

Digitization of Indigenous knowledge systems in Africa: the case of South Africa's National Recorded System (NRS)

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Abstract

Purpose – The purpose of this study is to highlight the indigenous knowledge systems (IKS) preservation efforts in South Africa, with a focus on the National Recordal System and the Indigenous Knowledge Systems Documentation Centres (IKSDCs) across South Africa.

Design/methodology/approach – Anchored in the interpretivist paradigm, the qualitative research approach was adopted to explore the objectives of the study. The multiple case study method was considered appropriate and adopted for the study. The data for this study was collected through comprehensive face-to-face interviews and Web content analysis. The population of the study consisted of the staff at the IKSDCs in the selected academic institutions. The purposive sampling technique was used to select the following set of participants in each academic institution: IKS managers/coordinators, digitization officers and online collection administrators.

Findings – The findings provide an in-depth understanding of the IKS landscape in South Africa. The findings and recommendations of this paper would be useful to researchers who wish to know more about digitization efforts in South Africa. It would also be useful to all stakeholders and policymakers.

Originality/value – The paper brings to the fore the efforts of the South African government in preserving IKS through documentation and digitization. The paper highlights the sources of indigenous knowledge, types of indigenous knowledge captured, how the indigenous knowledge is ingested in the repositories and how the data is captured. Generally, the roles of the IKSDCs in the capture and preservation of IKS are highlighted.

Keywords Indigenous knowledge system, Digitization, National Recordal System, Biopiracy, South Africa, Africa

Paper type Research paper

Background

According to Fela Kuti:

Africa has to improve by its own methods [...] Africa has not been able to contribute its own knowledge to this universe, but we have knowledge in Africa [...] All these things need to be in the education system of African countries (Reelin' In The Years Productions [ReelinInTheYears66], 2018, np).



This statement highlights the importance of indigenous knowledge (IK) as a key tool for development in Africa. IK is the collection of interrelated practices that are peculiar to a group of people, and it influences the way of life of a local people (Adeniyi and Subair, 2013). It is the “basis for local level decision making in healthcare, education and a host of other activities in rural communities” (Anyaku *et al.*, 2015, p. 34). The Tassa irrigation system in Niger Republic and the Gacaca community-based judicial system in Rwanda (Brehm *et al.*, 2014; Ezeanya-Esiobu, 2017) are good examples of how African indigenous knowledge systems (IKS) have been applied successfully. In South Africa, *Buchu* aromatic plant (Hulley *et al.*, 2016) and *riel* (Wyk, 2012) are also examples of available IK. Some benefits of “*D/nhora buchu*” (a type of buchu) include the treatment of colds, tuberculosis, influenza, chest ailments, haemorrhoids and convulsions, among other uses (Hulley *et al.*, 2016). The rooibos plant is another example of IK in South Africa (Ajuwon *et al.*, 2018).

To promote the preservation of IK, the South African government came up with a policy framework. In 2004, recognizing the importance of IK, the South African government adopted the National indigenous knowledge systems policy, which was a platform for recognizing, affirming, developing and protecting IKS in South Africa (Pretorius and Bezuidenhout, 2011). The Department of Science and Technology (DST) initiated the National Recordal System (NRS) through the National indigenous knowledge systems policy framework to coordinate and standardize the capture, storage, maintenance and dissemination of science and technology related data on IKS in South Africa were formulated. In 2014, the DST promulgated an additional IKS Bill, which aims at further improving the management of IK in South Africa.

The National Recordal System

This paper focuses on the DST’s NRS initiative. The 2004 IK policy laid the foundation for the NRS project, which is an initiative of DST. It coordinates and standardizes the capturing, storing, maintenance and dissemination of science and technology-related data on IKS in South Africa. The National indigenous knowledge systems policy paved the way for the establishment of the National Indigenous knowledge system Office, whose role is mainly to help facilitate the coordination of the academic institutions and other organizations with regards to IKS. This has led to the creation of the National Indigenous knowledge Management System (NIKMAS), similar to India’s Traditional Knowledge Digital Library (TKDL), to support, on a national scale, the recordal, management and protection of IK and the mitigation of the risks associated with Intellectual Property and biopiracy. Biopiracy is a serious issue and one of the driving forces for many IK digitization projects. For example, it was discovered in 2009 that Nestlé had filed patent applications related to the uses of rooibos and honeybush to treat inflammatory disorders and for skin and hair-related products (Natural Justice, 2023). This knowledge, which raised biopiracy concerns, was obtained from the Khoi and San indigenous peoples of South Africa (Bagley, 2018). However, the company was forced to reach a benefit-sharing agreement with the National KhoiSan Council and the South African San Council (Bagley, 2018).

The move by the South African government through the NRS to prevent issues related to intellectual property and biopiracy led to the creation of Indigenous Knowledge Systems Documentation Centres (IKSDCs) across the nine provinces in South Africa to cater to fifty (50) indigenous communities. The University of KwaZulu-Natal (UKZN) hosts the main hub in South Africa. The UKZN hub, in collaboration with some academic institutions, is known as the virtual IKS Centre, also known as the DST-NRF Centre in IKS (CIKS). It is managed by the National Research Foundation (NRF) Directorate of Research Centres and Centres for Excellence. The DST-NRF Centre in IKS is expected to promote, protect and preserve IKS, and this is to be achieved through research, postgraduate training, community engagement,

networking, IKS curriculum studies, knowledge brokerage and service rendering. Its focus areas are traditional medicine, food security, biodiversity and environmental management. The DST-NRF Centre in IKS is also in strategic partnership with institutions within and outside South Africa.

Apart from being responsible for the collection and organizing of information materials, the IKSDCs, in partnership with the communities involved, also actively engage in the production of information that is shared, disseminated and distributed. The IKSDC also has the responsibility of providing services to the various communities, national government, local government and the general public in terms of the captured IKS in the NRS. The NIKMAS serves as the information management engine of the NRS.

Literature review

One of the most important factors in ensuring long-term access to heritage materials is preservation (Graham, 2003). In recognition of its importance, the International Federation of Library Associations and Institutions (IFLA) stated that libraries and archives are required to be involved in the collection, preservation and dissemination of indigenous and local traditional knowledge resources (IFLA, 2002). Libraries are also expected to consider the use of digitization in preserving IK to ensure it does not become extinct (Sraku-Lartey *et al.*, 2017). According to Poorna *et al.* (2014, p. 1246), “preserving and safeguarding TK [Traditional knowledge] has assumed great significance in the recent past, and a variety of initiatives are being made across the globe towards achieving it”. However, Poorna *et al.* (2014) added that it is important to take urgent measures to preserve oral knowledge due to the great risks of misappropriation and loss. According to Plockey (2014, p. 21), “African nations are going through many changes resulting in a loss of traditional, cultural and customary knowledge as a result of a lack of the preservation and digitization of African Indigenous knowledge (AIK)”. Nakata and Langton (2005) note that there have been major efforts in the preservation of IK in accessible forms by recording and documenting traditional knowledge, enabling the retrieval of knowledge in memory and current practice, identifying and retrieving previously documented knowledge stored in institutions. Information and Communication Technologies can play major roles in the improvement and ensuring the availability of IK in Africa by “enhancing its blending of modern scientific and technical knowledge” (Plockey, 2015: 32).

Studies have been carried out on digitization and the use of Information and Communications Technology to preserve IK in Africa and the rest of the world (Chisenga, 2002; Nakata *et al.*, 2014; Plockey, 2014; Akinwale, 2013; Owiny *et al.*, 2014; Swanepoel, 2008; Sraku-Lartey *et al.*, 2017; Christian, 2009). In fact, Chisenga (2002: 5) asserted that “preservation of Indigenous knowledge systems in Africa should be a concern of all Africans, and not only international organizations and research institutions”. Chisenga (2002) added that Africa should play an active role by contributing to knowledge on the internet through IK; through dedicated IK websites, Africa can contribute to the information content of the global information infrastructure. According to Swanepoel (2008), digitization initiatives are driven by a variety of motives, two of the most common being preservation and enhanced access. One major advantage of documenting, digitizing and preserving this delicate knowledge is that, through digitization, wider dissemination of the knowledge is ensured (Christian, 2009). More people can therefore gain access to this knowledge than previously. Also, it is easier to search through digitized content than it is to search through print media, thereby reducing the time used in conducting such searches (Sraku-Lartey *et al.*, 2017). Digitization of IK is also an effective tool for defensive protection from bio-piracy as well as the reduction of the misappropriation of IK without compensation by multi-national entities

(Christian, 2009; Nakata and Langton, 2005). Several examples exist of the bio-piracy of IK by multinational entities worldwide in India, South America and South Africa (Avantika *et al.*, 2015; Bhattacharya, 2014). Documentation and digitization of medicinal knowledge have also gained prominence in several countries in the fight against bio-piracy (Poorna *et al.* (2014). However, IK also involves various sectors such as agriculture, environment, architecture, culture and heritage, among others, that are interlinked and applied to daily living. All this knowledge needs to be preserved to achieve inclusive development (Poorna *et al.*, 2014).

Several countries like Venezuela, India and China have managed to compile digital databases, inventories or registries of traditional knowledge over many years (Nair, 2006; Swanepoel, 2008). Digitization initiatives are usually driven by a variety of motives, with preservation and access being the most common (Swanepoel, 2008; Balogun, 2018). To ensure access to digitized IK, there are initiatives to ensure that IK is accessible online. Such initiatives include the TKDL (www.tkdl.res.in), Korean Traditional Knowledge Portal (www.koreantk.com), Chinese Traditional Medicine Database System (www.megabionet.org), Seni Tradisi Indonesia (www.piknikdong.com) and the Smithsonian Centre for Folklife and Cultural Heritage (<https://folklife.si.edu/>). In Africa, there are initiatives such as the African Indigenous Science and Knowledge Systems (<http://africahistory.net/>) and Elimu Asilia – Kenya’s IK Online (www.elimuasilia.org/). In South Africa, the Ulwazi Programme and the Digital Innovation South Africa (DISA) projects are examples of digitization projects on IK made available online (Greyling and McNulty, 2012; Pickover, 2008). The Ulwazi Programme in particular “operates as an integral part of local public library and information services in the eThekweni Municipal Area in the province of KwaZulu-Natal in South Africa, using both conventional and the latest mobile technologies” (Greyling and McNulty, 2012: np). The DISA project, on the other hand, is a non-profit collaborative project which is funded by Andrew W. Mellon Foundation and has been able to attract heritage and research stakeholders, including academic institutions (Pickover, 2008).

Salazar (2005, p. 68) pointed out that “it is possible to claim that we are undergoing a phase of increased digitization of cultural resources and information: museums, libraries, universities, governments and international governance institutions are among some of the drivers of this recent obsession with digital preservation”. In recent times, there has been a growing tendency for governments in the Sub-Saharan Africa region to pay close attention to IKS and to develop mechanisms to incorporate them into sustainable development initiatives (Jaya, 2006: 2). For these programmes to be effective and provide the necessary impact, there is the need to develop a framework within which these digital initiatives are implemented (Jaya, 2006). Also, there can be economic benefits for indigenous communities who build digital libraries through the creation of training and employment opportunities and possibly by sharing knowledge for commercial use (Sullivan, 2002). Other benefits include the long-term preservation of the resource, reduced costs of handling and storing the digitized material and the ability to index and store the material in a document retrieval system (Sraku-Lartey *et al.*, 2017).

The digitized IK resources will have a higher value when digitized, and the interest in preserving and disseminating similar IK resource will increase (Tjiek, 2006). Unquestionably, digitization and digital library hold great potentials for the preservation and dissemination of African IK. According to Tjiek (2006), a digital library for AIK, in particular, can provide the following:

- Digital preservation of AIK includes the historical and cultural heritage of local communities, thus preserving their collective memories;
- Channels for the dissemination of AIK of local communities to a global audience.

- A way to transform local communities from consumers of information/knowledge into producers of information/knowledge;
- Positive impacts on local campus communities; and
- A service for libraries to reach out and expand their sphere of influence, thereby strengthening their roles in the information age.

The internet can be used to provide access to a wide range of IK (Okore *et al.*, 2009; Chisenga, 2002), which argues that harnessing, repackaging and providing access to Africa's IKS using the World Wide Web infrastructure will present the people of Africa with an opportunity to make a major contribution to the development of the information content on the Web. This will also ensure that information consumers in Africa will have access to information content produced on the continent. In Australia, the provision of online engagements with Indigenous people's knowledge is being attempted, but it is happening haphazardly due to a range of constraints (Nakata *et al.*, 2014). These online engagements range from restricted online databases to stand-alone databases with community-only access to public webpages of varying standards (Scott, 2004). The globalization of Africa's IK can only happen if there is a deliberate approach to capturing, documenting, storing and providing access to such knowledge on the Web (Balogun and Kalusopa, 2021). One way of ensuring this is for African countries to set up national IK resource centres (Chisenga, 2002; Plockey, 2014), which revealed that lack of human resource, finance, infrastructure, internet connectivity and copyright, among other things, poses a great challenge in the digitization of IK. Plockey (2014) therefore advocates training of public librarians, conducting of research based on endogenous approach, provision of infrastructure and providing a policy framework that will enhance the process of converting information into a digital format.

Objectives of the study

The general objective of this paper is to highlight the IKS preservation efforts in South Africa, with a focus on the NRS and the IKSDCs across South Africa. The following are the specific objectives of the paper:

- to identify the sources of IK;
- to identify the types of IK captured;
- to highlight how the IK is ingested in the repositories; and
- to ascertain how the data is captured.

Methodology

The interpretivist research paradigm/philosophy guided the study. The interpretivist paradigm is based on the understanding of the subjective nature of human experience through inductive reasoning (Chowdhury, 2014; Kankam, 2019). Interpretism is predominantly associated with qualitative methods (Ponelis, 2015; Pham, 2018), which is why the qualitative approach was adopted in this study to explore the objectives of the study. Qualitative approach uses a naturalistic, in-depth inquisition to explore the studied phenomenon (Ritchie and Lewis, 2012). This approach also allowed the researcher to apply a subjective understanding of human experiences in the natural setting where the research was conducted (Silverman, 2010). The multiple case study method is considered appropriate and was adopted for the study. The multiple case study helps to understand similarities and differences between multiple cases through several experiments (Ridder, 2017). This was adopted for the study because of the need

to collect data from different institutions involved in the IK digitization project. The study was carried out in IKSDCs in four academic institutions across three provinces (Gauteng, KwaZulu-Natal and Western Cape) in South Africa. Data was also collected from the institutional repositories. The population of the study consisted of the staff at the IKSDCs in the selected academic institutions. Through the application and usage of the purposive sampling technique, the researcher selected a population for study that is relevant and related to the purpose of the research. The purposive sampling technique was used to select the following set of participants in each academic institution: IKS managers/coordinators, digitization officers and online collection administrators. The data for this study was collected through comprehensive face-to-face interviews and Web content analysis.

Findings

The interpretation and discussion of findings are presented in accordance with the research objectives stated earlier in the study. The findings are based on the interviews and content analysis. As previously indicated, this paper aims to highlight the IKS preservation efforts in South Africa, with a focus on the NRS and the IKSDCs across South Africa. The findings are based on interviews conducted with eight key staff members at the IKSDCs in four academic institutions spread across different provinces in South Africa. The study strictly focused on the digitization aspect of the project, and the indigenous people from the communities were not considered for inclusion in the interview process. The interviewees were named A, B, C, D, E, F, G and H to ensure anonymity. The institutions were also named 01, 02, 03 and 04 for the purpose of anonymity in the data analysis. The interpretation and discussion are hereby presented as follows.

Sources of indigenous knowledge

The respondents were asked for the sources of IK captured in their repositories. The responses show that the main source of IK in the institutions is the primary source where they go to communities to harvest IK. All the respondents affirm the fact that the source of their IK is the local communities. For example, A said that “the sources of IK that we currently have are first-hand where we have interviews with the community knowledge holders”. Respondent F also affirmed this by stating that “the source of our IK in terms of what we do is to go to the communities to collect information”.

The primary sources seem to be a standing source of the IK, as noted by E, who stated that “Our sources are the local communities. That is standard for all institutions”. Respondent C painted a better picture of how this process is done by saying that “We actually got to the IK holders themselves at the community level. We go down to the heads of the people and talk to them. We interview them, and then we record what they have to tell us about Indigenous knowledge”. Respondents A and B affirmed this.

The responses from respondents A and B also show that apart from the data collected at the community level, other sources of IK mentioned are grey materials in the form of print materials, journal articles, conference presentations, conference proceedings, documentaries and published theses relating to IK. For instance, A noted that “we also have our print materials which are grey materials like our journal articles, conference papers, proceedings, audio and video recordings, documentaries and published thesis as well”. B, on the other hand, said that they also “have IK materials like journal articles and other published materials”.

However, D, in response to the question, said that they:

[...] collect and preserve more heritage materials for now, but we are also working on collecting Indigenous knowledge with the support of the Department of Science and Technology. A lot of what we have right now are very important materials related to South Africa’s national heritage.

Even though D's institution is involved in the digitization of heritage materials and IKS, their main focus at the moment is the heritage materials collected and managed by the institution.

Data capture of indigenous knowledge

Respondents were asked the question, "How is Indigenous knowledge data captured?" The responses show that data is captured by field workers (also called IK recorders). C noted that they "interview people using voice recorders, cameras to record what they are saying, but it also goes with the forms that we use because the interviews are guided by these forms". G affirmed this with more details about this process and its rationale by saying that:

We go out to the people. I have got field workers (I call them IK recorders) and they are from the communities, so they themselves got to the people in the communities. And because of the issue of trust, the chiefs assign people from that community. For them, if it is someone they know from the community, especially if it is a small community, they open up more unlike if it was someone from outside who cannot even speak the language. So we usually take photos, audio, and video recordings.

Data is captured mainly through audio and video recordings and the use of digital cameras to take photographs. H affirming this fact said that they "do audio, videos and we do forms (questionnaire)". Respondent E gave a clearer picture of this process by stating that "the recording is done either on paper, digital camera, audio recordings, photographs, and it goes through the process unto the laptop eventually". C added that:

There are 2 phases in the data capture process. There is a stage where we record what people claim to have as knowledge and then we agree with that person that we want to come and harvest the knowledge that they claim they have. And at that stage where we harvest, that is when we require the person to demonstrate, to tell us everything (the gist of what they claim to know), and the process [...] and there is a database that is designed for that. When you are in the field we note in these forms and from these forms, we transfer into the database [...].

Adding a little twist to the data capture in another institution, A also noted that they also capture other IK data that are not from primary sources, and the method is a bit different from the way primary materials are captured into the system. According to A:

From a process perspective, we have certain keywords and priority areas that form an Indigenous knowledge perspective we have certain focus areas that we are interested in (for now) because the depth of information is a lot. So, we use those keywords together with the words Indigenous knowledge, Traditional Knowledge, local knowledge, or cultural knowledge, just as a way to source or mine the data itself. And then each data is captured or the person sourcing for this data will then submit it to our Online Collection Administrator, who then tries to authenticate or confirm that yes or no this is the relevant information that we are supposed to be collecting. This information is then saved in specific folders that we save on a hard drive and she basically uses certain checks to make sure that the data complies with what we require before uploading to the system and adding the metadata to the online collection.

D also expressed that they have different methods and noted that:

Intangible and tangible cultural artifacts are converted into a computer-readable format using technological hardware and software. They are described so that they will be meaningful to the user community (metadata added) and thereafter uploaded in an organized manner in the institutional repository. Analog materials are scanned and integrated with the born-digital materials.

Similarly, respondents B and D said that data is also captured through scanning of documents. For instance, B said that apart from documenting IK collected from the communities, they also "scan some that are in print form in order to include them with what

we have in the electronic form already". From the responses, it is evident that audio recordings, videos, photographs from the communities and scanning seem to be the most common ways that data is captured in the institutions. The captured data are transferred to the IK recorder laptops by the IK Coordinators through synchronization. As noted by B, data is captured through data mining using specific keywords.

However, before data is captured from the primary sources, forms such as Non-Disclosure Agreement (NDA), Prior Informed Consent (PIC) forms, Catalogue Form and the Harvesting Form are to be completed. C expressed this by saying that they "have informed consent with people that they are signing. We also have necessary documents for legalities, and we feed everything into the database including the forms for legal purposes". According to G:

When we start the project, we have four (4) different forms to fill out by the IK recorders, and then from there, we transfer this information to the IK recorder laptops. Now, the forms are the NDA (Non-Disclosure Agreement) and the Prior Informed Consent (PIC) forms. Then from there, there is a Catalogue Form and the Harvesting Form.

Respondent G noted that the Harvesting Form "is the one that has more in-depth information about the plants or food".

Types of indigenous knowledge in the institutions

The respondents were asked a question on the types of IK acquired by their institutions.

Respondents B, G and H all said that the types of IK acquired are IK on traditional medicine, medicinal plant and food, traditional farming and indigenous food. According to F, for example, they "deal with traditional medicine, food, and traditional plants". F added that for them as a unit, they "currently specialize on those types of knowledge. We also get information from a specific tribe of fishers on the West Coast and around the East Coast. They have a lot of knowledge on the fishing community". However, respondent E emphasized that the kind of IK they collect largely depends on the community they are dealing with, and this will vary slightly. Giving reasons for this E, further stated that:

[. . .] because one of the things I have found out is that people quickly jump to medicinal plants. Medicinal plants are one big thing but there is a lot more than that. My interest is food. What we harvest is mostly about food and medicine, but we could be harvesting more such as astronomy and other things depending on the community that you are working with.

Respondent C also said that although the type of IK they focus on for now is mainly traditional medicine and African food, they are also interested in other IK. According to C:

We are also interested in other knowledge systems but at the moment we are only focusing on the two mentioned (African food and medicine). Astronomy is also one of them (Indigenous Astronomy), but for now, the mandate is for these two.

A on the other said they also collect print materials, journal articles in addition to the recordings related to medicine, plants, food and so on. According to D, who deviated from the other respondents, they:

[. . .] have tacit and explicit Indigenous knowledge, personal knowledge, oral knowledge (such as language, beliefs, religions, origin, demographics. Expression of knowledge (cultural events, performance, songs, games), tangible (historic and cultural buildings, traditional tools that can operate without electricity or technology) and intangible cultural artifacts (art, craft), food, clothing, environmental (plants, herbs), unique skills, methods and techniques (water management, agriculture), cultural practices (marriage, pregnancy, traditional court practices, circumcision, family planning midwifery).

Table 1 below shows that IK related to traditional medicine, traditional plants, medicinal plants, farming and food is the main focus of the institutions for now. These are collected in form of documents, photos, audio and video files that are the most common across the institutions.

The data collected through interviews were supplemented with the content analysis of the institutional repositories. The aim of the content analysis with regards to this question was to confirm if the IK is available in the institutional repositories and what types of IK are available. The content analysis revealed that 01 has IK materials and has the following focus areas:

- African traditional medicine;
- Biodiversity, environmental and climate change management;
- Indigenous food security;
- IKS epistemologies and research methodologies in education;
- Mental health;
- Neglected infectious diseases;
- Sexual and reproductive health; and
- History of African ideas.

Respondents	Types of indigenous knowledge systems	Format
A	Traditional medicine, plants, food	Print materials, journal, photos, articles, recordings (audio and video)
B	African Traditional Medicine, traditional plants, food	Print materials, journal, photos, articles, recordings (audio and video)
C	Traditional medicine, African food	Documents, photos, articles, recordings (audio and video)
D	Tacit and explicit Indigenous knowledge, personal knowledge, oral knowledge (language, beliefs, religions, origin, demographics, expression of knowledge (cultural events, performance, songs, games), tangible (historic and cultural buildings, traditional tools, intangible cultural artifacts (art, craft), food, clothing, environmental (plants, herbs), unique skills, methods and techniques (water management, agriculture), cultural practices (marriage, pregnancy, traditional court practices, circumcision, family planning midwifery).	Documents, audio, audio-visual
E	Food and medicine	Documents, photos, articles, recordings (audio and video)
F	Traditional medicine, food, traditional plants	Documents, photos, articles, recordings (audio and video)
G	Traditional medicine, medicinal plants, food	Documents, photos, articles, recordings (audio and video)
H	Traditional medicine, traditional farming	Documents, photos, articles, recordings (audio and video)

Table 1.
Summary of types of indigenous knowledge systems as listed by the respondents

Source: Author's own work

Institution 03 has a digital collection, which is a collection of digitized heritage materials available in the institutional repository. These are materials of historical, political and cultural importance, encompassing the mid-17th Century to the present, available in document form, digital audio and audio-visual. These IK materials are mainly available in document form.

Ingestion of indigenous knowledge in the institutional repository

The respondents were asked how the IK is ingested in the institutional repository. The responses show that majority of the respondents acknowledged that the digitized IK in their institution is not ingested in the institutional repository, although efforts are currently being made to ingest and integrate them with other materials in the institutional repositories. According to E “we do not ingest the materials in the institutional repositories for now. It comes to us as IKSDC and it is kept with us, it does not go anywhere else until it goes to the DST”. F also noted that “they are currently not part of the institutional repository”. It is part of our plans and we are working towards it”. This was also affirmed by H, who simply replied, “No. For now, they are not ingested in the institutional repository”.

Most of the respondents who admitted they are currently not ingested in their institutional repository expressed the hope of getting them as part of the collection in their institutional repositories in the nearest future. F, expressing this optimism, noted that:

[. . .] the Indigenous knowledge being collected at the moment will eventually become part. “They are currently not part of the institutional repository but they will eventually become part. It is part of our plans and we are working towards it”.

Also, C and E stressed that they are facilitated by the DST, and the department would have to authorize them before they can ingest them in the institutional repositories. For example, C said that:

Basically, the DST is currently facilitating the documentation that we are doing here. We have machines in the form of laptops that are out in the communities that are used by field workers. And on top of that, they use digital cameras. The way the information is fed to the main computer in this office is through synchronization of the computers. Basically, we do not transfer from drives or hard drives; we do transfer from computer to computer. That is the way it is done and that is the way it is the same way it is transferred to the institutional repository.

In support of the statement by C, respondent E also said that “it comes to us as IKSDC and it is kept with us, it does not go anywhere else until it goes to the DST”.

However, respondents A, B and D said that the IKS are ingested in their institutional repository. For instance, A said that they “are hosting a special collection. Our special collection is in the repository, so our information is ingested via the institution”. D also acknowledged that “the materials are digitized and described, that is, adding the metadata. We organize them and then upload them to the institutional repository in an organized manner”. In addition, A stressed that the collection is part of the Special Collection of the institution and is managed by the institution’s library department.

However, content analysis was used to supplement the interview to assess the institutional repositories available online and compare them with the responses. [Table 2](#) shows the availability of IKS in the institutional repositories of the respondents.

The content analysis, as shown in [Table 2](#), reveals that only one of the institutions has IKS available in their institutional repositories online. However, the IKS available online are only available in the form of documents. Also, a respondent claimed that IKS are available in their institutional repository. However, an assessment of the institutional repository revealed that the institutional repository makes digitized heritage materials but no IKS-related data.

Table 2.
IKS in institutional
repositories

Institution	IK in institutional repository	Type	Format
01	Yes	African traditional medicine Biodiversity, environmental and climate change management Indigenous food security IKS epistemologies and research methodologies in education Mental health Neglected infectious diseases Sexual and reproductive health History of African ideas	Document form
02	No	N/A	N/A
03	No	N/A	N/A
04	No	N/A	N/A

Source: Author's own work

Conclusion

Digitization can help with the issue of IK biopiracy by creating a digital record of IK and making the knowledge available to the public. Biopiracy can be prevented by proving that a specific has been traditionally held by a particular community. Additionally, digitization can facilitate collaboration between indigenous communities and researchers, ensuring that the use of IK is done with informed consent of the community and ensuring equitable shared benefits. Within this context, the paper has been able to highlight the digitization efforts with a focus on the NRS IKS initiative in South Africa.

South Africa has taken major steps and still making serious efforts to ensure the preservation of IKS through the use of technology and digitization (Greyling and McNulty, 2012; McNulty, 2014). This paper established that the main source of IK in the institutions is primary sources, and other sources of IK are print materials, journal articles, documentaries and published theses related to IK. The paper also revealed that the major types of IK that are captured in the academic institutions are IK related to traditional medicine, traditional plants, farming and food. Data is captured through scanning, audio/video recordings, data mining, purchase of grey IK materials and the use of digital cameras to capture data. The academic institutions' IKS Centers are under the umbrella of the IKSDCs, and the data are currently uploaded on NIKMAS. Even though the academic institutions are actively involved in the collection of IK data, the fact that they are also a part of the NRS project through the IKSDCs makes it unclear if they are responsible for ingesting the IKS into the institutional repositories. Only one of the institutions directly ingests IKS in the institutional repository and has a Special Collection website dedicated to IKS. Some of the institutions are actively involved in the digitization of IKS, but being a part of the NRS initiative makes them restricted from uploading or ingesting some of the captured IKS in their institutional repositories. This shows that they do not have total archival control over some of the IKS data currently captured. The DST's NRS project has achieved a lot in the preservation of IKS, and there are continuous and ongoing projects in this area. Also, there is a need to consider problems related to long-term digital preservation to ensure that digital information is permanently secured and protected for integrity, authenticity and future access (Balogun and Kalusopa, 2021; Balogun and Kalusopa, 2021) emphasized their assessment of the digital preservation policies and plans for long-term digital preservation

for the NRS digitization project, with a proposed a digital preservation framework for the preservation of IKS in South Africa.

Recommendation

The major sources of IK as established in this study are primary sources from the knowledge holders in the communities. One of the institutions noted that they also collect grey literature through purchases, data mining, publications and documentation. On the sources of IK, it is recommended that other sources of IK should be explored. There has been a rise in empirical research involving IK in recent times, and even studies conducted at postgraduate level (Bishop, 2019; Bourget, 2020; Kapepiso, 2018). The academic institutions need to focus more on those grey materials and incorporate them into their institutional IK collection. The study also established that there is currently a focus on certain types of IK which are considered to be at risk of bio-piracy, and these are mainly IK related to medicinal plants and food. This is good for ensuring that IK is protected from bio-piracy and misappropriation (Christian, 2009; Avantika *et al.*, 2015; Poorna *et al.*, 2014). However, it is recommended that the scope of the IK collection should be broadened to include other types of IK, which are also very important. For example, IK is related to astronomy, soil conservation, traditional water-management and water conservation systems, traditional judicial systems, traditional soil network systems and pastoral systems, among others. For example, Indigenous Astronomical knowledge helps in the integration of several aspects of IK, such as food economy, social structure, seasonal calendars, ceremony, navigation and law. IK related to the judicial system and irrigation system has also proven to be successful in countries like Niger and Rwanda. The Tassa irrigation technique in Niger and the Gacaca system of community justice in Rwanda (Brehm *et al.*, 2014) are good examples of how IK has been used to solve practical, real-life problems in an African setting (Ezeanya-Esiobu, 2017). Exploring these other IK can be used to solve problems related to soil fertility or degradation of farmlands. IK researchers have also focused on the issues related to drought, and encouraging this kind of research can yield ground-breaking results which might be the solution to issues related to drought in the near future. Although some of the respondents acknowledge the importance of collecting other types of IK for future use, it is recommended that this should be considered more and as soon as possible. There is an assumption that the IK will always be there after prioritized ones considered at risk are collected. The knowledge holders of vital IK related to astronomy or other areas that are not currently under focus might not always be available. Therefore, it is important to consider expanding the scope of the collection.

The study established that the use of technology is adopted in the collection of IK. Field workers at the community levels use equipment such as audio/video recorders and digital cameras to collect data from the knowledge holders. These field workers are sometimes from the host communities to break the ice between the IK collectors and the knowledge holders in the local communities and also to gain trust from the knowledge holders. This is a good method of data collection, but it is recommended that the field workers should have adequate training before being recruited. Being a member of a certain community where knowledge holders are from should not be the sole criteria for recruiting certain IK recorders. The IK recorders need to be properly trained on the purpose of the IK project and how to use the equipment effectively. Skills such as proper interviewing and recording skills, photo skills and video recording skills are required to ensure that the IK data captured are of top quality. It is also recommended that academic institutions should be more involved in the data capturing and ingesting of IK in their institutional repositories. Different sources of IK should be explored more by the academic institutions, which should be ingested in their institutional repositories for researchers and external users.

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Further reading

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