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Technology and innovation landscapes in the context of a knowledge-based economy

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Abstract

As a country rich in natural resources Namibia seeks to move towards a Knowledge Based Economy (KBE) by 2030. However, the aim of reconciling more effective exploitation of these resources with the conservation of biodiversity and sustainable development, poses political and legal challenges that promise to have a substantial impact on research, science, technology and innovation (RSTI). This article critically reviews the current state of Namibia's RSTI policy and framework. It argues that even though Namibia has made substantial progress in improving the institutional and policy frameworks of RSTI, a lack of consensus on what RSTI entails and on how (or even whether) it should be contextualized and adapted to the social and economic particularities of Namibia is hindering its development and implementation.

Introduction

Namibia's economic growth has improved remarkably since Independence, but not enough to address the numerous social and economic challenges the country is facing. Economic growth is partly inhibited by Namibia's overreliance on the primary sector of its economy (i.e. agriculture, mining and fishing). The secondary sector (processing these materials, manufacturing) remains very limited. To take full advantage of its abundant natural resources and thus boost economic growth, Namibia has adopted several development strategies. These approaches are enshrined in short and long-term development plans such as the current Fourth National Development Plan (NDP4) and Vision 2030. One such strategy is to leverage the use of knowledge and technology in order to strengthen and expand Namibia's secondary sector.

Both Vision 2030 and NDP4 articulate the call to exploit Research, Science, Technology and Innovation (RSTI) through the increased production, distribution and use of

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knowledge, and both documents allude to Namibia's aspirations to become a Knowledge-Based Economy (KBE) by transforming into an innovative knowledge society. KBE is an economic framework that turns to innovations, mainly scientific and technological ones, to find practical solutions to social and economic challenges. Against the backdrop of this economic framework, Namibia's achievements in the field of RSTI have been considerable. It enacted, for instance, the Research Science and Technology Act of 2004 (Act No. 23 of 2004) and established The National Commission on Research, Science and Technology (NCRST) to coordinate the implementation of RSTI initiatives. Nevertheless, the pace of progress has been slow: for example, the RST Act took over 10 years to come into force after enactment and has not yet been fully enforced. Among the reasons for this – delays that have reduced the original ambition of a KBE by 2030 to a distant utopia – are challenges such as an inadequate policy environment, disjointed efforts without any systemic linkages, and limited capacity in areas of expertise needed to support the transitional activities at the borderline between Research and Development (R&D) and industrial applications.[1]

This paper argues that even though Namibia has made substantial progress in improving the institutional and policy frameworks of RSTI, the latter's development and implementation face great challenges through the lack of consensus on what RSTI entails and on how (or even whether) it should be contextualized and adapted to the social and economic particularities of Namibia. The paper first sketches a brief historical context followed by a critical account of RSTI policy and its legal framework, with special reference to the RST Act. It then considers the main actors in RSTI in an attempt to account for the current mismatches and disjointed character of the Namibian National Innovation System (NIS).

At the most basic level, research entails gathering information to answer a specific inquiry or to solve a problem. From a scholarly perspective, it is linked to systematic or methodical investigation into and study of materials and sources in order to establish facts and reach new conclusions. Thus, it is creative work undertaken on a systematic basis in order to increase the stock of knowledge. Knowledge – whether tacit or codified – and its application are the basis for economic growth in a KBE. Innovation, on the other hand, is the first effort to apply the idea practically, undertaken in pursuance of the intended novel outcomes. These are either new or improved products or processes and could entail product technology, production process technology or organizational innovations. Although knowledge is central for innovation, until such knowledge is applied it cannot be considered innovation. Also, while traditionally innovation was regarded as a linear progression from research (often scientific research) to development, production and commercialization, more recently it has come to be considered a systemic collective activity. This is the premise of the concept of the National Innovation System (NIS). Metcalfe defined it as

[1] See the website of the National Commission on Research, Science and Technology, *Programme & Policies – National Programme on Research, Science, Technology and Innovation*, <http://www.ncrst.na/about-us/Programme-Policies/47/> [accessed 28 July 2015].

> a set of distinct institutions which jointly and individually contribute to the development and diffusion of new technologies and which provides the framework within which governments form and implement policies to influence the innovation process.[2]

In essence, the concept of the NIS rests on the idea that the flow of information and technology, among people, enterprises and institutions, are key determinants to the process of innovation.

Brief historical context

At Independence in 1990, concerted RSTI efforts were basically absent. They emerged only in 1995, under the leadership of the then Minister of Education, Hon. Nahas Angula, who restructured the ministry by splitting the basic education and higher education components. The ministry was then named Ministry of Higher Education, Vocational Training, Science and Technology and included a Directorate to deal with the issues of RSTI and, explicitly, to mobilize RSTI efforts for social and economic development. Since then, the ministry has undergone a few name changes and shifting competences.

An important milestone for the Directorate was the adoption of the National Policy on Research, Science and Technology in 1999. The main aim of this policy was to create an enabling environment to foster the transition towards a KBE. Therefore, it established a roadmap for the development of the aforementioned RST Act. Subsequently, a structured and systematic approach to RSTI initiatives – and the ambition to make them serviceable to development – began to emerge in key national documents. In 2002, for instance, the then Second National Development Plan (NDP2) acknowledged that the underdevelopment of the science and technology sector inhibited technology-based value addition. In the same vein, Vision 2030 expressed Namibia's aspirations to increase local value addition and called for a transition to a knowledge-based and innovation-led industrialized economy. This percolates into the current NDP4. Discussing the weaknesses of RSTI in Namibia, the text states that

> R&D and innovation […] are at a fairly low ebb in Namibia. Innovative products and processes are essential for companies to participate in markets and to sustain competitiveness. The interaction between key actors – the State, research institutions and the private sector – in respect of innovation is minimal, while incentives for targeted R&D in respect of introducing new technology and promoting innovation are non-existent.[3]

Namibia has, in other words, integrated RSTI into its mainstream development plans. This, in turn, necessitated a systematic approach and a long-term RSTI strategy. It also

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[2] Stan Metcalfe, "The Economic Foundations of Technology Policy: Equilibrium and Evolutionary Perspectives", in: P. Stoneman, (ed.), *Handbook of the Economics of Innovation and Technological Change*, Oxford, Blackwell, 409-512 (462f.).

[3] Republic of Namibia, *Namibia's Fourth National Development Plan (NDP4) (2012/13 to 2016/17)*, Windhoek, National Planning Commission, 2012: 56.

required the creation of policy instruments and an appropriate legal framework. To this effect, the Directorate of Research, Science and Technology was mandated

> [to] spearhead, co-ordinate and influence the development and implementation of appropriate policies, infrastructure, institutional arrangements and advocate the mechanisms necessary to encourage research, technical and scientific education, innovations and their output and to facilitate value added linkages between and amongst industry, commerce, S&T institutions and wider community.[4]

In preparation for the implementation of its mandate, the Directorate carried out various fact-finding and exploratory studies, some of them with the technical assistance of UNESCO. In addition, the Directorate began the promotion and facilitation of human, scientific and institutional capacity-building efforts and initiated extensive awareness creation initiatives aimed at demystifying science. Finally, and against all odds, the Directorate embarked on efforts to forge links between actors in government, industry and research – important players in the innovation chain. As part of this, a number of promotional and knowledge sharing platforms were established such as the National Research Symposium and the National Science Technology and Innovation Awards in 2004 and 2005. Throughout the country, mathematics and science improvement centres were established; as was a pearl millet cereal research and development centre in Ondangwa.

Even though the RST Act was enacted in 2004, it only came into effect as recently as 2012, when the National Commission on Research, Science and Technology (NCRST) was established. The main provisions of the Act are discussed below. Here, it is important to note that the Directorate had to overcome many hurdles, including the limited number of staff and the lack of appropriate qualified personnel; the tasks set aside for the Directorate were only broadly circumscribed; funding and administrative difficulties also challenged the workings of the Directorate. Yet, when His Excellency Dr Hage Geingob assumed office as Namibia's third president, he placed prominent focus on RSTI by creating the Ministry of Higher Education, Training and Innovation. Although still in its formative stages, the Ministry's mandate on innovation mainly covers policy development and implementation, as well as programme supervision. The overall coordination of programme implementation efforts rests with the NCRST. The expectation is that this functional division will enhance policy development, and improve overall coordination and implementation.

RSTI policy environment

The RST Act is a framework instrument that outlines general principles and establishes an institutional framework for coordinating and managing RSTI activities. This is of particular importance to Namibia, whose RSTI initiatives evolved in a piecemeal manner resulting in wasteful duplications. The RST Act, in other words, aimed to set up a system

[4] Republic of Namibia, *NDP4*: 37.

of innovation where previously there was none. Specifically, the Act establishes the NCRST with the specific mandate to coordinate, facilitate, promote and manage the implementation of RSTI activities (as the actual implementation remains with the various stakeholders). It is also tasked with RSTI agenda setting and prioritization of systematic funding including the promotion of linkages, networks and strategic alliances at the national, regional and international level. As the demand for skilled workers is on the rise world-wide, internationalization of RSTI is becoming more and more important and, in order to take full advantage of these trends, internationalization was moved to the fore as a key innovation policy directive.[5] According to the Act, the focus will be on the exchange of knowledge, experts, financial and technical resources between Namibia and international partners in the areas of RSTI. This, however, also underlines the need for better coordination with foreign policy. The Act also aimed to link and co-opt all actors in the innovation chain to work together and address anomalies and mismatches.[6]

One of the drawbacks is that despite its noble objectives, the Act attempts to do too much all at once. For instance, it also proposes substantive research regulatory and management rules such as research permits and registration requirements. Another issue is that the banner of RSTI covers fields normally addressed by various other, distinct policies and directives.[7] This is perhaps not that strange – other countries, too, have various research policies – but it does create ambiguity and overlap. In addition, and contrary to popular conception, there are important distinctions between research, innovation, science and technology. These complex terms need to be separated and aligned to the practical reality in Namibia. The RST Act lumps all these issues together. This all-encompassing nature, together with the weak conceptions of RSTI, undermine the Act's effective implementation and compromises the attention paid to various programme interventions. These challenges are highlighted in the current court challenge to the RST Act.[8]

Some of the grievances in this court case are indicative of the lack of shared understanding of what research is, let alone of how it should be promoted or what aspects should be strictly regulated. On the one hand, for instance, it can be argued that research is any activity aimed at creating or using knowledge in one way or another

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[5] Organisation for Economic Co-operation and Development (OECD), *OECD Science, Technology and Industry Outlook*, Paris, OECD; 2002: 4, <http://www.oecd.org/science/inno/2762979.pdf> [accessed 26 August 2015].

[6] Zerubabel Nyiira, *New Directions for Namibia's Science and Technology Sector: Towards a Science and Technology Plan. Report submitted to Government of the Republic of Namibia and UNESCO*, Windhoek, August 2005.

[7] Jan Fagerberg, David C. Mowery and Richard R. Nelson, (eds.), *The Oxford Handbook of Innovation*, Oxford, Oxford University Press, 2005: 4.

[8] In the case between the *Legal Assistance Trust and 2 others vs. the President of the Republic of Namibia and 2 others,* the Applicants are challenging the constitutionality of the Research, Science and Technology Act, 23 of 2004. Alternatively they are seeking for an order to strike out some of the provisions of the Act, such as Article 20 and 21 that, respectively, deal with registration of research institutes and monitoring of research and related activities.

and thus needs to be promoted as part of the creation of a knowledge-based society. On the other hand, some types of research (such as medical research), or at least certain aspects of research (such as intellectual property rights) need to be more strictly regulated. These efforts at defining research raise complex epistemological questions that transcend the various disciplines, and illustrate that definitions vary depending on context and specific regulatory objectives. As the court case again demonstrates these fundamental issues impede the Act's implementation.

It is important to note here that the Act's scope and objectives do not explicitly mention innovation, even if some provisions do allude to it. This peripheral inclusion of innovation compromises efforts aimed at improving the national innovation capacity, such as the establishment of linkages between the various actors. Moreover, on the whole, the provisions of the Act also reflect the weakness of the interaction between its socio-economic context and RSTI policies in Namibia. This means that RSTI interventions are not, but should be, 'Namibianized.' This is particularly true for those RSTI objectives oriented towards economic growth, more so because Namibia is a developing country with one of the highest inequality rates in the world.[9]

These RSTI objectives oriented towards economic growth are laid down within the KBE. As mentioned in the introduction, KBE is essentially an economic development strategy.[10] History and development studies have demonstrated that market oriented economic growth has only benefited the elite and contributes to widespread inequality.[11] Moreover, KBE is anchored in highly technical scientific information, often exclusively owned by scientific elites, and in expensive technology. The danger is that KBE will mainly benefit the elite few.[12] So if wealth indeed creates the ability to produce knowledge, and this knowledge creates (further) wealth, then social disparities will increase unless adequate measures are taken to distribute the economic benefits accruing from such knowledge. Moreover, RSTI strategies yield better results in countries where social disparities are offset by a well-established social welfare system.[13] While the Namibian social welfare system is advancing relatively well, the prevailing inequality that might be amplified by the adoption of RSTI strategies could undermine overall development efforts. From a policy perspective, one of the underlying questions then is how Namibia

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[9] Central Bureau of Statistics National Planning Commission, *A Review of Poverty and Inequality in Namibia*, Windhoek, Republic of Namibia, 2008, <http://cms.my.na/assets/documents/p19dmr33n31i1b1ko1f0016hg1jdq1.pdf> [accessed 9 June 2015].

[10] Brian Chi-Ang Lin, "A Sustainable Perspective on the Knowledge Economy: A Critique of Austrian and Mainstream Views," *Ecological Economics*, 60 (1), 2006: 324-332 (324).

[11] See for instance David M. Trubek and Alvaro Santos, (eds.), *The New Law and Economic Development: A Critical Appraisal*, Cambridge, Cambridge University Press, 2006.

[12] Sheila Jasanoff expounds on how scientific knowledge, and economic and political power are aligning and supporting each other to produce new scientific elites, cf. Sheila Jasanoff, *Designs on Nature: Science and Democracy in Europe and the United States*, Princeton and Oxford, Princeton University Press, 2005.

[13] Mihaly Simai, "Knowledge, Research, Development and Innovations: Some Ideas from a Research Programme," *Society and Economy*, 25 (3), 2003: 305-319 (305).

should orient its RSTI policy imperatives in line with sustainable development, to avoid deepening the socio-economic gap while preventing environmental degradation.

Lastly, one should realize that the success of RSTI interventions depends on the type and interaction of the various actors involved. These actors range from policy makers, innovation producers (those who invent, build and sell) and innovation supporters (those who communicate, create, exchange and transfer knowledge and thus support dissemination and market penetration of new products and services).[14] They, and the collaborative links between them, make up the component parts of the National Innovation System (NIS).[15] Remarkably, whether or not Namibia has a National Innovation System is questionable because, as already noted, innovation efforts are highly fragmented and disjointed and, moreover, some critical actors and institutions are absent.

Actors in the national innovation system

Research is the principal tool by which knowledge is generated and applied in technology and innovations.[16] Therefore, the actors involved in the research and development domain are the obvious starting point. In Namibia, the public research system, which mainly consists of universities, government research institutions and research departments in specific ministries, are the main drivers of research – albeit, greatly underdeveloped. Therefore, basic and applied research, as well as experimental development, is conducted predominantly at the two Namibian universities, the University of Namibia (UNAM) and the Namibian University of Science and Technology (NUST), the former Polytechnic of Namibia. These institutions conduct their R&D activities mainly for academic purposes. In general terms, their output and research capacity have remained relatively low, mainly because UNAM has remained a teaching university for most of the time since its inception in 1992. Despite recent progress in this regard, it is safe to say that the potential for applied research at UNAM remains underexploited. This under-utilization should also be attributed to a number of other pertinent weaknesses elsewhere in the NIS (see below). As for NUST, the former Polytechnic is currently in transition as it becomes Namibia's second university and has beefed up its research capacity and capability. This transformation process, however, has not yet been fully completed.

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[14] Institute for Innovation and Technology, *Indicator-based Analysis of the National Innovation System, Report on the Determinants of the Mauritian Innovation System*, Windhoek, Institute for Innovation and Technology, 2015.

[15] See Uwe Seidel, Lysann Müller, Gerd Maier zu Köcker and Guajarino de Araújo Filho, "A New Approach for Analyzing National Innovation Systems in Emerging and Developing Countries", *Industry and Higher Education*, 27 (4), 2013: 279-285 (279).

[16] Organisation for Economic Co-operation and Development (OECD), *Frascati Manual: Proposed Standard Practice for Surveys on Research and Experimental Development*, Paris, OECD, 2002.

In addition, there are several well-established research institutions connected to government departments. Although they span the traditional disciplines, these efforts are mainly dominated by environmental and agricultural research (see, for instance, the Desert Research Foundation, Geological Survey, or the various research institutes under the Ministry of Agriculture).[17] One problem here is that the research being done at these government institutions only rarely finds its way to Namibian society at large. Public research is, obviously, important. The significance of industrial research, however, cannot be overemphasized. OECD studies indicate that countries with a steady growth of industrial research also experience significant growth in high-technology manufacturing (including ICTs and pharmaceuticals) and in service sector industries. In Namibia, though, virtually no industrial research takes place.

In sum, despite considerable research efforts, the knowledge developed in Namibia is only rarely exploited for economic benefits. This low level of application of research results (also reflected in the lack of patents applied for) is further exacerbated by the small number of institutions and the limited capacity to support transitional activities at the borderline between R&D and industrial application. These transitional activities include start-ups, tooling up, design, prototype construction and so on; they are crucial in transforming innovation policy into economic outputs, and take up a pivotal role in the NIS.[18]

The next category of vital actors in the NIS consists of the innovation support and funding providers. Their task is to improve and promote innovation capacities. In Namibia they are virtually non-existent, even if efforts are being made to address this. The NCRST, for instance, also established a research fund, and significant research support funding has been dedicated to a number of research projects, including support for PhD researchers. From a legal perspective, though, it is unclear whether this funding also covers innovation support activities at the borderline between R&D and industrialization. Such activities bear high financial risks that cannot be covered by the ordinary requirements of commercial banks in Namibia, and the latter, which include the Small and Medium Enterprises (SME) Bank, do not have a specific funding category for such activities. It is no wonder then that in Namibia funding for these activities remains very low.

Furthermore, the country has almost no technology transfer centres, incubators or dedicated sector-specific industrial clusters. This is of particular concern because innovation activities require very scarce inputs of specialized knowledge. Expertise in patent filing and licensing, for instance, is very rare in Namibia. The Namibia Business Innovation Centre (NBIC), though limited in its scope, covers some of these aspects.[19] Under its research and development component, the NBIC comes closer to addressing

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[17] See Institute for Innovation and Technology, *Indicator-based Analysis* ; Nyiira, *New Directions*.

[18] See The World Bank, *World Development Indicators: Science and Technology*, <http://wdi.worldbank.org/table/5.13> [accessed 25 July 2015].

[19] Namibia Business Innovation Institute, <http://nbii.polytechnic.edu.na/?page_id=104> [accessed 14 October 2015].

the specific needs of borderline innovation support activities. Its scope is very much restricted as it only provides desktop support. As soon as activities such as design, prototype construction and manufacturing come in, they turn to the industry for support. However, industries of sufficient magnitude to support these activities are virtually non-existent in Namibia.

Part of the underlying problem is that the limitations and weaknesses of the NIS described above have historic roots. For instance, as a former colony of South Africa, Namibia did not profit from innovations and industrial developments as these took place in Cape Town, Johannesburg or other centres in South Africa.[20] Furthermore, Namibia is nowadays to a large extent economically dependent on its neighbour as many companies are local spin-offs or outlets of South African parent companies. Therefore, most R&D, manufacturing plants or industrial centres are located across the border. This means that the small Namibian industrial sector still lacks the capacity to support borderline innovation activities. This weakness is fundamental and reinforces the urgency of the need for industrialization as per the national development plans and the Industrial Policy.

Additionally, linkages between the various players in innovation are among the critical factors in bringing about successful innovation. Such linkages could be created, for instance, through collaborative research funding between the various actors in innovation. As stated by the OECD "(l)inkages between industry and science as well as the diffusion of knowledge within the national innovation systems are emerging as a primary focus for innovation policy".[21] For Namibia, all this also needs to be addressed speedily.

Concluding remarks and recommendations

As the OECD states, if RSTI activities are (to become) an essential part of social and economic development, they need to be attuned to the socio-economic context from which they emerge.[22] To this effect, Namibia needs to consider whether it should let its innovation policy be guided by a neoliberal model (that emphasizes non-interventionism and limits state intervention to establishing framework conditions) or by an expansive systemic model.[23] In its extreme form, the former view regards basic research and general education as the only public activities and intellectual property protection as the only legitimate field of government regulation. It only tolerates public initiatives (for instance, to foster entrepreneurship) up to a certain extent. The latter view, in contrast, aims to review and design linkages between the different components and actors in the

[20] Bertil Odén, *Namibia's Economic Links to South Africa*, Uppsala, Nordiska Afrikainstitutet, 1991.

[21] OECD, *Science* : 4.

[22] Organisation for Economic Co-operation and Development (OECD), *The Well-being of Nations. The Role of Human and Social Capital education and skills*, Paris, OECD, 2001: 18, <http://www.oecd.org/site/worldforum/33703702.pdf> [accessed 15 October 2015].

[23] Fagerberg et al.: *Handbook*.

innovation system. As may be clear from the argument developed here, in Namibia the interventions gravitate towards the latter view.

Importantly, to promote local industrial development Namibia should gear its policy frameworks to support R&D in SMEs also, especially addressing research questions dealing with borderline innovation activities. This augments the need for an enabling environment that prioritises such imperatives because "successful promotion of business R&D now hinges less on financial support to individual firms and more on the development of a fertile environment for innovation."[24]

There are two further points which should be noted here. Firstly, there is a proven positive correlation between innovation potential and the amount of resources devoted to R&D. Secondly, sufficient scientific and technological capacity is a requirement, especially capacity to address borderline innovation activities, currently one of the major weaknesses in Namibia.[25] Consequently, funding should be extended to include all the broad-ranged activities in the innovation process, and equally engage all stakeholders, particularly in industry, through the appropriate linkages.

Having noted the above, it is true that Namibia now has a critical mass of highly trained researchers and potential institutional capability to engage extensively in RSTI activities, especially when it comes to research and development. It is therefore imperative that the relevant policies address fundamental shortfalls in the other component areas of the NIS. The starting point should focus on forging answers to questions such as how would or could policy effect the course by which discoveries, mainly scientific ones, are transformed into useful applications relevant to Namibia. Given the strong *laissez-faire* tendencies in the RSTI thinking and the deepening levels of inequality, how do we ensure that these initiatives gravitate towards the actual needs of Namibian society? Such need for contextualization underpins the importance of a Namibian consensus on what perspective of KBE should be relevant in addressing the country's specific socio-economic challenges, and how to attune RSTI efforts to achieve this.

Hence, structured and directed research needs to be commissioned to answer these policy questions and to focus strategic interventions in RSTI. These should have a multidisciplinary approach to link RSTI initiatives to the broader development context in order to address real social, economic and environmental challenges in the country. Therefore, while discipline-specific research has its place and relevance, it needs to be understood and adequately integrated into mainstream development policies to enhance the practical relevance of the knowledge generated. Only then can RSTI be used as vehicle for addressing socio-economic ills on the ground.

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[24] OECD, *Science* : 17

[25] See OECD, *Science* ; Benoit Godin, "National Innovation System: The System Approach in Historical Perspective," *Science, Technology and Human Values*, 34 (4), 2009: 476-501 (476).

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