

Climate Change: Rural pastoral farmers' coping strategies to extreme temperatures in southern Botswana

TARIRO MADYISE

Lecturer, Faculty of Business, Department of Occupational Health, Safety and Environment, Gaborone University
College of Law and Professional Studies, Gaborone, Botswana

Email – tndangamad70@gmail.com

Abstract: *Extreme temperature challenges are felt by pastoral farmers globally, as climate changes. The study focused on assessing the coping strategies implemented by smallholder animal farmers in Kweneng and Kgatleng districts of Southern Botswana in response to temperature changes. Strategies implemented in animal production by Kopong, Kumakwane and Dikwididi to boost food security were evaluated. This was a qualitative study, when 200 participants were sampled, that is 198 farmers and 2 Ministry of Agricultural Development and Food Security (MADFS). Convenience and purposive sampling methods were used to select the sample. Structured questionnaires and individual interviews were used to collect primary data from the pastoral farmers whereas MADFS animal section and Meteorological Department records, provided secondary data. From the findings, pastoral farmers are adapting to climate change to improve animal production through supplementary feeding with fodder crops, indigenous and drought resistant Tswana breeds, rotational grazing. Farmers are recommended to collaborate and integrate local indigenous, technological and scientific knowledge gained from agricultural officers to develop better coping strategies for survival of animals as temperatures continuously rise, affecting the grazing lands and livestock numbers.*

Key Words: *Pastoral farmers, climate change, coping strategies, extreme temperatures, Botswana.*

1. INTRODUCTION:

Botswana and the rest of the world have acknowledged the effects of increase in temperatures as climate changes through, both, experience and research conducted since the late 20th century. Climate change poses various risks to livestock farmers, hence causing threats to food security, natural resources and livelihoods (1, 2). Rural communities depend on crop and livestock subsistence farming, thus contributing to climate change. Historically, Botswana has been experiencing harsh temperature conditions due to its position in the semi-arid region, which has the greatest impact on poor livestock farmers who depend on pastoral farming, rearing mainly cattle, goats, and donkeys (3). However, livestock production, as an activity, is both, a contributor and victim of climate change (4, 5). The country is highly vulnerable to seasonal variations in climate influenced by the La Niña and El Niño events (6). The study was conducted as a multiple case study in southern Botswana's districts of Kweneng and Kgatleng. The southern districts of the country experience extreme temperatures of up to 42°C, long summers from October to April with low humid conditions, and minimal rainfall annually (7).

Main objective

The main objective was to establish the coping strategies implemented by small scale pastoral farmers to sustain livestock in response to temperature changes.

2. BRIEF LITERATURE REVIEW:

As climate changes, it follows that there are variations and increase in temperature which affect grassland production (8). The impacts are visible in various communities vulnerable to frequent occurrences of heat waves and extreme droughts affecting economic drivers such as agricultural yields, infrastructural development and biodiversity (9). Climate change threatens the livelihoods of poor people, causing communal farmers to lose hundreds of livestock due to lack of grazing and water shortage (10, 11). In addition, increasing temperatures, increase risks of diseases and insufficient supply of food to livestock (4). Although, animal agriculture is contributing to climate variability in various

countries, farmers are taking stringent measures such as changing farming strategies, to reduce the effects on their livelihoods (12).

Scientists and researchers predicted and concluded from previous studies, that, further climate variations will be experienced up to the end of and beyond the 21st Century, causing the earth to warm with up to 3 degrees Celsius, influencing and causing climate transformation by the first order, with a substantial impact on human livelihoods and food security (13). Initial reports by the IPCC (14) had shown evidence of a global temperature rise of between 1.4°C and 5.8°C as a projected rise in the next decade, with irreversible damage. The effects are now, for example, earth warming being experienced worldwide, due to climate change. Further research predicted that Africa, as a continent, will experience a temperature rise of up to 4°C by the 21st century (15). Excessive heat and temperature trends have significantly changed over the past years with the maximum fluctuating from around 30°C and in summers, rising to above 40°C. Similarly, (16) realised that temperatures were showing a rising trend throughout the 21st century across many regions. As the global temperature increased by approximately 0.7 degrees Celsius, in the last Century, there has been need for socially acceptable livestock measures (5).

Pastoral farmers, worldwide, are affected by continuous rise in temperatures and have adopted several coping measures to boost food security. Some changed grazing strategies to maintain a limited number of vulnerable livestock e.g exotic cattle which cannot express their maximum genetic potential due to heat stress and harsh conditions, provision of supplementary feeding with forage and water (12, 10); use of legumes as diet improvement options to increase productivity on mixed dairy systems (17); destocking livestock in communal lands to reduce herd sizes during extreme drought and moving livestock to areas with forage (10, 12, 18, 19, 20, 21); rearing drought-tolerant livestock genotypes and species of cattle and donkeys which improve beef, milk production and draught power (10, 19); keeping more than one species of livestock provide a wider range of adaptive options as climate change impact growth of pastures and grazing land (22). In addition, selection of breeding animals that are low or high greenhouse gas emitters due to the diets consumed is essential as feed intake and composition, influence methane production, mostly in ruminants (5). The strategies proved to be successful and effective in reducing the effects of rising temperatures on livestock production. Breeding browsers for example goats and donkeys are effective practices as these are hardier than cattle and positively adapt to high temperatures and extremely dry conditions (20). However, rearing indigenous types such as Nguni and Afrikaner increase adaptability to harsh conditions and performance mostly, when crossbred with exotic cattle (23). Shifting to mixed arable farming, keeping small stock and browsers rather than cattle, uses less land and generate quick income, which benefits rural communities (18, 20, 24). Smallholder farmers in other areas adopted livestock diversification, mixing farming and non-farming activities, depending on the experience. This involved concentrating on small stock – for example, poultry, on a small scale, which could easily be monitored (25). There is need for more research to develop new mitigation and adaptation technologies (5). Livestock training, technical knowledge and skills on climate change and climate smart agriculture enhances farmers to adopt diversification, feeding and weather resistance strategies (26).

3. MATERIALS AND METHODS:

This was a multiple case study as 198 small scale pastoral farmers in Kweneng and Kgatleng, communal lands were purposively sampled, considering the fact that large populations of rural areas in the southern districts depend on pastoral farming, as main activity of livelihoods. A questionnaire was administered to the farmers while 2 Ministry of Agricultural Development and Food Security (livestock section) officials were interviewed to obtain primary data. The use of multiple sources was necessary, to establish whether findings occurring in the first case could apply to other areas. This allowed comparison of climate coping strategies used by livestock farmers in the two districts for generalisation purposes, and to enhance the validity of results (27). Secondary data on trends and patterns of temperature and occurrence of droughts, were obtained to validate the respondents' responses through documentary analysis of records kept by the Botswana Meteorological Services. Information on identifying farmers sample involved in pastoral farming activities was derived from records kept by the agricultural extension officers who administer activities of farmers in various districts.

4. STUDY FINDINGS:

The study focused on establishing the coping strategies implemented by pastoral farmers to sustain livelihoods as extreme temperatures lead to climate change. The trend of the results showed that most of the respondents rely on livestock production as one of the main activities for food security and income generation through selling to local and international market. Livestock farmers adopted several strategies (see Table 1) to cope with extreme temperatures, sustain livestock rearing and enhance food security.

Table 1: Climate-smart livelihood strategies by livestock farmers. Source: Survey results (2020)

STRATEGY	COMMUNITY			Percent
	Kopong	Kumakwane	Dikwididi	
Supplementary feeding from fodder crops	79	67	12	79%
Use of supplementary water from boreholes and wells	45	52	5	51%
Vaccinating regularly to reduce intestinal diseases from eating dry grass	51	34	7	46%
Rearing indigenous Tswana and cross-bred exotic breeds of cattle, goats, donkeys which are resistant to harsh conditions.	62	51	9	61%
Rotational grazing to fields with pastures	11	5	1	9%
Construction of shades to prevent effects of extreme temperatures in the late afternoon	18	11	6	18%
Use of government initiatives e.g LIMID, education and training, subsidies for feeds	83	49	11	72%
Mixed farming (crop and livestock)	36	21	4	31%

Generally, the participants observed temperature changes, with extreme heat. Concerning livestock production, common trends and patterns observed included low production and lack of natural pastures, with low grass cover. However, basing on study findings in Table 1, pastoral farmers adopted several climate-smart strategies with the majority (79%) practicing supplementary feeding using fodder crops, either purchased or planted. Supplementary feeds with legumes (Lucerne, Lablab, fodder grass), dry grass and salt, boosted nutrition with positive results when jointly implemented with supplementary water from boreholes. However, only 51% of the farmers could afford to buy feeds regularly while failure by others was owed to lack of funds to buy feeds and drill boreholes as well as extreme low water tables. Arguably, in the absence of supplementary feeding, some farmers (9%) opted for rotational grazing, enhanced shades, shelters and kraals for livestock to limit animal movements during daytime when the temperatures are at maximum.

The study further established that several farmers (61%) opted to rear indigenous Tswana cattle breeds. Furthermore, the same farmers believed that cross breeding of indigenous with exotic breeds' boosted resistance to diseases. However, by using indigenous knowledge, the communities were convinced that to succeed in dealing with climate change, rearing other animals like goats and donkeys which can survive harsh drought conditions was viable. In addition, the findings suggest that the use of government initiatives such as Livestock Management and Infrastructure Development (LIMID), education and training, subsidies for feeds and vaccines was helpful. These were convincingly common among farmers as the majority (72%) appreciated the assistance they got from MADFS. For this reason, farmers vaccinated livestock regularly against intestinal diseases. Those who failed to sustain cattle rearing opted for mixed farming (31%) mainly with small stock which could generate income within a shorter period.

Basing on the findings of the study, pastoral farmers had mixed perceptions concerning the impact of climate-smart strategies. For instance, fifty-eight (29%) of pastoral farmers believed these strategies were effective. Likewise, one hundred and sixteen (58%) saw the strategies as slightly effective, whereas twenty-six (13%) were not convinced by the effectiveness of the measures. Instead, they complained of prevailing low rainfall and extreme temperatures which could not sustain their livestock even though they received inputs from MADFS. Having said that, the evidence of the effectiveness of strategies from pastoral farmers in all communities included: livestock increasing in numbers with fewer deaths unlike before strategies especially the drought-resistant Tswana breeds; fewer disease outbreaks and receiving income from selling cattle to Botswana Meat Commission.

5. ANALYSIS AND DISCUSSION:

The study participant statistics showed that there are more males than females involved in pastoral farming in Botswana as men dominate the industry, owning cattle posts (*meraka*) but are directly affected by climate change. With development of coping measures, there was compelling evidence from the farmers' that livestock numbers and income increased from selling cattle which boosted food security as climate changes. Most of the farmers introduced supplementary feeding using fodder crops such as lablab, lucerne, dried grass and watering from boreholes, constructed reservoirs and storage tanks with sheds to cover kraals and reduce heat just like pastoralists in other countries as research done by (10), (17) and (12) suggested the same findings. This agrees with (28) who noted that intercropping forage legumes and cereals increases supplementary feed for livestock production in sub-Saharan Africa.

Furthermore, some farmers in Kweneng and Kgatleng districts introduced indigenous Tswana cattle and goats, which are resistant to harsh conditions and cross-bred with exotic breeds of cattle, goats, donkeys, which improved animal survival chances and boosted their activities. The findings concurred with results from other studies by (10), (19) and (23) who contributed to the debate by arguing that rearing donkeys and browsers like goats are effective practices, as the latter, are stronger, more resistant than cattle and can withstand extreme temperatures. Cumulatively, more research had shown that rearing various types of livestock can improve livelihoods of farmers when there is continuous income from sales, despite poor weather conditions.

Regular vaccinations to control infections done in the two districts is similar to what South African pastoral farmers in various provinces. The pastoralists choose to treat the drought-tolerant livestock genotypes and species as higher-potential breeds, to increase beef and milk production with limited disease infections. In addition, animals are moved to productive pastures to cope with climate variability (19), which is similar to Botswana farmers' rotational grazing. The role of government through the MADFS in dealing with effects of climate change on the livelihoods of pastoral farmers include providing stock feeds at subsidised prices to favour supplementary feeding, and this allows all to afford for continuity in livestock rearing.

6. CONCLUSION:

Pastoral farmers in Southern Botswana districts are aware of increasing temperatures causing climate change, affecting livestock farming activities. Therefore, they had developed climate coping strategies, with positive impact on livelihoods. Arguably, in relation to the literature reviewed in this study, and based on the findings, there are challenges faced by pastoral farmers in implementing the coping strategies which include lack of money to buy supplementary feeds, shade and vaccines for the livestock, shortage of water for watering livestock, as boreholes are drying due to very low water table and extremely high temperatures, resulting in shortages of pasture and livestock death.

7. RECOMMENDATIONS:

Small scale pastoral farmers should practice mixed farming to allow dependency and conversion to the other activity if the initial effort failed. Mixing dairy systems with farming of legumes can improve productivity as drought-resistant breeds can interchangeably be reared, depending on crop residues. There is need for more education for pastoral farmers on how to deal with extreme temperatures and remain productive even when climate changes. Livestock farmers need to contribute and pay attention to climate change mitigation though rearing breeds which are low GHG emitters. Globally, animal welfare should be the main agenda in continental dialogue and decision-making in agriculture as livestock contribute much to food security worldwide.

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