Building an Innovation System and Indigenous Knowledge in Namibia

Lauri Johannes Hooli, *Researcher, Department of Geography and Geology, University of Turku, Finland. Address: Section of Geography, Department of Geography and Geology, University of Turku, FI-20014 TURKU, FINLAND. Phone: +358 2 333 6031, Email: lauri.hooli@utu.fi*

Jussi Sakari Jauhiainen, *Professor, Department of Geography and Geology, University of Turku, Finland & Institute of Ecology and Earth Sciences, University of Tartu. Address: Section of Geography, Department of Geography and Geology, University of Turku, FI-20014 TURKU, FINLAND. Phone: +358 2 333 5581, Email: jussi.jauhiainen@utu.fi*

Abstract

Namibia, like many southern African countries, aims to become a knowledge-based society with a well-established innovation system (IS). Development based on knowledge and innovation reduces poverty and inequality, even if this causality is also contested. In this study, we analysed the development of an IS in Namibia with a particular focus on indigenous knowledge (IK). Embedding IK in innovation policies is often seen as an opportunity to adjust the general concept of ISs to local contexts and practices and include bottom-up approaches in policies. In Namibia, the establishment of key institutions and strategies for an IS is supported by international development aid. In operational IS practices, the focus is on a science-technology-innovation mode of learning that requires high analytical knowledge and a well-functioning IS – which are rare in Namibia. The results of our study reveals that the doing-using-interacting mode of learning and IK create comparative advantages and provide ability for positive societal change in the local communities. However, despite high expectations, the practical outcomes of innovations based on IK are limited. Nevertheless, beyond its economic value, IK is important for developing countries' innovation policy development, as it can facilitate the participatory processes of local communities in the establishment of ISs.

Keywords: Innovation System; Innovation Policy; Indigenous Knowledge; Africa; Namibia

Introduction

A knowledge economy founded on a well-functioning innovation system (IS) is a crucial engine of socio-economic success in the most developed countries (Tödtling et al. 2013). Subsequently, the application and concept of an IS – the collaboration between all economic, political, social, organisational, and institutional aspects and all other factors affecting the application, development, and diffusion of innovations (Edquist 2005, 182) – are now showing increasing importance in the developing world (Pietrobelli and Rabelotti 2011, 1262). It is regarded that innovation-driven spatial development promotes transformation towards a knowledge economy. A well-established IS is a beneficial instrument for decreasing inequalities, reducing poverty, and promoting socio-economic resilience (OECD 2012).

According to the African Union Agenda 2063, science, technology, and innovations (STI) should be a driver for resolving the economic and social challenges deterring the progress of southern African countries. Recently, IS has become a general policy instrument in the region (African Union 2014). In this context, Namibia, which gained its independence in 1990 when it was liberated from the South African apartheid government's ethnic-based homeland system, aims to develop a knowledge economy with a highly competitive industrial sector, great quality of life, and sustainable economic achievements (Republic of Namibia 2004). To accomplish these goals, the country aims to foster cooperation between the public, private, and civil sectors as well as universities and to institutionalise an IS (NCRST 2014).

Despite the growing interest in IS in less developed countries, it is not reasonable to base the development of their innovation policies on the transfer of successful policies tailored for more developed countries (Tödtling and Trippl 2005). Instead, the place-based policies should be based on smart specialisation supporting the economic divergence founded on unique characteristics, comparative advantages, and assets in that specific socio-economic context (McCann and Ortega-Argiles 2013; Boschma 2015). Notwithstanding, in southern Africa, the foundations of the economy are the agricultural and extractive industries relying solely on raw materials. The local value addition in industry is scarce, and the service sector is immature. For the past two decades, the ISs in southern Africa have been considered emerging systems (Biggs et al. 1995; Arocena and Sutz 2000; Oyelaran-Oyeyinka 2006; Szogs et al. 2011; Adebowale et al. 2014; Watkins et

al. 2015; Tigabu et al. 2015). The essential elements of ISs – such as relevant institutions, organisations, and actors – are essentially weak, poorly developed, work inadequately or in isolation, and might even be fully non-existent (Moodysson and Zukauskaite 2014). Therefore, STI modes are rare. For the STI activities, most of the institutions and expert knowledge competences need to be transferred from elsewhere (Pietrobelli and Rabelotti 2011).

Our research has two particular contributions to the existing literature on ISs in developing countries. First, by systematically scrutinising the chronological development of the IS in Namibia, we demonstrate how the IS in Namibia is a unique assemblage combining the development objectives of local government and international development-aid suppliers. Thus, we contribute a still rare in-depth study focusing on the formation of an IS in a developing country (Bartels et al. 2016). Furthermore, in the existing IS studies of developing countries, the applications of the term *developing country* are vague and oversimplified. Most often, the term *developing country* refers to a heterogeneous group of rather 'developed' middle-income countries outside Europe and North America – such as South Korea, Taiwan, China, and Brazil (Watkins et al. 2015). Only a few comprehensive analyses of ISs exist about African countries – excluding the studies regarding South Africa, a relatively advanced country. Furthermore, the existing studies focus on sectorial ISs, most often agriculture.

Second, we focus on the processes of the attempts to include indigenous knowledge (IK) in the IS in Namibia. IK is regarded as a unique approach and asset to root the ISs into the local southern African context and is also considered a source of new innovations (Domfeh 2007; Sillitoe and Marzano 2009; Head and Atchison 2015; Jauhiainen and Hooli 2017). IK is knowledge that is accumulated over time and is unique to a particular culture or society (Sillitoe and Marzano 2009). An increasing number of researchers consider IK a significant part of social development in Africa and an inherent source of innovation there (Warren et al. 1995; Berkes et al. 2003; Maila and Loubser 2003; Dekens 2007; Weichselgartner and Kasperson 2010; Bohensky and Maru 2011). IK has the potential to enhance the inclusiveness of the innovation policies and strengthen the comparative advantages of local ISs. Lately, IK has been included in official development policies, for example, in Ghana, Botswana, Tanzania, and South Africa (Nfila and Jain 2011). Notwithstanding, there is barely any research about the policies of how IK is

embedded in local IS development in southern Africa. Hence, our objective is not to map or identify the various types of IK existing in Namibia but rather to unravel the political process and the development objectives regarding the inclusion of IK in the IS development in Namibia.

The rest of the article is structured as follows. After this introduction, we reflect on how theories and earlier studies demonstrate the relationships between ISs and IK, especially in the southern African context. Subsequently, we explain our research data and methodology in detail. In our empirical analyses, we first scrutinise the chronological evolvement of the IS in Namibia until early 2017. We pay attention to the development of the social and economic context and processes, specifically to the foreign development cooperation associated with the IS's evolvement since the beginning of the millennium. For this, we analysed the innovation-related policies, laws, strategies, and key stakeholder interviews in Namibia through a qualitative content analysis. Later, we explore the political attempts to integrate IK in the IS in Namibia and contextualise it with three examples of IK – namely the traditional non-alcoholic beverage *oshikundu*, the *hoodia* plant and its specific nutritional impact, and the heritage-related tourism in Ovamboland. Finally, in the conclusions and policy recommendations section, we reflect on the impact of the IS's framework on the social and economic challenges it is expected to tackle in Namibia.

Innovation Systems and Indigenous Knowledge in Southern Africa

The development of innovations is a local practice containing complex, non-linear, and evolutionary processes grounded on the knowledge sharing and cooperation of institutions and individuals (Pavitt 2005, 87–88; Strambach and Klement 2012). The social and economic context affects the capability of institutions, regions, and countries to apply, diffuse, and develop innovations (Doloreux 2002; Tödtling and Trippl 2005). The development paths in the past impact the contemporary opportunities and the general appearance of ISs (Boschma 2015).

Because of varying social and economic contexts, the IS approaches diverge considerably between countries in southern Africa and the more technologically and economically successful countries (Lundvall et al. 2009). As specified below, the countries in southern Africa experience

both institutional and organisational thinness concerning the IS evolvement. Organisational thinness is described as the insufficient quality or lack of a critical mass of universities, private sector enterprises, research and development (R&D) laboratories, intermediate organisations, associations, unions, and other organisations significant to the processes of innovation (Moodysson and Zukauskaite 2014). The universities in southern Africa have scarce resources to do international peer-reviewed research, they are not included in the governments' strategies, and they concentrate on education at the level of bachelor's degrees (Bartels et al. 2016). Private companies conducting R&D activities are rare, and the networks between various actors are insufficient. The knowledge exchange between the actors in the public and private sectors is very limited. This restricts the mutual learning and systematic interactions in innovation development. Furthermore, in southern Africa, a major obstacle is the constant absence of advanced human capital and professionals acquainted with the comprehensive nature of ISs (Adebowale et al. 2014).

Institutional thinness is the absence or inadequate quality of both formal institutions (laws, regulations, and rules) and informal institutions (norms, values, and other cultural assets important for innovation and cooperation more generally) that stimulate knowledge exchange and collective learning (Moodysson and Zukauskaite 2014). In the activities related to innovation development in southern Africa, there is inadequate funding, a vague operational description, and absence of cooperation. Moreover, the related formal legal, institutional, and regulatory settings are immature (Oyelaran-Oyeyinka 2006). The administrations seldom create exclusively transparent development strategies with explicit plans of implementation (Watkins et al. 2015). The effectiveness of administration and the quality of regulations are the two institutional features that have the greatest corresponding effect on innovation in the region (Oluwatobi et al. 2015).

Due to these issues in the local environments, the foreign development cooperation and the collaboration between national and international stakeholders have had an important role in the IS establishment in southern Africa. Likewise, in Namibia, development cooperation has provided essential for IS development, for example, in Rwanda (see Tigabu et al. 2015), in Malawi (Lemarchand et al. 2015), and in Tanzania (see Hooli et al. 2016). Due to the United Nations'

reclassification of Namibia as a transition country (United Nations 2012), several former donor countries, such as Germany and Finland, retracted their former bilateral grant support. The traditional development assistance has transformed to intensify trade relationships, foster institutional collaboration, and maintain economic growth and the capability to foster an IS in Namibia (DGIZ 2016; MFA 2016).

Varying socio-economic context is not the only characteristic that distinguishes ISs from each other, but they are also distinct due to the knowledge they are expected to create (Asheim et al. 2011). Innovations emerging from analytical knowledge are based on novel scientific knowledge, formal learning procedures, and proper R&D that is founded on the STI mode of learning. Innovations based on synthetic knowledge are created through the processes of combining or applying existing knowledge with novel ideas. Here, the doing, using, and interacting (DUI) mode of learning is emphasised (Jensen et al. 2007). Symbolic knowledge refers to the aesthetic elements of innovations. This division is not exclusive, and usually, each of the three knowledge bases is included with varying roles in every IS (Asheim et al. 2011). However, because of the institutional and organisational thinness, southern African countries have only a limited number of innovations based on analytical knowledge. Most often, the innovation processes there are founded on symbolic and synthetic knowledge bases, the DUI mode of learning, and informal networks (Jensen et al. 2007; Kraemer-Mbula and Wamae 2010). Furthermore, transfer of technology and science from the Global North has often been unsuccessful in meeting the needs of the people in the Global South, particularly in southern Africa (Briggs 2013, 232). Thus, IK is regarded to have an important role for ISs (Hoppers 2002).

IK is local, traditional, and geographically situated knowledge transmitted from former epochs and affected by external knowledge (Bohensky and Maru 2011). Commonly, IK is transferred verbally or through imitation and demonstration, and repetition is the main learning method (Subba Rao 2006, 224). Every local society possesses culturally and economically positioned IK that has been evolving over generations (Siyanbola et al. 2012). IK is particularly important for the poor rural societies, where it is regularly the most available and appropriate knowledge in daily living. As IK cannot be owned by any certain person, company, or group (Hagar 2003; Domfeh 2007), it generates challenges for institutions that develop, transfer, and store IK

(Bertelsen and Muller 2003). The ownership and the protection of it are particularly challenging due to patent laws and intellectual property rights that were created to protect knowledge developed in formal institutions (Nakata 2002). Additionally, there are open questions of equitable benefit sharing regarding IK that are essential to be answered (Sen 2005; Wynberg et al. 2009). These issues are also apparent in Namibia, as we elaborate in our empirical analyses.

Poverty and inequality are concerns that need to be especially considered in innovation development and policies in developing countries. Thus, there is a necessity to deliberate on the potential of socially and culturally inclusive innovations and ISs. Inclusive innovations strengthen the economic and social conditions of disenfranchised members of society (Heeks et al. 2014). These innovations are new to the context and could be various products, services, business models, institutions, processes, and supply chains (George et al. 2012). Such inclusiveness demands a paradigmatic shift from the IS (Sillitoe and Marzano 2009). Altenburg (2009) argues that ISs in less well-off areas should primarily focus on adapted and affordable technologies rather than 'new to the world technologies'. IK is one potential aspect to increase inclusiveness in ISs.

IK cannot be regarded separately from other kinds of knowledge without considering their reciprocal profits (Table 1). IK is influenced by communities' experimentation and creativity driven by transformation in localities (Flavier et al. 1995). It is always a dynamic mix of inherited knowledge and contemporary innovations (Bertelsen and Müller 2003). Innovations built on new external knowledge can be adjusted to the local context through IK (Weichselgartner and Kasperson 2010), or IK may be an important measure of innovations based on external knowledge – for example, a component of a new medicament. Innovations based on IK span from the farming techniques and commodities in southern Africa to the space technology in India (Baskaran 2001). Although the development of IK may have been centuries long, it is a continuously evolving process and tangled with external knowledge (Siyanbola et al. 2012). Thus, the emphases of applying IK need to be on process – the method of observing, questioning, making sense of, analysing, and discussing novel and received information – rather than focusing on the transferable information passed from one person to another (Berkes 2009; Briggs 2013).

Table 1. Analytical knowledge (AK) and indigenous knowledge (IK) based innovations.

	AK based innovations	IK based innovations
Priority source of knowledge	Codified K combined with tacit K	Tacit K combined with codified K
Main mode of learning	Science-Technology-Innovation	Doing-Using-Interacting
Predominant actors	Industry-Academy-Government	Local Communities, Civil Society, NGOs, Government
Spatiality of knowledge creation	Local buzz with global interaction	Locally evolving process
Temporality of knowledge creation	Quarters / Years	Decades / Centuries
Predominant institutions	Formal	Informal
Usual owner of knowledge	Person / Enterprise / Organisation	Community
Protection and benefit sharing	Property Rights and Patents	Common good with unclear sharing
Focus	Universal content	Embedded processes

Research Data and Methodology

The empirical material of this study includes public documents, interviews, and studies relevant to the IS evolvement in Namibia from the 1990s until 2017. Our analytical strategy is based on the triangulation of different data for generalising the subjectivity of any particular qualitative empirical material (Philip 1998). We consider the various empirical materials as complementary rather than mutually exclusive.

Strategy, policy, and legal documents constituted the main research material of our study. These documents may connect the current processes to the longitudinal historical evolutionary processes and scale; furthermore, they can offer knowledge about the other significant events occurring elsewhere (Spradely 1980). Moreover, public documents are often produced by authorities to steer and anticipate future development. For science, those public documents indicate the broader changes in the government regarding spatial development. Documents often represent a broader institutional view of their producer, and according to Flick (2006, 249), they represent a certain form of truths created for a specific reason. Thus, it is essential to scrutinise for what purposes the documents have been created and by whom. The most important documents scrutinised in this study include *The National Research, Science, and Technology Policy* (1999); *The Namibia Vision 2030* (2004); *the Fourth National Development Plan* (2012); *the Research, Science and Technology Act* (2004, in effect from 2013); and *The National Programme on Research, Science, Technology and Innovation* (2014).

We traced IK-related case examples from these documents and from the earlier IK-related studies concerning Namibia (World Health Organization 2006, 345; Wyndberg et al. 2009; Percy et al. 2010; Saarinen 2011; Shapi et al. 2011; Embashu et al. 2013; Chinsembu et al. 2015; Novelli 2015). Additionally, we participated in the 2nd Symposium, Indigenous Knowledge Systems in 2012, in Windhoek. The symposium resulted in the publication of the book *Indigenous Knowledge of Namibia* (Chinsembu et al. 2015).

The content analysis of the strategy, policy, and legal documents was supplemented with the thematic interviews of 19 key stakeholders. The interviews enabled us to validate the observations from the documents and gain more accurate knowledge of the dynamics and processes behind the laws, strategies, and policies. Face-to-face interviews were conducted in Namibia in March 2009 (10 interviews) and October 2012 (9 interviews). The interviewees included two executive officers from the Ministry of Education who had led the innovation policy development as well as rectors, deans, professors, and coordinators from the two most important higher education institutes – the Namibia University of Science and Technology (formerly the Polytechnic of Namibia) and the University of Namibia. Those universities have been the strategic and operational forerunners of the IS in the country. The interviewees have been leading the development of universities' innovation strategies and coordinated the operational actions related to their innovation work. Moreover, we interviewed managers, special experts, and other key persons connected to the topic, namely professionals from the Southern African Innovation Support Programme and the Namibian Business Innovation Centre, the consultant who prepared the proposal for the first draft for the national innovation policy, the official responsible for IS affairs at the Embassy of Finland in Namibia, and the special counsellor from the Ministry of Trade and Industry. The average interview took an hour, and except for two informal meetings, the interviews were recorded. Later, the recorded interviews were transcribed and scrutinised via the content analysis.

Socio-Economic Context of the Innovation System in Namibia

Administratively, Namibia consists of 14 regions, but the central government has major control in terms of policies concerning regional development. After Namibia gained independence in

1990, elections have been free and fair, and the new constitution has strengthened Namibia to be one of the most stable and democratic countries in southern Africa. This is a valued advantage for the evolvement of the IS. Nevertheless, SWAPO, the largest political party, has staunch dominance in local politics, and it has had a simple majority in all local, regional, and national elections. There is a lack of respectable challengers from the opposition (Sims and Koep 2012). Notwithstanding the discordant history with South Africa, economic and political ties between these two countries are strong. Over 5% of gross domestic production (GDP) is generated from South African exports, and South Africa is also the main source of foreign direct investments, as up to 80% of total inward foreign direct investments come from South Africa (World Bank 2016, 166). Furthermore, South Africa plays a significant role in Namibia's policy development. The contents of several policies applied in Namibia, including innovation policies, originated from South Africa.

Namibia has a particular geography that affects the IS's development (Fig. 1). Its population density is the second lowest among the sovereign countries. The population of 2.3 million inhabits a huge surface area of 824,292 km^2. The most densely populated parts of the country are in north, and more than half of the country's population lives in small rural towns and villages. The capital, Windhoek, is expanding rapidly and is home to over 400,000 inhabitants. The rest of the towns have less than 80,000 inhabitants. A major part of the territory is unpopulated. The small population, the long distance between towns, and the small size of towns hinders the establishment of an interactive IS.

Because of the low population, the overall GDP in the country is also very low – a bit over 10.0 billion USD in 2016. However, in the past two decades, the economic growth has been remarkable (4–5% annually), and it is expected to continue (World Bank 2016). The most significant industries – marine technology, mining, and tourism – are potentially appropriate for the IS and innovations. Diamonds alone contribute 8.5% of the GDP. Other minerals – like uranium, gold, copper, and quarrying – contribute 11.5% of the GDP (World Bank 2016). After the opening of the latest mine in 2017, globally Namibia has become the second largest uranium producer. Nevertheless, the local value addition in the mining industry is low, as it is mainly based on unprocessed raw materials. The mines are primarily owned by foreign corporations,

have low contribution to local taxation, and employ only a few locals (Hopwood et al. 2014). Agriculture accounts for about 7% of the GDP. The field struggles with low productivity even though the livelihood of the rural majority is dependent on it. Notwithstanding the potential, marine technology and mining are barely connected to the IS of the country.

The smallness of the GDP is a challenge for R&D investments. In the past, the annual STI expenditure has been tiny, under 3 million USD (0.04% of the GDP) annually (NCRST 2014: 69). The gross domestic expenditure on R&D in 2010 was around 10 million USD (African Innovation Outlook II 2014). Recently, the R&D funds have significantly increased and should be 38 million USD in 2016–2017. There are about 250 technology companies in the country, mainly located in the capital, and R&D companies employ less than 1,000 people. In all, expenditures on research, science, technology, and innovations are very limited even compared to less developed countries in the region. The Global Innovation Index 2015 that measured countries' innovation capabilities ranked Namibia 107th out of 141 economies and 11th out of 32 sub-Saharan African countries (Global Innovation Index 2015).

Namibia has one of the highest per capita GDPs (around 5,600 USD) in the southern African context. Nonetheless, the income distinction between rich and poor is one of the most extreme in the world with a particularly strong distinction between urban and rural areas. Despite that, after Namibia gained independence, poverty has remarkably decreased; approximately a third (29%) of Namibians live in poverty. The unemployment rate (28%) is estimated to be the highest in southern Africa (World Bank 2016). Unemployment affects most severely the uneducated young population in rural areas. Additionally, the informal economic sector accounts for 44% of non-agricultural employment (Vanek et al. 2014). Extreme income differences and a large informal economic sector hinder the establishment of an IS, which is mainly founded on formal institutions.

According to evaluations, Namibia has one of the poorest education systems in southern Africa (Matengu et al. 2014). At the highest academic level, Namibia has two universities. The University of Namibia (UNAM) has an enrolment rate of over 19,000 students, and the Namibia University of Science and Technology (NUST) has over 12,000 students. Both are in the capital,

Windhoek, and have small university satellites and research centres in other parts of the country. Both universities are mostly educational institutes for lower academic degrees. Less than 200 of the staff have a PhD, and the general level and impact of the research is relatively poor. The universities have not succeeded in creating comprehensive research policies or allocating proper budgets for research. Around 10,000 Namibians are educated annually abroad, mainly in South Africa for bachelor's degrees, and annually only around ten Namibians gain a PhD abroad. Poor education levels, especially regarding the highest academic degrees, is a large challenge for the IS formation.

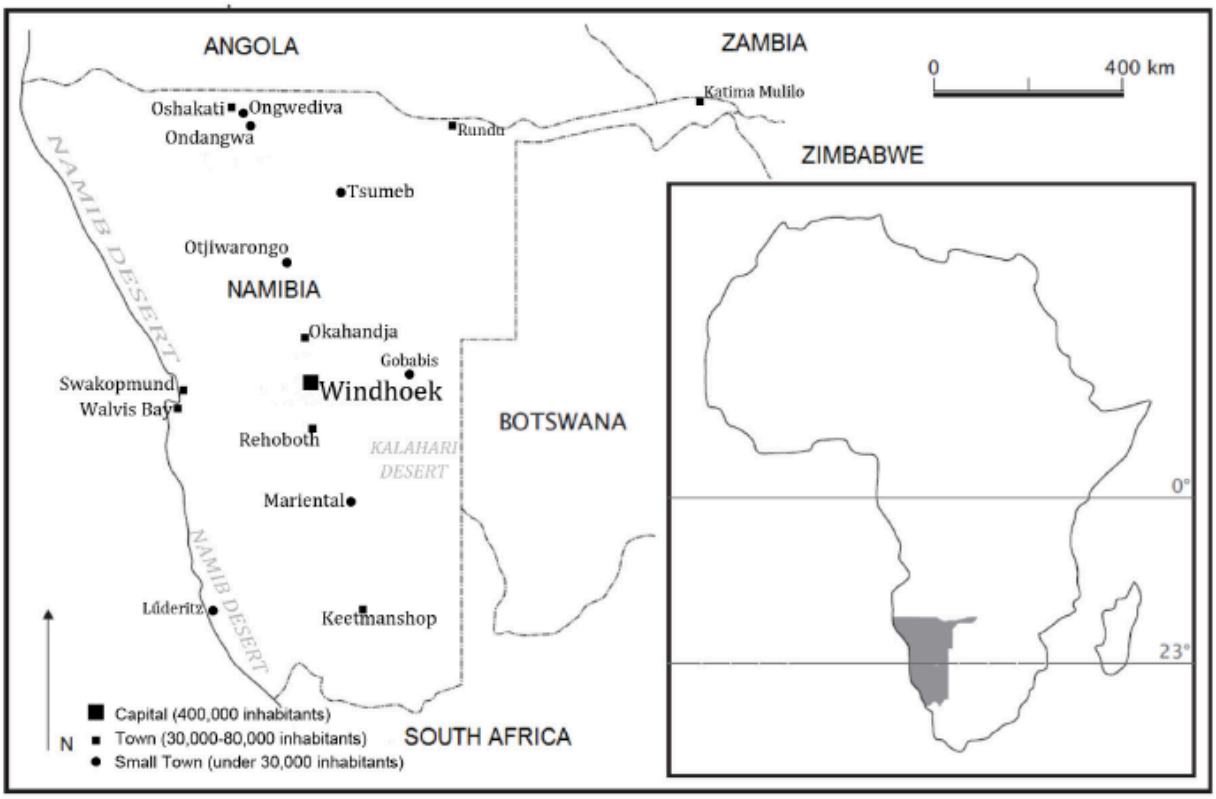


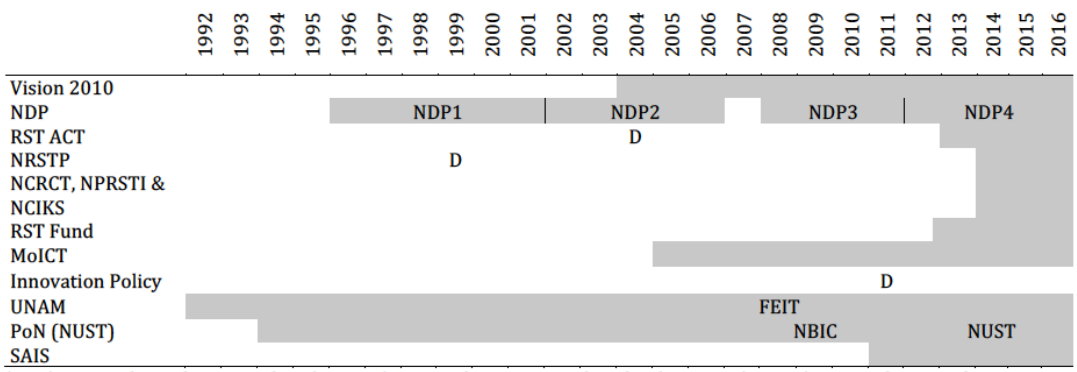
Figure 1 Namibia.

Development of an Innovation System in Namibia

Despite the socio-economic challenges, the government of Namibia, together with its international partners, has started to develop several policies and institutions supporting innovation development. Namibia was an early and consistent mover towards the institutionalisation of the setting for a knowledge-based economy and IS (see Table 2).

As early as 1999, the government of Namibia released the National Research, Science, and Technology Policy (NRSTP). This policy included the establishment of several key institutions – such as the National Commission on Research, Science, and Technology; the Foundation for Research, Science, and Technology; the Council for Research and Industrial Innovations; the Council for Science and Technical Education; the Council for Vocational and Industrial Education and Science; and the Technology Information Centre. Five years later, in 2004, the parliament of Namibia approved the monumental Namibia Vision 2030 strategy. The Vision 2030 expressed the necessity to modernise Namibia to become a competitive, knowledge-based, industrial society (Republic of Namibia 2004). The Vision 2030 also indicated the need to '[c]reate integrated approaches, and genuine partnership between government, business, communities, NGO, academic institutions, donors, etc.' (Republic of Namibia 2004, 35). In the same year, the Research, Science, and Technology (RST) Act no. 23 was drafted, and a year later, in 2005, the new Ministry of Information, Communication, and Technology (MoICT) was established.

Table 2 Evolution of Namibian innovation system



(NDP) National Development Plan; (RST Act) Research, Science, and Technology Act; (NRSTP) National Research, Science, and Technology Policy; (NCRST) National Commission of Research, Science, and Technology; (NPRST) National Programme on Research, Science, Technology, and Innovation; (NCIKS) National Commission on Indigenous Knowledge System; (RST Fund) Research, Science, and Technology Fund; (MoICT) Ministry of Information, Communication, and Technology; (UNAM) University of Namibia: (FEIT) Faculty of Engineering and Information Technology; (PoN) Polytechnic of Namibia; (NBIC) Namibian Business Innovation Centre; (NUST) Namibia University of Science and Technology; (SAIS) Southern African Innovation Support Programme; (D) Draft

After these early years, the initiative in innovation-related activities was taken over by the universities and foreign donors. Since its establishment in 1992, UNAM mostly dealt with education at the bachelor's degree level and had little competence in technology education and

research. To tackle this, a new UNAM Faculty of Engineering and Information Technology was founded in 2008. Its grand facilities were built in Ongwediva on the outskirts of a small town of under 30,000 inhabitants in rural northern Namibia (Fig. 1). In the beginning, the faculty struggled with the lack of staff members, especially lecturers, and the number of students remained low. In 2016, there were around 260 students within six engineering disciplines. This number is expected to increase rapidly when phase two, sponsored by the government of India, and phase three, sponsored by the government of Germany, are finalised in 2017. According to the plan, the faculty will host around 1,000 students when all five phases are completed (University of Namibia 2015).

In 2009, occurring almost simultaneously with the expansion of UNAM, innovation-related incubation activities were initiated in the capital, Windhoek, this time by the competing university NUST. The Namibian Business Innovation Centre (NBIC) was launched to promote business incubation and IS. The aim of NBIC was to build capacities and business skills; to offer incubation, training, and mentoring services for companies with initial business ideas; and to foster cooperation in R&D in order to develop innovations. The Ministry for Foreign Affairs in Finland funded the preparation of the NBIC business plan. Experienced Finnish technology business consultants and incubation experts, among them Technopolis plc, designed the plan. Namibia was then still an important development-aid-receiving country in terms of Finland's development policy. However, a change occurred in the Finnish development policy to support innovation promotion in aid-receiving countries and create technology-related business partnerships with these countries. Germany was another key donor behind NBIC. During the first five years, around half of the staff were German experts employed by the German Development Agency, which also financially supported the activities of NBIC.

In 2011, an additional significant innovation-related activity began called the Southern African Innovation Support Programme (SAIS). The aim of SAIS was to support macro-regional and national innovation system development in four pilot countries, namely Botswana, Mozambique, Namibia, and Zambia. Later, in 2016, Tanzania was included as well. SAIS is funded from the government of Finland's development cooperation funds. SAIS is another example of a new Finnish development policy in which the creation of innovation policies is seen as an appropriate

measure to foster economic growth and eradicate poverty in an aid-receiving developing country. SAIS, as a macro-regional intermediate organisation that supports the establishment of sustainable knowledge-sharing networks for innovation support and partnerships, strengthens human capacity related to innovation; adapts and replicates selected best practices, projects, and initiatives for practical outcomes; and builds the institutional and operational elements of the national and regional IS. In 2011–2015, SAIS organised 29 innovation dialogues between governments, universities, and industries in the area; conducted business plans for international science parks; provided mobility funds for over 300 people; organised innovation funds to the value of 20,000 euros in each participating country; and supported country-specific projects. In Namibia, open knowledge creation spaces and Living Labs were created to offer platforms for different actors to meet and interact through innovation activities (regarding the Living Lab concept in Africa, see Hooli et al. 2016), and a technology transfer organisation was also established to assist companies with intellectual property (IP), design, manufacture, distribution, and sale of technology (MFA 2016). The four-year continuation phase of SAIS was launched in 2017. NBIC and SAIS are located at the same Innovation Village in Windhoek close to the premises of NUST.

As indicated earlier, the actions of the government of Namibia in innovation-related activities were slow after the initial start. The Vision 2030 strategy is being implemented through five-year national development plans (NDPs). The fourth plan, the NDP4, was launched in 2012. The strategic objectives of the NDP4 are high and sustained economic growth, employment creation, and increased income equality (National Planning Commission 2012). Compared with its predecessor NDP3 (National Planning Commission 2008), the NDP4 is more focused and precise in identifying four focus areas – logistics, tourism, manufacturing, and agriculture – upon which Namibian economic development should rely. However, unlike in the NDP3, in which the IS development had extensive emphasis, the NDP4 has only minor reference to the Vision 2030 target of making Namibia a knowledge-based society. The ‘innovation system’ and ‘innovation policy’ are not named in the document, and, for example, the role of higher education institutes in national development is not discussed at all. Also, the emphasis on IK varies between the plans, as the NDP3 highlights its commercialisation as an important source of poverty reduction and the

development of rural communities (National Planning Commission 2008, 152), but in the NDP4, this is no longer mentioned.

The NRSTP was designed in 1999 as the key policy to create a knowledge-based economy, and the RST Act would be the legal framework for it. However, it took 14 years, until 2013, to establish the first institution mentioned in the NRSTP, namely *the National Research, Science, and Technology Fund.* Another year later, the second institution appeared, *the National Commission on Research, Science, and Technology.* In 2016, only two out of the six institutions mentioned in the NRSTP existed, and most of the objectives of the NRSTP had not been fulfilled. A rather similar delay occurred with the legal framework of the innovation-related activities. The RST Act came into force in 2013, i.e., nine years after the draft was finished. As a result, in 2014, a key institution was established for innovation-related activities, namely the National Commission on Research, Science, and Technology (NCRST). The main role of the NCRST is to promote, coordinate, and provide information on STI activities that take place in Namibia.

With approval of policies and the legal framework pending, there are questions about who actually leads the innovation-related policies in Namibia. As mentioned, MoICT could have taken the leading role because of its early establishment in 2005. However, over the years, the Ministry of Education (MoE) possessed substantial say in the innovation-related practices. In fact, when the NCRST was established in 2014, it was placed under the MoE. Also, the Ministry of Trade and Industry (MoTI) had a role due to its influence on infrastructure and on tasks involved in export-oriented economic activities, which are fundamental for innovation-related activities. Furthermore, and typical for Namibia, the Office of Prime Minister has a significant position in many key policies, including those of innovation, science, and technology. The key actors and their responsibilities, relations, and interactions in the Namibian IS are outlined in Figure 2.

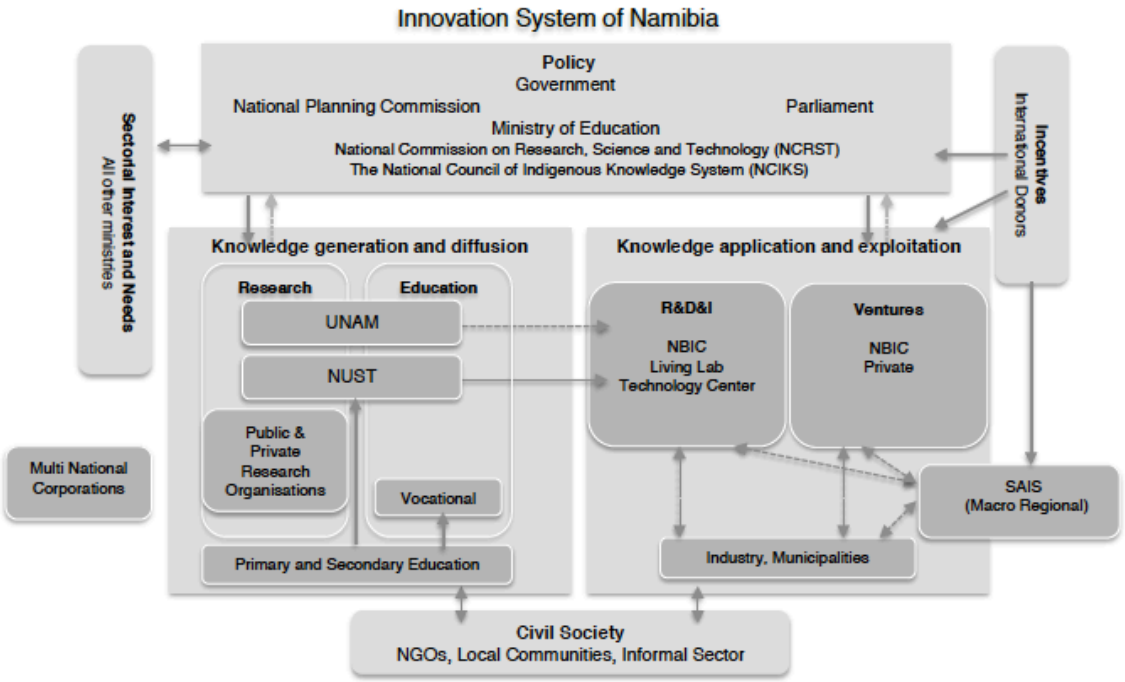


Figure 2 Innovation system in Namibia.

In 2014, a formalisation of public-led STI action in Namibia took place when the recently established NCRST launched its first three-year National Programme on Research, Science, Technology, and Innovation (NPRSTI) (NCRST 2014). The programme was created together with UNESCO. The programme's focal areas address economic and social challenges in Namibia (health, agriculture, fisheries, water, energy, geoscience, mining, IK, social science and humanities, logistics, the environment, and tourism), and it is aimed to enable technologies (manufacturing, ICT, biotechnology, and space science) that 'provide wide-application solutions and will contribute with solutions to the economic and social challenges' (NCRST 2014, 63). The programme emphasises the building of R&D infrastructure, such as research laboratories to support research in universities. However, it does not emphasise innovations at all or acknowledge the linkages between universities and the private sector in technology-related issues.

The activities for 'enabling technologies' and 'economic and social challenges' focus especially on R&D. New analytical knowledge should be created at UNAM and NUST with an STI mode of learning. However, in many mentioned activities, such as clinical biomedical research, ICT,

biotechnology, and space science, Namibia does not have any significant research or comparative advantage at the moment. For example, space science depends on increasing cooperation between China and Namibia. Nevertheless, it is not clear how space science helps Namibia to fulfil the strategic goals of the NDP4.

The NCRST is a small commission within the MoE. It has only limited inter-ministerial influence and few direct resources. The NCRST is governed in a strictly political way without representatives from the scientific community. The NANGOF Trust, the Legal Assistance Centre, the Institute for Public Policy Research, and other civil society actors in Namibia have expressed concerns regarding the NCRST (OSISA 2016). As the coordinator of national research programmes and funding instruments, the NCRST has a strong influence on setting research priorities. The goal of the NCRST is to 'monitor and supervise the promotion, co-ordination, development and continuation of research, science and technology in all sectors in Namibia, and to minimise overlapping in the fields of research, science and technology' (RST Act 2004). Thus, the NCRST has authority to restrict academic freedom indirectly due to its strategic and funding positions. However, according to the interviewed government representatives, research, science, and technology need to be steered strictly to concentrate the limited resources towards strategic spearheads. Nevertheless, the principles of open science, open data, and open innovation that are nowadays important for the IS and for micro and small enterprises (see de Beer and Armstrong 2015) are not transparently obvious in Namibia.

Regardless of several attempts, the government of Namibia has not adopted a comprehensive and cross-cutting national innovation policy, although one was drafted in 2011. According to the interviews, the government and the rest of society more generally do not comprehensively understand the importance of innovations and ISs. Furthermore, due to the long history of apartheid and the precarious competition of this small country's limited resources, a general mistrust exists between different actors. This causes a lack of social capital among the stakeholders who should interact in the IS. The interaction is also poor between the universities and between ministries, not to mention the relationships between the competing UNAM and NUST. Moreover, the interviewees were not sure about the government's ability to make transparent and equitable decisions. Different ministries and local governments are isolated and

fragmented and do not interact with each other. This hinders the implementation of cross-cutting policies. In addition, the low industrialisation of Namibia and the constant lack of skilled human capital hinder the finding of a strategic direction for an innovation policy. The stakeholders see that there is no existing path in the economy that the IS could follow.

Indigenous Knowledge in the Namibian Innovation System

Despite the small population, Namibians are diverse according to ethnic origins. The population consists of over ten ethnic groups who speak at least nine different languages. The largest group, Owambos, live in central-north Namibia and make up about half of the country's population. Other larger ethnic minorities are Kavango, Herero, OvaHimba, Damara, Coloured, White Namibians, Nama, Caprivian, San, Tswana, and Chinese. The high ethnic and cultural diversity indicates a rich variety of IK. In fact, the IK is distinct in many local communities (Sillitoe and Marzano 2009).

The appreciation of IK by the public authorities has changed substantially since Namibia gained independence. During the apartheid governance, many practices related to IK, for example, the use of traditional medicines, were forbidden by the Witchcraft Suppression Act of 1970 (Republic of South Africa 2007, quoted in Meincke 2016). After independence, IK became an inherent part of the national building process. IK is frequently mentioned in different strategies, policies, and political rhetoric. For example, Vision 2030 emphasises IK as a potential income-generator for the poor rural population (Government of Namibia 2004).

According to the RST Act (2004), the primary objective of the NCRST is to establish national councils to coordinate economic sectors with particular national importance. One of the first councils the NCRST established was the National Council for Indigenous Knowledge Systems (NCIKS), launched in July 2014. NCIKS facilitates policy development, strategic directions, and promotion of IK, as it is considered to be an economically valuable source of innovation and a way to include local communities in innovation development (NCRST 2014).

The role of IK for the Namibian IS is stated most clearly in the NPRSTI, which is the most important document for the innovation policy (NCRST 2014). The document mentions

'indigenous knowledge' no fewer than 26 times. The strategic development of IK is highlighted as one of the 'cross-cutting thematic area(s)' of the program (NCRST 2014, 27). IK is considered a 'significant factor' in the development of new products based on natural resources (NCRST 2014, 49). Despite the fact that none of the national policy documents clearly define IK, the NPRSTI mentions that indigenous knowledge is 'developed over centuries of learning from the environment' and that it plays a 'role in transforming and modifying technologies to suit local conditions and the local context; [and] … in the development of indigenous home-grown technologies' (NCRST 2014, 14).

The NPRSTI programme lists nine strategic initiatives for IK: to strengthen linkages between research institutions and industry; to develop a database to protect, promote, and preserve IK; to establish IK policy, an R&D platform, and a development strategy; to validate IK with the potential for commercialisation; to expedite IK IP policy legislation; to promote research; to utilise and document IK, including the history, experiences, and aspirations of IK; to document the role of indigenous languages and culture in development; and to promote and document indigenous languages (NCRST 2014, 59). The strategic initiatives are coordinated by the NCRST together with different ministries. Traditional authorities are supposed to be partners in one initiative (to promote research and documentation and the utilisation of IK). Universities could potentially play a role in a few initiatives, but, for example, civil society organisations, local communities, or private sector organisations are not mentioned at all. This creates additional challenges for the commercialisation of IK and its proper integration in the IS.

UNAM and NUST conduct ongoing research to create innovations from pharmaceutical, social, and agricultural IK. According to the interviewed researchers, the Multidisciplinary Research Centre (MRC) of UNAM runs several programmes to research 'innovation and value addition in indigenous knowledge'. Some projects directly relate to R&D, such as the attempt to utilise indigenous plants to develop compounds for anti-malaria drugs, medicinal plants for HIV/AIDS-related conditions, and various food and agricultural products (see Chinsembu et al. 2015). The National Botanical Research Institute, financed by the MoE, aims to document and register various types of IK existing in Namibia for a database (see Shapi et al. 2011). NBIC has a similar initiative, based on the Honey Bee Network originating in India (to learn more about the Honey

Bee Network, see Fressoli et al. 2014). The Honey Bee Network maps and registers potential IK for possible product developments. The interviewees considered the documentation to provide more systematic understanding of different types of IK. The documentation could clarify the intellectual property rights of IK that has the potential for inspiring innovation.

One example of an MRC IK-related research project relates to *oshikundu*, a traditional, non-alcoholic nutritious beverage made of fermented millet (*mahangu*), which is an important cultural and traditional heritage of the Owambos. The beverage is produced daily in almost every rural household, and it is an important part of the daily diet of local communities (Embashu et al. 2013). It is commonly brewed and sold in informal urban settlement areas and marketplaces in larger towns. The population growth, rapid urbanisation, and migration of many Owambos to Windhoek and other town centres have created a new market for *oshikundu.* In the MRC research project, feasibility studies were conducted on the possibility of producing *oshikundu* on an industrial scale and on benefit-sharing procedures for subsistence farmers. The research was conducted with UNESCO, the Netherlands Organization for International Cooperation in Higher Education, local communities, and a Namibian brewery (Embashu et al. 2013).

Another example of IK-related innovation is the case of *hoodia*, which many of the interviewees mentioned. This case shows the complexity of commercial innovations based on IK. Hoodia is a cactus-looking plant (*Hoodia gordonii*) in southern Africa. The San and Nama people use it to treat high blood pressure, diabetes, and gout and, most importantly, as an appetite suppressant during hunting times and to survive the harsh conditions of the Namib Desert. The potential commercial value of hoodia as a weight-loss product was discovered by South Africa's premier scientific research and development organisation, the Council for Scientific and Industrial Research (CSIR). CSIR patented the active ingredient of hoodia without acknowledging the San and Nama people's claim to using hoodia and the fact that it originated from their IK. CSIR licensed the patent to a British private enterprise. Later, the patent was sold first to the multinational pharmaceutical company Pfizer and then to the multinational food industry company Unilever. In 2003, due to global public pressure and legal means, the South African San Council managed to negotiate with Unilever a benefit-sharing agreement in which the San people would receive significant revenue from the sale of hoodia products. The San signed a benefit-

sharing agreement with the South African Hoodia Growers (Pty) Ltd in 2006. However, in 2008, Unilever abandoned the plans concerning the commercialisation of hoodia as an appetite-suppressing succulent due to the cost of clinical studies and product marketing (World Health Organization 2006, 345; Wyndberg et al. 2009). Similar challenges exist with the protein-rich marama bean (*Tylosema esculentum*), a legume widely used by the Khoisan people in Namibia. The bean grows in the wild and is not yet cultivated, but several registered patents already exist in relation to marama and its products. The benefit-sharing issues are complex and need to be solved by involving patent holders, the government, and the indigenous people (Percy et al. 2010).

The interviewed university stakeholders, who were involved in IK research activities, mentioned biopiracy as the main concern when IK is connected to analytical knowledge, such as the development of a patented biopharmaceutical product from IK. These ambiguities are less relevant to IK that relates mostly to synthetic and symbolic knowledge, such as innovations or business models based on cultural or symbolic artefacts. Synthetic knowledge is sticky, and its development requires close spatial proximity (Asheim and Coenen 2005). Close cooperation with local knowledge owners is necessary, and benefit-sharing identification should be clear.

Tourism is the third example of the use of IK-based innovations relying on synthetic and symbolic knowledge. Tourism is also a key strategic activity the government of Namibia advocates in order to encourage socio-economic development and employment creation in the NDP4. The main attractions of tourism are Namibia's wildlife and wilderness landscapes, but there is interest in various indigenous cultures and local communities as well. Some of these IK-connected tourism activities are run between local people and international donors. For example, the Living Culture Foundation Namibia focuses on cultural cooperation in rural areas and aims to eradicate poverty, preserve traditional culture, and foster intercultural exchange (Novelli 2015). According to Saarinen (2011), the indigenous OvaHimba communities in northwest Namibia and their indigenous practices have become an important tourism attraction. The local OvaHimba communities value tourism, as it brings direct economic benefits to them, even though households have received very little and unequal economic benefits. Nevertheless, there are ethical and moral considerations related to the impact of tourism on the maintenance of traditions,

power asymmetries between the host and visitors and between different ethnic groups in the area, and a postcolonial ethos in which the indigenous cultures are seen as exotic others.

The interviewees, especially government officials, considered IK to be an important knowledge source because of its localised uniqueness, which creates comparative advantages. IK was the central element that was used to contextualise the universal IS to the Namibian context successfully. The development of IK-based innovations was seen as a linear and straightforward process. Similarly, the NPRSTI mentions '(v)alidation of IK with potential for commercialization' (NCRST 2014, 59). However, it was challenging for the interviewees to name any successful innovations based on IK. The researcher, who was directly involved with several IK-related research projects, would argue that the image of IK's utilisation is often portrayed in an oversimplified way and that politicians and government officials have overly high expectations of IK's potential. Their main concerns are the legal and institutional framework, and they fail to acknowledge the complexity, slowness, and high expense of developing IK-based innovations. Moreover, they have failed to recognise the interaction that is needed for innovation development; for example, private companies are not interested in investing in R&D related to IK, as the risks and uncertainties are too high, and appropriate platforms for involving local communities in the process are lacking.

In Namibia, the importance of IK relates not only to its innovation potential but also to its significance within nationalistic political rhetoric. The significance of IK goes beyond the possible economic benefits, and IK is considered to be a traditional heritage, a cultural artefact, and part of the national and African identity. It echoes the nostalgic Namibian past before that past was suppressed and neglected due to colonial history. Many interviewees also emphasised the long traditions and suppressed nature of IK. In their definitions, IK is clearly juxtaposed with Western colonial knowledge and heritage.

Conclusions and Policy Recommendations

In its public documents and discussions, Namibia emphasises the role of an IS as a key engine to solve many of the social challenges and to boost economic development for the future. This is a common contemporary phenomenon in most of the countries in southern Africa. Compared to

other countries in the region, Namibia began to develop its institutional settings for the IS and knowledge economy early. Already, at the end of the last millennium, Namibia gradually developed relevant institutions and frameworks for the IS. Nonetheless, over time, Namibia gave up the early momentum in the practices and policies concerning innovation development. At the same time, during the past decade, the two high-education institutes and international development partners, especially Germany and Finland, have taken the initiator role. The role of the development partners form the Global North reveals transformations in foreign development cooperation (Hooli & Jauhiainen 2017). Instead of conventional aid focusing on social welfare and humanitarian issues, the contemporary development cooperation emphasises technology development, innovations, and common business relations between the receiver and the donor.

At present, Namibia has identified the most important stakeholders and institutions for an IS. Nevertheless, there are still many hindrances preventing the proper interaction and knowledge creation in the IS. In terms of policy development, according to the analysed empirical materials, the DUI mode of learning and IK generate comparative advantages and support significant societal change in the local communities. However, in reality, the focus in Namibia has been on an STI mode of learning. This demands advanced technology, high analytical knowledge, a well-functioning IS, and human capital, which are rare in Namibia.

The inability to develop a comprehensive innovation policy has hindered the coordination of the IS. This has caused strategic uncertainty about the knowledge bases the IS should be built on. Moreover, public policies need to more appropriately recognise the evolutionary, complex, and non-linear process of innovations. A well-established IS needs solid cooperation and interaction between the public and private sectors as well as within civil society related to social, political, institutional, organisational, and economic factors, and this remains missing in Namibia. Innovations are regarded to be a process mainly controlled by the government's own institutions. Still, the government's tangled management and the dispersed policy application among and between ministries trigger overlaps and inconsistencies in the innovation policy framework. The few multinational companies, mostly in marine technology and mining, are not investing in local capacity building, R&D, or interaction with local stakeholders but are operating as enclaves without proper relation to the local IS. The national IS needs to be open for the international

knowledge flows, connections, and innovation capabilities from other regions and countries (see Watkins et al. 2015). This would foster the building of local capacity and attract international talent to support the development of critical mass in Namibia.

The role of IK is recognised in the most relevant strategies for innovations, in universities' research programmes, and in new institutions. The early formation of NCIKS suggests the high significance of IK for the government. The interviewed stakeholders considered IK among the most significant sources of innovation. Though, currently, barely any prominent examples of IK-related innovation of meaningful commercial opportunities exist. Namibia does not have sufficient competence in several vital matters, such as analytical knowledge, R&D activities, and institutions, which are required for the development and commercialisation of many IK-based innovations. For example, developing, patenting, and testing medicines based on IK is a slow and costly process with high uncertainty of success in the markets. The biggest expectations are in IK-related innovations founded on synthetic and symbolic knowledge – like in tourism. In addition to its economic importance, IK is relevant as a cultural artefact and traditional heritage in the strengthening of the national and pan-African identity. IK could foster smart specialisation of policies by supporting the identification of unique assets that would lead to diverse place-based policies.

The main strategies, the donor countries' development policies, and the interviewed actors shared the view that the IS should tackle Namibia's immediate severe development issues. Less clear was how the IS could tackle poverty and inequality in practice. An IS can impact positively on local community development if it supports the participation and competence building of the disadvantaged majority and if the IS is implemented accordingly (Cozzen and Kaplinsky 2009). Presently, the IS in Namibia is capital centric with only weak ties to local communities, their knowledge, and their development needs. Therefore, bottom-up structures need to be developed to systematically identify and support innovations stemming from the practical experience and everyday challenges of local communities. Although the development of new product innovations from IK is challenging, IK can, as a final policy recommendation, facilitate a focus on participatory development processes in innovations, IS, and related policy. The IS in Namibia

can become a platform for local people as active stakeholders, initiators, and developers of new products and innovation processes.

Acknowledgement

This research article is partly based on the unpublished doctoral dissertation "Adaptability, Transformation and Complex Changes in Namibia and Tanzania: Resilience and Innovation System Development in Local Communities" (Hooli 2016).

References

Adebowale, B. A., B. Diyamett, R. Lema, and O. Oyelaran-Oyeyinka. 2014. "Introduction" *African Journal of Science, Technology, Innovation and Development,* 6 (5): v–xi. doi:10.1579/0044-7447-31.4.358.

African Innovation Outlook II. 2014. Accessed 13 January 2017 http://www.nepad.org/humancapitaldevelopment/knowledge/doc/3330/african-innovation-outlook-ii

African Union. 2013. "Agenda 2063: Unity, Prosperity and Peace" Accessed 13 December 2016 http://agenda2063.au.int/en/

African Union. 2014. "Science, Technology and Innovation Strategy for Africa 2024" Accessed 22 December 2016 http://hrst.au.int/en/content/science-technology-and-innovation-strategy-for-africa-2024

Altenburg, T. 2009. "Building inclusive innovation systems in developing countries: Challenges for IS research" in *Handbook of Innovation and Developing Countries: Building Domestic Capabilities in a Global Setting*, edited by Lundvall, B.-Å., K. J. Joseph, C. Chaminade, and J. Vang, 33–56. Cheltenham: Edward Elgar.

Arocena, R. and J. Sutz. 2000. "Looking at national system of innovation from the South" *Industry and Innovation,* 7 (1): 55–75. Doi:10.1080/713670247.

Asheim, B. T. and L. Coenen. 2005. "Knowledge bases and regional innovation systems: Comparing Nordic clusters" *Research Policy,* 34 (8): 1173–1190. doi:10.1016/j.respol.2005.03.013.

Asheim, B. T., R. Boschma, and P. Cooke. 2011. “Constructing regional advantage: Platform policies based on related variety and differentiated knowledge bases” *Regional Studies,* 45 (7): 893–904. doi:10.1080/00343404.2010.543126**.**

Bartels, F. L., R. Koria, and L. Andriano. 2016. “Effectiveness and efficiency of national systems of innovation: A comparative analysis of Ghana and Kenya” *African Journal of Science, Technology, Innovation and Development*, *8*(4): 343–356. doi: 10.1080/20421338.2015.1128037

Baskaran, A. 2001. “Competence building in complex systems in the developing countries: The case of satellite building in India” *Technovation* 21 (2): 109–121. doi:10.1016/S0166-4972(00)00022-5.

Berkes, F., J. Colding, and C. Folke. 2003. *Navigating Social-ecological Systems: Building Resilience for Complexity and Change*. Cambridge: Cambridge University Press.

Berkes, F. 2009. "Indigenous ways of knowing and the study of environmental change" *Journal of the Royal Society of New Zealand,* 39: 151–56. doi:10.1080/03014220909510568.

Bertelsen, P. and J. Müller. 2003. “Changing the outlook: Explicating the indigenous systems of innovation in Tanzania” In *Putting Africa First*, *the Making of African Innovation Systems,* edited by Muchie, M., P. Gammeltoft, and B.-Å. Lundvall, 123–138. Aalborg: Aalborg University Press.

Biggs, T., M. Shah, and P. Srivastava, 1995. “Technological capabilities and learning in African enterprises” *Discussion Papers* 2. New York: United Nations University.

Bohensky, E. L. and Y. Maru. 2011. “Indigenous knowledge, science, and resilience: What have we learned from a decade of international literature on "integration"?” *Ecology and Society,* 16 (4). doi:10.5751/ES-04342-160406.

Boschma, R. 2015. “Towards an evolutionary perspective on regional resilience” *Regional Studies*, 49 (5): 733–751. doi:10.1080/00343404.2014.959481.

Briggs, J. 2013. “Indigenous knowledge: A false dawn for development theory and practice?” *Progress in Development Studies,* 13, 231–243. doi:10.1177/1464993413486549.

Chinsembu, K. C., A. Cheikhyoussef, D. Mumbengegwi, M. Kandawa-Schulz, C. D. Kasanda, and L. Kazembe, ed. (2015). *Indigenous Knowledge of Namibia*. Windhoek: UNAM press.

Cozzen, S. E. and R. Kaplinsky. 2009. “Innovation, poverty and inequality: Cause, coincidence, or co-evolution?” In *Handbook of Innovation and Developing Countries: Building Domestic*

Capabilities in a Global Setting, edited by Lundvall, B.-Å., K. J. Joseph, C. Chaminade, and J. Vang. 57–82. Cheltenham: Edward Elgar.

de Beer, J. and C. Armstrong. 2015. "Open innovation and knowledge appropriation in African micro and small enterprises" *The African Journal of Information and Communication,* 16: 60–71.

DGIZ (Deutsche Gesellshaft für Internationale Zusammenarbeit). 2016. Accessed 21 December 2016 http://www.giz.de/en/worldwide/323.html

Dekens J. 2007. *Local Knowledge for Disaster Preparedness: A Literature Review*, Kathmandu: International Centre for Integrated Mountain Development.

Doloreux, C. 2002. "What we should know about regional systems of innovation" *Technology in Society* 24 (3): 243–263. doi:10.1016/S0160-791X(02)00007-6.

Domfeh, K. A. 2007. "Indigenous knowledge systems and the need for policy and institutional reforms" *Tribes and Tribals* 1: 41–52.

Edquist, C. 2005. "Systems of innovation: Perspectives and challenges" In *The Oxford Handbook of Innovation,* edited by Fagerberg, J., D. C. Mowery, and R. R. Nelson, 181–208. Oxford: Oxford University Press.

Embashu, W., A. Cheikhyoussef, G. Kahaka, and S. Lendelvo. 2013. "Processing methods of Oshikundu, a traditional beverage from sub-tribes within Aawambo culture in Northern Namibia" *Journal for Studies in Humanities and Social Sciences,* 2 (1).

Flavier, J. M., A. de Jesus, and C. Navarro. 1995. "The regional program for the promotion of indigenous knowledge in Asia" In *The Cultural Dimension of Development: Indigenous Knowledge Systems,* edited by Warren, D. M., L. J. Slikkerver, and D. Brokensha, 479–487, London: Intermediate Technology Publications.

Flick, U. 2006. *An Introduction to Qualitative Research*. 3rd ed. SAGE, London.

Fressoli, M., E. Arond, D. Abrol, A. Smith, A. Ely, and R. Dias. 2014. "When grassroots innovation movements encounter mainstream institutions: implications for models of inclusive innovation" *Innovation and Development*, 4 (2): 277–292. doi:10.1080/2157930X.2014.921354.

George, G., A. M. McGahan, and J. Prabhu. 2012. "Innovation for inclusive growth: Towards a theoretical framework and a research agenda" *Journal of Management Studies* 49 (4): 661–683. doi:10.1111/j.1467-6486.2012.01048.x.

Global Innovation Index. 2015. *The Global Innovation Index: Effective Innovation Policies for Development*, Ithaca, and Geneva: Fontainebleau.

Hagar, C. 2003. "Sharing indigenous knowledge: To share or not to share? That is the question" Paper presented at the *CAIS/ACSI 2003 Conference*, Ontario, Canada.

Head, L. and J. Atchison. 2015. "Entangled invasive lives: Indigenous invasive plant management in northern Australia" *Geografiska Annaler: Series B, Human Geography,* 97 (2), 169–182. doi:10.1111/geob.12072.

Heeks, R., C. Foster, and Y. Nugroho. 2014. "New models of inclusive innovation for development" *Innovation and Development*, 4 (2): 175–185. doi:10.1080/2157930X.2014.928982.

Hooli, L. J. 2016. "Adaptability, Transformation and Complex Changes in Namibia and Tanzania: Resilience and Innovation System Development in Local Communities." *Unpublished PhD Thesis*. University of Turku. Permanently available at: http://urn.fi/URN:ISBN:978-951-29-6549-6

Hooli, L. J., J. S. Jauhiainen, and K. Lähde. 2016. "Living labs and knowledge creation in developing countries: Living labs as a tool for socio-economic resilience in Tanzania" *African Journal of Science, Technology, Innovation and Development,* 8 (1), 61–70. doi:10.1080/20421338.2015.1132534.

Hooli L. J. and Jauhiainen J. S. 2017. "Development Aid 2.0–Towards Innovation-Centric Development Co-operation: The Case of Finland in Southern Africa." In *IST-Africa 2017 Conference Proceedings*, Cunningham P. & Cunningham M. (eds.), IIMC.

Hoppers, C. O. ed. 2002. *Indigenous Knowledge and the Integration of Knowledge Systems. Towards a Philosophy of Articulation*. Claremont: New Africa Books.

Hopwood, G., N. Shejavali, and F. Links. 2014. *Easing the Way for Investment in Namibia*. Windhoek: Institute for Public Policy Research (IPPR) Research Report.

Jauhiainen, J. S. and L. J. Hooli. 2017. "Indigenous knowledge and developing countries' innovation systems. The case of Namibia" *International Journal of Innovation Studies*, 1 (1), 89–106.

Jensen, M. B., B. Johnson, E. Lorenz, and B.-Å. Lundvall. 2007. Forms of knowledge and modes of innovation. *Research Policy*, 36 (5): 680–693. doi:10.1016/j.respol.2007.01.006.

Kraemer-Mbula, E. and W. Wamae. 2010. *Innovation and the Development Agenda*. Paris: Organization for Economic Co-Operation and Development.

Lemarchand, G. A., and A. Tash. 2015. *Mapping research and innovation in the Republic of Rwanda* (Vol. 4). UNESCO Publishing.

Lundvall, B-Å., K. J. Joseph, C. Chaminade, and J. Vang, ed. 2009. *Handbook of Innovation and Developing Countries: Building Domestic Capabilities in a Global Setting*. Cheltenham: Edward Elgar.

Maila, M. W., and C. P. Loubser. 2003. "Emancipatory indigenous knowledge systems: implications for environmental education in South Africa" *South African Journal of Education*, 23 (4): 276–280.

Matengu, K., G. Likando, and B. Kangumu. 2014. "Governance and coordination of the higher education system in Namibia: Challenges and prospects" *FIRE: Forum for International Research in Education*, 1(2).

McCann, P., and R. Ortega-Argilés. 2013. "Modern regional innovation policy" *Cambridge Journal of Regions, Economy and Society*, 6 (2): 187–216. doi:10.1093/cjres/rst007.

Meincke, M. 2016. "Public health, science and the economy: The onto-politics of traditional medicine in Namibia" *Publications of the Department of Political and Economic Studies 27*.

MFA (Ministry for Foreign Affairs of Finland). (2015). Development Cooperation. Embassy of Finland, Windhoek. Accessed 18 December 2016 http://www.finland.org.na/public/default.aspx?nodeid=41066&contentlan=2&culture=en-US

Moodysson, J. and E. Zukauskaite. 2014. "Institutional conditions and innovation systems: On the impact of regional policy on firms in different sectors" *Regional Studies*, 48 (1): 127–138. doi:10.1080/00343404.2011.649004.

Nakata, M. 2002. "Indigenous knowledge and the cultural interface: Underlying issues at the intersection of knowledge and information systems" *IFLA Journal*, 28 (5-6): 281-291, doi: 10.1177/034003520202800513

National Planning Commission. 2008. *Third National Development Plan (NDP3). Volume 1 2007/08–2011/12.* Windhoek: Republic of Namibia/Office of the President.

National Planning Commission. 2012. *Namibia's Fourth National Development Plan (NDP4) 2012/13–2016/17*. Windhoek: Republic of Namibia/Office of the President.

NCIK (National Council of Indigenous Knowledge). 2016. Accessed 16 December 2016 http://www.ncrst.na/news/31/National-Council-on-Indigenous-Knowledge-System-IKSC-Inaugurated/

NCRST (National Commission on Research, Science and Technology). 2014. *The National Programme on Research, Science, Technology and Innovation (NPRSTI) 2014/15 to 2016/2017*. Windhoek: National Commission on Research, Science & Technology.

Nfila, R. B., and P. Jain. 2011. "Managing indigenous knowledge systems in Botswana using information and communication technologies" Paper presented at the 1st International Annual Conference of the Faculty of Communication and Information Science, National University of Science & Technology (NUST), Bulawayo, August 23–24.

Novelli, M. 2015. *Tourism and Development in Sub-Saharan Africa: Current Issues and Local Realities*. London: Routledge.

Oluwatobi, S., U. Efobi, I. Olurinola, and P. Alege. 2015. "Innovation in Africa: Why institutions matter" *South African Journal of Economics* 83: 390–410. doi:10.1111/saje.12071.

OECD (Organisation for Economic Cooperation and Development). 2012. *Science, Technology and Industry Outlook*. Paris: Organisation for Economic Cooperation and Development.

OSISA (Open Society Initiative for Southern Africa). 2016. Accessed 19 December 2016 *http://www.osisa.org/law/blog/clear-and-present-danger/*

Oyelaran-Oyeyinka, O. 2006. *Learning to Compete in African Industry: Institutions and Technology in Development*. Ashgate: Aldershot.

Pavitt, K. 2005. "Innovation Processes" In *The Oxford Handbook of Innovation,* edited by Fagerberg, J., D. C. Mowery, and R. R. Nelson, 86–114. New York: Oxford University Press.

Percy, C., M. Isaac, and C. Pamela. 2010. "Understanding the relationship between indigenous (traditional) knowledge systems (IKS), and access to genetic resources and benefits sharing (ABS)" *African Journal of Biotechnology,* 9: 9204–9207.

Philip, L. J. 1998. "Combining quantitative and qualitative approaches to social research in human geography—an impossible mixture?" *Environment and Planning A*, 30 (2): 261–276. doi:10.1068/a300261.

Pietrobelli, C., and R. Rabellotti. 2011. "Global value chains meet innovation systems: are there learning opportunities for developing countries?" *World Development*, 39 (7): 1261–1269. doi:10.1016/j.worlddev.2010.05.013.

Republic of Namibia. 2004. *Namibian Vision 2030, Namibian Framework for Long-Term National Development*. Windhoek: Office of the President.

Republic of South Africa. 2007. *Traditional Health Practitioners Act*, 2007.

Saarinen, J. 2011. **"**Tourism, indigenous people and the challenge of development: the representations of Ovahimbas in tourism promotion and community perceptions towards tourism" *Tourism Analysis,* 16 (1): 31–42. doi:10.3727/108354211X12988225900009.

Sen, B. 2005. "Indigenous knowledge for development: Bringing research and practice together" *The International Information & Library Review,* 37 (4): 375–382. doi:10.1016/j.iilr.2005.10.004.

Shapi, M., A. Cheikhyoussef, D. R. Mumbengegwi, K. Matengu, A. Van Kent, and J. Sifani. 2011. "Evolution of data collection methods for indigenous knowledge systems at the Multidisciplinary Research Centre of the University of Namibia" *Knowledge Management for Development Journal*, 7 (3): 308–316. doi:10.1080/19474199.2011.652155.

Sillitoe, P. and M. Marzano. 2009. "Future of indigenous knowledge research in development" *Futures,* 41 (1): 13–23. doi:10.1016/j.futures.2008.07.004.

Sims, B. M., and M. Koep. ed. 2012. *Unfinished Business: Democracy in Namibia*, Pretoria: Idasa.

Siyanbola, W., A. Egbetokun, I. Oluseyi, O. Olamade, H. Aderemi and M. Sanni. 2012 "Indigenous technologies and innovation in Nigeria: Opportunities for SMEs," *American Journal of Industrial and Business Management*, 2 (2): 64–75. doi: 10.4236/ajibm.2012.22009.

Spradley, J. P. 1980. *Participant Observation*. Holt, Rinehart and Winston, New York.

Strambach, S. and B. Klement. 2012. "The organizational decomposition of innovation and territorial knowledge dynamics. Insights from the German software industry" In *Innovation and Institutional Embeddedness of Multinational Companies,* edited by, Heidenreich, M., 193–221, Cheltenham: Edward Elgar.

Subba Rao, S. 2006. "Indigenous knowledge organization: An Indian scenario" *International Journal of Information Management,* 26 (3): 224–233.

Szogs, A., A. Cummings, and C. Chaminade. 2011. "Building systems of innovation in less developed countries: The role of intermediated organizations supporting interactions in Tanzania and El Salvador" *Innovation and Development,* 1 (2): 283–302.

Tigabu, A. D., F. Berkhout, and P. van Beukering. 2015. "The diffusion of a renewable energy technology and innovation system functioning: Comparing bio-digestion in Kenya and Rwanda" *Technological Forecasting and Social Change*, 90: 331–345.

Tödtling, F. and M. Trippl. 2005. "One size fits all?: Towards a differentiated regional innovation policy approach" *Research Policy*, 34 (8): 1203–1219.

Tödtling, F., B. Asheim, and R. Boschma. 2013. "Knowledge sourcing, innovation and constructing advantage in regions of Europe" *European Urban and Regional Studies*, 20 (2), 161–169. doi: 10.1177/0969776412457173

United Nations. 2012. *World Economic Situation and Prospects 2012*. New York: United Nations Publications.

University of Namibia. 2015. *Faculty of Engineering and Information Technology, Prospectus*. Windhoek: UNAM Press.

Vanek, J., M. Chen, F. Carré, J. Heintz, and R. Hussmanns. 2014. *Statistics on the Informal Economy. Definitions, Regional Estimates and Challenges*. Cambridge: WIEGO Working Paper 2.

Warren, D., L. Slikkerveer, and D. Brokensha. 1995. *The Cultural Dimension of Development: Indigenous Knowledge Systems*. Ottawa: Intermediate Technology Publications.

Watkins, A., T. Papaioannou, J. Mugwagwa, and D. Kale. 2015. "National innovation systems and the intermediary role of industry associations in building institutional capacities for innovation in developing countries: A critical review of the literature" *Research Policy*, 44 (8): 1407–1418.

Weichselgartner, J. and R. Kasperson. 2010. "Barriers in the science-policy-practice interface: Toward a knowledge-action-system in global environmental change research" *Global Environmental Change*, 20: 266–277. doi: 10.1016/j.gloenvcha.2009.11.006

World Bank. 2016. *Global Economic Prospects, January 2016: Spillovers amid Weak Growth*. Washington, DC: World Bank. doi:10.1596/978-1-4648-0675-9

World Health Organization. 2006. "Protecting traditional knowledge: the San and hoodia" *Bulletin of the World Health Organization,* 84 (5): 345.

Wynberg, R., D. Schroeder, and R. Chennells eds. 2009. *Indigenous Peoples, Consent and Benefit Sharing: Lessons from San-Hoodia Case.* Berlin: Springer.