

Climate Change Versus Pastoral Communities in Butana of Sudan Vulnerability and Adaptability

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Abstract:- This paper is focused on impacts of climate vulnerability on pastoral livelihoods and adaptive capacities of pastoral communities in Goz Rajab and Alazaza of River Atbara Locality of Butana of Kassala State- Eastern Sudan .It aimed to to assess impacts of climate vulnerability on the current livelihood of pastoral groups in River Atbara Locality of Kassala State, analysing adaptive capacity at the community level and to propose guideline measures that enhance pastoral groups ability to adapt to climate change and ensure food security. Approach used is Climate Vulnerability and Capacity Analysis in line with Sustainable livelihood approach. Data were collected based on many participatory tools include desk research well-structured questionnaires for household (H/H) historical timelines, group discussions. Key findings were summarized that, drought seems to be the biggest climate hazard, 38 % of respondents indicated that recently its frequency has increased resulting in negative impacts that affects pastoral community's livelihoods. The vulnerability of the pastoralists in Goz Rajab is highly pronounced compared to Alazaza agro pastoralists. H/H headship was male dominated it constitutes 97.7% of sample size. Both women and men had less access to education in Goz Rajab. Elder's illiteracy in Alazaza was 71% for both sexes. Protection of key livelihood asset was quite low as accessed by only 4.5% of respondents' H/H heads. Feed shortage reported by 97 % resulted in increased mobility and migration (90%) and shift from pastoralism to other production system as agreed by 90% of respondents. Findings indicated that access to finance provided by livestock traders who provide 50% on loan basis and Producers Union provides 50%. Access to early warning and climate information reported by only 24.4% hence climate information provided by elderly observations (68.4%) or depends on physiognomy (31.6%) to nature for planning for mobility or cultivation. Selling animals among more significant coping mechanism (66.7% of H/H); brokerage practiced by 47.5%. Adaptation capacities varied between study areas, practices include shifting to raise small ruminants, cultivation, utilize sorghum stoves as roofs and building material dry season feeding; Accessibility to knowledge and skills were varied ,2.4 % have no idea about the information availability and accessibility (Mustafa,2015).

Keywords:- Climate, Vulnerability, Pastoral, Community, Butana of Kassala.

I. INTRODUCTION

Semi-arid zone is characterized by low and erratic precipitation, high temperatures and high rates of evapotranspiration. They are considered as the world's poorest region with climatic and ecological vulnerability greatly enhanced by the socio-economic situation and the low adaptive capacity. Agriculture in Semi-arid zone is predominantly rain-fed, where crop harvest and animal stocking rate, income and ultimately survival; depend critically on sufficient and timely soil moisture.

Rainfall is the most important climatic factor in the Butana area. However, variations of rainfall coupled with differences in soil types are responsible for the diversity of rangelands species composition. and shapes the movement of pastoral groups. Traditional movements of pastoral groups, occur between wet and dry season grazing areas. The length of the wet season depends on the ecological zone. The summer wet season, when all the nomads congregate on the Butana from different regions to graze the available pastures.. In winter, , the nomads are preparing to face the dry season when they concentrate around the permanent water points, graze the merge pasture in those areas, or migrate to irrigated schemes around the area to purchase fodder for their animals (AbuSin, 1970, Elhassan, 1981).

The total population of the River Atbara Locality was 136,911 person represents 7.6% of the total Kassala State population. Pastoralists estimated as 72% of population mainly spend dry season at the Goz Rajab ranging between 50-154 "Fareques" depend on rainy season and availability of pasture.

The inhabitants of River Atbara are mainly agro – pastoralists of Shukriya tribal group, nomadic tribes from the southern part of the state (Lahaween, Rufaa and Kawahla) enter the area during the rainy season (July–September) to make use of the natural pasture. The total number of households amounts to about 5,200 households living in thirteen villages. The herd is composed of small ruminants (sheep and goats), camels and cattle of the structure 75%, 15% and 10% respectively.

This means herds move to New Halfa and Gezira Schemes, as well as to the large-scale semi mechanized schemes of Gadarif, and River Atbara in the State.. Pastoralism in the River Atbara Locality, being marginal,

both socially and politically Main source of income/ livelihood is subsistence oriented and is based on pastoralism and traditional agriculture, (Sajak, 2013, Elgolzli, 2013.).

Vulnerability varies considerably among the different groups of pastoralists and agro-pastoralists and within the groups, however, the two production systems are vulnerable to climate change, but the vulnerability of the pastoralists in Goz Rajab is highly pronounced compared to Alazaza .

Pastoral nomadism in the Butana area has been undergoing rapid changes in the nature of the pastures, as well as strategy and pattern of mobility. This change is basically due to climatic factors and the expansion in the agricultural development schemes in the Butana area. Climate extremes together with poor land mismanagement resulted threaten ecosystem biodiversity(Elhag, 2012, Abuksawi eatal ,2017).

II. STUDY AREA AND METHODOLOGY

➤ Study Area :

Butana of Kassala State is located between latitudes 13^o, 23^oN to 15^o, 30^oN and longitudes 29^o, 33^oE to 30^o, 45^oE, in a Semi Desert Zone eastern Sudan. It constitutes three. Goz Rajab and Alazaza village clusters of River Atbara Locality are targeted study area is situated in the Northeast Butana extending from the northern border of New Halfa Agricultural Scheme to the Northern fringes of River Nile State the area falls within the arid zone, with Semi-Desert and Desert Zones occupying the north-west and north-eastern parts of the area. Rainfall is unreliable, ranges from 200-250 mm, occurring dominantly between May to October while evaporation amounts to 2-2.5 mm.

Seasonal rainfall records for New Halfa 1971-2012, demonstrates that, variability is high during 40-year period (1971-2012), deviation below average frequent seventeen (17) times out of which severe drought occur four (4) times in 1984, 1987, 1989 and 1991. Above-average rainfall years were recorded twenty-three (23) times while very wet years frequency is four times in 1974, 1980, 1993, and 2003 (New Halfa Weather Station ,2012)

Temperature, is high all year around, the highest temperatures being in April above 40^o C January is the coolest month with the maximum temperature being 17^o C. relative humidity varying between 16% -77%.

The area receives summer dust storms “Haboob” with their highest intensity during April–May. These are associated with south winds

Atbara River at the eastern boundary is main seasonal source of water. The area is intersected by a number of seasonal water courses (Wadies and Khors). Seasonal runoff is collected in a number of “Hafirs” which provide water for livestock and humans during the rainy and dry seasons. Irrigation canals of New Halfa scheme provide additional source of water for pastoral herds and River Atbara as well

Vegetation, the plant diversity increase towards the south where the area was dominated by grasses: Extensive areas are bare and sand deposition is a common feature.

Rangeland is divided into four types, {Wadies grazing, Plains grazing, Mountainous grazing and Al-karab grazing average production of grassland is 0.29 ton/ha. Average Browse yield was. Waste water of New Halfa Sugar Factory that drains to the east of pastoral villages resulted in growth of a good stand of tree cover known as Alazaza forest composed of a mixture of trees that form a useful source of feed for the animals of the surrounding villages (. The result, considerable number of the nomadic tribes who used to seek graazing outside the area, shifted to spend the dry season around the forest (Elgolzli, 2013, SMA, 2020).

Combination of drought and overgrazing has resulted in the steady deterioration of both the productivity and biological diversity of the area rangelands and the intensified pressure on its fragile and deteriorating resource base, further exacerbating the vulnerability of its population.

➤ Data Collection

- Approach used is Climate Vulnerability and Capacity Analysis in line with Sustainable livelihood approach. Primary data were collected based on many participatory tools included , well-structured questionnaires for household (H/H), historical timelines, group discussions and consultations with pastoral leaders, and key informants.
- Secondary included desk research, previous inventories, project documents, Main unit of measurement is H/H heads cluster quota sampling cover two study area Goz Rajab Fareques Cluster mainly they are mobile pastoralists mainly pastoralists (nomads) groups and Alazaza Village Cluster, mainly they are agro-pastoralists.

➤ Data Analysis

Data collected were coded, computerized and analyzed using the Statistical Package for Social Sciences (SPSS) software version 16. Simple statistical measures were used to calculate averages, percentages and means for different parameters.

Demographic characteristics of the respondents, and their attitudes towards suitable production systems and mainstreaming the adaptation measures was described.

III. RESULTS AND DISCUSSION

Headship is male dominated constitutes 97.7% of sample size while female constitute only 2.3%. Age structure of respondents' males ranging between 22-year-old and <60. Female-headed household are of more than 45-year-old. Education levels of respondents are quite low since 57% were found illiterate or have Khalwa education, of which female are illiterate, giving below education level. Primary education represents 29 % and secondary school found to be only 14% (Figure 1)

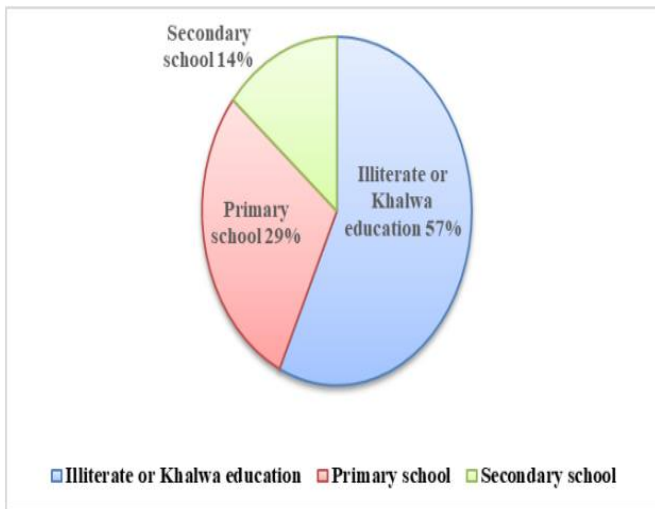


Fig 1 Education Percentages Among Community

Both pastoralism and agriculture are considered to be highly climate-sensitive production systems. Pastoral and agricultural production systems are impacted by changes in rainfall patterns, extreme events; vulnerability to these changes varies with time, geographic location, and economic, social, and environmental conditions. there is significant difference in the livelihoods sources.

Main occupation of H/H heads of households is animal raising 56%, who practice cultivation and animal raising are 36%, other occupations include: wage labours, , brokers .

Group discussion reported that sale of livestock is the main income source used to purchase basic food and non-food items. About 74-86% of the total income for all wealth groups is derived from livestock sales.

The poor groups who rely on social support are very few (2.9%). Animal raising and cultivation agro-pastoralists represent 18.8%. They rely on animal raising and sorghum cultivation depends essentially on harvesting of rainwater,. Wage labours for herding, cultivation represents 23.2% and others who seek work outside the area or migrants elsewhere only 1.5 %.

The research captured local perceptions of both hazards and long-term trends, which communities felt, had affected their livelihoods. The research then used responses to weather-related shocks and trends to assess adaptive capacity more generally and how it has been affected by other factors. In the study area climate changes, impacts were well observed by community members. Their perception of these changes is attributed to the drought occurrence state by 40 % of group discussion members. Only 25% believed that increased period of dust storms and blowing velocity is observable in the area, 15% associated the changes as result of observable increase in minimum and maximum temperatures, 20% of respondents the former mentioned climatic events behind the observable changes. Likewise, these statistics obtained by the questionnaire, it may be useful to give some of the information agreed upon by the participants in focus discussion in historical timeline for the periods 1972- 2012(Figure 2).

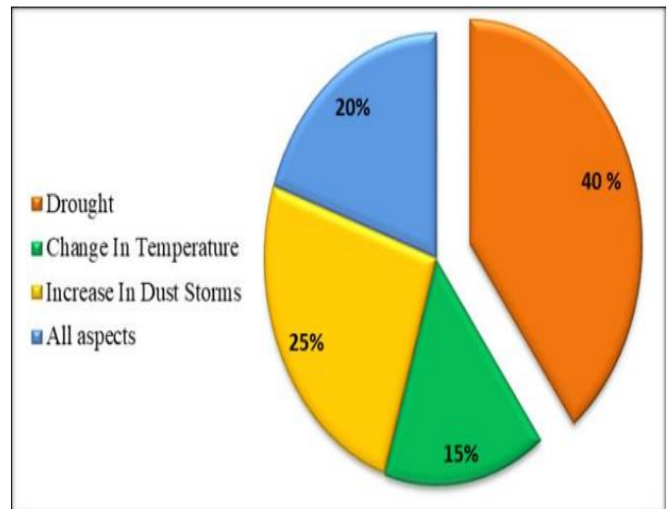


Fig 2 Percentage of Community Perception on Climate Change Impacts in Study Area (1972- 2012)

Results showed that, decreasing trends of rainfall amounts while its distribution became more erratic in space and time during 1982- 2012; Most interviewees have noticed changes in the weather and seasons, and experienced drought, changes in rainfall amount and distribution, and temperature increases over time, as well as increase of hot days .It is clear that rainfall amount and distribution coupled with increased temperatures as experienced in the past decade put pastoralists and their animals under significant stress. One of the most pressing effects of reduced rainfall levels, which increases the pressure on available rangelands. Availability of grazing showed deteriorated trend which constitutes a major concern pasture conditions witness remarkable decrease palatable range plants and increase of invader unpalatable plants species such as *Leucas urticifolia* and *Ocimum basilicum* In addition, comparable results were counted from studies in the in this study area (During the last 20 years there was a change in the plant species composition where five (5) grass species disappeared and one decreased, (16) of the herbs disappeared while one increased and another decreased, six of the fodder trees and shrubs decreased and two increased. In forage range plants species are very localized (around wadies), the area is invaded by (4) unpalatable plants species and there is spread of wind erosions over vast area (Idris 2013).

One of the major implications is that, mobility of whole family decreased and production pattern transformed towards settlements although soil fertility decreased.

Group discussions results that interviewees agreed that these impacts affect livelihoods have increased over time were 57. % of respondents expressed that changes have happened in speedily manner. Only 8% expressed that changes took place reasonably, while 23% of them thought that changes happened suddenly. The remaining 12. % have no idea about these changes. However, they also agreed that their ability to react and adjust had changed. Respondents observed that the impacts of climatic hazards felt indirectly. More uncertain rains and below-average rainfall and the length of rainy season have been shortened from (4) months in past to almost less than (2.5) months. The variability in

rainfall and occurrence of droughts have forced pastoralists to shift their stock routes and watering points. Drought seems to be the biggest climate related hazard affecting pastoral and agro-pastoral community groups in the study area (Figure.3). Other hazards mentioned included land degradation, the quality of range plants, diseases. About 38 % of the respondents ranked drought as the main hazard followed by land degradation and soil erosion as indicated by 32. % of respondents. Only 14% of them believed that, climate related hazards include deterioration of the quality of range plants and animal diseases while 16% agreed that the climate related hazard is complex issue that constitutes all aspects mentioned by other.

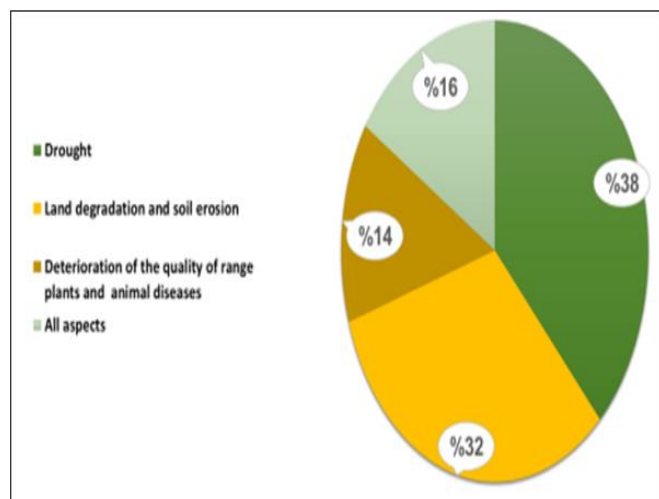


Fig 3 Ranking of Climate Related Hazard Affecting Pastoral and Agro-Pastoral Community Groups in Study Area

Further, the erratic rainfall pattern observed by community members falls in line with the increasingly unpredictable rainfall patterns expected for the country. Community observations indicate fluctuating temperatures in place of the general increases predicted for the country. Observations of climate change by communities included a shortening of the rainy seasons during the last decade and rains seem to have decreased in the area as well. This supports ARC and SMA (2009) findings that there is a decrease in the number of the rainy days during the period 1940 to 2010 (Rain = ≥ 0.85 mm).

Local observations in the area indicated that temperatures have increased significantly. Communities' witness, the daily temperature highs used to occur mainly in the afternoon, but now begin from sun shine, and night temperatures from December to March are also warmer than before. During group discussion in Goz Rajab the interviewees declared that both day and night temperatures have increased in recent years. Similarly, according to local observations of interviewees in Alazaza, that temperature have increased significantly since 2000, with May 2012, being cited as the hottest month ever, both during day and night, while the winter period has also become warmer. All respondents and interviewees in study sites identified distinct perceived changes to the local climate in the recent past.

Patterns of change differ, although in all sites respondents identified increasing temperatures, particularly at night, and changes in seasonality. All respondents and interviewees agreed that such changes had profound implications for their livelihoods.. Similar findings were also reported from studies in Butana Area (Eltayeb et al., 2012), the level of crop yields is perceived to have decreased over the 40 years. Community observations of increasing temperatures are consistent with scientific observations and projections for Sudan as a whole (HCENR, 2013). Observations of increasing frequency of drought spell and rainfall variability are consistent with climate change projections for Sudan, although not confirmed by scientific observations due to insufficient historical daily rainfall records in the area. Majority of respondents (51.9%) identified that lack of control over the management of natural resources is among non-climate related hazard that affecting their lives and livelihoods. Lack of availability and accessibility of basic services is main non-climate related hazard as mentioned by (23.3%) of respondents, 21.1% of them trust that poor governance influencing their livelihood. The remaining 3.7% mentioned other non-climate factors (include poverty, food insecurity etc.) influencing their livelihoods. Figure (4) illustrates ranking of non-climate related hazard affecting pastoral and agro-pastoral community groups in study area.

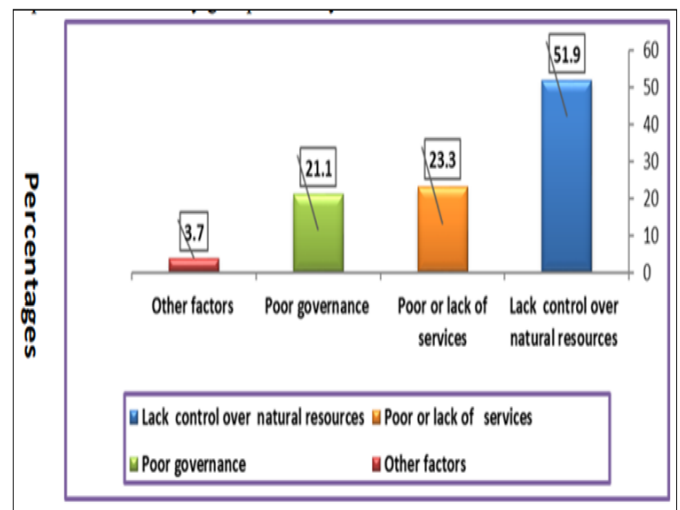


Fig 4 Ranking of Non-Climates Related Hazard

Findings indicated that, households that perceived to be rich are those that own the largest numbers (more than 100 head of camel) of livestock. These households are also assumed more resilient; however, they may be highly sensitive to climate-related shocks and stresses due to their reliance on livestock for income and food. Agro-pastoral households, with a mix of livestock rearing, crop production and other income generating activities, seem to be more resilient as they have more options available to them due to diversification of income sources.

Results indicated that there are insignificant actions towards protection of key assets from climate hazards to reduce risks. Only 4.5% or less than six respondents agreed on the protection of key livelihood asset. The situation was more or less the same regarding access early warning to

make appropriate adaptation action. Only 24.4% could access to early warning information. Group discussions reveal that a frequent barrier to accurate climate predictions on a local level was the lack of reliable information about climate history. This was to be stated to be coupled with inadequate information about climate impacts at these levels. It is therefore important when conducting climate adaptation to examine the perceptions of community members to inform the design of adaptation response activities. Over 64.3% of respondents stated that they practice irregular and emergency movements during critical times to reduce risks of climate change and its consequences. This was also true for most of Goz Rajab pastoralists. Consultations with NGOs and government officials indicated that declining availability, productivity and quality of pastures and cropland. This is supported by respondents who observed that the impacts of climatic hazards are felt indirectly. Deterioration of rangeland plant, animal diseases and, decreasing water availability are good examples. There is insufficient animal feed as mentioned by 47.5% of respondents also insufficient foodstuff mentioned by 36.2%. Local community is sufficiently aware of climate shocks in the area through their assessment of the witnessed climatic extreme events and their related hazards. These have negative impacts on their livelihoods as agreed by all group discussion members More concern of interviewees was about the vegetation cover. It was described as “quality and quantity of range plants and diversity of trees during 1972 to 1982 period affected by droughts as expressed by elder herders in both Alazaza and Goz Rajab. Pastoralists from Goz Rajab reported that “their Butana area used to have plenty palatable range plant species, have but disappeared and replaced by invaders "That leads to increased mobility and migration (90%) and shift from pastoralism to other production systems as agreed by 90% of respondents.

Other impacts of climate shocks of the livelihood assets as reported by the people in the area were feed shortage 97 % in all group discussions.

Results also showed that, climate change impact had increased poverty for 62 % of the respondents while almost all group discussions members reported poverty increased through, drop of livestock prices, crop failure and reduced incomes.

Interviewees reported that impacts of climate shocks are becoming worse, in large part due to factors independent of the climate, as decreasing availability of and access to natural resources, decreasing landholdings and increasing costs of inputs. Access to assets helps to diversify livelihoods and to deal with climatic variability. In Alazaza cluster, being able to access irrigation water as described recurrently as a key determinant of wealth accumulation in a changing climate as it allows cropping and decreased dependence on rainfall. Those who access irrigated agricultural lands have a more diverse range of livelihood options. Currently these are small areas that are under irrigation and which may help some households to adapt.

The main sources to pastoral groups within the targeted community include animal raising (53.6%).. They mentioned that about 74-86% of the total income for all wealth groups derived from livestock sales. Income used to purchase basic food and non-food items. Access to financing is very limited to pastoralists in the area.

In River Atbara Locality, the main sources of finance are Livestock Traders who provide 50% of animal raising funds on loan basis and Producers Union provides 50%. In New Halfa banks are the only sources of financing for both Localities for agricultural inputs including livestock raising (Figure 5) most of respondents (79% of them) agree on that the households do not access financial services. Only 21% of respondents agree on accessibility of the financial credits upon which communities depend for livestock raising. Due to lack of liability regarding mobile pastoralists, this financial credit had been exclusively availability to agro pastoralists of New Halfa Locality.



Fig 5 Percentage Access to Financing in the Study Area

Communities' financial resources are strongly impacted by drought and availability of agricultural inputs. All interviewed communities seemed to agree that diversification of financial resources are key to adapting to change.

Mobile groups of pastoralists think it is the responsibility of government and NGOs to respond to changes in climate. They feel that as individuals they are unable to respond to environmental challenges or to adapt, instead they are calling for organized assistance.

Social and economic safety nets are available to limited H/H as stated by 37.3% of respondents. Only 21.5% of respondents agree on that H/H received fund from different fund sources such as bank credits, social support (gifts or loans from relatives) or in case of well-off H/H they have their own fund. Some respondents 18% agree on that they do not know about provision of finance.

Access to seasonal forecasts and other climate information was very limited only 34.1% of respondents can access the seasonal forecasts and other climate information. Traditional asset redistribution systems are important social resources in this area. These social systems are meant to support poor vulnerable households or those who have lost good part of their assets due to hazards such robbing. group discussions reveal that,, asset redistribution systems include: (i) Supporting of affected households by tribe members; (ii) providing milking goats to hazard-affected households; (iii) practice a mutual aid system where local; institutions (Sheikh) and community members get together to help a neighbour hazard-affected and poor household; (v) Provide land for cultivation on temporary basis and; (vi) Zakat Chamber as traditional social protection mechanism but it is ineffective in term of distributions and amount; (vii) Sometimes disadvantaged groups from poor pastoralists herd for richer relatives as hired labours. They receive food and other in kind benefits as payment. (viii) adopting livestock offspring from richer households, sometimes on barrowing especially during dry season. Majority (62.7%) of respondents stated that this traditional resource management system is ineffective among nomads while only 37.2 % of respondents mentioned effective social support (Figure 6).

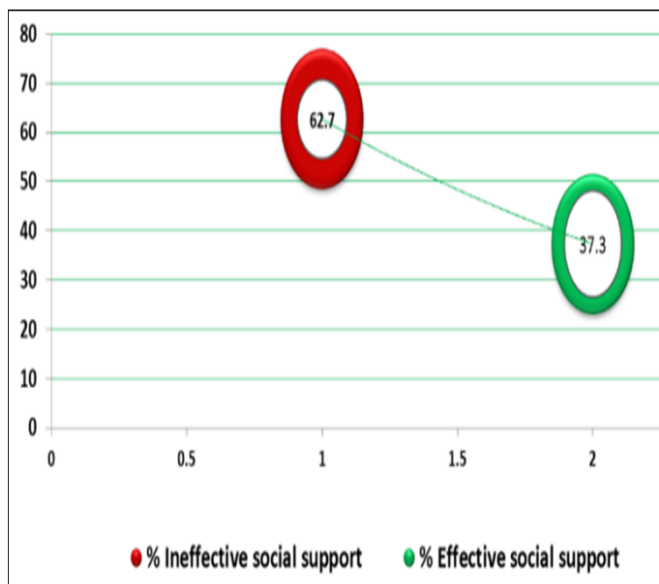


Fig 6 Percentage of Effectiveness of Social Support System

Social relations are also negatively affected by increased roaming far away from home durations spent, and little time devoted to social activities and their families. Although they are affected by drought, all of these social aspects are important to increase the adaptive capacity.

The interviewees stated that they followed number of climate-resilient livelihoods practices, adaptation, and coping strategies, The most significant coping mechanism is selling animals during the dry season decrease the cost of buying crop residues and agro- industrial by -products for them, this is practiced by over 66.7% of the respondents. Also they are used to selling weak and old animals. wage labour and /or brokerage practiced by over 47.5 % of the respondents.

Promotion of Climate-resilient livelihoods indicated could be through creating and using climate information provided by elderly observations or depending on physiognomy to nature for planning for mobility or cultivation as adaptive mechanisms which , adopted by about (27.3%). 42.8% of respondents, Managing risk by planning for cultivation and settlement, mainly Goz Rajab as non-livestock production strategies.

More significant existing adaptive strategies and adaptation potential is irregular mobility (35.7%, and increasing watering interval. The respondent stated that the apparent effects of drought were reflected in increasing the radius of their movements, increased theft and robbery of livestock, loss of livestock. Similar findings were also reported from study in North Kordofan (Elsheikh, *et al.*, 2013) The movements of pastoralists with animals or reduction of drinking intervals are considered as the main strategies to cope with scarcity of drinking water in the study area. However, roaming inside Butana of Kassala are challenged by inaccessibility to land and Alazaza Forest, which entails insecure social environment. One of the Key dominants coping strategies in the area is settlement the majority of respondents are settled farmers (31.3%)or agro-pastoralists they changed their production pattern and shift to practice rainfed cultivation.

Other mechanisms reported; include rainfed cultivation of sorghum, People are expanding agricultural activities to cope with drought, but the land and rainfall in this area are not suitable for agriculture, so it is a risky strategy. Crop production in such semi-arid environments relies on irrigation from the Sugar Factory Canal, which prevents livestock from accessing water at critical times. This trend is still limited, though increasing, but in other pastoral areas, the spread of illegal sorghum fields has inhibited the movement of animals and increasingly led to conflict with pastoralists. Further more, sorghum production practiced as mono cropping by agro-pastoralists also affected by drought. so, frequent crop failure during drought/dry years and some are even questioning the suitability of cultivation in view of changing climatic.

Other local adaptive strategies that emerged, include: (i) Diversification of animal species and cultivation as some of camel raiser (33%) in the area began to raise sheep, goats and to a lesser extent cattle and practice cultivation for subsistence mainly in Alazaza. (ii) Utilization of the sorghum straw as roofs and building material to be utilized as dry season feed for small ruminants. Major constraints facing the pastoralists were shortage of water in summer, access to land, poor grazing resources, and expansion of agriculture on rangelands. pastoralists women affected by illiteracy, lack of income generating activities, shortage of water, access to land, health services and lack of credit particularly Goz Rajab pastoralists. (Figure.7) shows that knowledge and skills and accessibility to employ adaptation strategies varied as reported by respondents that 36.4 % acquired knowledge and skills to employ adaptation strategies; 38.6 % have no knowledge and 25% are indifferent.

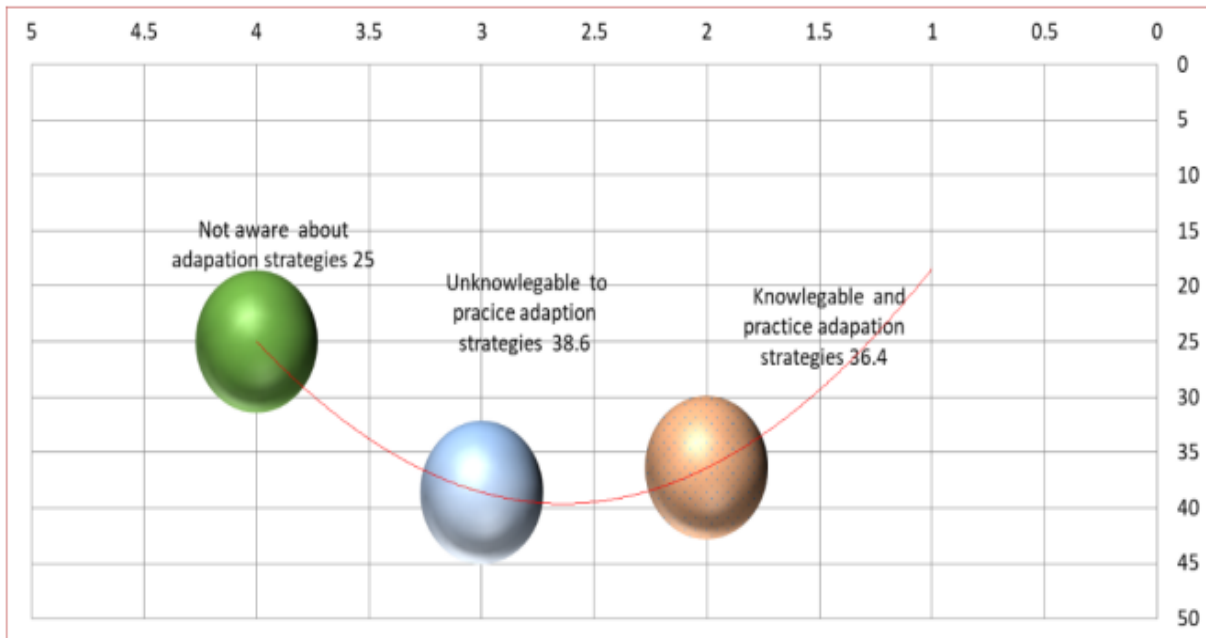


Fig 7 Percentages Knowledge and Skills and Accessibility

As access to climate information is critical for implementation of adaptation measures. It is a major factor determining ability to act on adaptation. Availability of appropriate, timely and locally relevant climate information such as weather forecasts, seasonal forecasts and early warning for climate hazards (WISP, 2012). In the area, 73.2% have no access to climate information or early warning for climate hazard, while only 24.4 % have; the remaining 2.4 % of respondents have no idea about the information availability and accessibility...

Early warning systems are critical to advance knowledge about potential disasters that may enable communities to establish safeguards at household level. However, such warning systems must go together with building the capacity of pastoralists to make informed choices using the information they receive, and raising their capabilities to implement their preferred adaptation strategy.. Pastoralists as a group, living in remote areas, achieved a

high degree of self-reliance and specific culture of their own and their way of life is centred on their developed experiences which helped them to adapt to the harsh conditions. In the area, local communities have their own local indigenous climate prediction system.

Rainy season is calculated by moon phases, and stars. the calculation is a proxy indicator (an expectation) for the season predictions. About 68.4% of respondents mentioned that they have skill on the prediction by the elderly observation and 31.6% stated that physiognomy skill to nature (Figure 8) This includes star, and animal behaviours. This skill was affected by unpredictable weather variability. This is supported by Mohamed (2013) who mentioned that pastoralist and agro-pastoralists are going to lose their sense of prediction about the rainy season and this will be a real and serious problem for them. In this situation, indigenous knowledge will need an external support to overcome this problem.

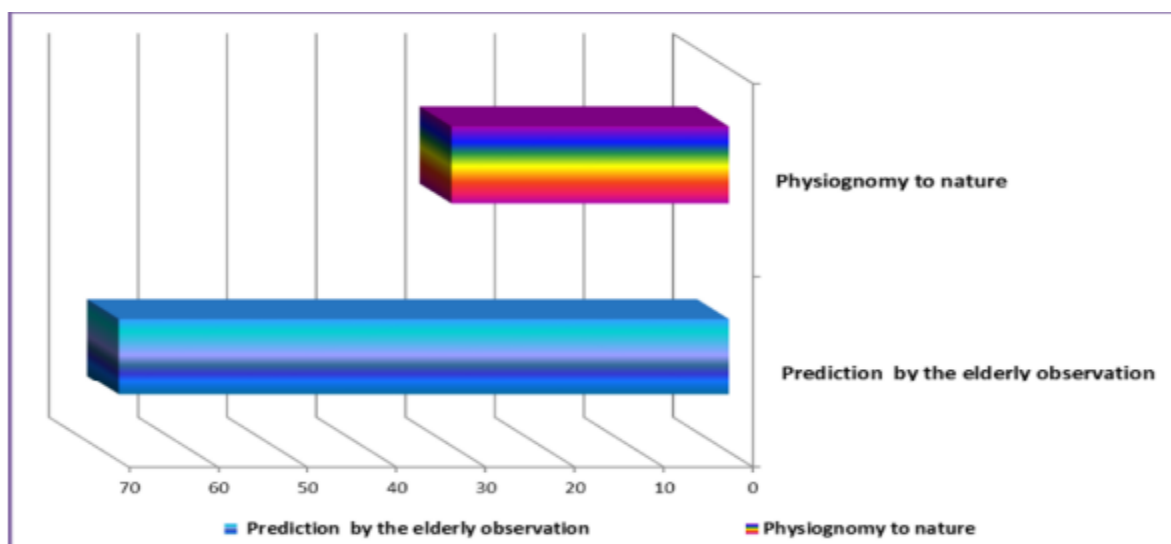


Fig 8 Percentages of Indigenous Climate Prediction System and Physiognomy

In order for the communities to effectively adapt to climate change, their wealth of indigenous knowledge must be complemented with scientific and technical information that enables adaptive decision-making.

Analysis demonstrated a need to create demand for this information and to help community members to understand the value and necessity of using scientific information for planning, whether short-term seasonal planning or longer-term.

Adaptation efforts often emphasize changes in livelihood strategies to respond to changing conditions. This assumes that the most vulnerable communities have access to the resources needed. Unlikely the pastoral communities including women have no equal rights to access available rangelands as reported by 81.9%. Only 9.1% from respondents' access to and control over resources such as rangelands, agricultural lands and the forest. When people do not have secure access to these critical livelihood resources, their options are limited and they are less able to act on adaptation. Interviewees reported that the impacts of climate stress and shocks are becoming worse, in large part due to factors independent of the climate, such factors could be decreasing availability of and access to natural resources, decreasing landholdings and increasing costs of inputs. Existing local adaptation (coping strategies) are ineffective or unsustainable, and may aggravate vulnerability to climate change over time. Coping with immediate hazards often meant calling on the support of relatives, neighbours and traditional institutions. In two study areas traditional support institutions were set up to deal with particular, individual shocks, robbery or the death of a family member, rather than weather-related shocks which impact upon the entire community. As well effectiveness of social support system is a function of many factors such as favouritism that may weaken social support mechanisms. Respondents at Goz Rajab indicated that they are not planning for the future. The reliance on credit and sale of assets to meet basic needs, as opposed to investment purposes, highlights how close to the edge of poverty. This limits their ability to innovate in their livelihoods or to plan for the future as they are generally focused on immediate needs and priorities. However, when asked what they would like to do to manage the impacts of climate change, the potential for innovation emerges. Community members identified a number of ideas to manage the impacts of droughts, including diversification of livelihoods to non-land based income sources, range improvement, water and storage systems and land for cultivation. They also called for a return to traditional rangeland management practices, with wet and dry season grazing areas. Focus Group participants emphasized the role of savings and credit in enabling these activities. From an adaptation point of view, access to climate information is also critical to enable forward-looking planning and adaptive decision-making.

IV. CONCLUSION

Vulnerability to climate change is influenced by multiple, inter-connected factors. It is unevenly distributed across and within the pastoral communities, especially women and pastoralists of Goz Rajab. Affected communities practiced local adaptive strategies, the climate hazards exceed their capacity of communities to adapt on their own. Livelihood assets such as effectiveness of social support system in area are function of favouritism that weakens social support mechanisms and increase exposure to vulnerability. There are supporting fragmented adaptations related interventions offered by various sectorial local institutions. Key recommended actions include:

Development of effective institutional arrangements; establish more effective governance mechanisms, support community level responses; create effective fund mobilization mechanism and need for further capacities. Traditional pastoral systems have different capacities to adapt to climate change. Pastoral systems often been defined by their adaptive capacity and can only have survived in highly uncertain and climatically extreme environments by being very adaptive. But the climate-induced hazards may exceed the capacity of communities to adapt on their own. They may need external support to expand their existing knowledge and skills to respond adequately to these changes in a timely manner.

Livelihoods systems in the research area are diverse, complex, and highly vulnerable, with few ready opportunities for household income diversification and adaptation.

Most vulnerable communities to climate change are most often the poorest, who lack effective coping strategies to deal with shocks and stresses and who have to resort to ineffective responses. Communities reported a wide range of responses, ranging from small incremental changes to existing structures and systems to deep major changes to systems, including livelihoods.

Some of these adaptation strategies are being undermined by developments in other areas, building human capacity and provision of services are critical and highly recommended to strengthening coping and resilience to climatic shocks in Sudan's vulnerable communities, and should be considered as priority.

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