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Coping Strategies During Drought: The Case of Rangeland Users in Southwest Iran

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On the Ground

- This study assesses the drought coping strategies of rangeland users (RUs) in Fars province in southwest Iran.
- Our findings reveal that in the RUs experience, the most effective drought coping strategies include reducing stocking rates and the gradual reduction of inefficient, old, and sick livestock.
- The data also indicate that RUs promote rangeland resilience during a drought through range protection/exclosures, seeding, and broadcast seeding.
- This study therefore suggests that the indigenous knowledge of RUs could improve existing training and extension programs by providing localized environmental contexts for developing coping strategies before, during, and after drought.

Keywords: sustainable rangeland management, rangeland improvement, indigenous knowledge, stocking rate, grazing capacity, drought.

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Drought is a common natural hazard in arid and semi-arid regions. It is a prolonged period of abnormally low rainfall that negatively affects land managers, ranching enterprises, and pastoral systems.[1] Drought may be the most complex but least understood of all natural hazards, and it directly affects more people globally than any other natural hazard.[2] Heim (2002) divides drought into four categories based on myriad localized effects on human and natural phenomena: meteorological, agricultural, hydrological, and socioeconomic. Drought is a normal, recurrent feature of climate that may occur anywhere, even if its characteristics and impacts vary significantly from one region to the next.[3] Thus, an objective evaluation of drought conditions in a particular area is the first step for planning natural resource protection and allocation to prevent and mitigate the negative impacts of future occurrences.[2]

In recent decades, the frequency of drought in arid and semi-arid regions such as West Asia, North Africa, Eastern Australia, and Southwestern United States has been increasing.[2,3] This climatic phenomenon has negatively affected agriculture (e.g., crop and livestock production) and natural resources (e.g., rangelands and surface waters). Rangeland users (RUs) in arid and semi-arid regions consider drought to be a significant problem because it can lead to forage production losses between 30% and 100%. Rangelands within advanced economies are not immune to this hazard. For example, from 2014 to 2015, drought caused an 80% forage production loss in San Luis Obispo County, California.[4] The widespread droughts of the early 1990s in particular had a major detrimental impact on rangelands and livestock production.[4–6] A drought usually entails a number of different and interconnected social, economic, and environmental consequences. For example, a drought will significantly affect rangeland activities, and in developing countries in arid and semi-arid regions, it can be a primary cause of poverty and emigration.[2]

Arid and semi-arid regions are characterized by wide deviations in annual precipitation that make them highly susceptible to drought.[6] Turning the focus to Iran specifically, in the past 40 years, the country has experienced 27 droughts. Drought is clearly not an unusual climatic hazard in Iran, but it nonetheless remains a phenomenon that has not been fully considered in the country, despite the clear challenges that drought presents for RUs' livelihoods and environmental management policy making.[7] Droughts in Iran affect large numbers of people, causing tremendous economic losses and social hardships as well as severe environmental damage.[7] According to statistics reported by the Office of Foreign Disaster Assistance/Centre for Research on the Epidemiology of Disasters International Disaster Database, drought was the major natural disaster affecting Iran between 1900 and 2008.[8]

Global and regional climate change is expected to increase the frequency of drought in Iran. South and southwest Iran, including Fars province, are highly susceptible to frequent and

intense droughts.[9] Fars is one of Iran's leading provinces for livestock production, yet drought has had numerous deleterious effects on its rangeland ecosystem.[10] As such, this paper's first objective is to review earlier research that underpins our current understanding of the impacts of drought on rangelands, including rangeland management strategies before, during, and after drought. Following that, we present a descriptive-analytical study that assesses the drought coping strategies of RUs in Fars province in southwest Iran. We briefly contexualize our study area and describe our data collection and sampling methods before detailing our findings on drought coping strategies and rangeland improvement (RI) activities. Lastly, we discuss the broader implications of this study's results for sustainable rangeland management (SRM) during drought in arid and semi-arid regions.

Effects of Drought on Rangelands

Drought affects rangeland ecosystems in many ways. For rangeland managers, the most concerning impact is lowered soil moisture levels that inhibit plant growth and thereby reduce forage yields.[11] In arid and semi-arid regions, such as West Asia and North Africa (WANA), rangelands with less than 200 mm of average annual precipitation are the main source of forage for small ruminants.[12] It then follows that drought is one of the most important factors influencing livestock production in the rangelands of semi-arid regions. The most direct impact of a precipitation defecit on RUs' livelihoods in WANA is the dessication of hydrological resources, which reduces forage for sustaining livestock.[5,6] The effects of drought may appear more rapidly on pastures that have coarse-textured soils (i.e., sands and gravels) due to poor moisture storage and lower water holding capacity.[13] These soil characteristics directly influence the condition of rangeland resources that are essential for livestock productivity and, consequently, for the livelihoods of RUs.[12] Reduced forage yields during drought cause a decline in nutrient availability for livestock. This has significant adverse effects on livestock production, including reduced weight gains due to increased energy expenditure while foraging, poor body condition in livestock by fall, an increase in disease susceptibility, and higher wintering costs.[14] Minimizing these effects requires formulating management strategies during drought that can provide essential information for SRM. Such information is critical for drought management policy makers, who often must prioritize limited resources when designing vulnerability-reducing interventions.[15]

Rangeland Management During Drought

RUs may employ a variety of drought risk management options to minimize drought's effects. More options (e.g., moderate use of rangelands, reduced stocking levels, deferred grazing, and so on) allow for greater flexibility to reduce damage to a rangeland's soils and vegetation, the health of livestock, and the RUs' livelihoods.[16] Although there is no "cookbook" approach to drought risk management, many of these points are principles of range management that can be relevant to all RUs. Other suggestions may not be practical for some operations for a variety of reasons, such as legality concerns and the cost-benefit analysis. No one knows better than the RUs themselves which management strategies are viable and will be most effective in their localized contexts.

Past attempts at range management during drought have tended to exhibit a reactive, crisis management approach. Such attempts have therefore been ineffective, ineffectively coordinated, and poorly timed in both developed and developing countries.[17] Although drought is complex and remains poorly understood, scientists worldwide have developed and tested early warning indicators of drought and drought mitigaton strategies (e.g., groundwater extraction, cisterns and water harvesting systems,[6] reserve pastures, rotational grazing, drought planning,[18] increased preparation for drought such as operation experience with drought, type of livestock operation, grazing system[19]). Moreover, some countries (Australia, New Zealand) and regions (East and Southern Africa) have developed drought risk management approaches (e.g., the standardized precipitation index, field monitoring, and remote sensing systems) for their agro-pastoral sectors. However, in arid and semi-arid regions, including in Iran, national-level implementation of these approaches remains largely stalled due to insufficient funding and an entrenched patchwork of local strategies for drought risk management.[6]

The lack of integration of the various approaches to drought risk management (e.g., sustainable land management, water resource management, food security, etc.) at the national level is often highlighted as a weakness. Yet local approaches tend to better emphasize vulnerability factors in relation to livelihood strategies and efforts to manage rangelands during drought.[7] This is because RUs possess highly localized knowledge of their rangeland ecosystems and how these ecosystems respond during drought conditions.[20] This knowledge has allowed them to develop their own adaptive capacities to cope with recurring droughts and sustain livestock production.[21,22]

Hazell et al. (2001) summarize the strategies that some agro-pastoralist societies arid and semi-arid regions have developed. Some of these strategies include 1) mobile or transhumant grazing practices that reduce the risk of having insufficient forage in any particular location, 2) reciprocal grazing arrangements with more distant communities for access to their resources over dry periods, 3) adjustment of herd sizes and stocking rates to match available natural feed resources, 4) keeping extra animals that can be easily liquidated in a drought, either for food or cash, 5) diversification of crops and the storage of surplus grain, straw, and forage for use in dry years, and 6) diversification among animal species and breeds within species.[22]

Rangeland Improvement during and after Drought

Once a drought has ended, rangeland managers must allow the pasture to recover so that grasses can resume growing and