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Drought Management Strategies among Agro-Pastoral Communities in Non-Equilibrium Kalahari Ecosystems

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Abstract: Rural Kalahari communities whose livelihoods are heavily dependent on rain-fed agriculture are exposed to increasing intensity and frequency of drought spells. Subsequently their resilience is gradually being eroded and they are left increasingly vulnerable. This study unearths and highlights the myriad measures employed by small scale agro-pastoralists to cope with and adapt to droughts. Such strategies include enrolling in the government's Labour Intensive Public Works Programme, harvesting larvae of *Imbrasia belina* (Westwood) moth for consumption and/or sale, supplementary feeding of livestock, providing water for livestock and selling part of the livestock herd while some households moved livestock to better grazing areas within the communal area and sought alternative sources of income outside agriculture. This fluidity and flexibility is necessary to manage the often harsh and unpredictable environment communities operate under. But more importantly, some of these currently used measures could be enhanced to buffer Kalahari agro-pastoralists from anticipated future dry spells in the Southern African region.

Key words: Adaptation, Botswana, coping, drought, Kalahari, semi-arid, strategies

INTRODUCTION

Small scale rain-fed subsistence agriculture has for centuries been the backbone of rural economies in semi-arid southern Africa. This holds in spite of the fact that some parts of the region experience low and highly variable rainfall regimes-both in space and time. Subsequently, droughts have seized to become surprises and are generally expected phenomena. Future climate scenarios predict increased frequency and intensity of dry spells throughout the region (Below *et al*., 2010; Boko *et al*., 2007). Under such circumstances, small scale farmers efforts to subsist on the land are challenged and compromised as their resilience is gradually being eroded. This is further exacerbated by other socio-economic constraints including but not limited to lack of diversified sources of household income, unemployment and curtailed livestock movement due to conflicting adjacent land use patterns (Mogotsi *et al*., 2011). Agro-pastoral communities are exposed to increasingly high risks especially when there is a succession of years with overly dry spells. Then, how do agro-pastoral communities adjust to such challenges to avert disruption to their livelihoods?

Coping and adaptation strategies: Adaptation and coping strategies, like vulnerability are not new concepts (Campbell *et al*., 1990; Burton, 1997; Eriksen *et al*., 2005; UNEP, 2009). According to IPCC (2001) adaptation refers to the adjustment in natural or human system in response to actual or expected climate stimuli or their effects which moderates harm or exploits beneficial opportunities. Blaikie *et al*. (1994) define coping as the manner in which people act within existing resources and range of expectations in a given context to achieve various ends. Instantly one can appreciate that adaptation involves longer-term shifts in livelihood strategies to respond to change in the environment while coping on the other hand involves temporary adjustment to respond to change or a short-term modification of livelihood activities in the face of a shock or stress (De Stage *et al*., 2002). Adaptation and coping measures are scale-dependent and may vary from individual households to local communities to catchment to the (inter) national scale.

Having said that it is nonetheless worth noting that coping with climatic variability forms an inherent and fundamental part of societies hosted in arid, semi-arid and dry sub-humid temperate and tropical landscapes (Kelbessa, 2007). The livelihoods of communities in

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semi-arid lands such as found in Botswana have evolved under variable climatic conditions, marked by multiple livelihood strategies deployed in response to changing environmental conditions (Dube and Sekhwela, 2007). For example at the community level, the traditional coping mechanisms employed in rural areas during drought years as documented by Botswana Institute of Development and Policy Analysis (1997) included Mafisa (leasing out of livestock especially cattle), Majako (provision of labour during harvesting, in return for a share of the harvest/ looking after someone's cattle in return for a beast) and Masotla (communal crop production and storage for use during drought years). Although, these strategies provided some form of buffer for the communities and especially the poorer households during drought, they have nonetheless weakened or collapsed over the years (Siegle, 1990). UNEP further recognizes this point and argues that as a result of high poverty rates, changing socio-economic and political circumstances and demographic growth, traditional coping strategies are generally becoming insufficient.

Using semi-arid Botswana as a case study, this study therefore proposed to unearth and characterize the coping and adaptation strategies currently employed by agro-pastoral communities in the face of increasing dry spells. Not only will this enhance understanding on how small scale farmers manage droughts but it will also assist in guiding targeted intervention and aid extended to such communities. Perhaps most importantly, coping and adaptation strategies currently in use could be enhanced and ultimately employed to buffer semi-arid communities against future climate changes in the Kalahari and elsewhere.

MATERIALS AND METHODS

Study areas: The study was conducted in two regions of Botswana, namely Kgalagadi North and Bobonong Sub-districts. The former lies within the western sandveld area and is characterized by highly variable and erratic rainfall regime with an annual average of 350 mm (Bhalotra and BMS, 1985). Rainfall follows a uni-modal pattern with most rain events between October and April. Maximum summer temperatures are 41°C in January and February and mean minimum for August of -8°C in winter months. Evapo-transpiration rates are high, exceeding precipitation by more than a factor of three (Chanda *et al*., 2003). The soils of the area are arenosols (FAO, 1991) and cover most parts of Botswana. The vegetation type is southern Kalahari bush savanna (Skarpe, 1986).

The Bobonong region lies within the eastern hardveld part of Botswana. Temperatures above 33°C and below 4°C are common in summer and winter, respectively. Long-term rainfall averages 350 mm per annum and occurs mostly in October-April. The main soil type is Eutric Regosols and in some areas petric calcisols/chromic luvisols (FAO, 1991). The vegetation consists of Mopane woodlands and Acacia tree/shrub savanna (Weare and Yalala, 1971).

Subsistence small scale agriculture is the main source of livelihood for the rural communities in both study areas with some people not cultivating crops at all when edging towards the southern Kalahari desert ecosystem. Furthermore, the two selected regions are prone to drought outbreaks (Mogotsi *et al*., 2011) and thus offered a more holistic representation and understanding of drought management strategies in semi-arid Kalahari.

Data collection: Primary social data collection was done during the 2009/2010 season for a week in each of the study areas. Detailed standard questionnaires used comprised of open-ended, multiple response and dichotomous questions. Considering the complex nature of drought and its associated dynamics, the questionnaire design enabled both solicited and pre-determined set of responses to be captured as well as unprompted but insightful opinions. The interviews were also done in the local language (Setswana) understood by the respondents to avoid misrepresentation. Before commencing with the actual field survey, a pilot study was done and this exercise aided in eliminating and rephrasing ambiguous questions to inform the final questionnaire. Data gathered included demographic and socio-economic characteristics of respondents as well as strategies used by households to cope with and adapt to drought shocks. Selection of agro-pastoral communities was done with the assistance of the agricultural extension officers from the Ministry of Agriculture in both study areas. Within each sub-district, random sampling was used firstly to select villages after which a sampling unit of agro-pastoral households was drawn. In the Bobonong Sub-district (Lepokole and surrounding communal areas of Sekgopye, Mmamanaka and Mmaditshwene), 50 subsistence farmers were interviewed while 38 were interviewed in Kgalagadi North sub-district (Hukuntsi, Lehututu and Tshane villages). Additionally, Focus Group Discussions (FGDs), key informant interviews and other secondary sources of data augmented the survey in each study area to get a holistic scenario of drought mitigation measures employed by the respective communities.

The data collected were coded and entered using Excel after which where appropriate, analysis was done using the Statistical Package for the Social Sciences (SPSS, 2009). Frequencies were calculated using simple descriptive statistics for coping and adaptation strategies used by the respondents and summarized in tabular form.

RESULTS AND DISCUSSION

The demographic and socio-economic variables of the respondents in the same study areas of Kgalagadi North and Bobonong Sub-districts have been reported by Mogotsi *et al.* (2011).

Drought coping and adaptation strategies used: Communities have evolved adaptation and coping mechanisms to mitigate or buffer the adverse impacts of drought throughout history and rural Batswana agro-pastoralists are no exception. When faced with dry extremes, a number of coping strategies were employed by farmers in both study areas (Table 1). It is interesting to note that as many as eighteen coping and adaptation strategies were employed by households, further giving testimony to the diverse livelihood strategies in semi-arid areas observed by Twyman *et al.* (2004) as well as Dube and Sekhwela (2007). So no one strategy totally dominates. This fluidity and flexibility is key to managing the harsh and unpredictable climate that the farmers operate under.

In Bobonong area, the government's Labour Intensive Public Works Programme (Formely the Drought Relief Programme) was used as a coping strategy by 15% of the households while 13% harvested larvae of *Imbrasia belina* (Westwood) moth (locally known as phane) for consumption and sale. Another 11% of the households sought alternative sources of income during droughts. Storage of crop harvests from good seasons and supplementary feeding of livestock were practiced by 8% of the households each. Other strategies were planting of drought tolerant crops (7%) and moving livestock to better pastures within the communal area 6%.

Table 1: Household coping and adaptation strategies against drought in the study areas

	Respondents (%)	
Strategy employed	Bobonong (n = 50)	Kgalagadi North (n = 38)
Move livestock	6	13
Provide livestock with feed	8	22
Sell livestock	2	17
Provide livestock with water	3	17
Enroll in drought relief programme	15	7
Harvest natural resources	6	2
Phane harvesting	13	-*
Plant drought tolerant crops	7	2
Store crop harvest	8	2
Reduce/skip meals	5	-*
Sell firewood	2	1
Receive remittances	2	5
Seek alternative income	11	6
Borrow money	2	-*
Sell household durables	1	-*
Consume stored seed	2	-*
Do nothing	4	2
Other	5	4*

Not mentioned by respondents

In Kgalagadi North by contrast, the top coping and adaptation strategies revolved around livestock farming (especially cattle and goats). Farmers fed livestock commercial feed during drought periods (22%), 17% provided water for livestock and another 17% sold their livestock. Moving livestock to better grazing areas within the communal area was done by 13% of the farmers. Households relied less on the Labour Intensive Public Works Programme to cope with drought (7%) while even less tried seeking an alternative source of income outside agriculture (6%). Only the four high ranking coping and adaptation strategies from each study area are further discussed.

Labour intensive public works programme: Unlike other countries in southern Africa that can realistically hope that they may be spared a serious drought for some time (Holm and Morgan, 1985), Botswana has a long history of droughts. As a result of drought being recognized as a prevalent hazard, many policies aimed at mitigation were developed among which is the Drought Relief Programme of 1980 (Ministry of Finance and Development Planning, 2002). This programme was used by 15% of farmers in Bobonong area. The main purpose of the programme is to firstly alleviate human suffering (avoid deaths, malnutition and migration) and secondly to safeguard rural households' assets and thus enable immediate return to full production after droughts. The selected projects under this programme are labour intensive and use traditional skills (Ministry of Local Government, 2009). These include improvement of local infrastructure such as constructing dams and associated soil erosion control barriers, clearing bush along roadsides and creating and/or maintaining firebreaks. Wages paid to the participants are set high enough to provide a meaningful return yet low enough so as not to attract those already employed elsewhere.

Perhaps the programme has succeeded in the sense that in the households surveyed, none mentioned migration from their rural areas to urban centres as a coping strategy and only 1% of the households in one study site (Bobonong) sold their non-animal assets like ploughs, axes, building materials and weeding hoes in order to meet their subsistence needs. A similar food for

work programme and free food in northern Namibia during the 1991/92 drought resulted in only 5% of households selling their assets to cope (Sweet, 1998). The latter also emphasized that selling of domestic assets was a drastic response to drought and indicated failure of conventional sources of food and income to meet household subsistence needs.

Harvesting larvae of *Imbrasia belina* (Westwood) moth: In the Bobonong study area, the phane caterpillar, the larvae of *Imbrasia belina* moth which thrives on the host *Colophospermum mopane* woodland (Ditlhogo, 1996) was harvested for household consumption and/or for sale. This strategy was employed by 13% of the households surveyed. Each year, phane harvesting commences with the first generation emerging from pupation in November-December and then the second in March-April. This coincides with the rainy season in Botswana. Preparation of phane is simple the larvae of *I. belina* are degutted, cooked in brine and sun-dried. Phane is nutritious containing 56.8% protein, 16.4% fat and 0.458% calcium and 13.8% carbohydrate in g/100 g sample (Sekhwela, 1989; Allotey and Mpuchane, 2003).

Apart from harvesting phane to meet their daily dietary requirements, the Bobonong farmers also sold it to get cash to buy household essentials during drought years. Phane can also be used as a supplement in poultry and cattle feeds (Madibela *et al*., 2007). An established market in the region offers opportunities. For example, Moruakgomo (1996) estimates that around 4000 ton of air-dried phane worth US$9 million were exported to South Africa between 1991 and 1994 with each harvester averaging 150-250 kg per harvest period.

Alternative sources of income: When droughts compromise the agricultural sector which provides the main source of income for rural households, a myriad of activities are undertaken to augment the little if any at all, derived from agriculture. According to Reardon and Vosti (1995), the rationale for diversification is to create a portfolio of livelihoods with different risk attributes so that risks can be managed exante and that recovery is easier ex post. From the survey, 11 and 6% of households in Bobonong and Kgalagadi North, respectively engaged in informal economic activities such as brewing of traditional alcohol, selling craftwork and fat cakes. Most of the other activities revolved around harvesting and sale of natural resources like firewood or poles (e.g., from *Colophospermum mopane* tree), honey, thatching grass (e.g., from *Eragrostis pallens* and *Stipagrostis uniplumis*), wooden chairs/stools (e.g., from *Commiphora* tree species) and fruits of *Adansonia digitata*, *Sclerocarya birrea*, *Ximenia* and *Grewia* species. In some instances the households harvested vegetables like *Amaranthus thunbergii* (locally known as Thepe) which are often classed as weeds in ploughing fields during non-drought years. This strategy of having a wide portfolio of income-generating activities is recognized throughout most rural Africa (Barrett *et al*., 2001; Paavola, 2008) as income diversification to reduce dependence on rain-fed agriculture.

Supplementary feeding of livestock: In Botswana, important livestock grasses decline drastically in both quantity and quality during the non-rainy period, though some woody browse species may still meet minimum nutritional requirements of livestock (APRRU, 1976; Moleele, 1998). It is during this period that livestock lose weight or if the dry season is extended or during a drought year, animal mortalities may rise after exhausting the remaining feed. Thus supplementation becomes a necessity. This strategy was used by 22% of surveyed households in Kgalagadi North and less in Bobonong area (8%). Generally for poor farmers, purchasing commercial livestock feed is seldom a realistic option and because of limited irrigation options in the study areas, fodder production is unpopular. A mere 16 and 13.2% of the farmers produced their own fodder in Bobonong and Kgalagadi North, respectively, the bulk of which was from standing crop residues (*Zea mays* stover). Thus agricultural relief from the government of Botswana through provision of animal feeds at heavily subsidized prices offers a lifeline. Some of the common feeds available under this programme include winter licks and drought pellets.

Providing water for livestock: One of the most limiting factors to livestock productivity in Kgalagadi during drought periods is inadequate water supplies for livestock. Because of an erratic and highly variable rainfall regime, the district is characterized by almost no surface water bodies for most periods of the year. Only the numerous pans dotted around the district provide any water for livestock following good rains but quickly dry up due to excessive evaporation rates. Traditionally, livestock keepers in the communal grazing areas water their stock in hand-dug wells at the edge of the pans or occasionally in syndicate boreholes in areas where underground water is not too saline.

About 17% of the households in Kgalagadi North provided water for their livestock during droughts. The water is transported from the water points adjacent to the villages in large plastic or metal containers to cattleposts (traditionally open access grazing areas) or where animals

are grazing. Resources such as transport, fuel and labour are needed which may prove beyond the reach of poorer farmers. The government also offers assistance to farmer groups (syndicates) to improve their water supplies by sinking boreholes (Ministry of Finance and Development Planning, 2002).

Moving of livestock to other grazing areas: Because of the non-equilibrium dynamics of semi-arid ecosystems such as found in the study areas, livestock have to seasonally track the scattered available forage. Unfortunately, the current land tenure system in Botswana and associated fencing as well as limited water sources curtails this movement. In Kgalagadi North only 13% of the households moved their stock around cattleposts in search of better grazing areas while only 6% did so in Bobonong area. In the case of Kgalagadi North for example, the communal area in which the cattleposts are located is adjacent to Wildlife Management Areas (WMAs) and the Kgalagadi Transfrontier Park (State land), some privately-owned ranches (leased under Tribal land) and the permanent human settlements/villages (Tribal land). So mobility would not be a viable strategy under the circumstances and thus livestock can only be moved around within the communal area. Nonetheless, movement of livestock to areas with secure water and pastures can be an effective strategy against droughts and remained important for herders in southern Kajiado district of Kenya (Campbell, 1999).

Sale of livestock: Livestock owners in Botswana's communal areas are generally reluctant to sell their animals, simply because they are not commercially-oriented but rather rear animals for subsistence and other social/cultural reasons. And because they are often blamed for degrading the rangelands (Darkoh and Mbaiwa, 2002), pastoralists may view with skepticism any government efforts aimed at destocking. The 17% of the households covered in the survey sold their livestock to cope with drought while in contrast only 2% did so in Bobonong area.

There are a number of possible explanations for these differences in off take rates. Firstly, the Bobonong area is prone to outbreaks of the economically important Foot and Mouth Disease (FMD) and thus the Botswana Meat Commission (BMC) which has the monopoly of exporting Botswana's beef to the lucrative European market does not buy cattle from this high risk area for export. Secondly, on the rare occasion that there is no outbreak of FMD, the animals are sold at the low-paying local butcheries (91.7%) or at the better paying BMC abattoir in Francistown (8.3%), approximately 200 km away. Thirdly, the combination of FMD outbreaks and recurrent droughts in Bobonong area means farmers spend most of their time trying to reconstitute enough herd numbers an often futile and uneconomic cycle. All these contribute to the low off-take rates in the area. In Kgalagadi, by contrast, there is no FMD threat. This area, together with the adjacent Gantsi district, forms the bulk of the beef exports to the lucrative European Union market. Most of the farmers sold their cattle to the BMC (64.3%), 10.7% to local butcheries and 25% to both markets. In fact, the BMC has implemented a marketing incentive scheme in the area where it goes directly to farmers to buy live animals thereby eliminating the costs of transport for the farmers (Direct Cattle Purchase Program).

The preceding measures help communities to buffer the adverse effects of droughts and thus lower their exposure to drought risk and in return avert or minimize their vulnerability. These strategies further demonstrate the fighting spirit of the inhabitants of drought-prone semi-arid environments, despite being often portrayed as passive victims.

CONCLUSION

Kalahari agro-pastoral communities use a myriad of strategies to cope and adapt during drought years. This fluidity and flexibility is necessary to manage the often harsh and unpredictable environment communities operate under. Some of this accumulated experience of indigenous knowledge which has been refined for decades should be explored and strengthened where necessary to enhance resilience to future climatic shocks. Also, the economic and ecological viability of some strategies can be explored in future research.

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