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# Indigenous Knowledge and Developing Countries' Innovation Systems: The Case of Namibia

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**Abstract:** This article analyzes in-depth the development trajectory of the innovation systems (IS) in the case of Namibia. The research data consists of documents, interviews and studies related to IS development in Namibia from the 1990s until early 2016. The case study highlights the spatiotemporal challenges of creating an IS in a developing country with limited STI resources and the potential mismatch between related strategies and practices. IS is a broad framework that identifies and maps potential relevant actors for innovation development but it does not necessarily enhance interactions between the actors of IS. For developing countries, the doing-using-interacting mode of innovation fits better when the aim is to integrate indigenous knowledge (IK) into an IS. An IK-included IS can facilitate participatory development processes, foster socioeconomic resilience of local communities and enhance the comparative advantage of a developing country.

**Keywords:** Innovation systems; Indigenous knowledge; Developing countries; Namibia; Africa

## 1. Introduction

A knowledge economy based on knowledge creation and a well-established innovation system (IS) is a critical driver of socioeconomic success in the most developed countries (Tödtling *et al.*, 2013). The concept and application of an IS—the cooperation between all economic, social, political, institutional, and organizational factors, and all other factors influencing the development, diffusion, and application of innovations (Edquist, 2005: 182)—have become a recent policy tool in developing countries to foster transformative change. Key national actors, supported by the international donor community, have conceived that innovation-driven regional development fosters a knowledge economy, resilience to various changes and the capacity to create new growth paths (OECD, 2012).

Notwithstanding the growing popularity of the IS, the development and implementation of innovation

policies in developing countries is not sufficiently analyzed. Few studies have addressed the IS in-depth and their creation in developing countries. Most scholars have conducted analyses under the label of “developing countries” rather than “developed” middle-income and BRICS countries, such as South Korea, Taiwan, Brazil, and China (Watkins *et al.*, 2015). Much less attention has been paid to the creation of IS in poorer countries, especially in sub-Saharan Africa (Muchie *et al.*, 2003; Bartels & Koria, 2014; Oyelaran-Oyeyinka, 2014). Furthermore, there are substantial differences among developing countries in their socioeconomic contexts and their capacity to reach advanced knowledge-based societies and economies (see Intanakumnerd *et al.* 2002; Arocena & Sutz, 2003; Lundvall *et al.*, 2009; Bartels & Koria, 2014; Yun *et al.*, 2015).

Additionally, there is a policy transfer issue in regards to ISs. Despite many innovation scholars’ claims that the imitation of successful innovation policies of more developed countries does not produce outstanding results in developing countries (see Tödtling & Trippel, 2005; Hidalgo *et al.*, 2007; Asheim *et al.*, 2011), innovation and technology policies are transferred from developed to developing countries. This means a heavy emphasis on research and development (R&D) and science, technology and innovation (STI) modes of innovation (Daka & Toivanen, 2014). According to Oyelaran-Oyeyinka (2014: 485), the promotion of horizontal collaboration of economic and non-economic actors has not been the key focus of innovation policies in sub-Saharan Africa. Instead, most attention has been on the transfer of skills and equipment from developed countries.

This article takes a novel perspective on IS in developing countries. As authors of this article, we analyze in-depth the development trajectory of the IS in the case of Namibia. The case study highlights the spatiotemporal challenges of creating an IS in a developing country with limited STI resources and the potential mismatch between related strategies and practices. International policy makers, donor communities, and experts are actively involved in IS development in developing countries, but they seldom understand how an IS can be properly developed, applied and governed in the specific cultural and political setting of different developing countries (Gebhardt, 2013). This challenges the needed focus of IS on smart specialization through place-based economic diversification policies supported by unique assets, characteristics and comparative advantages in the regions (McCann & Ortega-Argiles, 2013; Boschma, 2015).

The main focus in this article is to discuss indigenous knowledge (IK) in and with the IS in a developing country. IK is locally embedded knowledge that is context-specific, accumulated over time and unique to a given culture, society or local community (Sillitoe & Marzano, 2009). IK is often transmitted orally or through demonstration and imitation, and it is learned by repetition (Subba Rao, 2006), thus having characteristics of the doing–using–interaction (DUI) mode of development (see Lundvall *et al.*, 2009). IK is one strategic direction of the innovation policy in many sub-Saharan African countries and elsewhere in developing countries. However, hardly any previous research exists about the role of IK in innovation policies and ISs. IK may provide a potential competitive advantage towards fostering the content and impact of ISs in developing countries and create needed related varieties of IS. As our case study illustrates, however, various challenges exist in the creation of IK-based innovations and accommodating these innovations as inherent parts of innovation policy.

The theoretical framework is exemplified with a case study of Namibia, a transition country in southwestern Africa. In the context of sub-Saharan Africa, the case of Namibia is relevant because it was early in institutionalizing the national IS in the 1990s. International development aid and foreign

expertise—mostly from highly developed countries such as Finland and Germany and from organizations such as the Organisation for Economic Co-operation and Development (OECD), the World Bank and the Southern African Development Community (SADC)—have been important in supporting the creation of the IS (Hooli & Jauhiainen, 2016). They emphasize that an IS can be a key driver to fostering economic growth, tackling social challenges and increasing socioeconomic resilience. However, Namibia's population, gross domestic product and R&D activities are quite small, posing a challenge for an STI-based IS. Therefore, the public stakeholders have emphasized IK as a supportive element in developing the country's IS. This creates a potential mismatch and challenge regarding STI and DUI modes of knowledge creation and their application in the IS. Thus, Namibia is an interesting combination of external sources of development cooperation and foreign experts and endogenous sources of new path development and policy actions based on IK (Isaksen & Trippel, 2016).

After this introduction, the article reflects on the relationships between IS, innovation policy and IK in developing countries. This is followed by the empirical section illustrating the development of the IS in Namibia from the early 1990s until 2016 and how IK has been integrated into the IS. The conclusions discuss the strengths and challenges of the IS with IK in developing countries.

## 2. Innovation System and Innovation Policy with Indigenous Knowledge

Interaction and cooperation between different actors facilitate learning and knowledge creation in specific socioeconomic contexts in which innovation and development processes are embedded (Strambach & Klement, 2012). The impact of the context is reciprocal: it influences the capacity of individuals, institutions, sectors, regions, and countries to develop, apply, and diffuse innovations while these innovations change the context (Doloreux, 2002; Tödttling & Trippel, 2005; OECD, 2013).

The context is related to development path dependencies and path creations. According to Nefke *et al.* (2011, 261), new growth paths of a region “do not start from scratch but are strongly rooted in the historical economic structure of a region.” Thus, the scholars pay increasing attention to path dependency (Martin & Sunley, 2006; Martin, 2010; Nefke *et al.*, 2011), stressing the significance of pre-existing industrial and institutional structures for the regional environment where the activities take place and new ones emerge (Isaksen & Trippel, 2016). New path creation often emerges from knowledge spillovers of the current technological activities at the region where related variety is highly relevant. *Related variety* means that the variety of technologies existing in a region is related to and expected to influence the possibility for knowledge spillovers, as companies in diverse but related activities can benefit more from mutual spillovers than can companies in unrelated activities (Boschma & Frenken, 2009; Boschma *et al.*, 2010; OECD, 2013). However, smart specialization is challenged by the lock-ins of the past and by companies having too much cognitive proximity, lowering the learning opportunities between the actors (Nooteboom, 2000; Asheim *et al.*, 2011). In developing countries, this past is often related to the colonial modes and centralized means of developing the country.

Many authors claim that the smart specialization of an IS in developing countries should primarily contribute to socioeconomic sustainability, poverty alleviation and resilience instead of competing with more advanced countries in R&D and highly advanced technologies (Lundvall *et al.*, 2009; OECD, 2012; Adebowale *et al.*, 2014). An IS may alleviate poverty if it is designed and applied to tackle related problems

and it involves local communities (Altenburg, 2009: 37). According to Altenburg (2009), an IS in developing countries should develop and disseminate affordable and adapted innovations instead of “new to the world technologies.” Such local socio-cultural inclusiveness in innovation development requires a paradigm shift (Sillitoe & Marzano, 2009). There is a need to pay attention to the potential of socially inclusive innovations.

Inclusive innovations enhance the social and economic well-being of disenfranchised society members (Heeks *et al.*, 2014) and the participatory element in IS development. The redistribution of resources is combined by the active participation of the marginalized poor applying participatory processes in relation to problem, conflict solution and related strategies (Gupta, 2012; Johnson & Andersen, 2012; Arocena & Sutz, 2012). Other scholars, such as Kraemer-Mbula and Wamae (2012) and Fagerberg (2013), argue that in developing countries, a broader approach for user-driven, non-technological, service-based, and incremental innovation processes is needed. However, the relationship between innovation, poverty alleviation, and inequality is complex and coevolving (Cozzens & Kaplinsky, 2009).

One approach to make innovation policies more inclusive includes poverty reduction and smart specialization through the application of IK in innovation policy. Recently, in sub-Saharan Africa, IK has been incorporated into official development and/or innovation policies (e.g., in Botswana, Ghana, Namibia, South Africa, and Tanzania) (Nfila & Jain, 2011). IK is substantially important for inclusive innovations that are novel to the context and consist of heterogeneous products, processes, institutions, services, business models, and supply chains (George *et al.*, 2012). Furthermore, IK is often the best accessible and applicable knowledge for the daily livelihoods of poor rural communities in developing countries (Hagar, 2003; Domfeh, 2007). Besides scientific scholars, large development agencies such as the World Bank (2010) have also recognized that socially and economically marginalized local people have the capacity to use IK for innovation development. From a rather straightforward perspective, these organizations claim that IK can be utilized either as it is or by blending or bundling it with the knowledge of others into product and service innovations.

The discussion about path dependencies is relevant to addressing the potential of IK in IS. Local communities in developing countries possess IK originating from local traditions, and they may utilize it to meet current and future challenges. IK as a traditional, invariably local and geographically specific knowledge is developed through generations of continuous adaptation to changing circumstances. For some scholars, the notion of “traditional” fails to recognize that contemporary IK is in a constant process of change. It continuously transforms in usage and circulation in family and community contexts and between families, communities, and external parties (Anderson, 2009: 11). Therefore, IK constantly evolves in a process intertwined with external knowledge; it is not isolated from other types of knowledge but combines the past with the present and the local with the non-local (Bohensky & Maru, 2011).

Indigenous innovations may be based on the latest external knowledge adjusted to local circumstances through IK (Weichselgartner & Kasperson, 2010), or IK can be an essential part of any external knowledge-based innovation. Thus, there is also a need to access exogenous non-local knowledge and financial resources to enhance learning and knowledge development, increase the absorptive capacity, and stimulate economic catch-up (Ndabeni, 2016: 307). In sub-Saharan Africa, one increasingly popular process to combine IK (and/or locally available related varieties) with external knowledge is the living lab concept. In this context, living labs are common platforms where community members aim to solve their everyday challenges related to poverty and create IK-based innovations through interaction and access to external

knowledge pools via the Internet (Hooli *et al.*, 2016).

The inclusiveness of innovations and the relationship between IK and IS are related to broader types of knowledge, often synthesized with analytical, synthetic and symbolic knowledge (Asheim *et al.*, 2011) that is closely related to the STI and the DUI modes of innovation (Jensen *et al.*, 2007). Analytical knowledge as new scientific knowledge is the cornerstone of the STI-based IS. The STI mode requires systematic organization and accumulation of knowledge, often relying substantially on expert knowledge. Well-organized R&D activities and formal learning processes are required here for innovations. In general, developing countries are organizationally thin and lack various crucial resources in high-end scientific expertise, technology expertise, and development. Due to this, they rely greatly on external knowledge and foreign experts.

While the focus of the STI-mode IS is often on global competitiveness achieved through science and technology, the DUI-mode IS is more likely to contribute to local economic development, job creation and eradication of poverty (Hidalgo *et al.*, 2007; Ndabeni, 2016). The DUI mode potentially offers more opportunities to developing countries by turning the interest into material and immaterial resources that are locally available, thus linking DUI, IK, and IS. Synthetic knowledge fits in both STI- and DUI-based ISs. Innovations are created in processes by applying and combining existing knowledge to local practice-oriented experiences. Symbolic knowledge requires fewer or no scientific or engineering practices for innovations. The emphasis is on aesthetic elements of products and services, and there, IK can play a role, as exemplified in this case study. Often in an IS, one finds aspects from these three types of knowledge, and a resilient and inclusive IS needs a broad variety of knowledge bases.

The differences in the types of knowledge are also linked to the challenges of ownership, patenting, and commercialization of innovations in developing countries, especially those tightly connected to IK. As a principle, IK is not a property of any certain person, group, or company. The storage, development, and transfer of IK are thus challenging (Bertelsen & Muller, 2003). Patenting a discovery in scientific knowledge may require a long time, but it is possible. In IK, however, the ownership issues are difficult to solve (Wyndberg *et al.*, 2009). In synthetic knowledge, the patenting is not always feasible because application contexts change and a long patenting process may signify an opportunity loss. To combine IK with symbolic knowledge is possible, but patents and ownerships are seldom relevant for these user-driven innovations. Moreover, it is necessary to think about the role of individuals in relating IK with IS, as so far, the IS literature has treated individuals as almost exogenously given (Acs *et al.*, 2014).

So far, there is a lack of empirical research on the connection between IK and IS. One challenge is how to implement the IK to the IS, which often seeks more universal and transferable applied knowledge. Indigenous innovations can be inserted into IS formed by the STI policies, and/or they can be mobilized into alternative innovation systems. Regardless of the obvious difficulties of linking the often DUI-based IK with STI-based IS, encounters with mainstream STI institutions are important for indigenous innovations. The encounters provide resources and/or scaling-up experiences for locally initiated innovations (Fressoli *et al.*, 2014). Although developing a fully new product innovation from IK is often challenging, IK can facilitate addressing the participatory development processes and create broader ownership of IS among local populations. Moreover, as a strategy for smart specialization, IK can also be the origin of cultural-cognitive path dependencies that may hinder the uptake of more radical innovation trajectories and thus contribute to potential lock-ins in development.

### 3. Research Data and Methodology

The research data consists of documents, interviews and studies related to IS development in Namibia from the 1990s until early 2016, with attention to developing socioeconomic processes and contexts of the country, including international development aid related to IS formation. For this, the innovation-related strategies, policies, and laws in Namibia were analyzed, and key stakeholder interviews were conducted and analyzed.

The most relevant strategies, policies and legal documents analyzed 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* (NPRSTI, 2014).

Examples of IK were traced from these documents. Furthermore, additional IK-related material was acquired from earlier studies (World Health Organization, 2006: 345; Wyndberg *et al.*, 2009; Percy *et al.*, 2010; Saarinen, 2011; Shapi *et al.*, 2011; Embashu *et al.*, 2013; Chinsebu *et al.*, 2015; Novelli, 2015) and through the participation in the 2nd Symposium, Indigenous Knowledge Systems (IKS): From Concepts to Applications on October 8–9, 2012, in Windhoek, Namibia, resulting in the publication *Indigenous Knowledge of Namibia* (Chinsebu *et al.*, 2015).

The analysis of these published documents was complemented with nineteen key-stakeholder semi-structured interviews, conducted face-to-face in Namibia with ten in March 2009 and nine in October 2012. Two interviewed stakeholders were Ministry of Education executives who led the policy development for IS. The authors of this article also interviewed rectors and deans from the country's only two higher education institutes—the University of Namibia (UNAM) and the Namibia University of Science and Technology (NUST) (formerly the Polytechnic of Namibia)—because of their roles as strategic forerunners and operational initiators of the IS in Namibia and leaders of the universities' innovation strategy development. We also interviewed professors and coordinators who run operational activities related to the IS in Namibia. In addition, we interviewed key persons, managers and special experts related to IS development in Namibia, namely experts from the Namibian Business Innovation Centre and the Southern African Innovation Support Programme, the private consultant who drafted the national innovation policy, the special advisor from the Ministry of Trade and Industry, and the counselor in charge of knowledge society affairs in the Embassy of Finland in Namibia. The interviews took 45–100 minutes, were recorded (except for two informal meetings) and later transcribed and analyzed with content analyses.

### 4. Socioeconomic Context of the Innovation System in Namibia

Namibia in southwestern Africa (Fig. 1) has a large surface area (824,292 km<sup>2</sup>) with a small population (2.3 million inhabitants). It has the second lowest population density of any sovereign country. The capital, Windhoek, has more than 400,000 inhabitants and is expanding rapidly in the central part of the country. All other Namibian towns have fewer than 80,000 inhabitants, and the towns are distant from each other. The most densely populated area is the north, where more than one million inhabitants live in villages and small rural towns. Most of the territory is without permanent population. The creation of an interactive IS is constrained by the small population and long distances between small towns. Nevertheless, the population

consists of more than ten ethnic groups that speak at least nine different languages. Various tribes and indigenous populations possess and use distinct IK in their everyday activities, providing opportunities for an IK-supported IS.

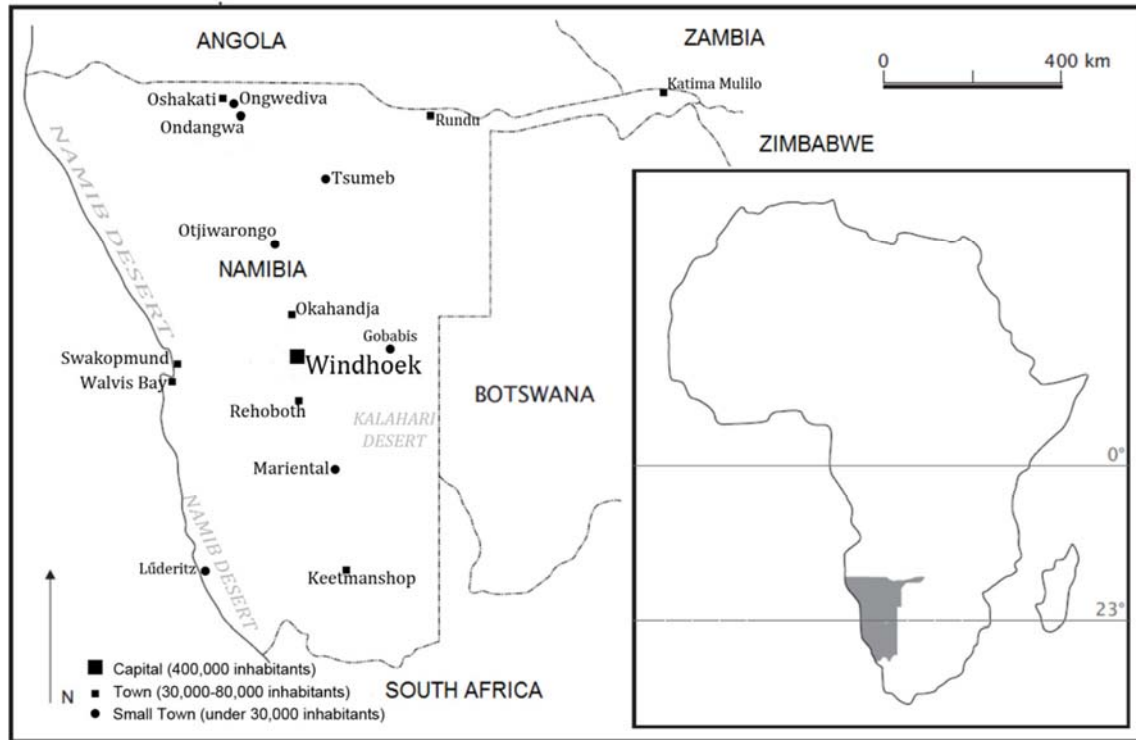


Fig. 1 Namibia

In politics, Namibia has been relatively calm and stable over the past quarter century. The area that was a German colony from the late nineteenth through the early twentieth century was afterward moved under the apartheid regime of South Africa. Namibia gained independence in 1990, and since then, the liberation army has formed the country's main political party, the South West Africa People's Organization (SWAPO). The SWAPO has dominated local and national politics and gained a simple majority in all national, regional, and local elections. The political system is centralized, thus strongly influencing the formation of national and regional ISs.

Despite their conflicted past, Namibia has strong economic and political ties to South Africa, a major source for Namibian policy development and the origin of some content of Namibia's innovation policies. Since the United Nations (2012) classifies Namibia as a transition country, the former donor countries of Finland and Germany withdrew their traditional bilateral grant assistance. Instead, they foster institutional collaboration, strengthen trade relations and support economic development and the capacity to establish an IS in Namibia (Deutsche Gesellschaft..., 2016; Ministry for Foreign..., 2016). In fact, the private sector development and aid-funded loans are back on the donors' agenda in many Global North countries. Villanger (2015) argues that private sector development and poverty reduction are feasible through developmental aid when they support innovation- and growth-oriented entrepreneurs who grow their businesses and employ more workers.



In the past few years, Namibia's economic growth has been strongly supported by rapid population growth and the demand for natural minerals. However, the GDP is still quite small—13.4 billion USD in 2015—and cannot become large due to small population. The most important industries—diamond and uranium mining, tourism, and marine technology—are potentially relevant for innovations and IS. Major industries are foreign-owned, extract and export natural resources, and provide relatively few employment opportunities. The few existing multinational corporations in Namibia do not invest in local R&D capacity building or interactions with local agencies but operate as enclaves without connection to the IS.

The Global Innovation Index 2015 ranks Namibia 107th out of 141 economies and 11th out of 32 sub-Saharan African countries (Global Innovation Index, 2015). The expenditures on research, science, technology, and innovations have been rather limited, and the education system is generally poor. During the early 2000s, the national STI expenditure was annually a few million USD (NCRST, 2014, p. 69); however, it grew recently to 10 million USD, and it is expected to grow to almost 40 million USD by 2017. There are about 250 technology companies in the country, mainly located in the capital of Windhoek, and R&D employs fewer than 1,000 people. Furthermore, of all university staff in the country, fewer than 200 have a PhD. In all, funding and impact of research is relatively poor.

Namibia's GDP per capita (around 5,600 USD) is among the highest in sub-Saharan contexts, but at the same time, the income differences are among the widest in the world. Almost one-third (29%) of the population lives below the poverty line, and unemployment is especially high among young and less-educated rural people (World Bank, 2016). Wide income differences and informal economies create challenges for the formation of ISs based on formal institutions.

## 5. Development of Innovation System in Namibia

Despite the independence war and recent gaining of independence, the development of IS in Namibia started in the 1990s. This is early in the context of developing countries, especially in sub-Saharan Africa. The Government of Namibia released the National Research, Science, and Technology Policy (NRSTP) in 1999. This policy stated the establishment of several key institutions, including the National Commission on Research, Science and Technology (NCRST). However, it took many years to put these institutions into action.

In 2004, the Parliament of Namibia approved the Namibia Vision 2030 strategy. This monumental vision aimed to modernize Namibia into a competitive, knowledge-based industrial society (Republic of Namibia, 2004). The vision was to be implemented through five-year national development plans (NDP). The vision also identified the need to “(c)reate integrated approaches, and genuine partnership between government, business, communities, NGOs, academic institutions, donors, etc.,” for example, the actors and elements of an IS (Republic of Namibia, 2004: 35). In the same year, the Research, Science and Technology (RST) Act No. 23 was drafted to create a legal framework for innovations and STI-based innovation development.

A year later, the new Ministry of Information, Communication and Technology (MoICT) was established. The Ministry of Education possesses a substantial role in the innovation-related practices, the Ministry of Trade and Industry is crucial for infrastructure and export economic activities and the Office of the Prime Minister is significant in innovation, science, and technology policies. The intergovernmental cooperation in Namibia has been challenging, and the role of MoICT in IS development has been limited.

The slowness of the formal implementation of the national innovation policy framework has created obstacles for IS development. Furthermore, the focus on the IS has changed over the years. The national development plans created a framework for IS development. The third NDP in 2008–2012 had an extensive emphasis on IS development and the commercialization of IK to reduce poverty and develop rural communities (National Planning Commission, 2008). However, the fourth NDP for 2012–2016 does not mention specifically an innovation system, innovation policy or the potential role and impact of higher education and R&D, nor does it mention the commercialization of IK (National Planning Commission, 2012). Furthermore, it took 14 years—from 1999 until 2013—to establish the first institutions mentioned in the NRSTP, namely the National Research, Science and Technology Fund. In the same year, after nine years of the draft, the legal framework for innovations, RST, came into force.

Then, in 2014, the second institution of the NRSTP, the NCRST, appeared. It is a key institution for innovation-related activities promoting, coordinating and providing information on RSTI activities in Namibia. The NCRST is strictly politically steered without representatives of a scientific community that has also gained criticism among academic and NGO interest groups (OSISA, 2016).

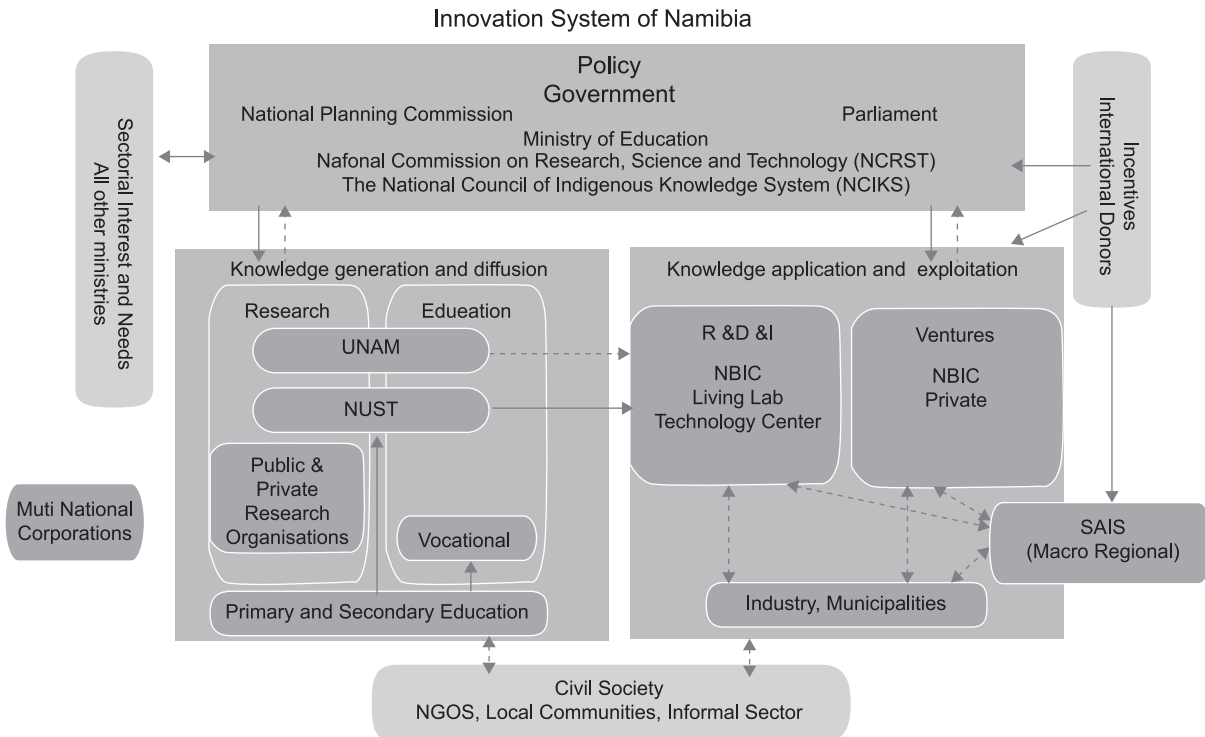
The NCRST launched its first three-year National Programme on Research, Science, Technology and Innovation (NPRSTI) in 2014 (NCRST, 2014). The United Nations Educational, Scientific and Cultural Organization assisted in its establishment and organized consultative meetings and stakeholder workshops to gather relevant information for the program. NPRSTI's focal areas address economic and social challenges in Namibia (such as health, agriculture, fisheries, water, energy, geoscience, mining, IK, social science and humanities, logistics, the environment and tourism) and enable technologies (such as 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 program emphasizes development of an STI infrastructure, such as research laboratories to support research at the country's two universities. However, it does not emphasize innovations at all or acknowledge linkages between the universities and the private sector in technology-related issues.

Foreign donors have substantially supported the development of IS in Namibia. Germany and Finland have been involved in directing the activities of the country's only two universities, UNAM and NUST, toward innovation-related issues. Consequently, UNAM founded a new Faculty of Engineering and Information Technology in 2008 in the northern part of the country, and a year later, NUST launched the Namibian Business Innovation Centre (NBIC) in the capital. The NBIC business plan was designed by experienced Finnish technology business consultants and incubation experts, among them the Technopolis plc. During 2009–2014, around half of the NBIC staff was comprised of German experts employed by the German Development Agency (GIZ) that also has financially supported its activities.

Moreover, in 2011, Finland launched macro-regional and national innovation system development—the Southern African Innovation Support Programme (SAIS)—in four pilot countries: Botswana, Mozambique, Namibia, and Zambia. SAIS supports the establishment of sustainable knowledge-sharing networks for innovation 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 ISs. Under this program, open-knowledge creation spaces and living labs were opened in Namibia.

One particular challenge regarding the IS in Namibia is the creation and combination of analytical and

synthetic knowledge, as resources are poor and cooperation between UNAM and NUST is limited. The key actors, their responsibilities, relations and interactions in the Namibian IS, as well as those involved in the knowledge generation and diffusion and knowledge application and exploitation, are outlined in Fig. 2.



**Fig. 2 Innovation System in Namibia**

The interviewed stakeholders related to the Namibian IS expressed that the government and the society do not comprehensively understand the importance of innovations and IS in Namibia. There is still a general attitude of mistrust and a lack of cooperation between potential key actors of IS. Public resources are extremely limited, competition over them is harsh, the transparency of political decision-making is unclear, and there is a constant lack of a highly skilled labor force. In general, Namibia's industrialization level is low (see Oyelaran-Oyeyinka, 2014, for a general situational overview in Africa) and the few key international industries are not mentioned in the IS. This is partly due to mistrust, but these businesses also do not expect to gain much from participating in highly political IS development. On the contrary, this could create obstacles for sensitive global business, such as uranium and diamond mining. In all, the Government of Namibia has not adopted a comprehensive and crosscutting national innovation policy, despite it has been drafted several years ago in 2011. The formation of IS and innovation policy would be important because they launch the operational development path toward national and regional economies.

## 6. Indigenous Knowledge in the Namibian Innovation System

The indigenous people in Namibia have long traditions of applying IK. As in many places, IK is context-sensitive, so it and its application vary according to the context and the people. Namibia's recent

past as a colony of South Africa created a formal negative attitude toward IK by the state. The Witchcraft Suppression Act of 1970 forbade the use of traditional medicines and many other practices related to IK (Republic of South Africa, 2007, quoted in Meincke, 2016). Many interviewed IS-related key stakeholders recognized the long traditions, suppressed the nature of IK, and saw IK as clearly juxtaposed to Western colonial knowledge and heritage. This is clearly stated by the national authorities in innovation-related documents: “With the arrival of Western philosophy of development, the indigenous knowledge was haltered, suppressed, outlawed, and neglected. This knowledge was thus not further developed and protected, though the knowledge among the elders still remains” (NCIK, 2016).

However, the situation changed soon after Namibia’s independence in 1990. In the past quarter-century, IK has become an inherent part of the national building process. IK is formally appreciated in several development- and innovation-related documents. Therefore, IK is not only potential for the IS in Namibia but also a politically loaded notion echoing the nostalgic history of the people and their traditional knowledge. In addition, IK is collectivized to Namibians and to indigenous people in these documents. In practice, however, different IK is often practiced and developed by specific individuals in different localities. This could create a potential related variety of knowledge for utilizing IK in the IS (Boschma & Frenken, 2009; OECD, 2013).

IK appears frequently in many crucial development- and innovation-related strategies and policies, including the Vision 2030 (2003), the RST Act (2004) and NPRSTI (2014), three key documents framing the future development path of Namibia. On one hand, IK is seen as a potential income-generator for the poor, rural population (Republic of Namibia, 2004). On the other, IK is seen as an economically important source of innovations and a mechanism for the involvement of local communities in the development of those innovations. Furthermore, the NCRST established the National Council for Indigenous Knowledge Systems (NCIKS) in 2014 to facilitate indigenous knowledge systems in all sectors and enhance, recognize, develop, and promote the value and role of indigenous knowledge and technology for development and advise education, practices and intellectual property right issues pertaining to IK (NCIK, 2016).

In addition, the UNAM and the NUST conduct applied research to create economic value-adding innovations relevant to pharmaceuticals, agriculture, and social development from IK. Some projects document, map, and register potential IK into a database for possible future systemic product development based on IK. Other projects are directly involved in the development processes from IK for product and service innovations either as is or blended with external knowledge (Shabi *et al.* 2011; Chinsebu *et al.*, 2015).

The IS-related documents mention IK frequently but are less precise in defining it. The clearest definition is offered by the NPRSTI that defines IK as “developed over centuries of learning from the environment; its role in transforming and modifying technologies to suit local conditions and the local context; its role in the development of indigenous home-grown technologies” (NCRST, 2014: 14). Furthermore, NPRSTI indicates various strategic initiatives to apply IK in Namibia. The commercialization of IK is the most frequently mentioned goal. Research is mentioned often as well (Table 1).

The participation of the IK holders and the IK researchers—the indigenous people and the academic staff, not to mention the innovation developers, that is, enterprises—are barely mentioned in the documents. Traditional authorities are planned to partner only on one initiative. This indicates how the IS supported by IK in Namibia is strongly designed by the central public authorities. Nevertheless, IK is an important part of contemporary policy-making in innovation-related activities.

Intellectual property issues regarding IK is one topic involving an amount of initiatives (Table 1). However, the value chain and the role of necessary actors from local indigenous peoples to global consumers have not been addressed, nor has the impact of potential eradication of IK from its local context (see Pietrobelli & Rabellotti, 2011). Therefore, the strategic initiatives do not necessarily provide resilience for the poor and their environments.

**Table 1. Strategic Initiatives for IK in Namibia (Source: National Commission..., 2014: 59)**

Strengthen linkages between research institutions and industry in IKS R&D research and capacity building;
Develop a database, protect, promote and preserve IKS technologies that show potential for commercialization;
Establish IKS policy, IKS R&D platform for product development, value-addition, innovation, and commercialization and development strategy;
Validation of IK with potential for commercialization;
Expedite IK IP policy legislation to protect IKS knowledge holders;
Promote research in IK and documentation, as well as the utilization of social knowledge and traditions;
The history, experiences, aspirations of the indigenous people and their relationship with other ethnic groups;
Role of indigenous languages & culture on development;
Promote and document indigenous languages

The interviewed government officials considered that IK is an important element to contextualize the general IS concept to Namibia. IK creates a comparative advantage because of its localized uniqueness. Therefore, the IK-based innovations can be developed straight from the locally embedded IK. Beyond this general political and economic speculation, the interviewees did not mention concrete practical examples of successful IK-based innovations in Namibia. The interviewed scholars in Namibia were concerned about legal intellectual property- and institution-related issues, especially when IK is blended with analytical knowledge into an STI-based IS. Of the latter, there are already problematic examples in Namibia, such as the case between the indigenous San people, the Hoodia plant, South African researchers, and the global companies aiming to use Hoodia without acknowledging the IK of indigenous people (Wynberg *et al.*, 2009).

More sustainable IK-related innovations in Namibia can be found in tourism relying on symbolic and synthetic knowledge. Such tourism relies heavily on international tourists enjoying wildlife, wilderness landscapes, and indigenous cultures. Some IK-connected tourism activities are organized jointly between local indigenous people and international donors. Tourism is a key strategic activity for socioeconomic development and employment creation in the present national development plan, NDP4 (National Planning Commission, 2012). However, there are also ethical considerations and ambiguities around benefit-sharing. Tourism brings direct economic benefits for local people, even though the households usually receive few economic benefits (Saarinen, 2011). Moreover, international companies or people living in the capital of Windhoek own most of the tour operators.

There are also examples of local development supported by IK-related artifacts. For example, the practice of fermenting, using, and consuming *Oshikundu*, a traditional non-alcoholic nutritious beverage made of fermented millet, has been revived. It is nowadays sold in both informal urban settlement areas in the north and in the marketplaces of Windhoek. It helps that an important tradition of indigenous people

survives through the modernization of Namibia, including migration of many indigenous people to the capital. The researchers of the UNAM have been involved in this IK-related commercialization project supported by international donors, such as the United Nations Educational, Scientific and Cultural Organization and the Netherlands Organization for International Cooperation in Higher Education (Nuffic), as well as the local private brewing enterprise (Embashu *et al.*, 2013).

## 7. Conclusions

Underdevelopment is a challenge, but it can also be an opportunity and a source of innovation and new economic opportunity. In developing countries, IS has become a common tool for fostering economic and social development, identifying and responding to the needs of transformation, and aiming for a resilient society.

There are obvious strengths of the IS as a developmental tool for developing countries. As a concept and policy tool, ISs have been practiced and analyzed around the world for decades, so one easily finds policy recommendations and best practices. However, since innovation is often strongly tied to the context it is emerging from, IS tends to be a broad framework that only identifies and maps potential relevant actors for innovation development. As a system, IS does not necessarily enhance interactions between the actors of IS. Therefore, IS must be carefully contextualized, especially in developing countries, due to general organizational and institutional thinness as well as local circumstances that impact the relationship between innovation-related actors and the (mis)trust between them. This makes the steering of IS challenging and creates difficulties in integrating different knowledge bases for related variety support. The challenges are common, because IS development often heavily relies on the public sector, as exemplified by the slow implementation of innovation-related policies and practices in Namibia. The centralized design of IS stressing the role of public authorities does not open the IS to other crucial stakeholders, such as the local inhabitants, NGOs, universities or enterprises. Furthermore, the centrally designed IS is not actively open to and engaged with external knowledge flows.

For developing countries, it is difficult to compete with more advanced countries in R&D and highly advanced technologies, so many look to alternatives for the STI-based IS. However, STI is still a common way to map and present the IS in a developing country, as the case of Namibia illustrates. The DUI mode potentially fits better, especially when there is an aim to integrate IK into an IS. As said, IK evolves in local contexts by applying, modifying, and adapting the knowledge. Further, such DUI mode requires organization; otherwise, it falls onto a spectrum of diversified practices that are difficult to manage and are not able to bring the sustainable competitive edge compared to the more formal STI structure in IS. The DUI mode also makes the IS more open and allows participation of local inhabitants who often do not have much formal education and advanced competences. This enhances the ownership of IS among local populations that are fundamental in terms of IK and helps to integrate alternative grassroots initiations into IS. The governance of the processes, the operationalization of the IS and the participation of broad-spectrum stakeholders are crucially important.

This research scrutinized how the IS of a developing country can be enhanced by better inclusion of IK. IK can support related variety for innovation policies of the IS, in which IK is embedded and supports diversifying place-based policies. An IK-included IS can enhance the comparative advantage of a developing country despite the thinness of their STI-relevant organizations and actors in innovation creation.

Notwithstanding that IK has many characteristics of the DUI mode and challenges of new product innovations from IK development, so far, the innovation policies in developing countries have treated IK in simplistic ways. The development path from IK to innovation is considered straightforward and connected to an STI-based innovation. This includes the discovery of an appropriate IK, then its enhancement through systematic R&D and, later, its introduction to the markets. As this research case indicates, the reason to integrate IK is not always due to enhanced related variety of innovation policy and generation of innovations. The integration of IK into IS and innovation policies is also due to political reasons and as a part of rhetoric supporting national identity and nationalism.

Similar to the problematic universalization of IS, there is also a risk of IK being treated universally as a common property shared by all inhabitants in developing countries. This is seen in the development and innovation policies of many countries that have introduced IK as a valuable asset in IS. For example, in Namibia, IK is introduced as a rather general attribute that covers the whole nation and country. Furthermore, IK does not “spread” equally among residents in these localities. There are individuals who possess and develop IK more than others. In relating IK to IS, one must pay attention not only to specificities of different local contexts but also to the individuals in these localities. The mode to organize IS in developing countries must take into account the specificity of knowledge providers and exploiters. In addition, if IK is stabilized, there is a danger for the cultural-cognitive path-dependencies that hinder emergence of radical innovations, and thus lead to lock-ins in development.

In the end, more important than the role of IK in product innovation is its ability to facilitate participatory development processes. IK may facilitate the embedding of explicit professional knowledge in local processes and emphasize the local communities’ ways of observing, discussing, and interpreting the occurring changes. The socioeconomic resilience of local communities in developing countries can be fostered by developing an IS. However, there is a need to adjust the general and universal concept of IS to local contexts and practices and include bottom-up participation, IK and local innovations in the innovation-related policies of a developing country.

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