

Understanding climate change adaptation dynamics in central Somaliland



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ILRI PROJECT REPORT



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International Livestock Research Institute

December 2018


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ILRI thanks all donors and organizations which globally supports its work through their contributions to the [CGIAR Trust Fund](#)



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Editing, design and layout—ILRI Editorial and Publishing Services, Addis Ababa, Ethiopia.

Cover photo— ILRI/Judy Kimani

ISBN: 92–9146–575–5

Citation: Crane, T., Marshall, K., Ahmed, M.A., Awaleh, I.A., Wane, A., Galié, A., Ahmed, M.A., Ahmed, H., Mohamed, B., Awil, A., Mohamed, H. and Ali, G. 2018. *Understanding climate change adaptation dynamics in central Somaliland*. ILRI Project Report . Nairobi, Kenya: International Livestock Research Institute (ILRI).

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Acknowledgements

This report is a product of a collaborative effort between the International Livestock Research Institute (ILRI), Terra Nuova and the IGAD Sheikh Technical Veterinary School (ISTVS).

We acknowledge and are grateful to the Danish International Development Agency for funding this study.

Disclaimer

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Introduction

The largest contributor to livelihoods in Somalia is the livestock sector, engaging an estimated 65% of the population. The Somali livestock sector is based on pastoral and agropastoral systems, with goats, sheep, camel and cattle—in decreasing order of national herd size—accounting for the majority of the species kept. In 2014, the Somaliland port of Berbera exported over 3 million goats and sheep, 250,000 cattle and 64,000 camels (Food Security and Nutritional Analysis Unit 2016). Only male animals are exported. The main markets for these animals in order of importance are Saudi Arabia, Yemen, Oman, United Arab Emirates and Egypt (Somaliland Chamber of Commerce, Industry and Agriculture 2016).

Annual rainfall variations in Somaliland from 1990 to date showed a saw-tooth pattern with an alternation of normal and bad years aggravating many events ranging from global insecurity to livestock ban on Somali exports. Rainfall data records from 1896 to 1985 in the Somali habitat indicates to expect 'short droughts' roughly once in every three years and 'long droughts' every 10 years (Elmi 1990).

Climate change adaptation occurs in the context of a wide variety of other change dynamics and livelihood considerations. The purpose of this research is to get the perspective of producers on the social and ecological dynamics of adaptation to recurrent droughts which they've been experiencing in recent years. Our qualitative approach is meant to identify how producer responses to recent climate stress in the last 5–10 years intersect with other processes of change, including, but not limited to, market dynamics, technological change and new governance practices (Crane et al. 2011). This approach allows us to identify the main drivers and constraints of adaptation, including how non-climate factors interact with climate stresses.

Methods

We selected focus group discussions (FGD) as the preferred instrument for this study because our objective was to get the perspective of producers on the overall system dynamics around climate change adaptation and changes in natural resources, technology, governance, markets and other factors. The strength of FGDs as a method is that they can rapidly elicit a variety of perspectives on an issue, effectively delimiting the range of considerations in play within the system. International Livestock Research Institute (ILRI) project staff drafted an FGD protocol drawing on literature and previous experience in the area. This protocol went through several iterations, including a final pretest by IGAD Sheikh Technical Veterinary School (ISTVS) field researchers with subsequent revisions. The final form of the FGD protocol can be found as Appendix I to this report.

In order to gather diverse perspectives, we took a stratified sampling approach to site selection, with emphasis on agroecological regions, livelihood strategies and gender. First, we selected two different agroecological zones—highland agropastoral and lowland pastoral. Four villages were selected from within each of these regions, largely following ISTVS networks that allowed relatively easy entry. In each village, separate FGDs were conducted with men and women in order to bring out potentially differing insights, as well as to give experience to male and female enumerators from ISTVS. In addition to village residents, FGDs were conducted with male nomadic pastoralists in both regions. This resulted in a total of 20 FGDs.

Number of FGDs disaggregated by gender and agroecological zone

	Male	Female
Highland agropastoral	4	4
Lowland sedentary pastoral	4	4
Lowland nomadic pastoral	2	-
Highland nomadic pastoral	2	

In order to support ISTVS in the implementation of the fieldwork data collection, two ILRI staff conducted a three-day training of two ISTVS tutors and 10 recent ISTVS graduates in support of this research activity. The training focused on the topics of climate change adaptation and animal husbandry practices; they also included methodological training on the nature of qualitative research specifically on how to conduct FGDs. In addition to classroom training and practice sessions, the trainees did two practice FGDs—one with men and one with women—in a village near Sheikh, and afterwards discussed the experience and challenges they encountered.

The implementation of the FGDs typically lasted around 90–120 minutes, with most variability depending on how expressive participants were. Each FGD was implemented by a team of three people. The facilitator started the conversation, following the outline of the research instrument (see Appendix). The facilitator was responsible for animating discussions, encouraging the participation of everyone in the group and probing into key issues that emerged in the discussion. Another key member of the team was the note taker, whose responsibility was to document the discussions as richly as possible. To support the documentation process, discussions were recorded with the consent of participants. Finally, the third member of the research team, the supervisor, acted as a back-up to both the facilitator and the note

taker. The supervisor also provided feedback to the facilitator and the note-taker after the FGD was completed. The supervisor takes note of the social dynamics of the FGD and prompts the facilitator to follow up on important points that may have been overlooked. The purpose of this was to reflect on what went well and what could be improved, contributing to the improvement of FGD implementation skills. Because this is fundamentally a capacity building project, the research teams rotate taking different roles so that everyone would get experience in each of them.

Notes from the FGDs were transcribed in Somali and translated into English by ISTVS staff in order to facilitate analysis by ILRI. A qualitative analysis software, EZText, was used to code the transcripts so that the range of responses given by the different categories of research participants could be viewed and analysed together. This also facilitated comparison of differences between the various categories of respondents.

Findings

Changing resource base and mechanisms of access

The first topic that FGD participants were asked to reflect on was how their key livelihood resources have been changing in recent years. The recurrence of droughts was the single most important theme that emerged across all FGD groups. Drought impacts pasture quality and quantity, as well as water availability. It is an all-encompassing and cross-cutting factor on which basic resources are dependent. However, in the men's FGD in an agropastoral village, it was pointed out that the number of livestock has also increased due to demographic growth increasing the number of households keeping livestock, even though per capita herd size has reduced.

The next most important observation of changing resources was fencing off of communal grazing land. While there was universal acknowledgement that this has been an important development in recent years, perspectives on the topic varied widely. FGDs in one of the agropastoralist villages mentioned that fencing off communal grazing land and implementing a communal grazing management plan, including reserve pasture zones for dry seasons, has proved to be an important adaptation technique in their approach to land management. Another agropastoral village stressed that although they didn't have a pasture management plan, they have had to actively protect their pastures from other communities who have tried to enclose it. In the pastoral villages; however, both male and female participants consistently underscored the importance of keeping pasture open with access for all, not just residents. They said that enclosure and exclusion lead to conflict between communities, emphasizing on a common cultural value among pastoralists that pasture should be open to all.

Another important change that came up with agropastoralists is the emergence of using lorries to transport animals to pastures during dry seasons or drought years. Customarily, herders would walk their animals to wherever they wanted to go. Participants cited the fact that lorries enabled some livestock keepers to go much further afield, as far as into Ethiopia, in search of pasture during the 2017 drought. This was especially important during the drought because many animals were already in a significantly weakened state due to hunger and would not have been able to walk the distance that the lorries had carried them. However, participants emphasized that use of lorries to transport animals was not a strategy that most people can use because it requires a substantial financial investment that most herders cannot afford, especially during times of ecological stress. Furthermore, one female participant from the pastoral zone observed that "camels can pass where lorries cannot go". This observation suggests that the use of lorries to transport animals instead of walking them affects the spatial distribution of grazing, meaning that increasing use of lorries could have important implications for the regional rangeland ecology, though further research will be needed to determine whether this is the case, and whether it is positive or negative.

Research participants also discussed how their ability to access key resources has changed. "Access" is meant to capture the social processes through which resource use rights are claimed, negotiated or contested. Pastoralists highlighted the issue of enclosure of land and water resources as their primary preoccupation. While none of the pastoral villages in our study has enclosed pastures around their own village, they noted that increased enclosures have become a substantial problem for those pastoralists who migrate with their herds. However, they pointed out that not all enclosed resources

are necessarily off limits to them. Some villages that have enclosed pasture and water resources welcome “strangers”, while others do not, leading to heightened uncertainty and conflict in the essential processes of herd migration. This observation was echoed in FGDs in agropastoral villages, who noted that migrating herders often encounter rules and regulations that they are not familiar with. Such rules and regulations asserted by people and communities who have enclosed resources operate on precarious legal footing. Pastoralists frequently cited the illegality of enclosing pastoral resources. Also, agropastoralists observed that some people have attempted to effectively privatize water points that had previously been common property, causing conflict within agropastoral communities. While two of the three agropastoral villages do not permit enclosure of common pastures, they do permit establishment of private household farm plots, sometimes very large ones, which still reduces the land available for grazing by local or migratory herders. It is unclear whether this fits within the official ban on land enclosure, making it a contested practice.

Changing livelihood strategies

Participants across all categories elaborated how the recurrent droughts have stimulated diversification of livelihood activities. Among those who continue to maintain livestock keeping as part of their livelihood strategy, there was a widely shared observation that people are rapidly decreasing the number of cattle and sheep they keep and increasing their goat and camel herds. This is because camels and goats are seen as much more drought and disease resistant than cattle and sheep. One common observation among sedentarised participants was that some people are starting to get out of pastoralism entirely, partly through involuntary destocking through devastating losses because of the recurrent droughts. Looking beyond pastoralism, typical pathways of diversification include opening of small shops or restaurants—an activity open to both men and women—and increasing crop cultivation and charcoal production.

The pastoralist respondents specifically cited that sedentarisation has been an increasingly rapid and important change in general livelihood strategy. Stimulated by diminishing herds due to recurrent droughts, sedentarisation has opened up, or required, new pathways for livelihood diversification. In addition to small shops and other types of commerce, sedentarisation enables pastoralists to send their children to school or keep them there longer in the recognition that it opens new opportunities for their children, both to get out of pastoralism or to get new ideas or resources to invest in pastoralism. Residents of one pastoral village noted that there has been an influx of formerly nomadic pastoralists who have come to reside there.

While formerly nomadic pastoralists are seeking new opportunities by settling in villages, pastoralists and agropastoralists who had already settled in villages migrate to urban centers, especially Berbera and Hargeisa, to engage in wage labor or open businesses. This shift in livelihood strategies is not just for adults. Across all categories, participants report people are increasingly sending children to urban areas to either continue their educations or seek work opportunities.

Participants in the pastoral villages specifically highlighted that these changes in livelihood strategies has not been without challenges. These are difficult and contested decisions that have stimulated intrahousehold conflicts and even occasional splitting of households due to disagreements over livelihood adaptations. Interestingly, the sedentary and nomadic pastoralists both specified that women’s roles in household decision making and economic production have increased significantly in recent years, as a function of sedentarisation and livelihood diversification, as well as external development interventions that were aimed at women’s capacity building.

Drought mitigation practices

Participants in the FGDs were asked to identify practices that they engaged in that helped them cope effectively with the 2017 drought. This is where we see the most significant differences between the agropastoralists, the sedentary pastoralists and the nomadic pastoralists. While all categories cited reduction of cattle and sheep in favor of goats and camels as an adaptation practice that helped them cope with the drought, subsequent strategies differed substantially. Both men and women from agropastoralist villages described how fattening animals for sale was a practice that helped them get through the drought more effectively. This is predicated on use of reserve pastures and reserves of cultivated hay, which are done

in two out of the three agropastoral villages in our sample. However, participants were quick to point out that the pasture and hay reserves were nowhere near sufficient to offset the fodder shortages caused by the drought. This highlights the fact that diversification or intensification of activities that are themselves drought sensitive does not necessarily help much in livelihood adaptation.

Sedentary pastoralists on the other hand, mentioned that those who had shifted toward total specialization on camel production fared better than others in the most recent drought. This is partly because camels can be migrated for longer distances. Herd splitting was also cited several times as a coping mechanism. However, this was generally mentioned in the context of giving a lactating animal to less fortunate households who had lost all of their animals so that they could at least get some modest amount of milk to address their nutritional needs. This highlights how coping with drought is about social support networks in addition to atomized household economic strategies. Other sedentary pastoralists pointed toward mixed farming as a practice that helped them better cope with the drought. Some also mentioned that there is less migration now because there are simply not enough animals anymore to justify the effort.

Nomadic pastoralists, on their part, primarily pointed to long-distance migration—as far as to the Somalia region of Ethiopia—as the practice that helped them get through the drought with fewer losses. As an indication of changing livestock keeping practices, one nomadic pastoralist said that one time during extreme drought, he bought grass for his animals. This is generally an anathema for dedicated pastoralists. Another nomadic pastoralist mentioned that he had participated in the construction of contours in a degraded pasture land in order to promote greater penetration of groundwater, thus improving fodder productivity. These last two practices, both characteristic of more intensive approaches to livestock keeping, are indicative of how change is occurring slowly even among the most extensive pastoralists in the region.

Looking forward, the agropastoralists and sedentary pastoralists expressed interest in engaging in more adaptation practices to reduce the impact of droughts. For agropastoralists, these included increasing farming, diversifying into businesses and destocking before droughts become serious. However, they noted that many of their aspirations require capital investment, which is currently lacking. Sedentary pastoralists identified fodder cultivation and improving local water catchment and storage capacities as key areas of interest for adaptation.

Animal husbandry practices

This section outlines responses of participants to the question of what animal husbandry practices have they recently adopted that have helped them get through droughts. While research participants shared many details of their general husbandry practices, it should be noted that they did not always identify whether or how particular practices helped reduce the impact of the drought, leaving it up to us to infer the likely or potential effects of a practice.

The practice that is most directly related to caring for livestock in the face of climate stress was protecting animals from the elements. Participants mentioned the importance of being able to provide shade for animals to protect them against the midday heat. This is not always possible if there are insufficient trees in the area of pasture. At nighttime, people from all three livelihood categories mentioned the importance of having covers over the animals' corrals to protect them from the cold. Men and women agropastoralists and sedentary pastoralists all mentioned the importance of regularly cleaning dung from animal pens in order to help avoid disease.

Many participants pointed out that disease can be an additional burden on animal health during times of pasture shortage, significantly compounding the effects of drought. Respondents from the nomadic pastoralists claimed that animal mortality during the 2017 drought was compounded by disease that affected already weakened animals. All three men's FGDs in pastoral villages cited the importance of occasionally spraying pens with acaricides in order to control for ticks and mites, which are disease vectors. Agropastoralists and sedentary pastoralists talked about the importance of disease control and prevention strategies that blend traditional and pharmaceutical treatments. They acknowledged the importance of Community animal health workers (CAHWs) in the successful implementation of pharmaceutical prevention and treatment of diseases. The role of CAWH includes ensuring good diagnosis, matching treatment to ailment and ensuring

proper dosage and administration of medicines. On the other hand, nomadic pastoralists expressed skepticism toward pharmaceutical treatment of livestock, preferring to exclusively use traditional treatment methods. One herder justified his skepticism by saying “I once dipped 50 sheep in a dip tank and they all died.” This shows that even pharmaceutical treatments administered by official government bodies or external organizations are not without their risks.

Another relevant practice mentioned as an adaptation strategy to climate stress was hand feeding weak or lactating animals. The green leaves and seed pods of *Acacia tortilis* were repeatedly mentioned by both agropastoralists and pastoralists as valuable feed resources. On its own, this is not sufficient for alleviating the worst effects of drought, but it can help keep a small number of weak or lactating animals alive, potentially contributing to household resilience and nutrition. Furthermore, FGDs in all livelihood categories raised the issue of ensuring that livestock had adequate salt intake, whether through salty water or provision of salty soils for consumption. The strategy for providing salt was connected to fodder and water availability. A participant said, “I provide salt supplements in the morning during rainy seasons, but when pasture is short, they get salt at the end of the day when they return from watering. But if you have access to salty water, this won’t be necessary.”

Because sheep are more susceptible to drought and diseases, many groups highlighted the importance of controlling the timing of sheep reproduction. While goats can reproduce at any time throughout the year, herders manage sheep reproduction so that the lambs are delivered at the beginning of the rainy seasons, making it possible for the mothers and newborns to have access to sufficient forage to support their growth.

Market dynamics and drought

The livestock export ban due to the civil war in Yemen was a very important topic of conversation across all groups. Yemen, and the Arabian Peninsula in general, is the primary market for livestock from Somaliland. While the 2017 drought was quite severe, its effects on household livelihoods was exacerbated by having been cut off from their primary market. It meant that any herder who wanted to sell animals was faced with weak demand from within the domestic market coupled with very low prices. However, across all sites, nearly all participants agreed that they haven’t proactively practiced destocking prior to droughts. They say that the droughts are the only situation that bring animal populations down.

The weak domestic market was also illustrated by changes in the nature of value chain. Previously, buyers would tour the countryside, visiting villages one by one to purchase animals for export. Traders pay cash and are generally perceived as being in control of prices, leaving little room for negotiation on the part of the herders. With the drought and export ban, buyers no longer come all the way out to villages, leaving people in villages no choice but to take animals into urban markets, particularly Burao, to fetch what prices they can. This requires renting vehicles, which reduces the profit margin for sellers. As the drought has receded, herders report that prices have started coming back up, but now there are few animals worth selling because of their poor condition.

Decision making and benefit sharing

The perspective of research participants on intrahousehold decision making and labor distribution were consistently in agreement, except for a few contrary perspectives that were put forth. The general consensus across livelihood and gender categories was that men are primarily responsible for providing for households’ economic well-being as well as community decision making. Furthermore, men are also responsible for all major strategic decisions and management within households, such as migration with animals, urban labor migration, implementation of new practices, divestment of livestock, etc. However, women in all livelihood categories indicated that they generally have their say in important decisions, even if it is still up to the man to make the final decision. As previously noted, disagreements between men and women over major decisions have been known to produce domestic strife, sometimes resulting in families splitting up, indicating some dynamics of contestation. Male nomadic pastoralists observed that women’s place in household decision making has risen in recent years, largely due to women’s capacity building interventions by external NGOs.

However, despite this overarching narrative about male economic provision and decision making, there were a small number of contrarian opinions put forward. One man in an agropastoral village said, “Currently, men do not do anything for the family. Women take care of livestock, farm and do household chores”. Similarly, one male nomadic pastoralist said, “Men usually chew miraa (khat) in the village centres. It is women who take care of animals and make the decisions”. These contrarian observations may indicate high variability between household gender relations, but they also could indicate that most men and women tend to bias their responses toward idealized norms rather than reporting actual day-to-day realities. Both interpretations indicate a degree of contestation around real and ideal gender roles.

Support networks

In all FGDs, informants cited a range of international aid organizations who provided famine relief or technical support to assist them through the 2017 drought. These organizations include Food and Agriculture Organization of the United Nations (FAO), World Vision, GIZ, World Food Program (WFP), ActionAid, Alla Amin, Save the Children, World Concern and Islamic Relief. The government of Somaliland was also seen building boreholes, providing animal vaccinations, managing security and delivering food aid, supplemental fodder and water trucks. While all participants pointed out that mutual assistance through kinship networks such as remittances and fellow villagers are important aspects of coping with drought, they served only as stop gaps and were not sufficient to offset the impact of the drought.

Forward looking perspectives

At the end of the FGDs, participants were asked if they had any observations or comments regarding their own forward-looking perspectives about adapting to drought. Across all participant categories, the primary interests were in diversification and intensification of their livelihood activities as adaptation measures.

Agropastoralist men and women both looked to increased investment in agricultural activities such as improvement of water catchments and dams for use as dry-season irrigation. Another frequently occurring theme was the development of hay stocks for use in the dry season, including cultivation of sorghum as a dual-purpose crop for feeding both people and livestock. At least one male participant stated that he was considering selling out of livestock in order to establish a small business. Citing their losses of large stock in the recent drought, some women FGD participants said that in the years to come, they would focus their production strategies on small ruminants for fattening and selling in markets, indicating a movement toward increasingly commercial orientation, as well as more drought resistant species.

Despite their lack of experience with agriculture, several pastoralist participants also indicated their interest in investing in farming as a means of mitigating their drought risk. This included improving water management for the cultivation of crops. They also pointed toward improving pastures and cultivation and storage of animal fodder as an appealing drought mitigation activity. The women participants in particular emphasized livelihood diversification as an important strategy going forward, including divestment from livestock to invest in small businesses and sending children to towns for formal education and learning trades. One male pastoralist said that the only response is to pray for God’s mercy because droughts are God’s punishment for people’s sins. The theme of praying for God’s mercy as a key component of adaptation to drought also arose in both nomadic pastoralist FGDs, though like the others, they also looked to farming and fodder storage during the rainy seasons as potentially interesting practices for adapting to future droughts. Unlike the others, the nomadic pastoralists said they would like to have better access to climate information services that could forecast droughts, enabling them to make more adaptive responses, such as early migration or selling livestock.

While participants from all categories expressed interest in new technical practices around water management and irrigation, agriculture and fodder cultivation and storage, they also repeatedly mentioned their lack of technical knowledge or skill in these domains. Agropastoralists already have fair capabilities in some agricultural domains, but for those who have maintained pastoralist livelihood strategies, this remains a point of ignorance that they want and need to fill in order to facilitate livelihood diversification. In addition to lack of technical knowledge, access to capital to fund these profound shifts in livelihoods was cited often as limitation to enacting changes.

Discussion

The results that emerge from our focus group discussions with male and female pastoralists and agropastoralists in central Somaliland indicates a socio-ecological system that is in flux. Climate change, primarily in the form of increasingly recurrent droughts, has been an important driver for recent change in the region, leading to significant diversification in terms of livelihood strategies. However, our research shows that peoples' shifting livelihoods have been shaped by many other factors besides climate, including access to new technologies, changing market dynamics and new aspects of land and water governance. Adoption of new and diverse livelihood practices also appears to be related to changing gender roles and processes of social differentiation.

The most notable aspect of climate adaptation evident in the region is basic livelihood diversification. For a region that has historically been dominated by pure pastoralism, the rise of farming is a major development. This trajectory is clearly more advanced in the highland regions that are more suitable to agriculture, though even participants from the lowland pastoral regions appear to be increasingly interested in pursuing some degree of agriculture in the near future in order to buffer against the vulnerabilities associated with pastoralism. However, because farming is a radical shift from full-time pastoralism, participants in the pastoral region emphasized that while they are interested in practicing agriculture, they have virtually no capacities for it due to their lack of knowledge, experience and necessary equipment. Participants from all regions, even the agropastoral region, further highlighted that developing agriculture as an important part of their livelihood strategy requires capital investments, which are hard to come by for many people.

Even with increasing interest in agriculture, livestock keeping remains at the heart of the regional economy and livelihood strategies. However, despite this continuity, the FGDs indicated several livestock keeping strategies are changing in Somaliland. Participants across the different categories indicated that cattle and sheep have died in greater numbers in recent droughts because they are more susceptible to stresses caused by drought. Participants indicated that more and more people are keeping greater numbers of goats and camels because they are more resistant to the impacts of drought. Increasing the proportion of browsers (goats and camels) compared to grazers (cattle and sheep) could have important implications for the rangeland ecology in the region.

In addition to composition of herds by species, many participants mentioned managing or enclosing grazing areas and cultivating fodder as practices that would help buffer against dry seasons and droughts. Two of the agropastoral villages are already practicing some variation of this, while the pastoral villages talked about fodder banking as an adaptation aspiration in the years to come. Such intensification of pastoral land use practices will inevitably lead to adjustments in how access to and control over those resources are asserted and/or contested. Both represent forms of enclosure in the name of pastoral intensification, with implications for how transhumant pastoralists access the pastoral resources.

Increase in agricultural practices as a means of earning household livelihood, combined with the rise of fodder cultivation and pasture management has several important implications for the regional socio-ecological system. They imply enclosure and privatisation of significant portions of land surrounding villages. This enclosure may be done by individual households or by some mode of village collective action. The pastoralists, both sedentary and nomadic, emphasized enclosure of pasture and water resources is illegal and such enclosures are torn down by the government of Somaliland. Nevertheless, enclosures are clearly emerging as important yet contested dynamic in the region.

The use of lorries to transport herds to far away pastures during times of drought is another practice that indicates how livestock keeping in the area is changing. Several participants from different categories cited transporting herds in this way is a practice that enabled some livestock keepers to get through drought more successfully than others. However, the use of motorized transport rather than transhumance movement represents a substantial financial investment in herd management, an investment that only a few households are wealthy enough to make. If this continues to prove a successful adaptation strategy for those practicing it, it could represent a mechanism of social differentiation in subsequent droughts. The rapid and long-distance relocation of herds along major road lines also seems likely to have implications for regional rangeland ecologies and natural resource governance systems.

Adoption of agriculture as a livelihood activity is a radical shift for pastoralists, but it may not be as radical as decisions to get out of basic production altogether. Both male and female participants cited formal education, urban employment and small businesses as important dimensions of adaptation to the challenges of making a living on livestock. The actual shift towards these activities was most prevalent in the participants from the agropastoral region, exemplifying their already diversified strategy. For participants from the pastoral region, especially the nomadic pastoralists, such adaptation was more likely an aspiration rather than a practical strategy, but these activities are under active consideration.

Women and men in both regions emphasized that men continue to be officially in charge of economic decision making within households and communities. Men consistently asserted their predominance and responsibilities in economic decision making. Women generally supported this characterization, but more clearly emphasized that women also have an influence over these domains, albeit bounded within their ability to influence men through intra-household negotiations. The role of men as primary decision makers was contested by at least two men from different regions, who both said that in reality, a lot of men just hang around while women are effectively responsible for all of the meaningful economic work and decision making. The adoption of sedentary lifestyles has created new economic opportunities for women. Being permanently based in one location increasingly allows women to start up small vending businesses or tea shops to supplement family incomes from basic production. Women are also getting into animal fattening as an economic activity.

Sedentarism is on the rise and even nomadic communities are now considering it more seriously. With more communities opting to become sedentary, situations are being created where families can be temporarily split apart for parts of the year. This is usually because men may migrate with livestock herds for part of the year in response to droughts, or they may migrate to cities to seek wage labor. This temporary or cyclical splitting of families puts greater economic and decision-making responsibility on women, even as men are still seen as the formal heads of households.

Conclusions

The results of our research outline a system that is in significant flux recurrent droughts are only partially responsible for this. The interaction between climatic, technical, economic and political dynamics evidence that adaption is a profoundly social process with multiple drivers and a complex array of outcome pathways. Technical practices around intensification of herd management and land resources—such as enforcement of reserve pastures, fodder cultivation, water management and conversion to agriculture—can be adaptive for the households and localities that practice them, but they also have important repercussions for regional socio-ecological fabric, which has historically been fundamentally rooted in the principles of pastoral mobility and open access resources. Consequently, climate change adaptation interventions will benefit from close attention to both technical practices and the social implications thereof.

Our research approach was designed to explore and outline the regional system dynamics in broad terms, raising at least as many questions as it answers. As such, it suggests a variety of in-depth research areas which could easily accompany development interventions around a wide range of topics. Some of these topics could be technical potential and feasibility of various herd, land and water management practices, social dynamics and implications of emerging local land and water governance practices, intra-household gender dynamics around livelihood activities and decision making, and the household and regional economics of emerging livelihood diversification strategies. Combining climate resilient development interventions with basic research on related topics will allow for progress in livelihood improvements while simultaneously deepening our understanding of the socio-ecological dynamics of adaptation.

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ISBN: 92-9146-575-5



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