



Understanding the current state of collaboration in the production and dissemination of adaptation knowledge in Namibia

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Abstract

Adaptation to climate change is challenging in terms of managing knowledge flow among diverse actors. This paper examines the roles of key actors in Namibia in the production and dissemination of climate adaptation knowledge. The intention was to identify opportunities for enhancing collaboration among actors to facilitate knowledge flow and uptake in adaptation action. The Omusati Region was used as a case study in understanding the chain of interactions among actors from local/district to the national level vis-à-vis the production and dissemination of adaptation knowledge in Namibia. The researchers conducted key informant interviews with representatives of key organizations in the Namibian adaptation network operating in the Omusati Region. The selection of the organizations of interviewed respondents was based on a previous climate change adaptation stakeholder and influence network mapping exercise in the region. Results indicate that adaptation knowledge generation by organizations happens mainly in the context of other developmental services. Furthermore, most organizations generate their adaptation knowledge internally through their directorates of research and also through cooperation with other organizations. However, there is little or no collaboration between organizations with respect to dissemination of adaptation knowledge to intended targets. The study, therefore, recommends a more concerted effort towards improving collaboration between organizations, and with local communities in the dissemination of adaptation knowledge as a way of enhancing knowledge uptake. This will have practical implications for the improvement in the rate of knowledge uptake in adaptation actions, particularly at the local level. In this regard, the use of workshop and field day meetings show the best prospect for improving collaboration between organizations in knowledge dissemination.

Keywords Climate risk · Risk response · Community · Indigenous knowledge · Livelihood

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1 Practical implication

This paper describes the adaptation knowledge production and dissemination networks in Namibia and is intended to inform research, policy, and practice concerning the production of adaptation knowledge, its transfer and subsequent adoption for effective adaptation action. As the paper makes clear, diverse actors are involved in the production and dissemination of knowledge on climate adaptation. While there are high rates of collaboration among these actors in the production of adaptation knowledge, the dissemination of adaptation knowledge to end users is characterized by a low rate of collaboration. The consequence is the challenge of ineffective knowledge dissemination. In most cases, the actual knowledge type needed by users remains unknown to producers, hence the low rate of uptake of generated knowledge by users in adaptation action. This problem is prevalent at the local level. The study offers insights for policy to improve feedback mechanisms between knowledge producers and users in the adaptation knowledge network in Namibia. This will have practical implications for the improvement in the rate of knowledge uptake in adaptation actions, particularly at the local level.

2 Introduction

Climate change is viewed as one of the greatest threats to sustainable development (Fröhlich and Knieling 2013). Policymakers and development practitioners face the complex task of ensuring that societies and socioecological systems adapt sustainably to the risk and impact of climate change (Bhaktikul 2012). In meeting this challenge, it is envisaged that policymakers' and development practitioners' demand for climate adaptation knowledge¹ may rise exponentially (Kalafatis et al. 2015). However, the knowledge required to manage the challenges of climate change is often situated in disparate locations and embedded in the traditional adaptive practices of the local people, national climate risk management agencies, regional climate risk management agencies, and elsewhere (Never 2012; Oppermann 2011). The same can be said for the wide range of actors whose operations are required to facilitate implementation of actions to aid societies to adapt to climate change (Lane and Rogers 2011).

At the global level, multilateral organizations like the Global Environmental Facility and the United Nations Framework Convention on Climate Change are some of the identified influential actors in climate change (Wilhelm 2012). At the country level, governmental organizations are the key influential actors in the production and dissemination of knowledge on climate change adaptation (Africa Adaptation Project Namibia: AAPN 2013). While scholars and practitioners have pointed out that enhanced knowledge is a crucial component of more effective adaptation actions, there is insufficient understanding of how the relationship between actors might influence knowledge uptake and use in decision-making and planning across different administrative scales (Kirchhoff et al. 2013). This has raised attention for the need to promote collaboration² between the wide ranges of actors with stakes in climate change adaptation, and to foster dialogue and knowledge exchange in

¹ The term climate adaptation knowledge as used in this study refers to acquired information on climate risk and risk response strategy.

² Collaboration as used in this study refers to stakeholders working together in the generation, dissemination and application of knowledge/information on climate risk and risk response strategy.

facilitating the implementation of effective adaptation action in different areas (Sitas et al. 2016; Wise et al. 2014).

The nature of collaboration that exists between actors in the production and dissemination of adaptation knowledge has been a long-standing issue of interest both in academia and among practitioners (Sitas et al. 2016; Partidario and Sheate 2013). Researchers and practitioners are giving increasing consideration to the ways that knowledge dissemination and exchange can link producers and holders of knowledge across different scales with users to support action on climate change adaptation (Prober et al. 2017; Sitas et al. 2016). This type of interest is receiving significant attention in many developing countries. This is partly because of the great need for effective utilization of local and research-based knowledge in development programs (Munoz-Erickson and Cutts 2016; Kirchoff et al. 2013). Much of the recent work on research-based knowledge utilization in most developing countries has focused on improving the relationship between knowledge producers and users as a means of ensuring that research is translated into action to secure better development outcomes (Lane and Rogers 2011; Straus et al. 2009).

In most developing countries, decision-making on climate change adaptation is often based on knowledge from climate information that is centrally generated and disseminated to relevant users through networks of collaboration among actors from national to the local level (AAPN 2013). This approach to knowledge generation and dissemination is basically rationalist and top-down and often leads to the existence of gaps between producers and users of adaptation knowledge (Kettle et al. 2014; Nair 2011). The growing criticism of this linear top-down approach to knowledge generation and dissemination is resulting in a debate on modalities of including the context of users in the process of handling knowledge (Haasnoot et al. 2013). In this regard, Van der Voorn (2008) and Van der Voorn et al. (2012) explored how participatory bottom-up processes can help to integrate different types of knowledge in an adaptive water management programme. Similarly, Nakashima et al. (2012) conceptualized how collaboration with indigenous knowledge holders can lead to co-production of a hybrid of scientific and indigenous knowledge relevant for effective adaptation action on the ground.

Accordingly, there is a renewed interest in understanding the context and relationships that exist among actors in the production, brokering, and translation of adaptation knowledge into action (Jones et al. 2014). This is based on the notion that a healthy relationship and network among actors in the production, brokering, and dissemination of adaptation knowledge can enhance the efficiency and effectiveness of knowledge translation to action. Furthermore, there has been increasing pressure from donors, government, and adaptation project sponsors for evidence showing how generated adaptation knowledge is communicated to intended targets and utilized in development actions (AAPN 2013). In addition, there has been little attention paid to the maximization of the different roles of governmental agencies in the generation and dissemination of knowledge for the adoption of effective adaptation action across various scales in such countries as Namibia (EIFN 2016).

This research uses the Omusati Region in northern Namibia as a case study to analyse various stakeholder roles and collaboration in adaptation knowledge production and dissemination. Namibia is one of the most vulnerable developing countries to the impact of climate change due to its socioecological characteristics. Namibia is the most arid country in sub-Saharan Africa and is characterized with frequent dry spells, persistent droughts, and sporadic severe flooding (Wilhelm 2012; Zeidler et al. 2012). According to the Notre

Dame—Global Adaptation Index (ND-GAIN)³ (2017), Namibia ranked the 53rd most vulnerable country to climate change and 97th in terms of her lack of readiness. In addition, 57% of the Namibian population live in rural areas where they are dependent on rain-fed farming and pastoralism which makes the people livelihood highly sensitive to climate variability and change (Namibian Statistics Agency 2013). Importantly, farmers in the Omusati Region of Namibia are not aware of climate change (Spear and Chappel 2018) and do not have information on adaptation (Davies et al. 2018); this makes them vulnerable to climate change.

As already alluded to, the study uses the Omusati Region of Namibia to illustrate the chain of interactions among stakeholders from local/district to the national level in the production and dissemination of adaptation knowledge. This was done by analysing the following two specific objectives:

Specific objective 1 To investigate current roles of key stakeholders in the production and dissemination of adaptation knowledge, and

Research questions What role do existing stakeholders play in the production and dissemination of adaptation knowledge?

Specific objective 2 To Investigate opportunities for enhancing collaboration among actors in the production and dissemination of adaptation knowledge:

Research questions How the relationships between the stakeholders may be enhanced for efficient and effective communication of adaptation knowledge to users

3 Materials and methods

3.1 Description of the study area

Namibia is situated in South-Western Africa. It has a population of 2.3 million based on 2013 census. Namibia is the second least densely populated sovereign country in the world (UNDP 2014). Overall, about 22% of the country is classified as desert, 70% as arid to semi-arid, and about 8% as dry sub-humid (Desert Research Foundation of Namibia 2013). The median annual rainfall in Namibia ranges from less than 50–250 mm in the southwest and coastline, and peak at 350–550 mm in the sub-humid northeast (Zeidler et al. 2012). Namibia has initiated a number of domestic activities to respond to the impacts of climate variability and change. The study was conducted in the Omusati Region (Fig. 1), which is situated in the North Central region of the country. Omusati Region is one of the fourteen regions of Namibia.

The dominant livelihood activity in the Omusati Region is subsistence crop and livestock farming. The majority of the farmers practise rain-fed farming (Angula and

³ The ND-GAIN Country Index summarizes a country's vulnerability to climate change and other global challenges in combination with its readiness to improve resilience (Chen et al. 2015). <https://gain.nd.edu/our-work/country-index/rankings/>.

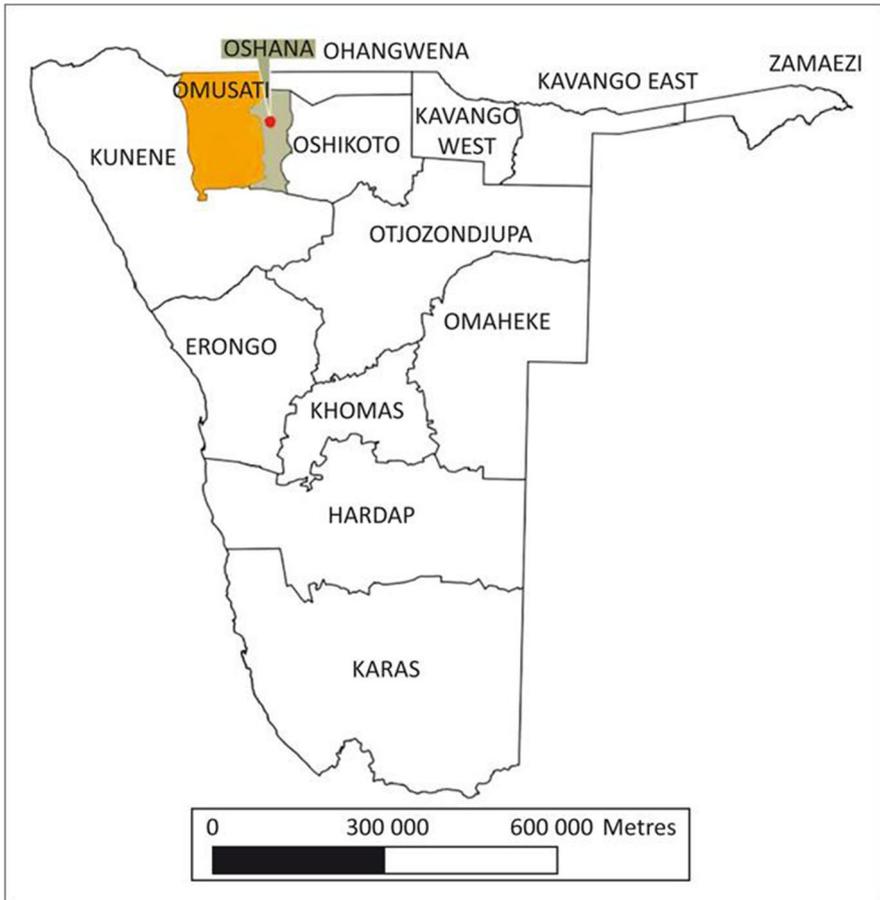


Fig. 1 A map illustrating 14 administrative regions of Namibia. *Source:* Geography and Environmental Studies GIS Technician, University of Namibia (Angula and Kaundjua 2016)

Kaundjua 2016). Most communities in Omusati Region are rural and characterized by numerous challenges including land degradation, deforestation and overgrazing, scarce water resources, and poor land tenure system (Angula and Kaundjua 2016). The Omusati Region has more female-headed households and female members in the population. This is because of the high unemployment rate in the Omusati Region. Consequently, many of the economically active male inhabitants have migrated to urban areas and to major cities and towns in Namibia (Namibia Statistics Agency: NSA 2011). The socioecological characteristics of the Omusati Region make it a hot spot in relation to climate change impacts (Spear et al. 2015).

3.2 Data collection and analysis

This study applied a qualitative research process, with key informant and semi-structured interviews being used to collect data. The interviews were conducted from March to April 2016. Interviews on adaptation knowledge translation at sub-national level were conducted with representatives from nine organizations identified as key in the Namibian adaptation network (Adaptation at Scale in Semi-Arid Regions: ASSAR 2015). Selection of key actors was based on a prior stakeholder and influence network mapping exercise carried out by the research team (ASSAR 2015). The study analysed stakeholders in the climate change adaptation network in Namibia with the view of understanding how they interact with one another and influence decision-making on adaptation to climate change in Namibia (Hegga et al. 2016). Institutional entities involved in the study included: the Red Cross Society, Regional Disaster Risk Management Committee (RDRMC), Directorate of Agriculture, Production, Extension and Engineering Services (DAPEES), Forestry Department—Onesi Constituency, Traditional Authority—Uukolonkadhi, Directorate of Water Resources Management (DWRM), Directorate of Planning and Rural Services (DPRS), Constituency Development Committee Members—Onesi (CDC), and Horticultural Producers Association—Olushandja. A semi-structured interview guide was used to interview the heads of ministries/departments from the selected organization. In the instance where the head of the department was unavailable, the researchers engaged the most appropriate person within the organization best placed to provide answers to the interview questions. The questions for the interviews were formulated in such a way as to tease out as much needed data on the organizations as possible. Thus, questions were asked on organizations' role in the production, dissemination, and use of knowledge on climate risk and risk response strategy. Questions were also asked on organization's web of collaborations in the production and dissemination of adaptation knowledge.

Participants were made to sign consent forms before interviews, and the interviews were digitally voice-recorded and later transcribed before coding and analysis. Thematic analysis was used in analysing data. Qualitative data analysis software (NVIVO 11) was used to organize the unstructured qualitative data, including coding and categorizing the codes into broader themes. Coding was applied to all the transcripts at three levels (Strauss and Corbin 1990): initial/open coding, focused coding, and thematic coding. The transcribed interviews were coded line by line during the initial and open coding until no further new codes emerged (thematic saturation) (Charmez 2011). Abductive reasoning was used to allow themes to emerge from the data (partly adopting a grounded theory approach such as the multi-level coding process) in order to strengthen our understanding of barriers and enablers of adaptation knowledge production and dissemination including the collaboration thereof. In an abductive reasoning process, logical inferences are made by finding the simplest and most likely explanation to an observation or set of observations (Haig 2008).

4 Results

4.1 Organizations’ role in the production and dissemination of adaptation knowledge

All organizations surveyed played important roles with respect to adaptation knowledge production and dissemination. The knowledge provided by these organizations is usually in the form of agriculture advisory and supports services to help people to respond to the impacts of various climate risks (list of knowledge on climate risk and risk responses provided by the surveyed organizations is attached in “Appendix”). None of the organizations currently provide long-term advisory and support services to help people anticipate and adapt their livelihood practices to projected climate risk events. As reported by the representative from Red Cross,

We do not currently have access to climate information on a 1–5-year term.

This was also echoed by the representative from the CDC,

We only get short-term information, and we don’t really get like for instance information on say 2–5 years climate projection.

All climate risk response advisory and support services provided by the surveyed organizations can be clustered around three major themes (Table 1): natural resource management, provisioning of social support, and provisioning of technical support.

Climate risk response advisory and support services clustered under the theme “natural resource management” include advisory services that support the sustainable utilization and management of water and forest resources in the region. The advisory services clustered within the theme “provisioning of social support” include the services that aim at providing relief materials, social security in the forms of grant, social work, and temporal employment to the populace to support their well-being. The advisory services clustered within the theme “provisioning of technical support” include services that provide the people with technical know-how, and best practices to support farming and other livelihood activities in the region.

Table 1 Thematic descriptions of organizations role in production and dissemination of knowledge

Organization	Natural resource management	Provisioning of social assistance	Provisioning of technical support
DAPEES			✓
DPRS	✓	✓	
CDC		✓	
RDRMC		✓	✓
Forestry department	✓		✓
Red Cross society		✓	✓
Horticultural association		✓	✓
Traditional authority	✓		
DWRM	✓		

✓ = service provided

The Directorate of Agriculture, Production, Extension and Engineering Services (DAP-EES) provides various services to communities to facilitate livelihood sustainability and resilience to climate change impacts. DAPEES provides agricultural extension information to farmers (e.g. on seeds selection for farming and best cultivation methods). They also train farmers on new agricultural technologies. In the same vein, the Forestry Department manages and facilitates the responsible utilization of forest resources in the communities by training farmers on the responsible harvesting of forest products. Similarly, the Directorate of Planning and Rural Services (DPRS) provides technical and social assistance to communities to enhance their livelihood sustainability and resilience to climate change. The DPRS provides facilities such as water supply, electricity, and sewer to enhance the communities' resilience. They also implement projects that support communities to improve their living standards through job creation. An example is the rural employment schemes that utilize projects such as road construction, bridge construction, dam construction, and water pipeline maintenance. Furthermore, the Regional Disaster Risk Management Committee (RDRMC) provides social support through provisioning of relief materials, food and non-food items to communities in the event of climate hazards.

Other surveyed organizations provide various forms of support, which enhances government services towards communities' livelihood sustainability and resilience to climate change. Organizations in this category include the Red Cross society, the Constituency Development Committee (CDC), and the Horticultural Producers Association. The Horticultural Producers Association assists farmers in sourcing resources (e.g. tractors and fertilizers) for their farming operations. They also assist farmers in marketing their produce. The Red Cross society complements government services to communities in the areas of health and care, disaster management, humanitarian diplomacy, and organizational development. The CDC assists in the identification and reporting of community development concerns to the responsible government agency. The Directorate of Water Resources Management (DWRM)—water basin management division—works mainly on the translation of water management-related technical information into usable information for relevant stakeholders.

4.2 Adaptation knowledge generation and existing collaboration

Collaboration in knowledge production and sourcing entails the exchange of ideas and experiences through an organization's networks of relationships. The actors were interrelated on the existing networks within their organizations for sourcing and generating knowledge on climate change adaptation. Three out of the nine organizations that were involved in knowledge generation generate their climate information and adaptation knowledge internally, utilizing the organization internal structure. These three, the DAPEES, the DPRS, and the DWRM, do generate their adaptation knowledge (climate advisory services) internally through their respective directorates of research. However, the remaining six organizations generate their adaptation knowledge through collaboration with other government agencies, the most notable being the meteorological department. The nature of this collaboration is mostly in the form of transfer and exchange of information relating to adaptation knowledge. As stated by the representative from the Red Cross,

We basically get our climate information from International Organisation for Migration (IOM), the Red Cross itself, the Meteorological Office and local knowledge from traditional leaders in communities where we operate.

The other sources of adaptation knowledge as mentioned by the surveyed organizations are presented in Table 2.

All the organizations involved in the study have existing collaborations with national and international organizations. However, most of the existing collaborations are in the area of production and sourcing of adaptation-related knowledge through exchange and transfer.

The DAPEES works with other stakeholders such as regional councillors, The United Nations' Food and Agriculture Organisation, and Japan International Cooperation Agency (JICA) in delivering climate-based advisory services around such activities as conservation agriculture and general crop and livestock production in the area to local farmers. DAPEES also works together with the Directorates of Water and Veterinary Services in delivering climate-based advisory services to farmers. The CDC works hand in hand with the traditional authorities (some of whom are part of the CDC) in the identification of vulnerable groups/families in the communities for targeted assistance through initiatives such as seed distribution and drought relief. The DWRM works with the Regional Council and the Office of the Prime Minister (OPM) in coordinating flood and drought responses in local communities. As stated by the representative from the CDC,

We work hand in hand with traditional leaders, they are our main stakeholder together with the regional council in terms of climate information delivery, and they really assist us and make it easier for us to reach the right people.

4.3 Adaptation knowledge dissemination and existing collaboration

Organizations involved in the study use diverse methods to disseminate adaptation-related knowledge to intended targets. The most common form of adaptation-related knowledge dissemination is workshops, which are used by seven of the nine organizations. Workshops are carried out mostly through extension meetings, field days, farmer training sessions, church services, and exposure visits (taking farmers in the region to other constituencies and regions to see what others in other areas are doing). Five of the surveyed organizations including the DPRS, DAPEES, CDC, the Red Cross society, and the forestry department

Table 2 Existing type of collaboration among actors in knowledge generation

Organization	Internally generated	Media	Mete- orological services	Other gov- ernmental agencies	Regional agencies	Traditional knowledge	Workshop
DAPEES	✓			✓	✓		
DPRS	✓			✓			
CDC			✓				✓
RDRMC			✓	✓			
Forestry department		✓					
Red Cross society			✓				
Horticultural asso- ciation		✓					
Traditional authority				✓		✓	
DWRM	✓		✓	✓	✓	✓	

✓ = yes

Table 3 Existing channels of adaptation knowledge dissemination

Organizations	Emails	Government agencies	Media	Videos, books, and notice boards	Workshop
DAPEES					✓
DPRS			✓	✓	✓
CDC		✓		✓	✓
RDRMC		✓			
Forestry department					✓
Red Cross society				✓	✓
Horticultural association					✓
Traditional authority					
DWRM	✓		✓		✓

✓ = used

utilize the workshop medium in disseminating adaptation knowledge to targeted communities. As stated by the representative from the Forestry Department,

We had training workshop on early warning, we will just elect some member of the community, and train them on preparedness, and how to respond in the event of any disaster e.g. flood.

The second most common method for adaptation-related knowledge dissemination is the use of videos, illustration books, and notice boards. Other channels include the use of such media as radio and televisions. Table 3 shows all the channels of adaptation-related knowledge dissemination as mentioned by the different organizations. Furthermore, the researchers did not record any form of collaboration among actors in the dissemination of adaptation knowledge.

4.4 Barriers to adaptation knowledge uptake

The surveyed organizations were interrogated on the nature and type of barriers they have encountered in disseminating adaptation knowledge to target communities. The general overview of the identified barriers to adaptation knowledge dissemination is presented in Table 4 and discussed below.

4.4.1 Poor cooperation of workshop attendee

The most common barrier mentioned by interviewees is largely associated with obstacles involved in the use of workshops as medium for adaptation knowledge dissemination. Four of the interviewed organizations mentioned this barrier. Barriers encountered in this regard include low attendance of meetings, low interest in the workshop subject, and non-transference of knowledge from adaptation-related knowledge workshop to other members of the communities by workshop attendees. As stated by the representative from the forestry department,

Table 4 Identified barriers to adaptation knowledge dissemination

Organizations	Insufficient fund	Lack of access to communication channels	Lack of trust in scientific information	No response	Poor capacity	Poor cooperation of workshop attendee	Unusable information
DAPEES	✓					✓	
DPRS	✓				✓	✓	
CDC			✓				
RDRMC				✓	✓		
Forestry department				✓			
Red Cross society	✓					✓	
Horticultural association							✓
Traditional authority			✓			✓	
DWRM				✓			

✓ = identified as a barrier

Sometimes the interest of the communities is a challenge. You don't know whether the community members are interested or not. This can be a challenge at a certain point because people have come for a meeting but their level of understanding is not that good, they will not really get to deliver the message the way you explain it to them.

This was corroborated by the representative from DPRS:

One of the problems, I think, is communication because you go to the place and tell them the specific issue or problem but the person coming to the meeting is not going to spread the news or anything. After the meeting they go back and nothing is done so the next person doesn't know anything.

4.4.2 Low capacity in the organization

Another barrier identified is the issue of low organizational capacity. Three of the interviewed organizations mentioned this barrier. This challenge is expressed in diverse forms. In some cases, the organizations do not have sufficient personnel (extension personnel) to cater for the needs of the targeted communities. As stated by the representative of traditional authority,

We need more extension officers for our constituency. We need like 2 or 3 more of them. You see most times an individual cannot manage to cover the whole constituency.

In other cases, the organization does not have a fund to adequately train their staff to be able to carry out the duty of adaptation knowledge dissemination.

4.4.3 Lack of trust in scientific information

Another barrier which came up is centred on the issue of lack of trust in scientific knowledge about climate change. Only one of the interviewed organizations (i.e. the traditional authority) mentioned this barrier. Doubts on the credibility of scientific climate knowledge are mostly as a result of the scale at which climate information is presented. Many times, climate information, e.g. rainfall and temperature forecast, is presented at sub-national level, and oftentimes such information is not relevant to all local communities within the district. As reported by the representative from the traditional authority:

Sometimes if it is announced in the radio that the northern part of Namibia will receive rains, you see maybe it will rain in Ohangwena region of the north and not in the Kavango region of the north. This makes people in the part that did not receive the rain to be confused.

This challenge was corroborated by the representative from the forestry department:

We don't receive weather information at constituency level. The information we receive is on weather from the news and that is at the national level.

The challenge associated with the scale at which climate information is disseminated leads to a wider mistrust of scientific climate information and to develop more preference for

indigenous knowledge. This trend is more widely observed among the elderly, as stated by the representative from the traditional authority:

When the farmers hear from the radio that the northern part will receive rain, they think it's the whole of the northern part at the same time. But when it's not so, the farmers become confused. This makes them to rely on traditional knowledge. But this is mostly the elderly ones.

The challenge associated with the scale at which climate information is disseminated is a concern that was expressed by nearly all the interviewees. The representative from the CDC, for example, stated that:

We need the metrological station to be decentralised. There should be meteorological stations in each region so that we get climate information at different times of the year that is specific to our region.

This was corroborated by the representative from the Horticultural association who noted that:

We want information on whether the rain will come that year or not and, also, we want to know temperature patterns, as this will help us to avoid resource waste. However, we want this information as it relates to our specific area.

4.4.4 Lack of access to communication channels

The barriers associated with the use of different communication channels in disseminating climate adaptation knowledge are manifested in diverse forms. Three of the interviewed organizations mentioned this barrier. In some cases, the effectiveness of the use of mobile phones for knowledge dissemination is constrained by network challenges. Many of the vulnerable communities have poor or no access to mobile phone networks which makes it difficult for them to access adaptation knowledge via mobile phones. In some cases, the vulnerable people are so poor that they do not have a radio which makes it impossible for them to access climate adaptation knowledge via the radio. As stated by the representative from DPRS,

The more vulnerable people don't have radios and they don't go to offices to see on the notice board, they are not really aware of it they don't have access to climate information.

4.5 Opportunities for enhancing collaboration

As more government and non-governmental actors take steps towards the implementation of climate compatible development through the provisioning of technical and advisory services to vulnerable people, the demand for knowledge on climate risk response strategies will increase (Agrawal and Perrin 2009). However, the array of actors generating, disseminating, and using this knowledge is correspondingly diverse, making the coordination of effective knowledge flow between producers, brokers, and users all the more challenging to manage (Ochieng 2009; Young 2004). Understanding the roles and activities of actors within the adaptation network and fostering collaboration between these actors to overcome gaps in knowledge production and dissemination offer a prospective means

to manage the challenge of knowledge flow in adaptation action. This thinking has been applied in this study.

Evidence from this study indicates that the services provided by the different organizations do not solely focus on climate change. As stated by the representative from the horticultural producers association,

The type of information we get from the extension office is just how to sow and what time to sow a specific crop and then how to take care of the crops and then what type of fertilisers to apply.

In most cases, knowledge on climate adaptation is part of a broader service being provided by the organizations. This is also corroborated by the representative from DPRS,

We do not have projects that are solely targeting climate change issues. We just try to target general issues.

Thus, effort is needed to increase the level of adaptation-related knowledge generated and disseminated to the local communities. This will help to improve knowledge and awareness about the causes, impacts, and responses to climate change in Namibia.

Nevertheless, study findings indicate that the generation of knowledge on climate information in Namibia is dominated by government agencies. The translation of this knowledge into advisory services on risk response strategies is also mostly done by government agencies. There are, however, a few national and international non-governmental agencies that are also engaged in knowledge translation into advisory services for targeted audiences. Nevertheless, the technical and advisory services provided by all surveyed organizations focussed mostly on improving households' livelihood sustainability and resilience to climate and socio-economic risks. The technical and advisory services are geared towards helping the people bounce back from the impact of climate and socio-economic challenge; that is, these services are basically reactive in nature. A similar pattern has been observed in many developing countries, where climate risk response strategies are dominated by actions tailored at assisting communities to recover from the impacts of climate variability and change (Granderson 2014 Bhaktikul 2012; Newsham and Thomas 2009).

There is still much to do to improve the supply of robust knowledge to policymakers and practitioners to enhance community capacity to adapt (both in terms of anticipation or reaction) to climate change. This will require improved collaboration between knowledge generators, intermediary government and non-governmental agencies, and users so as to capture the unique context of each user group in knowledge generation and translation (Hammill et al. 2013; Best and Holmes 2010; Harvey et al. 2009). As suggested by Kettle et al. (2014) and Coffey and O'Toole (2012), getting governmental and non-governmental actors to incorporate traditional practice rooted in local knowledge system in their advisory services might help to improve the delivery of robust adaptation option to the targeted audience. Thus, a hybrid system that draws from scientific knowledge system, practitioner knowledge, and traditional/local knowledge system will be required. This will entail adoption of a bottom-up participatory process that strives to mainstream local adaptation practices rooted in the people cultural practices into national adaptation policies and programmes. However, the implementation of such a hybrid system might require getting policymakers and government agencies to recognize the validity of local knowledge as a complimentary approach to climate change adaptation (Agrawal and Perrin 2009). In the case of Namibia, this will involve a participatory process that is cross-scalar and cross-disciplinary in approach and that involves a mix of actors including local traditional authority, community-based organizations, non-governmental organizations, farmers associations,

national agencies, and regional organizations in a planning process that seeks to mainstream diverse knowledge types into the national adaptation policies and programmes. This suggestion is very relevant to the Namibian case study, given the high preference of local adaptation practices rooted in indigenous knowledge systems in rural communities, particularly among the elderly. A good example has been reported by several researchers. For example, Harvey et al. (2009) reported of a participatory scenario planning process in Kenya that involves the participation of indigenous rainmakers collaborating with meteorologists on climate prediction. A similar approach has been reported by Van der Voorn (2008) in the context of Bangladesh's adaptive water supply management programme.

Furthermore, this type of collaboration can be useful in managing some of the barriers currently experienced in knowledge dissemination in Namibia. One of the barriers to knowledge uptake as observed in this study is centred on the issue of trust in the disseminated scientific knowledge by community members. This type of barrier has been observed by Ochieng (2009) as a common problem in many African countries. The study reported lack of trust in relations between the different category of actors such as scientists, knowledge brokers, and policymakers. This finding highlights the need for an improved relationship between actors in the generation and brokerage of knowledge and the user communities. Further, as we begin to dissect the reasons for preference of indigenous knowledge for adaptation by the local population, it becomes important to consider how to appropriately encourage collaboration with and between the bearers of this knowledge (Harvey et al. 2009).

There are opportunities for improving collaboration between knowledge producers, brokers, and users in order to facilitate uptake of knowledge in adaptation action in Namibia. The findings of this study indicate that the bulk of the existing collaboration is occurring at the interface of knowledge sourcing and generation. However, this form of collaboration seems to be limited in its approach. Currently, collaboration in knowledge production is mostly with international actors with no meaningful collaboration with local communities. For instance, DAPEES collaborates with FAO and JICA among other stakeholders in knowledge production. However, there is no evidence of their collaboration with local communities or traditional authority in knowledge production. Furthermore, the seemingly existing collaboration with local actors in knowledge production is mostly focused on assisting knowledge providers to identify members of the community that have been impacted more by some specific climate event. This form of collaboration was observed between the CDC and traditional authorities. This form of collaboration has limited impact and effectiveness. This is because unique locally observed climate risk and risk response strategies within specific local sociocultural contexts are often not captured. Thus, this information is not factored in by national actors in their generation of knowledge on risk and risk response strategy for the communities. Engaging community members in knowledge generation processes will help in ensuring that the knowledge provided is tailored to the context and needs of the people (Cvitanovic et al. 2015; Cornell et al. 2013).

The entrenched way in which knowledge is disseminated to the targeted audience needs to be addressed. Specifically, there is a need to explore options to improve collaboration in knowledge dissemination. This becomes apparent given the findings that all surveyed key actors are engaged in knowledge dissemination, yet there is no form of collaboration between these actors in knowledge dissemination. For example, both the DPRS and DWRM are using the media to disseminate knowledge to targeted communities, yet there is no collaboration between them in the dissemination of knowledge. The lack of collaboration in knowledge dissemination is leading to duplication of effort with scarce resources.

These can constitute a challenge or barrier to efficient knowledge dissemination. The issue of poor collaboration in knowledge dissemination can be linked to some of the barriers expressed by the actors in the dissemination of knowledge. For example, the barrier of poor capacity in knowledge dissemination, which is mostly as a result of insufficient staff to disseminate information to the numerous local communities in the area, can be managed through cooperation between government agencies. For instance, given the fact that most of the agencies such as DAPEES, RDRMC, and CDC disseminate almost the same kind of advisory services targeting improvement in livelihood strategy, through enhanced cooperation, the knowledge being disseminated can be streamlined to cover all knowledge emanating from all the relevant actors and communicated to the people. This will eliminate duplication of effort and also ensure maximization of the number of available extension personnel in the area. As reported by Kalafatis et al. (2015) and Ochieng (2009), improving communication activities can significantly enhance knowledge uptake. Improving collaboration between government agencies can aid the effectiveness and efficiency of adaptation knowledge delivery to local users. For example, the DAPEES can utilize CDC expertise in identifying the vulnerable member of the society, for targeted assistance.

As the socio-economic condition of people improves and their capacity to adopt a longer-term adaptation action increases, the demand for knowledge on multi-years (5–10) and decadal risk and risk response strategies are likely to surface. There is evidence that this demand is starting to occur. When respondents in this study were asked of any climate information that they would like to have that they currently do not have, a representative from the forestry department stated,

We would like to have longer (a yearlong or more) estimated information on how the weather could be, how land resources will be affected, how much rainfall we are going to receive if it is average or low. This would enable us to better plan to overcome any disaster that we will face.

Thus, it is important for national actors to begin to make a plan for the provisioning of knowledge on long-term risk response strategy to enable the people to anticipate and adapt to climate change. This is most likely to require the provisioning of climate advisory knowledge that is tailored to specific local context. However, transition from climate advisory knowledge that is broadly useful to the tailored knowledge that is usable in specific contexts may become too resource-intensive for a developing country like Namibia (Kirchhoff et al. 2013). It is thus important for actors in the Namibian adaptation network to begin to work towards the development of collaboration for the provisioning of long-term climate advisory knowledge to society, particularly the local communities.

5 Conclusion

The principles of knowledge translation suggest that knowledge adoption can be increased by tailoring the format and context to the adoptive capacity of the targeted audience. This will entail a more meaningful collaboration between actors and users to ensure the capturing of users' sociocultural context in knowledge generation and dissemination. Our study provided a systematic approach to understanding existing collaboration in adaptation knowledge generation and dissemination in Namibia. This understanding was also used to analyse barriers to knowledge uptake in adaptation actions. Collaboration among actors was observed to be occurring mainly in the generation of knowledge and less in the

dissemination of knowledge to the targeted audience. Furthermore, the diversity of actors involved in the management of climate change impact and the socio-economic profile of the local knowledge users was observed to, in most instances, constitute a barrier to knowledge uptake in adaptation action.

In the current mode of climate knowledge generation in Namibia, there is a marked disconnect between public policies and local traditional coping/adaptation practices. At present, processes of climate knowledge generation are typically focussed on the national level. National strategies developed and implemented by government agencies are, however, often not conducive to local coping/adaptation practices to climate changes, which are rooted in local knowledge, sustainable livelihoods, and community-based innovation (Zeidler et al. 2012). Evidence from this study suggests that policies that encourage a collaborative approach where local communities are directly involved in all aspect of knowledge generation and dissemination are more likely to succeed.

The implementation of effective adaptation action will, therefore, require collaboration among actors. This will also help in addressing barriers to knowledge dissemination and uptake raised during various interviews, and ensure the generation and dissemination of knowledge that is tailored to the sociocultural context of the users. The study insight on tailoring adaptation knowledge to sociocultural context of users is crucial, as the final uptake of knowledge in practice is often more dependent on the context of users than on the attributes of the generated knowledge. Consequently, local people's proactive participation in a bottom-up collaborative process that covers all aspects of knowledge generation and dissemination is becoming indispensable for the communication of relevant contextual knowledge on climate risk and risk response strategy to users. Fostering collaboration in knowledge generation and dissemination should include maintaining continuous collaboration throughout the value chain of knowledge generation and translation among the actors in the adaptation network. This will require an understanding of the functionality and capability of relevant actors within the adaptation network. This is very relevant in the context of much African and will enhance efforts towards knowledge uptake in adaptation actions. As evidenced from this study, local people's collaborative participation in knowledge generation and dissemination enables the availability of contextual knowledge and may lead to collective support for the outcomes of climate change adaptation, which in turn increases their legitimacy. In light of findings from this study, a participatory process that is socially all-inclusive, cross-scalar, and cross-disciplinary is recommended.

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Appendix: Advisory services provided—knowledge on climate change adaptation

Forestry division (Onesi constituency)

1. Communicates information on conservation and agriculture to farmers.
2. Provides training to farmers and villagers on how to overcome climate change impact on livelihood.
3. Receives information from meteorology department on amount of rainfall expected for the year processes the information into advisory services which is communicated to their audience. For example, they determine the variety of crop (e.g. maize) that should be planted that year which are then communicated to farmers.

CDC

1. Mobilizes community member's for collective action in development projects, e.g. road construction,
2. Serves as a mediator between government agencies and communities with respect to identification and facilitation of actions for tackling community and individual developmental needs, e.g. provisioning of vocational training, provisioning of relief materials, dam construction
3. Is responsible for profiling and forwarding community development concerns to responsible authorities at the regional level.
4. Is main point of contact with government and non-governmental stakeholders on community development projects.
5. Mobilizes community members on internal community development projects (e.g. road repairs).

Traditional authority

1. Engages in land allocation to community members.
2. Regulates the utilization of natural resources, e.g. trees, fish, water, in the community.

Horticultural association

1. Assists members in sourcing materials and resources to support their farming activities. Help farmers (members) in easily marketing/selling their produce and sourcing resources (e.g. tractors and fertilizers) for their farming operations.

Directorate of Planning and Rural Services

1. Focusses on development planning for the rural regions. Carry out projects that support communities to improve their living standards through job creation (e.g. food/cash-for-work projects, microfinance, rural employment schemes such as road construction,

bridge construction, dam construction, water pipeline maintenance) as well as improving people's living standards by putting up water facilities, electricity, and sewer.

Red Cross society

1. Works to compliment government effort in four areas which is health and care, disaster management, internal diplomacy, and organizational development.

Regional Disaster Risk Management Committee

1. Provides information to communities on impending disasters such as droughts and floods.
2. Distributes food and non-food items received from central government for disaster response.

Directorate of Agriculture, Production, Extension and Engineering Services

1. Provides agricultural extension information to farmers (e.g. on the right seeds, right cultivation methods)
2. Trains farmers on new agricultural technologies.

Directorate of Water Resources Management (water basin management division)

1. Implements water resources management at the basin level.
2. Is the main link for stakeholders in water management at the basin level.
3. Translates water management-related technical information into usable information.

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