. Government Gazette 23 December 2004, No. 3356.

NRST POLICY IMPLEMENTATION LEGISLATION, PROGRAMMES & AGENCIES (CONTINUED)

To give practical expression or promote the implementation of the RST Act of 2004, the RST Regulations of 2011 were gazetted by the Minister of Education in November 2011. The Regulations put more emphasis on the role of the NCRST as a promoter of innovation and catalyst for the development of a NSI. For example, Article 5(3) of the Regulations states: "[t]he Commission must encourage and promote the development of research, science, technology, innovation and invention within the Namibian industry and commerce, including the creation of research, science, technology, innovation and invention divisions within industrial and commercial entities."[47]

There are other aspects of the Regulations that are important to note. The Regulations explicitly define concepts such as 'innovation' and 'invention' while the Act does not. However, they do not provide any guidance on policy aspects of the generation, promotion and protection of inventions and innovations. The Regulations are largely focused on regulating the issuance of permits for scientific research activities. Their effect or impact on realising technology development and innovation goals or considerations of the NPRST of 1999 need to be carefully analysed.

The National Programme for Research, Science, Technology and Innovation (NPRSTI) for 2014/15 and 2016/17 adopted by Cabinet and Parliament in March 2015 is perhaps the main instrument for implementing the NPRST of 1999. The NPRSTI was developed and is being implemented within the broader context of Vision 2030 and the NDP4. It is aimed at supporting the realisation of Vision 2030: "a prosperous and industrialised country..., developed by her human resources, enjoying peace, harmony and political stability".

47 Republic of Namibia (2011). *Research, Science and Technology Regulations: Research, Science and Technology Act, 2004*. Ministry of Education, Government Gazette, 11 November 2011, No. 4828.

The NPRSTI's overall goal is to create appropriate conditions that will enable Namibia to use research, science and technology as a tool to solving pressing socioeconomic, environmental and technological challenges. Its priorities are to: (a) create "an enabling policy and regulatory environment required to frame and support ... science and technology development"; (b) build "research capacities, infrastructure and technical skills while creating research groups with a critical mass to guarantee the strength and sustainability of the research and innovation system"; (c) promote "cooperation in research and innovation activities resulting in an improved response to economic and social challenges", and (d) promote "innovation in the economic and social sectors."

The NPRSTI outlines strengths and weakness of Namibia's NSI as well as the system's opportunities and threats. It then describes a series of interventions that will be instituted in order to address the weakness and threats and harness the opportunities.

The programme covers in a holistic way STI policy measures with emphasis on specific technology thrusts, for example manufacturing technologies, biotechnology and information and communication technologies. It also puts emphasis on innovation promotion activities through enterprise development. The NPRSTI can be further improved to better articulate or have specific policy statements and measurable outcomes.

Agencies for policy implementation are spread across the institutional terrain or landscape. As stated in the NPRST document, sectorial ministries such as those responsible for agriculture, health, trade and industry, mining and energy, environment and natural resources and national planning are also responsible for integrating STI policy considerations into their respective policy regimes and implementation plans.

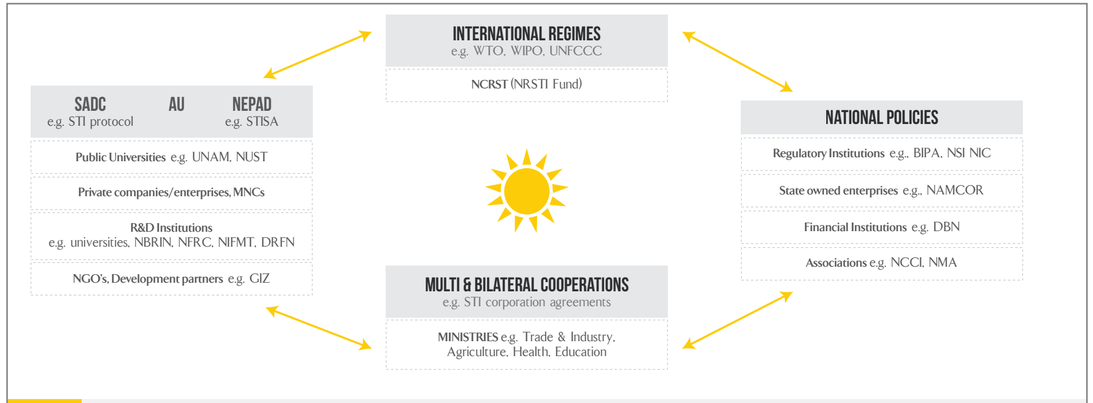


FIGURE 5 Illustration of Namibia's National System of Innovation

5 ASSESSMENT OF NPRST IMPLEMENTATION & NATIONAL SYSTEM OF INNOVATION

Having provided an overview of the NPRST of 1999 and its implementation instruments, it is important to have an 'indicative' assessment of what outputs and outcomes have been generated by or in the NSI either as a result of the NPRST of 1999 regime or from processes and activities that emerged post-1999 not necessarily stimulated by this particular policy.

Emphasis is put on trends in:

- **R&D funding,**
- **human resource capacity,**
- **R&D or scientific outputs,**
- **innovation activities and outcomes,**
- **institutional linkages particularly university-industry collaboration,**
- **the creation of new technology enterprises,**
- **kinds of technology development programmes,**
- **and other activities of the NSI that may be associated with the NPRST of 1999.**

The assessment does not in any way attribute the STI related outputs or outcomes to the NPRST of 1999, but is only intended to give an indication of the dynamism of the NSI since the adoption of the policy.

5.1

FUNDING OF R&D: SECTORIAL TRENDS & SOURCES

It is important to stress that statistical information on the funding of different aspects of STI activities in Namibia is at best scanty and at worst non-existent.

The NCRST has commissioned the first comprehensive national R&D survey that may provide some data on expenditure on R&D. This effort is supported by the ASTII of the AU and NEPAD. A pilot R&D and innovation survey was conducted in 2012 and published in the ASTII report African Innovation Outlook (AIO) 2014.[48] This review uses data from the AIO 2014 report, the NCRST's NPRSTI 2014/15 to 2016/17[49], and the draft Namibia National Survey of Research and Experimental Development: Statistical Report 2013-14.

According to the AIO 2014 (table 1), Namibia's 2010 Gross Expenditures on Research and Development (GERD) was estimated to be N$117 million. The NCRST, using data from the National Planning Commission (NPC), estimated that GERD, a percentage of Gross Domestic Product (GDP), increased from 0.02% in 2010/2011 to 0.04% in 2011/2012, but declined to 0.03% in 2012/2013 financial year.[50] According to NCRST's projection, as stated in the NPRSTI (2014/15-2016/2017), GERD/GDP is expected to increase to 0.3% in 2016/2017. This is the GERD/GDP target set in NDP4.[51]

48 NEPAD (2014), *African Innovation Outlook 2014*. New Partnership for Africa's Development and African Union.
49 Republic of Namibia (2014), *The National Programme on Research, Science, Technology and Innovation 2014/15-2015/16*. NCRST, Windhoek, Namibia.
50 Republic of Namibia (2014), *The National Programme on Research, Science, Technology and Innovation 2014/15-2015/16*, p. 69. NCRST, Windhoek, Namibia.
51 Republic of Namibia (2014), op. cit., p.70.

FUNDING OF R&D: SECTORIAL TRENDS & SOURCES (CONTINUED)

TABLE 1 Gross Expenditure in Research and Development 2010

GERD	TOTAL	BUSINESS	GOVERNMENT	HIGHER EDUCATION	PRIVATE NON PROFIT
GERD BY SECTOR AND SOURCES OF FUNDS	**117.0**	**15.0**	†	**102.0**	*
Business sector	23.2	15.0	†	8.2	*
Direct government	3.5	0.0	†	3.5	*
General university funds	88.5	0.0	†	88.5	*
Higher education	0.0	0.0	†	0.0	*
Private non profit	0.0	0.0	†	0.0	*
Funds from abroad	1.8	0.0	†	1.8	*
Amounts not specified	0.0	0.0	†	0.0	*

† Data not supplied
* Sector not surveyed
Source: NEPAD 2014

The NCRST GERD/GDP projections for 2016/2017 do not include funding or contributions from international sources through bilateral and multilateral programmes. The 2010 estimates in the AIO 2014 do not have completed government contributions and are based on at least 80% contributions from higher education institutions.

The draft Namibia National Survey of Research and Experimental Development: Statistical Report 2013-14, estimates GERD for 2013/2014 to be N$ 471.7 million and GERD/GDP to be 0.34%. According to this report, government accounts for 45.9%, universities 35%, business 11.4% and non-governmental organization 7.7% of R&D expenditure in the country.

In terms of R&D expenditure in specific fields or disciplines, the draft report shows that agriculture, forestry and fisheries received 14.3%, earth and related environmental sciences 14.% and industrial sciences 13.6% of the GERD. According to the R&D survey, of the 11.4% R&D spent by business, 32.1% goes to "Other Mining and quarrying". A majority of the mining companies are foreign owned and are likely to repatriate their profits and conduct R&D in their countries of origin. Relative to capitalisation and potential spin-offs, mining R&D spent in Namibia is low.

While the GERD/GDP indicators are important for ensuring that there is government attention to sustained funding of R&D, they do not tell much about the quality and relevance of investments in R&D and the productivity of the NSI. Often, the estimates say nothing about the impact of R&D on the national economy and social well being of the population.[52] They also do not necessarily tell the whole picture of the dynamism and productivity of the NSI as there are many non-R&D based innovation activities in the economy. In this regard, it is important for the GERD/GDP indicators to be used with great caution as they are subject to abuse and misuse in STI policy-making.

52 Bloch, C. and Sorensen, M., (2015), 'The size of research funding: Trends and implications' in *Science and Public Policy* 42 (2015) pp. 30-43.

HUMAN RESOURCE DEVELOPMENT

As stated severally above, the Government of Namibia recognises that building human resources and implementing policies that ensure efficient utilisation of scarce skills in science, engineering and technical fields are critical for the growth of the country's NSI. This recognition is articulated in the policy statements contained in Vision 2030, the NDP4 and the national Human Resources Plan.

According to the NPRSTI (2014-2017) target, the country should have five full-time (equivalent) researchers per 1000 persons of labour force by 2017. The AIO 2014 estimates show that there were 748 researchers (not all full-time) in 2010. UNAM is the main producer of post-graduate students in the country. Between 2009 and 2012 the University produced 27 PhDs. The distribution of researchers according to R&D fields in 2010 is shown in table 2.

The recent R&D survey (2013-14)[53] estimates that there are 1132 R&D personnel and 570 full-time equivalent personnel, 351.3 full-time equivalent researchers, 150 full-time equivalent technicians and 69 full-time equivalent support staff. The higher education sector has at least half of the R&D personnel (615 personnel). Most of the full-time equivalent researchers are in social sciences.

The right side data, just as in the case of GERD/GDP, gives an indication of human capacity for R&D, but not necessarily for technological innovation and entrepreneurial activities that are critical for a dynamic NSI. It is important for the country to build data on the available technical capacity particularly for skilled science and engineering in business or industrial firms.

53 NCRST (2016) "The Namibia National Survey of Research and Experimental Development: Statistical Report 2013-14" Namibia

TABLE 2 Researcher headcount by field of science 2010

RESEARCH BY LEVEL OF EDUCATION (HC)	TOTAL	BUSINESS	GOVERNMENT	HIGHER EDUCATION	PRIVATE NON PROFIT
TOTAL RESEARCHERS BY FIELD OF STUDY	**787**	**21**	**280**	**447**	*
Natural sciences	82	0	6	76	*
Engineering and technology	18	0	2	16	*
Medical sciences	51	0	8	43	*
Agricultural sciences	321	0	254	67	*
Social sciences	119	10	5	104	*
Humanities	43	8	3	32	*
Not elsewhere classified	114	3	2	109	*

* Sector not surveyed
Source: NEPAD 2014

SCIENTIFIC (R&D) OUTPUT

Since the 1990s, and particularly after 1999, Namibia's scientific R&D outputs have increased. As demonstrated by the figure 4 below, in the 1990s the country's R&D institutions generated or contributed approximately 50 publications per year in peer-reviewed papers in international journals.[54] The number of publications in international journals increased about 200 in 2013. The main R&D or science fields in which the country's R&D publications outputs increased are generally in the fields of environmental sciences, geology and agriculture. UNAM was the most prolific R&D publisher.

Analysis of the Namibian research publications according to scientific disciplines during the period 2013-2015 may provide an indication of the emphasis in the country's research priority areas. During the period 2013-2015, Namibian authors published 619 articles. Of these 71 (11.4%) were in manufacturing[55] related disciplines, 58 (9.3%) publications in agricultural sciences, 29 (4.7%) publications in fisheries and marine freshwater biology and 18 (2.9%) publications in logistics related areas.

While there is no linear or direct correlation between the adoption of the NPRST and the country's scientific productivity, it is notable that the number of publications increased remarkably after the adoption of the policy in 1999 and the enactment of the RST Act of 2004. An investigation into the effect on the policy on the country's scientific productivity can provide clearer insights on what specific policy measures are ideal for improving R&D.

The number of scientific publications in peer reviewed international journals does not tell the full story of a country's R&D productivity. R&D outputs often include research reports, conferences, trainees and other forms that are not publishable in international journals. Furthermore, Namibian scientists are more likely to publish in and have access to local journals than international ones.

54 The analysis and figure XX are based on the Thomson Reuters (T-R) citation databases.
55 Manufacturing related disciplines are: engineering, chemistry, physics, computer science, material science and mining mineral processing.

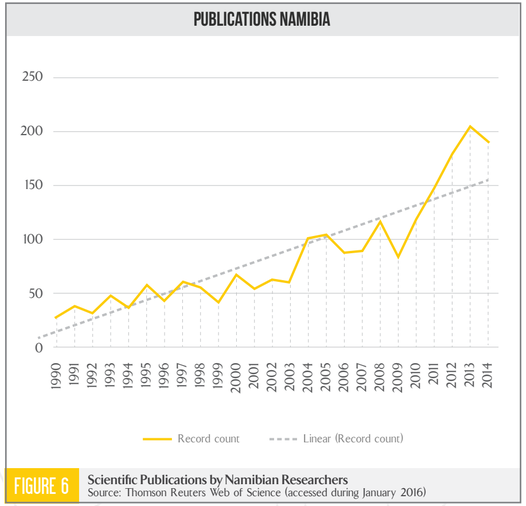


FIGURE 6 Scientific Publications by Namibian Researchers
Source: Thomson Reuters Web of Science (accessed during January 2016)

INNOVATION ACTIVITIES AND OUTPUTS: ENTERPRISE DEVELOPMENT & INTELLECTUAL PROPERTY TRENDS

As noted above, the NPRST of 1999 aims at promoting innovation for socio-economic development and industrialization of the country. Two policy measures that the NPRST of 1999 and related instruments such as the Namibia's Industrial Policy emphasise are: enabling the emergence and growth of technology-based enterprises and protection of intellectual property in the country.

Since the 1990s, the number of enterprises in general and technology-based ones in particular has increased. According to surveys by the Ministry of Industrialisation, Trade and SME Development and the World Bank, Namibia had just about 12,000 manufacturing SMEs in the late 1990s and by 2013 there was at least more than 20,000 of such firms in the country.[56] Between 2011 and 2013 manufacturing firms (including large enterprises) grew at an average of about 12% annually compared to services that grew at about 9.0%.[57]

There has been increased government attention and support for SMEs over the past decades. Government's support has included assistance in procurement of equipment and technology for the enterprises. During 2013/2014 the Ministry of Industrialisation, Trade and SME Development procured and provided equipment and machinery valued at approximately N$ 65.6 million to about 740 SMEs in 14 different regions of the country. The enterprises are from brick making, automotive, agro-processing and garment sub-sectors or economic activities.[58]

Considering intellectual property in general and patents in particular as indicators of the innovativeness and innovation capacity or potential of Namibia, the country has increased its number of trademark registrations, patent applications and registrations, and industrial design registrations since the 2000s. In 2004 Namibian residents registered 109 trademarks and non-residents registered 136 trademarks compared to 111 and 941 trademarks registered by residents and non-residents respectively in 2014.[59] The country's number of patents granted abroad increased from one patent in 2004 to eight patents in 2014.[60] Pharmaceuticals accounted for about 33% and organic chemistry 17% of the share of Namibia's patent applications between 2000 and 2014.

56 See www.enterprisesurveys.org
57 See www.enterprisesurveys.org
58 http://www.mti.gov.na/nsi.html

59 http://www.wipo.int/ipstats/en/statistics/country_profile/profile.jsp?code=NA
60 http://www.wipo.int/ipstats/en/statistics/country_profile/profile.jsp?code=NA

5.5

INSTITUTIONAL LINKAGES & COLLABORATION

As emphasised severally before, the dynamism of a NSI is largely based on the intensity and quality of institutional linkages and collaborations. It is really the extent to which public and private sector based R&D institutions, universities, industry, public policy agencies and sectorial ministries interact and collaborate that makes a country's NSI functional and productive.

Again, the NPRST aims at promoting such linkages and collaborations. Since its adoption, Namibia's R&D institutions have established different kinds of collaborations, through joint research projects and participation in regional and international programmes.

UNAM and NUST participate in several research programmes of the European Union (EU) and have bilateral cooperation arrangements with universities in South Africa, Finland and Germany. Analysis of the Namibia research publications during the most recent 2013-16 period identified that 87.2% of the country's publications in the Thomson Reuters databases were co-authored with researchers from other countries. Approximately 40.7% of the publications were co-authored with researchers in South Africa and co-authorship with researchers in USA and Germany followed with 27.4% and 20% of the publications respectively.

Regarding collaboration among and between Namibian institutions, there is a general consensus from interviews and review of various documents that it is weak or poor. National R&D institutions and universities are not adequately collaborating, and university-industry collaboration is weak.

Some of the barriers to university-industry collaboration or linkages include:

(a) **Mismatch between R&D priorities of industry and those of universities. While industrial firms or enterprises need R&D that explicitly focus on adding commercial value to their activities, most of the R&D activities at the universities are not organised in such ways as to target industrial needs;**

(b) **Funding from government to universities as well as funding from international sources tends to restrict the universities to R&D that is not focused on commercial interests or agendas. In some cases funding is tied by grant stipulations or provisions that restrict university participation in industrial R&D;**

(c) **Universities are just starting to develop an entrepreneurial culture and are only now formulating institutional policies that direct their R&D efforts to industrial or commercial ventures. Universities have limited internal capacities for collaboration with industry; and**

(d) **Venture capital financing or funding for R&D is not easily available in Namibia; and government funding of enterprises is not adequately used to stimulate university-industry collaborations.**

5.6

POLICY RELEVANCE & ADEQUACY

Though adopted more than a decade ago, the NPRST of 1999 has a certain measure of relevance to Namibia's development today. The regime focuses on a range of issues of funding of R&D, the creation of institutional arrangements for coordinating and implementing R&D policies, and incentives to stimulate enterprise engagement in R&D and innovation.

There are general opinions or perceptions about the relevance and adequacy of the NRST Policy. Most stakeholders consulted hold the view that the policy is not relevant and does not focus on innovation issues. A careful reading and critical review of the policy do not necessarily inform this view.

Since 1999 there are many policy developments that have taken place in Namibia. The country has now a sharply defined Vision 2030 and a development planning circle that generates NDPs. National economic growth, human development and other priorities are now clearly articulated in the NDPs. The NPRST is not well aligned with the NDPs or at least does not have a specific focus on the application of STI to priority development areas to achieve well-defined socio-economic outcomes.

Another limitation of the NPRST of 1999 has to do with *its generality and lack of conceptual clarity*. The policy regime contains many general statements as well as phrases, some of which are subject to misinterpretation. For example, the NPRST document contains phrases such as 'research and science innovation' 'innovation in R&D', 'R&D and innovation' and also provides for the creation of the 'Fund for Innovation in Science and Technology'. It should be noted that a phrase such as 'innovation in science and technology' could be misconstrued or interpreted to mean STI. Phrases such as these tend to cause policy ambiguity and reduce policy effectiveness.

Lastly, *the NPRST has scanty focus on key technology policy issues*. It fails to articulate specific policy measures to promote the prospecting, procurement/acquisition, diffusion and application of existing technologies. For a country such as Namibia with a resource-based economy, and low scientific and technological capabilities, STI policy should give more attention to measures that promote the acquisition and use of existing technologies as opposed to those policies that are founded on neo-classical linear approach to technological change, where R&D leads to technology development which is then followed with commercialisation of the technology.

Related to the limited focus on specific technology policy issues, the implementation of the NPRST has not been based on or *not even stimulated the emergence of national technology programmes*. It has no explicit recognition of (and contains no specific measures for promoting) transformative technologies such as biotechnology, nanotechnology, and Advanced Manufacturing Technologies (AMTS). Most of the sectorial policies for agriculture, health, energy, mining, fisheries and other areas have weak focus on technology. They do not articulate specific technological interventions that are required to address sectorial priorities and national development in general. In addition, existing funding instruments are narrowly focused on R&D.

5.7

POLICY COHERENCE, COORDINATION & GESTATION

The NPRST of 1999 aims at promoting the integration or mainstreaming of STI considerations into sectorial policies of various ministries and other state institutions such as state-owned enterprises.

This is to ensure that there is policy coherence such that sectorial policies for education, agriculture, health, environment, trade and industry and foreign affairs promote STI for national development or do not undermine the implementation of the NPRST of 1999 and related programmes. The aim is to avoid or at least reduce policy tensions.

Achieving coherence between the NPRST and sectorial policies is one of the main challenges facing Namibia. From consultations with various stakeholders and review of various reports, there is less coherence between the NPRST of 1999 and other policy instruments or at least sectorial programmes of various ministries do not adequately espouse and promote the STI policy regime. The limited policy coherence in the Namibian NSI is attributed to a range of factors including the following:

(a) **Different ministries and state-owned enterprises and private sector have different or diverging views of STI policy and limited understanding of the role of the NCRST as coordinating authority for the implementation of the NPRST of 1999;**

(b) **Competition for budgetary resources and institutional status leads to rivalry between different R&D institutions and ministries;**

(c) **The location of the NCRST in the Ministry of Higher Education, Training and Innovation seems to reduce its influence on sectorial ministries such as those of the Ministry of Industrialisation, Trade and SME Development, Ministry of Environment and Tourism, Ministry of Finance and the National Planning Commission (NPC); and**

(d) **Lack of pronounced strong political leadership for STI in general and the implementation of the NPRST of 1999 in particular. This is mainly so in terms of the weak or non-active engagement of the national parliament and political parties in ensuring active implementation of the RST Act of 2004. For example, many stakeholders and previous reviews note that the Act's provisions making the national President of the Republic the patron of STI are not really implemented.**

Related to the issues of policy coherence and coordination is the *unnecessary long policy gestation*. Policy gestation is defined here as the period of time between agenda setting, policy adoption, implementation and adjustment.

The policy gestation in the case of the NPRST in Namibia is at least five years. It took about five years from 1999 when the NPRST of 1999 was adopted by Government to when the RST Act was enacted by Parliament in 2004, and it took almost seven years from the enactment of the RST Act to the promulgation of the RST Act Regulations in 2011. It took more than 10 years from the adoption of the NPRST to the establishment of the NCRST.

The relatively long policy gestation period may be accounted for by the factors listed above, particularly the weak political and executive leadership for STI. There has been *no pronounced sense of urgency* within the Presidency, political parties and Parliament to ensure that the NPRST of 1999 is translated into practical actions through implementation programmes.

POLICY LEARNING & BENCHMARKING

6

6.1

POLICY LEARNING

Policy learning, the search, acquisition and use of knowledge and information in policy processes, is important for designing, evaluating, implementing and adjusting or reforming STI policy.

Recent studies show that countries that invest in policy learning often improve the quality and effectiveness of their STI policies and NSI.61 The learning enables policy-makers to gather information or evidence about policy instruments that work, what makes them to work and how to make them to be effective. It enables countries not to repeat mistakes or policy failures of their peers.

There are many avenues/channels and forms of policy learning. They include: conducting *ex ante* and *ex post* evaluations of STI policy instruments and programmes, policy missions, and participation of policy-makers in regional and international conferences on STI policy. Regional STI platforms such as those established by SADC, NEPAD/ASTII, SAIS and a variety of other initiatives are important avenues for policy learning among peer countries.

Namibia is investing in policy learning in a range of ways. Over the past decade or so the Government has supported its officials to participate in SADC STI processes, AU/NEPAD ASTII and ministerial conferences, bilateral dialogues with counterparts from South Africa, Finland and Germany and Uganda, and participation in EU programmes. In addition to the missions and participation in conferences, commissioning or undertaking a number of evaluations or reviews has promoted policy learning. The evaluations/reviews include:

- **The UNESCO supported review of the STI systems conducted in 2005;**
- **Review to develop a framework policy on innovation conducted in 2011;**
- **Namibia NSI gap analysis exercise undertaken by NCRST in 2015; and**
- **The NPRSTI outline of strengths and weaknesses of the NSI as well as opportunities and threats for the NSI.**

One of the main outcomes of these evaluations or reviews is consensus that the country needs a new modern NSTI policy regime and a more coordinated institutional set-up.

61 For a conceptual discourse on policy learning and its importance in innovation policy making see Borras, S., (2011). 'Policy learning and organizational capacities in innovation policies', *Science and Public Policy*, 38(9), November 2011, pp. 725-734; http://ingentaconnect.com/content/beech/spp

6.2

REGIONAL & INTERNATIONAL BENCHMARKING

As part of policy learning, countries (and even regions such as SADC and EU) engage in benchmarking of their NSI systems.

The benchmarking enables them to compare their NSI against their peer or reference countries, and helps to identify strengths and weaknesses of NSI as well as potential policy interventions. It is supposed to be used to induce learning and increase efficiency of the NSI.

OECD countries have a long established culture of undertaking NSI benchmarking exercises focusing on various aspects such as governance of innovation systems.[62] The United Kingdom has also established a traditional of benchmarking its NSI.[63] South Africa has also adopted a benchmarking approach in its policy review exercises.[64]

Benchmarking for or as part of STI policy review is not really an established approach in Namibia. Previous reviews have not really benchmarked the country's NSI and related STI policy. As such there is no agreed upon criteria for selecting comparator/reference countries or NSIs. For this review we propose the following criteria and countries for benchmarking Namibia's NSI.

The criteria are clustered as:

62 See for example OECD (2006), *Governance of Innovation Systems, Volume 3: Cases Studies in Cross-Sectoral Policy*. Organization for Economic Cooperation and Development, Paris.

63 See for example Allas, T., (2014), 'Insights from international benchmarking of the UK science and innovation system'. Department of Business Innovation and Skills. BIS Analysis Paper No.03

64 See Mugabe, J (2015). 'Literature Review on Advanced Manufacturing Technologies: Lessons for South Africa'. Report prepared for Business Enterprise, University of Pretoria.

(a) **Neighbourhood and peer in the SADC region - those countries that share borders with Namibia and are peers in the SADC region (Botswana and South Africa);**

(b) **Age/year of adoption of first national STI policy - those countries that adopted national STI policy regimes around 1995-2000 (Botswana, South Africa and Mozambique);**

(c) **Level of economic development/growth - countries in the category of middle to upper-middle income economies (Botswana, South Africa, Malaysia and Singapore);**

(d) **Established and active bilateral cooperation with Namibia in education, science and technology and have relatively long historical ties (Finland and Germany); and**

(e) **Country providing more leverage or market in terms of Namibian exports and increasing FDI inflows (Germany).**

Based on the above criteria, we propose to benchmark Namibia's NPRST of 1999 and the NSI against Botswana, South Africa, Mozambique, Malaysia, Singapore, Finland and Germany. The benchmarking is really indicative and not based on exhaustive indicators and analysis. We first benchmark the NPRST of 1999 in terms of the gestation period, from policy adoption to adjustment or reform.

REGIONAL & INTERNATIONAL BENCHMARKING (CONTINUED)

POLICY GESTATION

Namibia adopted its NPRST in 1999 just about a year after Botswana adopted its first National Science and Technology Policy in 1998 and three years after South Africa adopted its White Paper on Science and Technology in 1996. Botswana developed its national STI Plan in 2005. South Africa adopted its first National R&D Strategy in 2002 and the Ten Year Technology Plan in 2008 while Namibia only developed and adopted it first NPRSTI in 2014. Unlike Botswana and South Africa, Namibia invested in a relatively long legislative process of enacting the RST Act of 2004 and related RST Regulations in 2011.

In terms of establishing institutions dedicated to STI policy, Botswana had a ministry, the Ministry of Communications, Science and Technology established by 2002 and the Botswana Research, Science and Technology Agency (BRSTFA) in 2005 while in Namibia the NCRST only got established in 2013 almost 10 years after the enactment of the RST Act of 2004. South Africa established a fully-fledged department of science and technology in 2002 and had the National Advisory Council on Innovation (NACI) also established in 2001/2002.

FUNDING OF R&D

In terms of GERD, Namibia has not done as well as its neighbours and other countries. Table 3 below shows that in 2010 Namibia's GERD was below that of its peers (Botswana, South Africa and Mozambique) in the SADC region and also below Finland, Singapore, China and Germany.

TABLE 3 Gross Expenditure in Research and Development

COUNTRY	GERD/GDP (2010)
Finland	3.73
Singapore	2.01
South Africa	0.74
Namibia	0.18
Botswana	0.25
Mozambique	0.42
Germany	2.85

Source: UNESCO Institute of Statistics 2014 and NEPAD/AIO 2014

HUMAN RESOURCE BASE

Namibia's human resource base for R&D is generally smaller than that of its reference countries. Table 4 shows that Botswana has almost three times full-time equivalent of researchers as Namibia. This is despite the fact that they adopted STI policy regimes about the same time.

TABLE 4 Full time equivalent of researchers per million population

COUNTRY	RESEARCHERS (FTE) PER MILLION INHABITANTS
Finland	10414
Singapore	7288
South Africa	571
Namibia	93*
Botswana	305
Mozambique	89
Germany	7491

Sources: NEPAD 2014 and UNESCO Institute of Statistics 2014
*Estimate assuming that a researcher spends at least 25% of her time on research

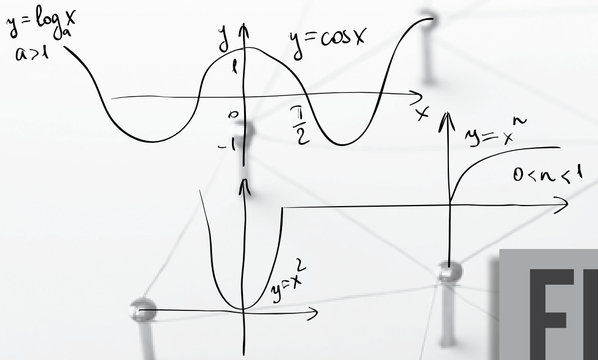
INNOVATION CAPABILITY RANKING

The World Intellectual Property Organization (WIPO), Cornell University and INSEAD launched the Global Innovation Index in 2007. Its objective is to assess the richness of NSIs using multiple indicators including those pertaining to institutional configurations and linkages. During the 2014 ranking the GII covered 143 countries. Namibia was ranked 109 below neighbouring countries, particularly Botswana (90), Mozambique (93) and South Africa (56). It should be noted that Namibia's ranking has been falling. In 2010 the country was ranked 92th, 78th, in 2011 and 109th 2013.

TABLE 5 Global Innovation Index (GII) Rankings: Namibia and selected countries

COUNTRY	RANKING GII 2014
South Africa	56
Botswana	90
Namibia	109
Finland	4
Singapore	7
Mozambique	95
Germany	12

Source: Global Innovation Index (2015)



7 FINDINGS & RECOMMENDATIONS

7.1

KEY FINDINGS

Namibia's NSI has grown in the past two decades. The main developments in the country's NSI and implementation of the NPRST of 1999 have largely been structural and legislative. Structural developments are related to the creation of a number of organisations or agencies for promoting STI. The establishment of the NCRST in 2013 and the NRST Fund are milestones in the implementation of the NPRST of 1999. The establishment of the NCRST has given new impetus to the NSI in a variety of ways particularly in terms of policy leadership and coordination. Since its establishment, the country has formulated the NPRSTI and is in the process of designing instruments for governing funding of STI through the NRST Fund.

There are a number of positive aspects of Namibia's NSI evolution since the adoption of the NPRST of 1999 that should be noted. The first is the *growth of the educational and training system*. In 1999 the country had only one university – UNAM – and today it has two public universities, with the establishment of NUST in 2015. Related to the growth of the university system is the considerable development of primary and secondary schools in the country as a result of Government's high expenditure or budgetary allocation to the education sector.

Funding for R&D has also generally increased since the late 1990s. Gross expenditure on Research and Development (GERD) has increased from below 0.02% in the 1990s to 0.04% in 2012 and is targeted at 0.3% by 2017. The country's scientific productivity and innovativeness have also improved. In the 1990s Namibia's researchers and research institutions produced less than 50 publications in international journals while in the 2000s the production is estimated at above 150 publications. There has also been an increase in intellectual property generated by the country as demonstrated by the increase in patents granted from zero in the 1990s to at least 8 by 2014.

Despite the post-1999 achievements and developments, Namibia's NSI has weaknesses and the country faces formidable challenges in harnessing STI to achieve its Vision 2030. *The NSI's deficits are related to an out-dated NPRST of 1999 and related legislative instruments, long policy gestation and weak policy implementation*, relatively low GERD compared to peers, shortage of skilled human resources particularly few full-time researchers and engineers, poor linkages between academic R&D institutions and industry, challenges of policy coordination and coherence, fragmentation of R&D activities and thin spread of resources across the institutional terrain, and weak political leadership for STI.

Though the NPRST of 1999 has explicit reference to the concept of national systems of innovation, it is largely a body of R&D policy statements. It gives inadequate attention to policies for technology development and technological innovation. The regime also lacks conceptual clarity and policy specificity as well as proper policy sequencing and coherence. It has many policy statements that are not well framed and sequenced in a logical way so as to lead to some clear policy outcomes.

KEY FINDINGS (CONTINUED)

Below is a summary of strengths and weaknesses of Namibia's National System of Innovation.

TABLE 6 Summary of strengths and weaknesses of Namibia's National System of Innovation

STRENGTH AND OPPORTUNITIES	
• Political stability, favourable macro-economic conditions and positive growth trajectory.	• Creation of agencies for STI policy coordination and regulation e.g. NCRST, BIPA.
• Articulation of National Vision 2030 and a culture of planning through NDPs.	• Growing self-discovery e.g., R&D survey by NCRST and recognition of need for NPRST of 1999 review/reform
• Relatively good physical infrastructure including ICT and mobile telephone.	• Deepening regional and international relations, e.g. growing participation in the SADC STI processes and programmes.
• Increased FDI inflows due to favourable investment climate.	• Existence of higher education and training institutions, e.g. UNAM and NUST.
• Existence of explicit R&D policy and implicit STI policy instruments.	• Relatively high GDP expenditure (compared to other African countries) on Education and Health.
• On-going efforts to establish favourable property rights regimes, e.g. National Intellectual Property Bill.	• Existence of state owned enterprises and a growing population of SMEs.

WEAKNESS AND CHALLENGES	
• Economic growth with low levels of human development (persistence of poverty, unemployment and in-equalities).	• Relatively under developed logistics framework, including rail and port infrastructure.
• Dependence on a narrow range of economic activities particularly natural resources.	• Weak institutional leakages/coordination particularly between industry and research institutions.
• Low levels of industrialisation and weak manufacturing base, as manifested in high imports and low exports.	• Lack of alignment of R&D investment with national development priorities outlined in Vision 2030.
• Water scarcity and ecological challenges such as drought, flooding and loss of bio-diversity are a threat to attainment of Vision 2030.	• Low levels of Gross Expenditure on Research and Development.
• Relatively high vulnerability to climate change.	• Weak political and civic constituencies for STI.
• Relatively weak education and training system as manifested in low skills base for industry.	

7.2

RECOMMENDATIONS

To strengthen its NSI in order to harness and effectively apply STI to achieve Vision 2030, *Namibia requires a new modern National Science, Technology and Innovation Policy (NSTIP)* – a regime of explicit or direct policy measures that will enlarge the country's scientific and technological capacities to industrialize through knowledge and innovation. The NSTIP should enable the country to: grow its GERD and human resource base in STI, increase national scientific productivity and innovation outputs, improve the quality and intensity of institutional linkages, and enhance policy coherence and coordination across socio-economic sectors.

The design or formulation of the NSTIP should be guided by the following principles:

PRINCIPLE 1

LEVERAGING POLITICAL CAPITAL AND EXECUTIVE LEADERSHIP

The successful implementation and effectiveness of STI policy to no small measure depend on political and executive leadership. Experiences of countries such as Finland, Singapore, Malaysia and the USA vividly demonstrate that presidents, prime ministers, parliaments, political parties, and a range of other political and related executive institutions are critical to the successful implementation of national policies for STI. In the cases of Finland and Malaysia, for example, the prime ministers' offices are responsible for coordinating the design and implementation of R&D and innovation policies.

In the USA, the President has special President's Council of Advisors on Science and Technology (PCAST) and the presidency spearheads special initiatives or programmes for promoting STI. One particular example of the presidential STI initiatives is promotion of advanced manufacturing technologies. In 2011 President Obama launched the Advanced Manufacturing Programme (AMP) that brings together industry, universities, research institutes and the federal government to invest in domestic advanced manufacturing sectors. The initiative is coordinated by the Office of Manufacturing Policy within the White House and co-chaired by the Director of the National Economic Council and the State Secretary of Commerce. There is also an AMP Steering Committee within the framework of the PCAST.

In addition to executive leadership from prime ministers and presidencies, the design and implementation of STI policy requires strong political support, particularly of the ruling political parties and national parliaments. This is mainly because the allocation of funds or determination of budgets for STI is linked to political power that is exercised in/by political parties in the legislatures. In this regard, we recommend that for the formulation of NSTIP in Namibia:

(a) The President of the Republic of Namibia should launch the policy process or at least give political authority to the process by addressing the nation on the need to develop the NSTIP. This will be in fulfilment of Constitutional obligations and requirements of section 3 of the RST Act of 2004; and

(b) The National Parliamentary Portfolio committee on education, science and technology should actively participate in the NSTIP policy process by having a representative in the STI policy advisory group and should receive and deliberate frequently on reports from the NCRST regarding the NSTIP policy process.

To avoid long policy gestation periods, particularly the time between the adoption of the NSTIP and the development of policy implementation instruments, it is recommended that the policy process should be organised in such ways that a coherent implementation plan is developed during the NSTIP policy design. The NSTIP development should include the formulation of implementation plan and related projects. The NCRST should thus present to Cabinet a package containing the NSTIP and its implementation plans and projects for approval. This will possibly fast truck the allocation of budgetary resources for NSTIP implementation.

PRINCIPLE 2

ENSURE THAT THE NSTIP IS ALIGNED TO VISION 2030 AND RELATED NDPS

It is recommended that during the consultative process stakeholders participate in the identification and adoption of national priorities based on Vision 2030. The priorities should be linked to specific R&D areas/them and potential innovation programmes. For example, the priorities could relate to those in the NDP4 (logistics, manufacturing, agriculture and tourism).

PRINCIPLE 3

ARTICULATION OF NSTIP VISION AND MISSION

Guided by Vision 2030 and priorities, it is important that the consultative process develops a clear NSTIP vision and mission. Without a vision and mission, the NSTIP is likely to become a collection of disjointed policy statements, without coherence.

PRINCIPLE 4

IDENTIFICATION OF STRATEGIC OBJECTIVES AND THRUSTS OF THE NSTIP

During the consultative process a few (about 5) strategic objectives and thrusts should be identified and agreed upon.

PRINCIPLE 5

ENLARGING FUNDING MECHANISMS AND INSTRUMENTS

The NSTIP will need to provide for a range or number of funding mechanisms. Currently, the NPRST of 1999 focuses on mechanisms for funding R&D with little attention to financing of technology development and procurement programmes and innovation activities. It is crucial that the new STI policy provides measures that will promote funding of technology and innovation thrusts.

PRINCIPLE 6

RECONFIGURATION OF THE INSTITUTIONAL SETUP

For better policy coherence and coordination (and avoid weak policy coherence and inadequate institutional coordination which are some of the barriers to the growth of the NSI in general and implementation of the NPRST of 1999 in particular), there is need to reconfigure the institutional setup by relocating the NCRST from the Ministry of Higher Education, Training and Innovation to the Office of the President. The NCRST should have similar or same status as the National Planning Commission.

PRINCIPLE 7

STIMULATING STRATEGIC ALLIANCES, UNIVERSITY-INDUSTRY COLLABORATIONS

It is important to stress again that one of the hallmarks of a good national STI policy regime is its explicit focus on promoting linkages between private and public sector institutions, particularly university-industry collaboration. Collaboration between universities and industry (industrial firms or enterprises) is critical for the generation, procurement, acquisition and adoption of knowledge and technology as well as for promoting the creation of new start-up companies. It is also important for helping to coordinate and ensure R&D agendas are appropriately targeted at national development priorities.

The National STI policy can influence and help to spur the emergence and growth of university-industry collaboration through a variety of ways and measures. First, the policy can ensure that universities are provided with funding that is dedicated to building collaboration or strategic alliances with industrial firms. Government, through policy and implementation programmes, can provide tax incentives and grants to universities and industry to develop joint R&D and innovation activities. Some interesting form of incentive used in the Netherlands and Ireland is the 'innovation voucher' scheme that comprises small credit lines that are given to companies to procure knowledge services from universities.

CONCLUSION

The review demonstrates that Namibia needs a new NSTIP with specific policy measures for revitalising the NSI.

The country's NSI is not currently configured to stimulate and sustain industrial development and the attainment of Vision 2030 in general.

Its R&D programmes and investments should be aligned to national priorities, and linkages strengthen between public and private institutions as well as among different ministries.

The NCRST's location in the NSI needs to be re-examined with the aim of enhancing its authority and influence as the national agency for coordinating the implementation of STI policy and programmes.

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ANNEXES

ANNEX 1

TABLE 7 Summary of key development and innovation indicators

YEAR	ECONOMIC GROWTH	GDP, CURRENT (US $)	HUMAN DEVELOPMENT INDEX (HDI)	EXPORTS, % OF GDP	IMPORTS, % OF GDP	FDI % OF GDP	INNOVATION INDEX	R&D EXPENDITURE (% OF GDP)	SCIENCE ARTICLES	EDUCATION SPENDING, % OF GDP
2010	5.96	11.28	0.61	47.8	60.7	6.8		0.14	10	8.35
2011	5.17	12.41	0.616	45.52	57.47	6	30.7		13	
2012	5.17	13.02	0.62	43.53	60.13	8.42	34.1			
2013	5.11	12.75	0.624	43.96	62.95	6.89	28.4	0.35		
2014	4.48	13	0.628	39.61	63.16		28.5			
2015							28.1			

Source: http://www.theglobaleconomy.com/indicators_data_export.php, (accessed 16 March 2016)

Notes:

1) The main sources of data include: The World Bank, The United Nations, U.S. Energy Information Administration, UNESCO, United Nations Development Program, the World Economic Forum and the Global Innovation Index Reports.
2) Def: The Human Development Index measures three basic dimensions of human development: long and healthy life, knowledge, and a decent standard of living. Four indicators are used to calculate the index: life expectancy at birth, mean years of schooling, expected years of schooling, and gross national income per capita
3) Def: The Global Innovation Index includes two sub-indices: the Innovation Input Sub-Index and the Innovation Output Sub-Index. The first sub-index is based on five pillars: Institutions, Human capital and research, Infrastructure, Market sophistication, and Business sophistication. The second sub-index is based on two pillars: Knowledge and technology outputs and Creative outputs. Each pillar is divided into sub-pillars and each sub-pillar is composed of individual indicators.
4) World Bank def: Scientific and technical journal articles refer to the number of scientific and engineering articles published in the following fields: physics, biology, chemistry, mathematics, clinical medicine, biomedical research, engineering and technology, and earth and space sciences.

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