



Memories of environmental change and local adaptations among *molapo* farming communities in the Okavango Delta, Botswana—A gender perspective



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ABSTRACT

This paper focuses on ways in which three riparian communities (Xobe, Shorobe and Tubu) practising flood recession (*molapo*) farming along the fringes of the Okavango Delta in Ngamiland District in north-western Botswana, present memories of experiential impacts of and adaptation to key environmental and anthropogenic change events. Participatory methodological tools were used to capture local knowledge of people who had resided in the Okavango wetlands for many years. Findings indicate that key environmental change events were characterized by intergenerational experiences of severe and frequent droughts, floods, and recurrent outbreaks of human and animal disease. These events had impacted livelihoods and well-being of communities. Community adaptation strategies were embedded in local institutions of governance, especially chieftainship and the *Kgotla*, as legitimate platforms for community re-organization against unpredictable environmental change. We concluded that policy/program formulation processes need to take cognisance of local communities' historical knowledge of environmental change and adaptation. In particular it emerged that men and women, and people of different ages have differentiated memories of historical events which are complementary and necessary in developing a comprehensive adaptation strategy.

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1. Introduction

Past and present societies in Africa, and elsewhere in the world, have been, and continue to be daunted by uncertainty due to vulnerability to environmental change risks (Phillips and Orlove, 2004; Suarez and Patt, 2004) and hydro-climatic change. Communities in southern Africa continue to struggle to mitigate such changes through locally embedded and innovative ways of coping and adapting to change. One of the most neglected areas of research is the gendered impacts and adaptation to environmental change (Ziervogel et al., 2006; Acosta-Michlik and Espaldon, 2008; Hertel and Rosch, 2010).

Women are among 'structurally vulnerable' social groups by virtue of their history and/or unequal treatment by the rest of the

society (UNDP, 2014). Other vulnerable groups include children, people with disability, ethnic minorities and the elderly. Women in rural and urban settings are particularly sensitive to environmental change (Watson et al., 1996; Kaspersen et al., 2005), partly because of gendered division of labour (Nelson et al., 2002) and their dependence on local natural resources (Kakota et al., 2011). Analysis of past and present experience of environmental impacts therefore has to consider these differences between and among men and women.

Memory is one of the most important ways that communities connect past and present experiences (Vogt, 2010) by searching for the things that bind and/or divide them (Weightman, 2012). Memory is therefore a crucial component of creating and maintaining individual and collective identities of women and men. Social memory however, is a context-sensitive process. Remembering (and forgetting) present and past events is mediated by complex relationships (social and institutional) (Vogt, 2010; Hautaniemi et al., 2006). This paper focuses on ways in which flood recession farming communities in the Ngamiland District in the north western

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Botswana, individually and collectively present compelling memories of key events depicting experiences of women and men on environmental change and local adaptations in the Okavango Delta.

The results presented in this paper are a product of a larger Botswana Eco-Health Project whose overall goal was to investigate the likely impacts of hydro-climatic change on the health, food security, environmental sustainability and livelihoods of the vulnerable communities dependent on *molapo* (flood recession) farming in the Okavango Delta (Chimbari et al., 2009). The Project adopted an ecosystem approach to human health, emphasising trans-disciplinarity, community participation, as well as gender and social equity (Charron, 2012).

2. Material and methods

2.1. Study area

The study was conducted in the Okavango Delta area in Ngamiland district, north-western Botswana. The Okavango Delta (OD), is a wetland of local, national and international importance, being a United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage and RAMSAR site (<http://www.ramsar.org>). Nationally, it is a flagship tourism destination and locally, a source of livelihood to resident communities. Among other livelihood activities, the local communities within the Okavango Delta practice flood recession farming, locally known as *molapo* farming. This traditional farming system is made possible by the flood-pulsed nature of the OD that forms the distal end of the Okavango River Basin, originating from the highlands of Angola, traversing through northern Namibia and culminating into the Okavango Delta in north-western Botswana (Fig. 1). The Okavango Delta system is dependent on rainfall in the highlands of Angola which averages 1400 mm per year. The average local rainfall within the Delta is 450–550 mm per year. The flooding, rainfall variability and local topography of the Delta leads to variations in nature-based sources of livelihoods such as fishing, harvesting of non-timber products, livestock as well as dry-land and *molapo* farming. *Molapo* farming is highly dependent on hydro-climatic variability and anthropogenic change processes, including timing and extent of flooding (Molefe et al., 2014).

2.2. Study sites

The study was conducted in three rural villages that practice varied *molapo* farming styles because they experience different types of flooding. Tubu experiences frequent flooding on a vast flood plain where the crops make great use of moisture left behind by a dropping water table, Shorobe is characterized by periodic flooding of local lagoons in which farmers plough following receding flood waters, while Xobe is subjected to occasional flooding of the river channel banks and farmers plough following receding water.

Tubu is in Ngamiland West Sub-district 10 km east of Gumare on the banks of the Thaoge River (Fig. 1). Flooding occurs every year but its extent varies. The major source of livelihood in Tubu is agriculture (both crops and livestock). The village population is 483, made up of 219 males and 264 females (CSO, 2012). Shorobe village is in Ngamiland East Sub-district, about 36 km northeast of Maun. To the northwest of the village there is an extensive network of *molapo* fields fed by the Santantadibe and Gomoti Rivers; and by backflow from the Thamalakane River (Fig. 1). Livelihood sources include both arable and pastoral farming, sale of traditional beer made from sorghum, palm wine, fish and baskets. The village has a population of about 1031, comprising 482 males and 549 females (CSO, 2012). Xobe is located on the southern bank of the Boteti River about 13 km east of Maun (Fig. 1). The village has 277 residents,

comprising of 160 males and 117 females (CSO, 2012). Livelihood activities in Xobe include rain-fed farming, *molapo* farming, irrigated vegetable production, livestock rearing, and harvesting of medicinal and edible wild plants (for domestic consumption or sale).

2.3. Data collection

Data were collected from the three villages in 2010 and 2011 using Participatory Rural Appraisal (PRA) tools. In Shorobe, there were 40 participants (15 males and 25 females); Tubu had 63 participants (22 males and 41 females), and Xobe 28 (17 males and 11 females). There was no specific inclusion criteria for workshop participants as that depended on people who presented themselves after a general invitation was sent out through the village chief. This paper uses data generated from 18 Focus Group Discussions (FGDs); 6 from each study site. The FGD groups comprised of men only (3 groups), females only (3 groups) and both males and females (12 groups). Additional data was sourced through field observations, unstructured interviews and secondary data.

2.4. Focus group discussions (FGDs)

Female or male FGD groups were constructed by grouping men and women of different ages separately. Each group had 8–20 members depending on the attendance, with Tubu having the biggest groups and Xobe the smallest. They were asked to construct a historical timeline (HTL) based on individual and collective cultural memories. Both males and female mixed groups were constituted asking participants to count 1–4 following their seating order. This generated four working groups in each site. The groups reflected the Project thematic areas namely environment and biodiversity; health; agriculture and food security; and hydro-climatic variability/policy/gender. These working groups at each site were asked to reconstruct trend-lines in relation to climatic variability (CTL) and people's wellbeing. Each FGD selected a scribe and a presenter.

Researchers, graduate students and community research assistants who had previously received a 2 day training on participatory rural appraisals (PRA) methodologies (Chimbari et al., 2010) from a PRA specialist facilitated in each of the FGD groups.

2.5. Field observations and secondary data

Field observations, informal unstructured interviews as well as secondary data sources were used for structural corroboration to enhance credibility (Ary et al., 2009). Direct and systematic unobtrusive field observations of the historical landscape and material culture were employed to gather additional data. The researchers took part in transect drives across the three study sites, accompanied by community guides to make observations. The community representatives, mostly comprising of community elders and authorities, made several stops along the transects to explain some key historical events. The respondents for the unstructured interviews comprised of either male or female tribal/community leaders; traditional health practitioner/personnel, community members and government/NGO officers.

Secondary data were collected from review of published scholarly articles and unpublished sources from government reports. This included health reports of trends of diseases from the Ministry of Health and District Health Management Teams in Ngamiland, meteorological data (rainfall and temperature trends) from the Department of Meteorological Services in Shakawe and Statistics Botswana. Hydrological flood inflow variability trends were sourced from the Department of Water Affairs at Mohembo and the Okavango Research Institute. Data related to pastoral

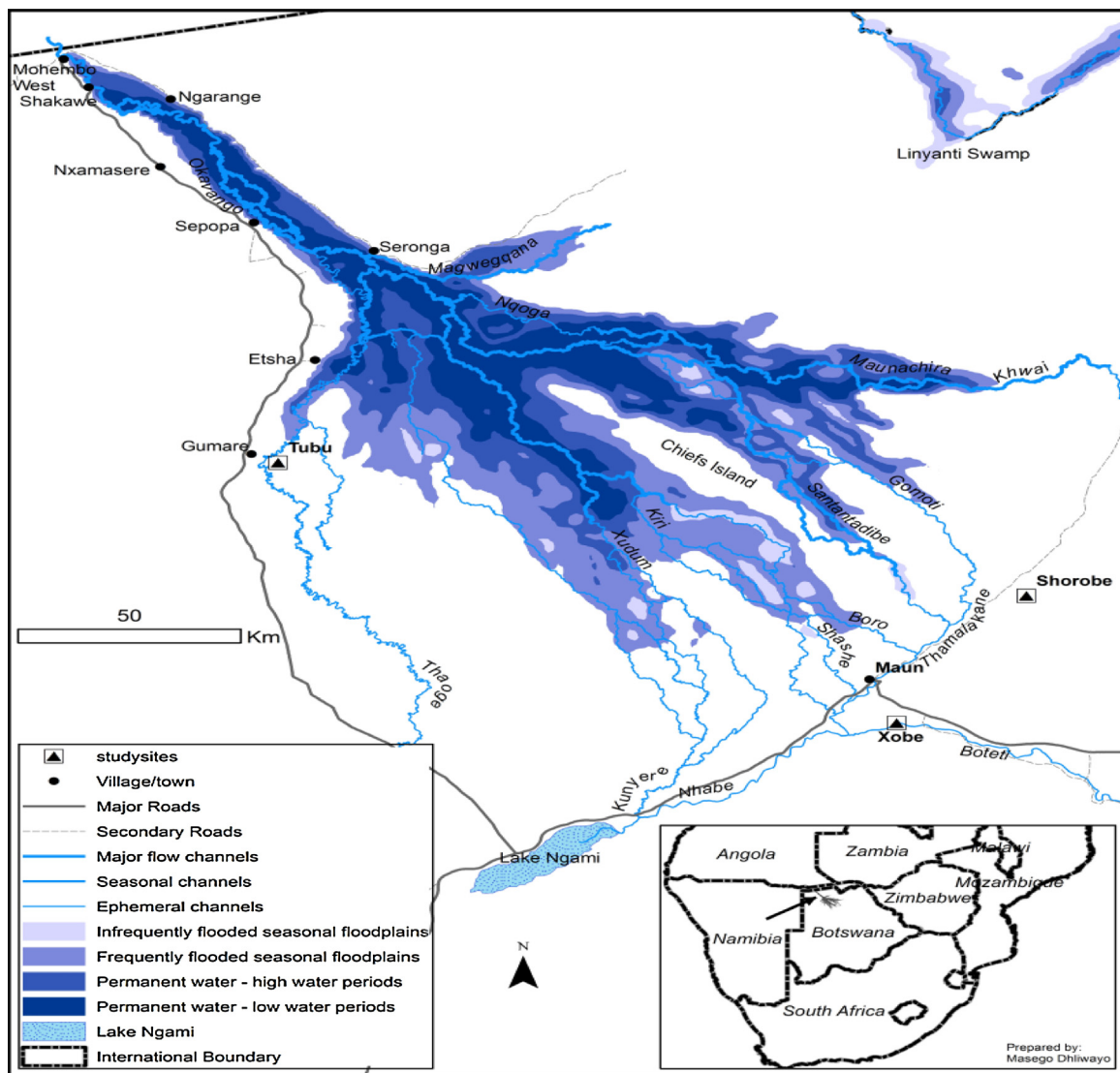


Fig. 1. The Okavango River basin and study sites showing Tubu, Shorobe and Xobe.

Source: ORI GIS Lab.

framing such as livestock holdings, diseases and carrying capacity were taken from Agricultural Research and Veterinary Services, Ministry of Agriculture, while social welfare data came from the Department of Social Services and population and migration from Central Statistics Office publications.

2.6. Data processing and analysis approaches

Each of the women or men only FGD primary source document was typed into a Word document followed by a data reduction process done partly mechanically and partly interpretively. The process comprised of three phases, namely familiarization and organization, coding/recoding and finally summarizing (Ary et al., 2009). In the familiarization phase, each data piece (comprising of the FGD record including accompanying notes of individual comments) was read and re-read (reflective logic). This was done simultaneously with the researchers' reflective field notes derived through "memoing" (Miles and Huberman, 1984) made during the PRA workshop processes.

The coding/recoding included identification of categories and themes focussed on key events and units of meaning (words and phrases) linking environmental change indicators such as drought,

desiccation, rainfall, animal and human epidemics outbreaks, and community adaptations, such as resettlement/migrations. The process was inductive as it is based on identifying connections and common aspects among categories and patterns (Ary et al., 2009; Miles and Huberman, 1994). Each theme/pattern constructed from the historical time lines was arrived at by counting the number of times ('entries'), for example phrases such as "kgotla¹ meeting"; "coronation of chief", "construction of a building (school, clinic, development project)", were mentioned in the historical timeline as key events (human or environmental) either to depict change

¹ The Kgotla is the traditional meeting place in Setswana culture. It is the seat of the Chief and his advisors who are normally his uncles (father's brothers). It is also the village court and venue for impotent cultural events such as young men and women's initiation ceremonies; rain making ceremonies and a place to register and witness families exchange bride price. It also refers to the assembly of tribesmen (traditionally not open to women, but the modern one is open to all). Another modern role it plays is to act as a meeting place for different organs of government to meet members of the community under the authority of the Chief. Botswana is a multicultural country, however several none Setswana cultural groups have adopted this system of governance it has therefore been largely assimilated into Botswana governance culture.

and/or adaptation to specific events. The process of keying in of these events/phrase yielded six themes/patterns as follows:

1. *Social development* – from events, developments, phrases, comments and references linked to education, health and social welfare, such as construction of schools, clinics, extension services, social work and water.
2. *Economic development opportunity* – reference to external trading, village garden, physical infrastructure, and telecommunications developments
3. *Community management/social cohesion* – reference to establishment of village-level civic associations, recreational, volunteerism and church and similar activities.
4. *Community governance* – reference to local political/administrative institutional developments such as the building of a *Kgotla*, coronation of a chief, establishment of 'modern' local governance structures such as village development committees (VDCs), farmers committee meetings and so on.
5. *Crisis related climatic risks/shocks/impacts* – reference to climatic change risks resulting in drought, floods, disease/pestilence, desiccation, human/animal diseases outbreaks.
6. *Community Adaptations/people mobility or migrations* – reference to displacement, relocation or migration (crisis or economic) in response to changing risk scenarios.

Data processing from the mixed-gender FGDs in each community focused mainly on impacts of climatic variability (CTL) on community wellbeing and was analysed differently. Each group produced visualized images of the phenomenon they described narratively.

Data interpretation followed the narrative and phenomenological approaches. The process includes phenomenological reduction, which entails a deliberate and purposeful opening to the phenomenon "in its own right with its own meaning". The units of meaning, i.e., explicating the data, in the statements that are seen to illuminate the researched phenomenon are extracted or 'isolated' are then delineated. The units of meaning are then clustered to form themes, summarizing each interview and extracting general and unique themes from all the interviews and making a composite summary (Groenewald, 2004; Creswell, 1998; Aspers, 2009).

2.7. Credibility, transferability and trustworthiness

The credibility (or internal validity) of the results was addressed through 'structural corroboration' or triangulation, i.e., the use of multiple data sources (FGDs, field observations, review of relevant documents) to increase the likelihood of phenomenon under study being understood from different points of view. Convergence of a major themes or patterns in the data from these sources lends credibility of findings (Ary et al., 2009; Bogdan and Biklin, 1998; Bernard, 2006a). To enhance transferability, or the degree to which study findings can be applied to other contexts, cross-case/literature comparison was done. Dependability and trustworthiness of findings, i.e., reliability, were addressed through intra- and inter code agreements (coding and recoding data) and corroboration (use of multiple data sources resulting in similar findings) and confirmability, i.e. interpretation/conclusion confirmed by other investigators in similar situations (Ary et al., 2009; Bogdan and Biklin, 1998; Bernard, 2006b).

Table 1

Total number of "entries" or key in events/developments around six thematic areas in three villages by men and women FGDs.

Village	FGD Gender		Total thematic "entries"
	Women	Men	
Tubu	66	35	101
Xobe	42	38	80
Shorobe	54	48	102
Total	162	121	238

3. Results

3.1. Historical timelines (HTL)

A total of 283 'entries' were made by both women and men's FGDs in the three study villages with regard to key events or developments based on the historical timelines. Generally, women made more 'entries' than men across the three villages while Tubu and Shorobe were almost similar on the number of total thematic 'entries' (Table 1). The FGDs narrative data produced six key thematic areas or events which occurred across the historical timeline. The thematic areas are, governance, social development, economic development opportunity, crisis, community management and social cohesion and social migration adaptation).

3.2. Men's HTL FGDs

Table 2 gives a summary of thematic analysis across men's FGD by village. Total number of narratives/phrases, events around community governance, economic opportunity and crisis/impacts was predominant across villages. Other sub-themes in the men's storyline reflected concerns around social development and community management/social cohesion. There were 35 "entries" for men's FGDs in Tubu (Table 1). Notably, the crisis theme entries (concomitant extremes of drying and flooding of the river channels and recurrent out breaks of pestilence) dominated the men's FGDs (29%). The imagery alluded to had adverse impact on livestock and *molapo* farming, the major source of livelihood whose loss resulted in severe food insecurity. In addition, community management/social cohesion themes (23%) were highlighted as aspects of the major theme. However, narratives on governance (20%) and social development (14.2%) emerged as subthemes whereas economic opportunity and social migration/adaptation tended to be minor (Table 2).

In Xobe, primary themes in the men's FGD narrative revolved around governance (31.57%) and economic opportunity (26.31%). The sub-theme narratives pointed to issues of community management/social cohesion (18.42%) and crisis (10.52%). There were 38 "entries" for men capturing men's FGDs narratives for Xobe (Table 1). While the narratives seem to have suggested people's movement from one place to another was apparent, the social development and migration and adaptation theme did not feature prominently (5.26%) (Table 2). However, notes from plenary discussions and key informants' interviews suggest that people moved outwards from the growing urban-village of Maun to Xobe as an outskirts locality.

The men's FGD major theme/s for Shorobe, represented by 48 "entries", reflected the following as predominant themes; governance (27.08%), social development (22.91%) issues and narratives of economic opportunity (20.83) and community management/cohesion (20.83%). Social migration and adaptation (6.25%) did not feature prominently in the storyline (Table 2). The community did not only initiate social development activities and facilitate their expansion, but also introduced tertiary institutions

Table 2
“Entries” depicting key events in six thematic area by men's FGD in each Village.

Village	Themes/Patterns					
	Governance	Social development	Economic development opportunity	Crisis	Community management and social cohesion)	Social migration/adaptation
Tubu	7 (20%)	5 (14.2%)	3 (8.57%)	10 (28.57%)	8 (22.8%)	2 (5.7%)
Xobe	12 (31.57%)	3 (7.89%)	10 (26.31%)	4 (10.52%)	7 (18.42%)	2(5.26)
Shorobe	13 (27.08%)	11 (22.91%)	10 (20.83%)	1 (2.08%)	10(20.83%)	3(6.25%)

Notes keyed “entries” for. Tubu – N = 35; Xobe – N = 35; Shorobe – N = 48.

and borehole technology to increase access to water resources, thereby contributing to rapid integration of the village.

The HTL key event marker of the Tubu men's FGDs was the arrival in the 1970s of a certain Xamwana family, being the first immigrants to settle and start *molapo* farming in the Tubu area. With the passage of time, more immigrant families rapidly moved in leading to gradual expansion and establishment of present day Tubu village. In the 1970s more infrastructural developments and settlement expansion took place and more families settled in the area. During the 1980s, a primary school was constructed by the community (eventually taken over by government). Concurrently, the decade also experienced strong rainfall and invasion of the ‘*lethobo*’ fly (*Stomoxys calcitrans*), which resulted in large numbers of livestock dying. The decade was also marked by a severe drought and an outbreak of ‘*tsie*’ – a locust pestilence resulting in severe food insecurity due to low grain harvest. However, these events did not induce any movement of people as village permanence was by this time institutionalised through provision of social infrastructure.

The 1990s were characterized by a severe drought and the outbreak of ‘*lekgwafu*’, i.e. contagious bovine pleuro-pneumonia (CBPP) – a cattle lung disease caused by *Mycoplasma mycoides*. CBPP resulted in the culling of the entire village herd in 1996, a dramatic collapse of a major livelihood asset, whose loss impacted on other forms of capital (arable and *molapo* farming). Subsequent re-stocking was done in 1997/98, during which period village households, at the brink of destitution, depended on government food rationing. The year 2000 experienced high floods and most *molapo* farms were inundated resulting in destruction of crops, but in 2001/02, the village received good rains resulting in a bumper harvest. In 2006, another *lethobo* invasion occurred. In 2008 and 2010, there was an outbreak of foot and mouth disease (FMD). The tsetse fly (genus *Glossina*), caused sleeping sickness (African trypanosomiasis) whose transmission affects fishers, farmers and hunters. In animals, the disease is called *Nagana*.

In Xobe, men's FGDs had 38 entries; with community governance (30.5%) and economic development opportunities (26%) being remembered most. This is not surprising since Xobe is a predominantly livestock village, which lacks social services and is concerned with provision of physical infrastructure, such as roads, bridges, cattle crushers (*mogotlha*), boreholes to open up marketing opportunities for farmers in the area. Key events and processes go back to the 1940s. The encroachment of humans and livestock during this decade transformed a natural habitat to cattle posts (singular- *moraka*, plural-*meraka*) for pastoral farmers and plough fields (*masimo*) for arable farmers. During the 1950s and early 1960s, however, other cultural changes occurred. In addition to the area around Xobe being used as pastoral and arable land, it became a cultural landscape for WaYei women from Maun and surrounding settlements, who used it as a ritual site for initiation of girls into womanhood. Men remembered vividly how, any men who wandered into this space inevitably faced humiliation by the women through shouting, chasing and at times beatings. In addition, women also hosted a range of dance festivals to dramatize a range of traditional dance genres (such as *seperu*, *setabo*, *modokota*) and mastery of musical instruments (*meropa* and *setinkane*). The

cultural landscape acted as a media for social cohesion organized around women centered cultural activities.

The river was also the main source of the reeds *Phragmites australis* and *Phragmites mauritianus*, which were harvested for construction of houses and courtyard enclosures. In 1966, there was a severe drought and people scattered/dispersed/migrated to other villages in the Delta including Maun, the district capital. A decade after this disaster, the 1970s were characterized by lots of rain and a good harvest. But the outbreak of problems related to the *lethobo* fly, people had to move their cattle and goats to less affected areas. Crisis migration is also observed here with people constantly moving between places in the context of environmental and climatic changes. Paradoxically, the same environment provided respite space as source of food. The Xobe Village development Committee (VDC) was also established in 1978 paving the way for future demand to have the settlement recognized as a village with >500 people and hence qualifying for certain social services. In the 1980s, mobile clinic services were provided for the settlement. Although road infrastructure had been improved, the primary mode of transport was still an ox-drawn ‘sledge.’ In this period the community notes that the river had a lot of reeds.

In Shorobe, men's FGD focused on events dating from 1920s. During this decade, immigrants came to the Shorobe area from an inland Delta island triggered by *tsetse* fly infestation. This migration continued into the 1930s, the period the institution of chieftainship was established. Other social changes in the 1940s decade included the arrival of Christian missionaries, expansion of access to primary education in the main settlement and later other satellite settlements such as Mochabeng emerged. Access to health came about with the construction of a clinic. The men also registered the arrival of the first foreign general dealer, who drilled a borehole for the village. In 1962, the village was officially recognized as a settlement with more than 500 people and a *Kgotla* was established. The 1960s were remembered for the first general elections held in 1965 to prepare for the country's attainment of full independence from British rule (colonial period 1886–1966). In the 1970s, expansion of access to services such as tertiary training institutions (training brigade) took place as well as the establishment of government extension services (agriculture), including village government structures. In addition, *Kgotla* tribal administration offices were built, chiefs were installed in satellite settlements, a tax collection office was set up and a VDC was elected and enacted. Further, commercial activities started (general dealer and retail), physical infrastructure (tarred roads) and globalization of the village through telecommunication (erection of the Orange and Mascom mobile telephone service provider towers).

3.3. Women's HTL FGDs

A thematic analysis of “entries” from women's FGD HTL in the three villages is summarised in Table 3. The major theme for women also point to the centrality of governance and social development. Other narratives revolving around economic opportunity, crisis and community management/cohesion constitute the sub-themes.

Table 3
“Entries”/phrases/development depicting key events six thematic area by women's FGD in each Village.

Village	Themes/Patterns					
	Governance	Social development	Economic development opportunity	Crisis	Community management and social cohesion)	Social migration/adaptation
Tubu	18 (27.2%)	10 (15.15%)	10 (15.15%)	15 (22.72%)	10 (15.15%)	2 (3.03%)
Xobe	14 (33.33%)	11 (26.19%)	6 (14.28%)	0	10 (23.80%)	1(2.38%)
Shorobe	14(25.92%)	15 (27.77%)	12 (22.22%)	3 (5.55%)	10 (18.51%)	0

Note keyed 'entries'. Tubu – N = 66; Xobe – N = 42; Shorobe – N = 54.

Tubu women's FGD HTL scored a total of 66 entries across the six thematic areas; of these 29% were narratives depicting the evolution of community governance; establishment of *Kgotla*, chieftainship genealogical succession, development of village administrative infrastructures and establishment of the village development committee (VDC), tribal offices, local police and construction of staff houses. Narratives of climatic and environmental related risks/shocks and their impacts on both human and livelihood sources and domestic animals also featured prominently (22.7%) (Table 3). Three sub-themes relating to social development, economic opportunity and community management both scored (15.1%). Social migration/displacement and adaptation had the lowest entries.

Xobe women's FGD had a total of 42 entries across the thematic areas; of these approximately 34% were on the community governance theme, with the crisis sub-theme did not feature at all. The entry for community management and social cohesion (23.8%) is the highest among the three villages.

Shorobe women's FGD, with a total of 54 entries, had major themes emphasising governance (25.92%) and social development (27.77%), and economic opportunity (27.77%) and community management (18.51%) as sub-themes, while social migration/and adaptation did not feature in the narratives.

For the Tubu women's FGD, the most memorable events were the establishment of two key institutions, coronation of the first village chief and establishment of the *kgotla*. In addition to the village *kgotla*, other local administrative structures were established (VDC, a primary school and a health post). During this period more and more immigrants settled from the interior islands of the Delta. The decade also experienced “good rains and good river flow.” Although the “flood was good” and the village received “good rains”, these events also brought *lethobo* flies. The decade culminated with the drying of the main river channel in 1979. In the 1980s, the government took over the primary school, embarked on road constructions and provided extension services (agriculture). The invasion of the locusts in 1985 and 1989 was followed by heavy rains and the high flood of 1987 and 1989. The river dried up again in the 1990, but was followed by another high flood in 1994 but then dry up again in 1995.

Social services and infrastructure in the village included, tap water, a clinic, a social worker, land-board officer, tribal administration offices and personnel, including the arrival of the first European tourist entrepreneur. The years 2000, 2004, 2006, 2009 and 2010 were characterized by heavy rains and flooding, including outbreaks of *lethobo* and tsetse fly invasions. Other infrastructural and social services developments included construction of tribal administration offices, expansion of the school classrooms, arrival of a trained registered nurse, extension service workers and a major conservation development intervention: the BOKAVANGO²

² The Biokavango project aimed at building local capacity for conservation and sustainable use of biodiversity in the Okavango Delta by lifting barriers to mainstreaming biodiversity conservation objectives into three production sectors: water, tourism and fisheries. The Project strategy was to remove the barriers through a two-

project (2006–2009), funded by the United Nations Development Program (UNDP), that improved natural resources management and conservation capabilities in three sectors, i.e., tourism, fishery and other water-related activities.

The Xobe women's FGD key events were tracked back to the 1950s. The women remembered that the decade had an abundance of aquatic food from the river such as water lily tubers (*tswii*), and reeds (*motebe*, *tshita*, *koma*, and *moxoo*). In 1965, the river dried up and there was a severe drought. In the 1970s, there was heavy rain. Other key developments during this decade were the construction of a self-help mud-hut used as a meeting place for a VDC. The hut was also used to distribute food rations to people. The construction of a gravel road made access to drought relief services easier. In the 1980, a “cattle crush” was built. The structure enabled farmers to have access to veterinary services (cattle dipping) as well as to sell their cattle to the local abattoir. The VDC “mud hut” was also used as a mobile clinic facility. In the 1990s the river was dry for three years (1996–1999) and during that period a community hall was constructed. Between 2000 and 2005, developments included drilling of a borehole, construction of a structure used for mobile clinic services and the *Kgotla*. The women's FGD provided a detailed supplementary rendition of village chief's lineage and succession from mid 1970s to 2007.

Shorobe women's FGD collective memories of the village social history started from the 1950s at the time a village chief was installed. Emphasis was placed on intensification of livelihood activities, especially arable and livestock farming in the new settlements with incoming migrants, construction of a school and affirmed chieftainship. The 1960s were characterized by a severe drought. Subsequent social developments in the 1960s, 1970s and 1980s were expansion of education, social and health services with the deployment of a qualified nurse and local police. In the 1970s and 1980s, “the river died.” Commercial activities expanded (village shop and butchery), more staff houses were built and electrified, election of local counsellor was held and extension service officers (arable agriculture and livestock) were made available. The 1990s were characterized by “modernization” of the village in the form of tarring of the Maun-Shorobe road, electrification, more extension service workers (social welfare, agriculture and animal health), fencing the cemetery, construction of a dumping site, a borehole (in the 2000s), more development agencies of central government came through election of councillors and integration of the village into national politics.

tiered set of interventions: i) To build capacity within the regulatory authorities and service providers to assimilate and supply biodiversity management objectives in decision making; and ii) to demonstrate how best to incorporate biodiversity management into day-to-day production practices through pilot projects. A strong emphasis was placed on participation and engagement between the various stakeholders, and building partnerships between government, private sector and rural communities.

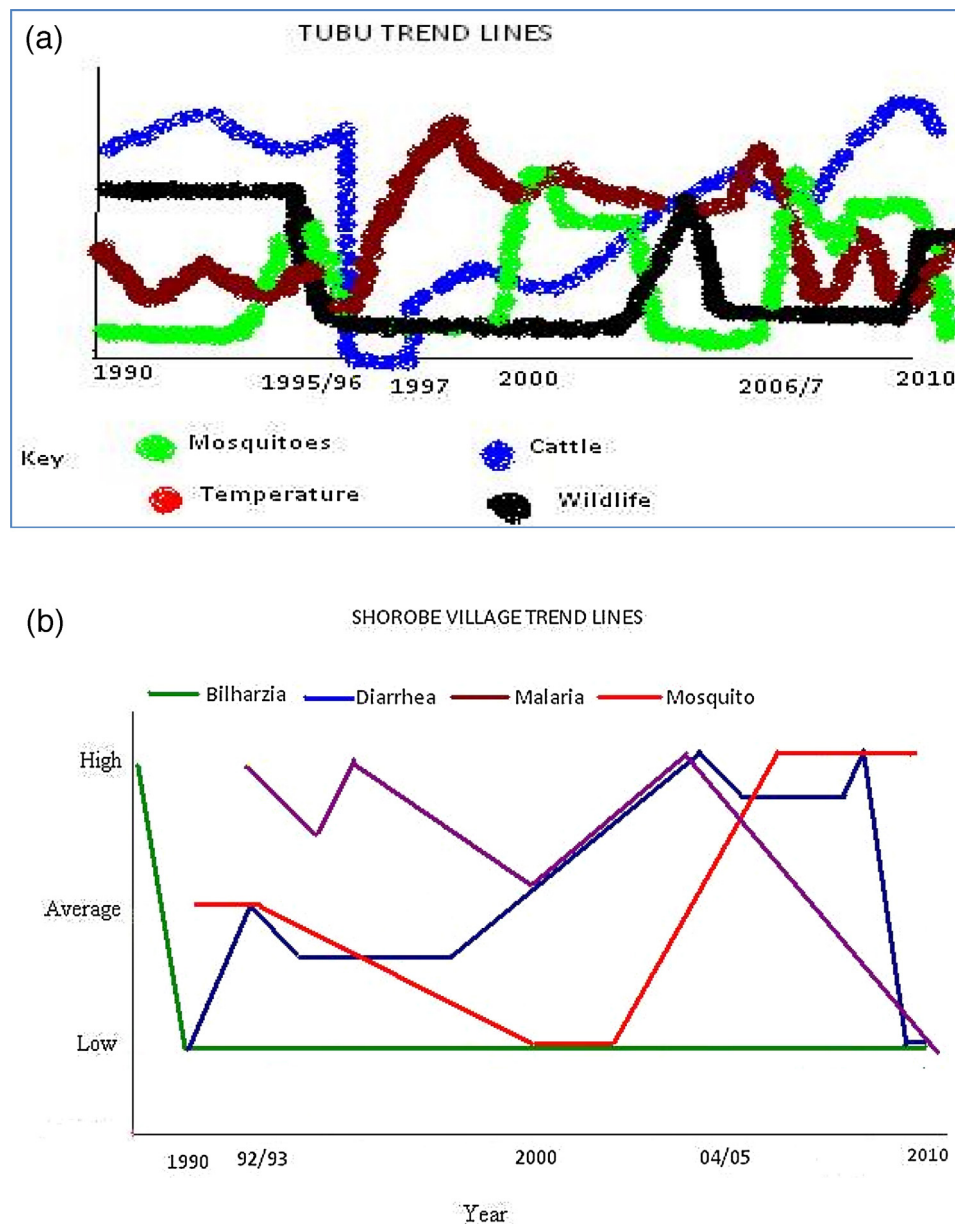


Fig. 2. a. Vector trends and animals and wildlife trends over three decades. b. Vector borne disease trends in Shorobe 2000–2010.

3.4. Community perceptions of impacts of climatic variability and adaptations

Pictorial presentations of climatic variability trends in Tubu suggest that the years 1981, 1987, 1994 and 1995 were characterized by severe drought. During these periods, the village is said to have experienced a huge burden of malnutrition. The group's recollections suggest how vector borne diseases such as malaria and *schistosomiasis* were low during the drought years. Diseases incidence is said to have peaked up in the early 1994/95, in 2000, 2006/07 and 2010, which was felt to be due to heavy rains. Pictorial presentations were also made depicting perception of mosquito vector trends during the years of heavy rains and high temperatures. During plenary, participants demonstrated good understanding of the signs and symptoms of malaria and local representation of illness – *letshoroma* – implying dizziness and fluctuating body temperature. They however demonstrated low knowledge and misconceptions of bilharzia (*thota madi* – literal translation being urinating blood), causes, signs and symptoms.

The group also demonstrated images showing a sharp drop in cattle and wildlife populations during the years of drought, including the total collapse of the livestock in 1996/1997 with the outbreak of CBPP. However, with re-stocking, there was a gradual recovery from mid-2000 to 2010. Fig. 2a and b gives a pictorial illustration of Tubu with respect to vectors, domestic and wild animals and vector borne disease trends in Shorobe between 2000 and 2010 respectively.

In Tubu, FGD climatic variability trends suggest the years 1981, 1987, 1994 and 1995 were characterized by severe drought. During these periods, the village is said to have experienced a huge burden of malnutrition. The group's recollections pertained to how vector borne diseases such as malaria and *schistosomiasis* were low during the drought years. Fig. 2a also shows that communities perceive a sharp drop in cattle and wildlife populations during the years of drought, including the total collapse of the livestock in 1996/1997 with the outbreak of CBPP. However with re-stocking there was a gradual recovery from mid-2000 to 2010. Diseases incidence were

said to have peaked in the early 1994/95, in 2000, 2006/07 and 2010, due to heavy rains

In Shorobe, the mid-1960s and mid-1980s were considered to have had relatively low rainfall, while the early 1990s and 2010 received relatively high rainfall. The 1980s had average floods and from mid-1990s to mid-2000 there was no flooding at all, the river was dry but got flooded again in the period 2008–2010. The 1980s had average floods and from mid-1990s to mid-2000 there was no flooding at all, the river was dry but got flooded again in the period 2008–2010. The group showed images which suggest that around the year 2000, the prevalence of malaria went down dramatically in spite of mosquito abundance due to the availability of treated mosquito nets, but around 2008/9 the malaria cases increased due to high rainfall. However, between 2009 and 2010, people under home-based health care, pregnant women and poor people received free mosquito nets from the government. With regard to *schistosomiasis*, the disease was very common before the 1990s because most people, especially children, used to play in infested water. Due to the long dry spell in the Gomoti River channel, the disease was no longer a threat. Also, prior to 2000, the village experienced relatively high mortality and morbidity due to the high HIV and AIDS pandemic. However, in 2002/03, the prevention of transmission from mother to child (PMTCT) decreased morbidity due to the introduction of the antiretroviral drugs program. The mortality rate in the village gradually declined; including the frequency of funerals. There was a particularly marked decline between 2005 and 2010 (Fig. 2b).

In Xobe, CTL stated that between 1965 and 1967, there was a severe drought. This was followed by heavy rainfall and abundance of wildlife, such as buffalos in 1979. In 1987, a severe drought resulted in loss of livestock. In 1993, there was heavy rainfall and much grass that attracted mosquitoes. In 2003, the river dried out completely and people relied on boreholes for water. Following the 2003 drought, there was adequate rainfall during the season 2004/05, which gradually increased from then to 2010 (5a), which was the year when buffalos reappeared. With regard to floods, participants stated that in 1991 the river flow was medium retreating to Samedupi Bridge and people could easily cross the river.

For the period 1994–1997, the river was completely dry and crocodiles and hippopotamus were seen stranded on parched land. In 2004/05, the river had water up to Xeridom settlement near the old bridge of Makalamabedi. However, between 2009 and 2010 rainfall and increased flood extended river flow further downstream to Mmadikola/Xumo. With regard to temperature, FGD participants stated that 1997 was characterized by very high temperatures when the river dried out completely. In 2000, temperatures were also very high and people were forced to relocate to places along the Boro River channel. However in 2010, abundant rain brought cooler temperatures and it was medium hot. Again the community recalls that in 2004/05, the river flow was medium and managed to reach Xeridom Settlement near Makalamabedi old bridge. From 2009 to 2010, the river flow increased and the flood extent went downstream as far as Mmadikola/Xumo. Heavy rains brought an abundance of mosquitoes 2004, 2009 and 2010 and a sharp increase in malaria cases which declined sharply from 2000 due to use of treated mosquito nets supplied by the ministry of Health.

Community members in Xobe stated that there was an outbreak of diarrhoea mainly among children under five years old, in 1996 and 2009 coinciding with high temperatures and when the river dried completely. During such times the villagers depended on water from hand dug wells (*dikwekwete*). Residents associated the outbreak of diarrhoea with outward migration of young mothers to peri-urban Maun. They argued that lack of food and child abandonment by their mothers often leaving them with less capable grandmothers were the root causes of the problem. The community

presented that severe malnutrition among children was averted partly because wild food plants were consumed extensively in the village and they were also given to children, either fresh or dried. Some wild foods fed to children included crushed *mokutshumo* (*Diospyros mespiliformis*) mixed with milk; *motsaudi* (*Garcinia livingstonei*), mixed with milk and *dithotse* (melon seeds), which were crushed and prepared as soft porridge. For them, a malnourished child was a sign of parental neglect.

4. Discussion

4.1. Historical timelines (HTL)

Both women and men's entries in Tubu equally remembered social development events related to education, health and social welfare. It is notable that, in the women's FGDs, older women remembered major events in detail and dominated the discussion, while younger women gave specific dates for most of the events. Overall, central government crisis interventions appear to have been instrumental in facilitating social cohesion and community governance processes in Tubu through establishment of village level institutions and civic associations.

In Shorobe the plenary discussion on leadership of men and women in village politics (governance), village level committees and the church (community management and cohesion), concluded that men tend to dominate village politics, although women are the majority participants. The same was true for traditional feasts such as weddings and funerals. Consequently, although men and women participated in community management roles for its development and political organization, community governance was primarily in the hands of men.

A synchronic analysis (contemporary) of both men and women's FGDs within and across locality dramatized through their groups' story line, transact field observations, plenary session notes and informal key informants' interviews suggest that the *kgotla* and chieftainship traditional institutions are at the heart of local governance structures. There is ample literature on the *kgotla* as a pre and post-colonial traditional institution of governance in Botswana (Comaroff and Comaroff, 1991; Mgadla et al., 1998; Logan, 2008; Morapedi, 2010; IUCN ROSA, 2016; Odell, 1985). The political-cultural tenacity of the *kgotla*, as an indigenous institution, is partly because, as Matowanyika (IUCN ROSA, 2016) put it, "ordinary people refused to see it die". Working in collaboration with central government agencies, the *kgotla* and chieftainship continue to mediate access to livelihood resource in their locality (Ngwenya and Kgathi, 2011).

Equally, diachronic (historical evolution and change overtime) analysis of the FGDs groups' narratives overtime depict the centrality of these institutions in the everyday lives of the residents' in the three study sites.

The *kgotla* has evolved as part of central government consultative machinery through which government policies are explained to the populace and through which the community can in turn pronounce on public policy issues (Matemba, 2005). Community contexts of Xobe, Tubu and Shorobe serve as an important unit in linking political or institution building and social learning processes that empower local capabilities which reciprocally affect individual or household abilities to adjust or manage livelihoods. The *kgotla* and chieftainship provide an enabling environment for participatory decision-making. Participatory processes can lead to better implementation through pooling of resources and incentivizing collective action to address climate change risks (Dumar, 2010). Participatory processes (predetermined constructions and responses to climate change risk by scientists, practitioners and policy makers) can also legitimate a pre-determined course of

action on climate change rather than enable meaningful community engagement (Ayers, 2011; Jennings, 2009; Few et al., 2007).

Although from the HTL, phrases denoting social displacement and migration events theme appeared less frequent, fieldwork observations, informal discussions with PRA participants and conversations with key informants suggested that people's voluntary movements within proximate localities by individual family members in response to environmental or anthropogenic change is not regarded as migration per se. This is so because firstly, this temporary-cum-permanent, incremental small scale movements are embedded in social networks (marriage and kinship alliances within a given geo-cultural space). Secondly, residents of Tubu, Xobe and Shorobe tended to have multi-residences, either temporarily or permanently. Tubu residents have homes in Gumare, while those from Shorobe and Xobe lived also in Maun. These multiple residences provide the flexibility for different household members to migrate either seasonally to cope with diseases (human and animal) climatic related shocks (drought, floods, extreme temperature) or to seek alternative sources of livelihoods.

4.2. Community perceptions of impacts of climatic variability and adaptations

Although recent debates on climate change and migration have tended to focus on migration as a problem or threat (Hartmann, 2010), the community perceptions trend lines (CTL) show more complicated processes and relationships which are more beneficial than detrimental. Economic opportunities emerge between natural and non-natural resource based livelihood sources and also between places. The social drivers are intricately interwoven with community sources of livelihoods, cultural expectations derived from investment in social development and welfare (educational, health and economic opportunities).

In the study sites, livelihood diversification is another adaptation strategy that emerges from the historical time lines. Communities depend on agricultural resources and switch opportunistically to forest and aquatic food resources as sources of livelihood (fishing, harvesting of edible wild food plants, and aquatic foods such as water lily tubers – tswii). Livelihood diversification as an adaptive strategy is used to minimise impacts of climatic variability such as extreme floods, drought, human and animal diseases.

Molapo farming system in response to flood variability is in and of itself an adaptation strategy. Motsumi et al. (2012), for example, noted that farmers in Tubu distinguish three types of *molapo* fields, namely *kama* that are on a raised ground and usually used when the floods are high; *moxhexum* that are generally sloping and located on the middle ground between floodplains used during periods of moderate flow; and *madiba*, which means that farmers plant their crops on low-lying floodplains during periods of low flow. In Shorobe, however the farmers use only one type of floodplain fields because of the geomorphology of the river downstream. In Shorobe and Xobe, farmers cultivate both *molapo* and dry-land fields and move between these depending on the rainfall and river flood conditions.

In Shorobe, the mid-1960s and mid-1980s were considered to have had relatively low rainfall, while the early 1990s and 2010 received relatively high rainfall. Temperatures gradually rose from above-average in the 1990s to high around the year 2000 and gradually declined in 2010 as rainfall increased in the following years. The 1980s had average floods and from mid-1990s to mid-2000 there was no flooding at all, the river was dry but got flooded again in the period 2008–2010 (Schapera and Comaroff, 1991). The group showed images that suggest that around the year 2000, the prevalence of malaria went down dramatically in spite of mosquito

abundance due to the availability of treated mosquito nets, but around 2008/9 the malaria cases increased due to high rainfall.

Tubu and Shorobe residents migrated from the hinterland islands primarily in response to negative impacts of *tsetse* fly on animal and human health. In Tubu, the community continued to use/converted/switched vacated land from residential cum farmland to grazing, hunting and harvesting of natural resources for domestic and non-domestic use. However, with the erection of the Buffalo Fence especially in Tubu, inbuilt adaptation strategies evolved. These included seasonal movement of livestock outside the Buffalo fence, thus alternative use of 'dry' or 'wet' floodplains for grazing livestock. Foraging movements of livestock by farmers' (rangeland risk management strategies) between dry-season and wet-season habitats buffers effects of extreme floods, drought and rainfall and was based on their local ecological knowledge. This was a complex socio-ecological systems landscape manipulation adaptation strategy deployed by local livestock farmers. Range ecology scholars refer to the system as adaptive foraging by both domestic and wildlife (Fynn, 2012; Fynn et al., 2015; Fynn et al., 2016). The system is based on variations in hydro-periods as well as mosaic vegetation communities of the Okavango Delta over temporal and spatial scales (Murray-Hudson et al., 2014; Mazvimavi and Wolski, 2006; Gumbrecht et al., 2004). Similarly, application of local ecological knowledge on flood variations as the basis for *molapo* farming system, is in and of itself, a robust adaptation strategy. These findings concur with the observation by Nyong et al. (2007) with regard to farmers' adaptation strategies to severe droughts in the African Sahel. Kettle et al. (2014) advocated refinement of risk-based management and climate adaptation approaches based on detailed local knowledge of places and priorities (governance structures and socio-economic conditions) as well as scientific understanding of climate projections and trends.

An analysis of the 2001 census data for instance, indicates, the Delta had a temporary migration rate of 13.2 in 2000/2001, which was the highest in Botswana (Kgathi et al., 2004). Elmhirst (2008) differentiates between migration as a response to crisis and livelihood failure, and migration as an accumulation strategy. But in the study site, movement of people or animals either temporarily, intermittently or seasonally are intricately intertwined with natural resources based livelihoods (especially livestock, *molapo* and dry-land farming). Furthermore, as stated earlier residents of Tubu, Xobe and Shorobe tended to have multiple-residences, either temporarily or permanently which allowed deliberate seasonal migration of part or whole families. This complex interplay is aligned to adaptive responses to specific climatic conditions at any given time and space.

When certain areas are flooded, for example, people move themselves and their livestock to drier areas. In both villages, *molapo* farming areas are converted to rain fed during drier season, hence complex system of rangeland risk management and natural capital switching/transformation through flexible land use strategies are deployed in response to the impacts of climatic variability on livelihoods. Kgathi et al. (2006) found that communities along the desiccating channels of the Okavango Delta adapt their agricultural systems by switching from *molapo* to rain fed dry-land farming. Ngwenya and Thakadu (2007) also observed capital switching as a shock adaptation strategy against the HIV and AIDS epidemic impacts on sources of livelihood. Bernard and Moetapele (Bernard and Moetapele, 2005) discovered that the drying of the river channels in the Delta acted as a push factor for migration and local mobility (intra-district mobility).

Multi residences also contribute to multiple-livelihood sources (Elmhirst, 2008) as communities switch to urban based sources such as employment and informal businesses or sale of forest and agricultural products. Magole and Ngwenya (2014) demonstrates a remarkably complex seasonally managed livelihood

diversification as adaptation strategy among communities in the Okavango Panhandle. These include harvesting water lily, edible wild fruits by the river or in the wild; harvesting and sale of water reed and grass, *molapo*, dry-land arable and irrigation farming, multi-gear fishing and hunting.

5. Conclusion

Individual and collective memory is connected with everyday life. Some incidents are connected with the present, while others are linked to important events that are remembered for a long time. Collective social memories are either connected with a common history of a specific group of people (kinship, tribe, and nation) or with the history of individuals or family. Across the three villages, both women and men regarded community governance as embodied representation of *Kgotla*, the chief and the polity (*morafe*). These pillar institutions portray a dynamic, holistic system of governance in a physical place at the centre of the village where rituals (coronation of chiefs and deliberation of justice) are carried out.

There are multiple actors, experiences and meanings inscribed at individual and community level. Responses to climate change therefore must be understood as an on-going process of negotiating and aligning past and present different constructions of risk, agency, capacity for collective action and adoption of a particular vision of the future (Granderson, 2014). Forms of socio-cultural capital, for example, kinship networks, allow communities to respond to climate-related risks through flexibility of resource mobilization including the capacity to learn and flexibility to re-organise livelihood (Batterbury and Mortimore, 2013). Communities develop shared understandings of problems and potential solutions that are embedded in local institutions, culture, social norms and obligations, gender relations and power with regard to access and control over resources (Jones and Boyd, 2011). In the FGDs, women emphasized community cohesion and social ties. These are not only critical in building capacity but also enable coordinated action in response to change risks at the community level (Adger, 2003; Eriksen and Selboe, 2012). Interpersonal relationships, such as kinship networks, social obligations, trust and reciprocity, mobilise capacity directly by enabling material responses to climate hazards or indirectly via institutional modifications (Pelling and High, 2005).

Climatic variability and environmental change had impacts on both humans, domestic and wildlife (stranded hippos and crocodiles) forcing each to cope (hand dug wells and child abandonment) and or adapt (migrate, drilling boreholes, extensive consumption of edible wild foods to avert child malnutrition). The study has also shown that the local populations in study area developed and implemented extensive adaptation strategies that enabled them to reduce their vulnerability to past challenges that even exceed those predicted by models of future climate change. Community exposure to climatic risks and environmental shocks such as episodic droughts and recurrent floods, pestilence and animal disease outbreak forced people to either migrate, depend on government crisis interventions or access natural resources especially harvesting of edible wild foods. Community exposure to climatic risks and environmental shocks are the main drivers of change and response, but to the rural communities these are not merely bringing disaster or inherently negative, hence the notion of “good rains and good river flow” to suggest abundance of resource for humans and animals.

The local populations in study area developed and implemented extensive adaptation strategies that enabled them to reduce their vulnerability to past challenges. For this study, the outcome over time of inbuilt flexibility based on local ecological knowledge which form the basis for livelihood diversification, rangeland

risk management/adaptive foraging, capital resource switching/or transformations, changes in land-use system, multi-residence, social capital and institutional mobilization responses to climatic risks, constitute community resilience. Looking at the historical trend line narratives and climatic variability trend lines, these present a basket of adaptation strategies, and community resilience as cross cutting thematic processes based on hydro-ecological and environmental resources (MacKinnon and Derickson, 2012).

Both local and scientific knowledge systems focus on inherent people-environment nexus. Some authors have argued that local knowledge is increasingly exhibiting a resemblance with scientific methods as many ideas in indigenous knowledge that were once regarded as misguided are now seen as appropriate and sophisticated. There is now consensus among scholars that scientists in general but particularly climate change researchers should tap into local knowledge systems of communities for a more comprehensive understanding of the biosphere in order to inform effective adaptation policies and strategies. Local knowledge is an asset for the people themselves and forms a legitimate base for response to climate change hazards through a range of appropriate adaptation strategies.

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