Pastoral Livelihoods and Adaptive Strategies under Climate Stress in Semi-Arid Regions

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Introduction: Understanding Pastoral Resilience

Resilience is a concept that emerged in ecology and later extended to social systems.

- ✓ It is not only about “bouncing back” but also about learning, renewal, and transformation.
- ✓ Defines the ability of pastoral communities to cope with uncertainty in harsh environments.
- ✓ Semi-arid regions are where climate change impacts are most visible and severe.
- ✓ Pastoral systems play a key role in food security and cultural heritage in these regions.

Climate Change: A Growing Threat to Pastoral Systems

Climate change poses serious risks, but pastoralists also have strong adaptive traditions.

🔴 Risks

- ✓ Warming in drylands is occurring at **twice the global average**
- ✓ Increasing water scarcity and reduced pasture productivity
- ✓ Pastoralists among the **most vulnerable**: droughts, land degradation, pasture loss
- ✓ Severe threats to **food security and pastoral livelihoods**

Climate Change: A Growing Threat to Pastoral Systems

Climate change poses serious risks, but pastoralists also have strong adaptive traditions.

🟢 Strengths

- ✓ Rich adaptive knowledge: mobility, herd diversification, communal management
- ✓ Intergenerational ecological knowledge passed down over centuries.
- ✓ Low-input, nature-based production systems aligned with ecological cycles.

Transformation Under Climate Change

Global climate change disrupts pastoral cycles herders respond with adaptive strategies and knowledge

Changing Patterns

Shifts in snowmelt and rainfall patterns disrupt traditional migration cycles.

Strategic Adaptations

Pastoralists are adjusting with rotational grazing, diversifying herd composition, and reorganizing labor, despite increasing pressures.

Ecological Knowledge

These adaptations are based on ecological knowledge passed down through generations, ensuring transhumance can continue under changing conditions.

Climate Challenges Exceeding Local Capacity

Extreme climate events sometimes surpass the ability of pastoralists to adapt.

🔴 Risks

✓Extreme climate events such as droughts and erratic weather cause livestock losses, production fluctuations

✓Threat to livelihood security; survival difficult without external support

🟢 Resilience Potential

✓Mountainous & semiarid areas: pastoralism remains more viable than many alternatives

✓With appropriate policy support, pastoralism can continue to provide food and secure livelihood

Socio-Economic and Political Dynamics

Transformation of pastoral systems is shaped not only by climate change but also by socio-economic and political dynamics.

Policy Interventions

Policies aimed at sedentary migration and the privatization or restriction of pastureland have disrupted traditional pastoral cycles and accelerated system transformation.

Land Use Changes

In Anatolia, the opening of pastureland to agriculture and socio-economic transformation have reduced the former prevalence of small livestock farming.

Generational Shifts

Many younger generations are abandoning the nomadic lifestyle of their ancestors due to rural poverty and uncertainty.

Nevertheless, transhumanist practices have not completely disappeared; some communities continue this tradition with innovative interpretations, such as the Sarıkeçililer in the Taurus Mountains who adapt their migration cycle using modern transportation vehicles.



Sustainability of Traditional Small Ruminant Systems

Traditional pastoralism endures as a sustainable, low-input model with wide benefits.

Low input–low output model relying on natural pastures
Local breeds are well adapted to harsh environments and efficient grazing
Sustainability benefits supports biodiversity, cultural landscapes, low fossil fuel use, and minimal waste
High-quality products: milk, meat, and cheese valued for natural origin and traditional production

Ecological Sustainability of Traditional Systems

Traditional pastoral systems support ecosystems, climate balance, and animal welfare.

Transhumance Benefits

Through transhumance, pastures at different altitudes are used, connecting high-value habitats and reducing landscape fragmentation.

Controlled Grazing

Mobile herds contribute to vegetation regeneration through controlled grazing practices.

Natural Waste Cycling

Unlike industrial livestock farming, in extensive pastoral systems, animal manure and waste are spread over a wide area and incorporated into the natural cycle.

Climate-Friendly Aspects

Low-density, mobile herds function as part of natural ecosystems, enriching soil carbon and nutrients, suggesting transhumance may have climate-friendly benefits.

Furthermore, animal welfare is generally higher in these systems, with animals raised in open areas where they can exhibit their natural behaviors. As a result, pastoral products (e.g., pasture-fed lamb, traditionally produced milk and cheese) are gaining value among consumers for their high-quality production.

Challenges to Traditional Pastoral Sustainability

1 Shrinking Pastureland

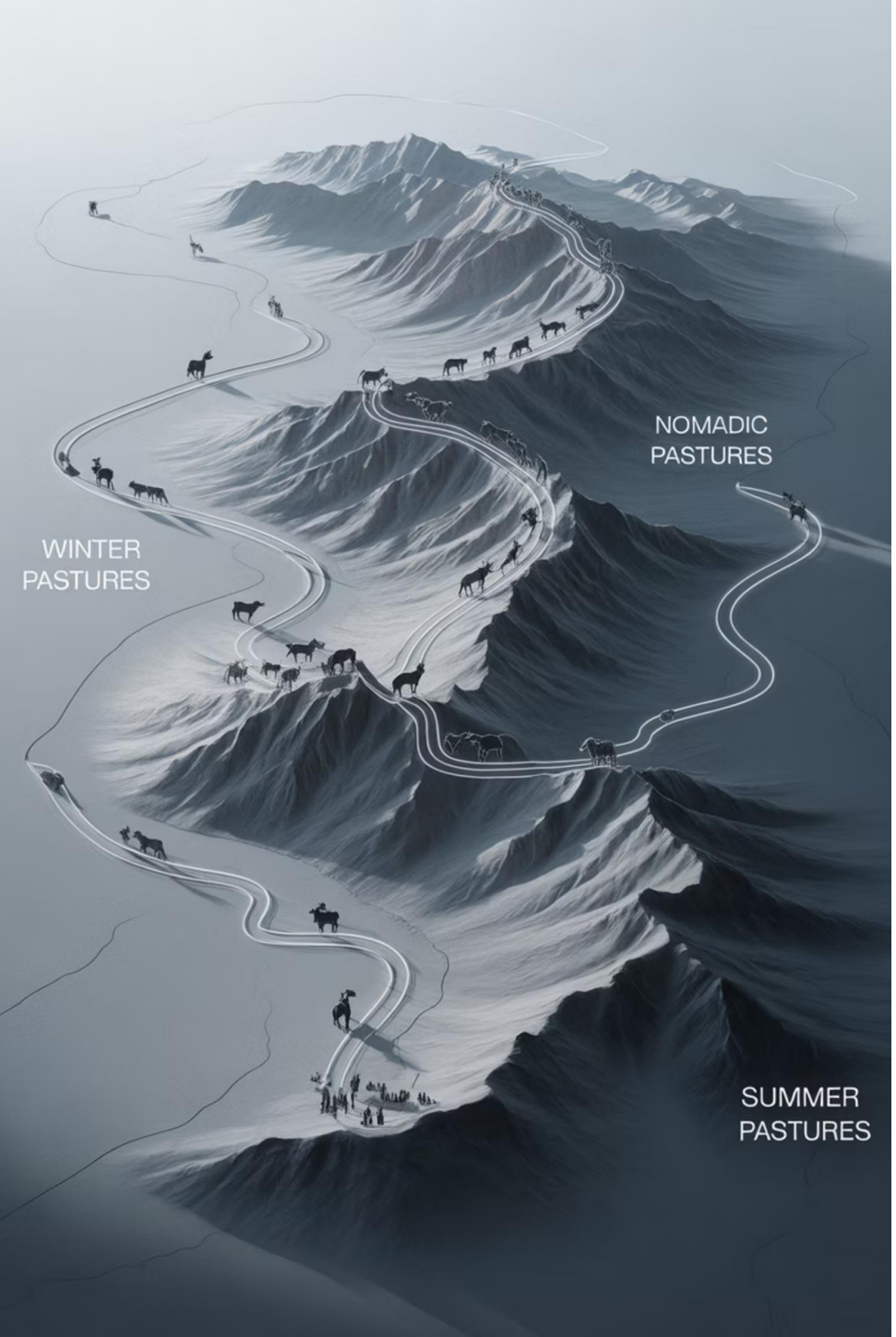
Rapid population growth has increased land demand for agriculture and settlement, while pastures have been destroyed by clearing, mining, or infrastructure projects.

2 Political and Institutional Barriers

Vast tracts of land once open to communal use by nomads may now be closed due to forest laws, protected areas, or privatization policies.

3 Loss of Intergenerational Knowledge

Nomadic lifestyle practices and values are rapidly changing, with rural poverty, lack of educational opportunities, and the allure of modern living leading young people to turn to cities instead of nomadism.



Flexible and Shared Use of Natural Resources

Pastoral resilience is based on the flexible, collaborative, and harmonious use of natural resources.

- ✓ **Flexibility is central,** nomadism adapts to spatial and seasonal resource variation
- ✓ **Collaboration:** shared use prevents overexploitation

Case example (Sarıkeçililer): The Sarıkeçililer (nomadic (trib) example demonstrates flexible resource use around 150 households continue to maintain their traditional lifestyle by moving approximately 90,000 goats along these routes. When regions with different altitudes and climates are evaluated seasonally, their herds are provided with sufficient grass and water throughout the year, preventing overloading of a single region.

Cooperation and Sharing Mechanisms

Flexible pasture use is not limited to geographical mobility; it also involves cooperation and sharing mechanisms between communities. Traditionally, unwritten rules and rotation practices have developed among nomadic groups for pasture sharing.

- ✓ **Unwritten rules & rotation:** minimize competition, allow pastures to rest
- ✓ **Local institutions:** common-pool management functioning since ancient times
- ✓ **Sustainability outcome:** avoids “Tragedy of the Commons”; norms ensure fair sharing

Local Knowledge Systems and Biocultural Heritage

Local/traditionally based knowledge systems play a central role in the continuity and resilience of pastoral lifestyles. Pastoralists possess a rich wealth of knowledge, accumulated through generations of interaction with nature.

Climate Interpretation

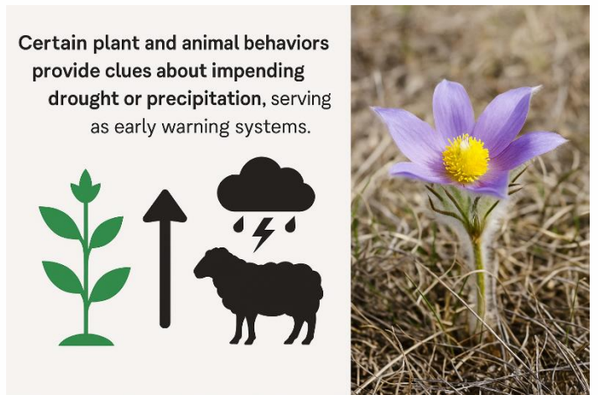
The Anatolian saying predicts cold snaps and guides pastoralists to keep their herds in sheltered areas.

Celestial Navigation

The appearance of certain stars in the sky signals the arrival of migration time, providing natural calendars for movement.

Natural Indicators

Certain plant and animal behaviors provide clues about impending drought or precipitation, serving as early warning systems.



Social Memory and Narrative Practices

Social memory describes a community's capacity to collectively remember past experiences and lessons learned, transmitting them to future generations.

✓Pastoral communities share past challenges—such as extreme droughts, devastating winters, or epidemics—through stories, idioms, folk songs, and conversations.

✓Narratives pass on adaptation strategies → strengthen rural resilience

✓Research (Kenya & Mongolia): elders' told their own "resilience stories," explaining their life strategies and adaptation to environmental change

✓These narratives reveal that resilience for pastoralists is embedded in everyday life practices, social networks, and cultural values. Resilience rooted in daily life, social networks, cultural values

Older generations associate resilience with "making sense of life and holding society together," as well as "the ability to cope with adversity."




Biocultural Heritage and Recognition

Pastoralism is both an economic activity and a cultural heritage to be preserved. Biocultural heritage is the totality of cultural practices, knowledge, and adaptations resulting from a community's interaction with its biological environment.

In 2019, UNESCO included "Transhumance – Seasonal Animal Migration Culture" on the Intangible Cultural Heritage List.

A similar awareness has been developing in Turkey in recent years, with nomadic culture festivals, exhibitions, and documentary productions being held in some regions in collaboration with local governments, universities, and civil society organizations.

Technological Interventions for Pastoral Resilience

Various technological interventions are being developed to increase the resilience of pastoral systems in the face of climate change impacts.

1

Remote Sensing

Satellite imagery and NDVI help monitor biomass and drought in real time

2

GPS Tracking

GPS-based herd tracking devices allow herders to follow animal movements across large areas with less labor.

3

Early Warning Systems

Climate and disaster alerts provide timely information on drought, extreme cold, and floods, Enable decisions such as herd reduction or feed storage.

Governance and Policies for Pastoral Systems

The continuity and resilience of pastoral systems depend not only on the efforts of individual communities but also on governance models and policy approaches.

Participatory Governance

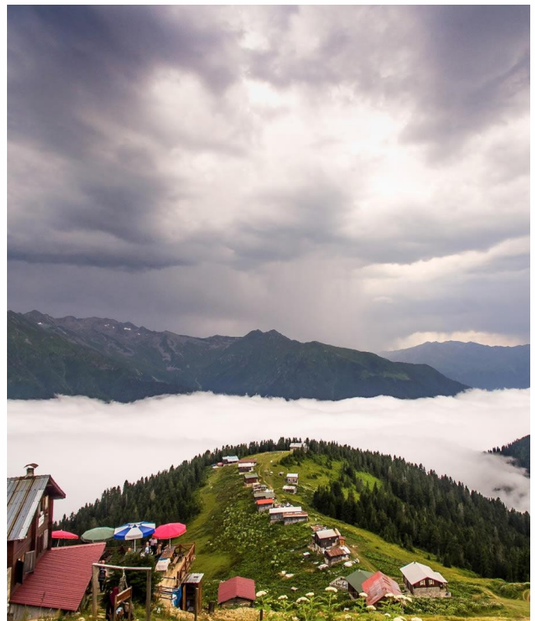
Policies should be designed with the direct participation of pastoral communities.

Co-management

Local communities and government institutions should come together to establish common rules and implement them together.

Adaptive Governance

Policies should not be static but can be updated based on ecological feedback.



Integrating Traditional Knowledge with Modern Approaches

One key step in rethinking pastoral systems under climate uncertainty is the integration of traditional knowledge with modern scientific approaches.

Traditional Knowledge

- ✓ Local nuances and long-term ecological understanding
- ✓ Weather forecasting through natural indicators
- ✓ Strong cultural practices and social institutions

Modern Approaches

- ✓ New technologies and monitoring tools
- ✓ Broad-scale climate predictions
- ✓ Data-based decision support systems

Transdisciplinary and Inclusive Approaches

Meteorologists

Local Pastoralists

Veterinarians

Sociologists

Pastoral resilience requires collaboration across disciplines and communities.

This complex system has social, ecological, and technological dimensions.

A transdisciplinary approach represents a collaborative model in which experts from different disciplines and local actors contribute equally, jointly defining problems and developing solutions. In a multifaceted issue such as pastoral resilience, this approach can yield tangible benefits.

Assessing Livestock Systems with Cultural and Ecological Dimensions

Pastoral livestock systems integrate culture, ecology, and sustainability beyond production.

Animal Welfare

In traditional nomadism, animals are not only a means of production but also part of the family and elements of cultural identity. Pastoral systems allow animals to freely exhibit their natural behaviors.

Pasture Management

Traditional pasture management is based on rotational grazing: pastures are rested and overgrazing is avoided. Community-based committees make and implement decisions to protect their own pastures.

Community-based Adaptation

Pastoral communities are the first to sense and respond to environmental changes. Their direct participation in the design of adaptation measures is essential.

Ethical Production

Pastoral production has a lower environmental footprint than industrial production. "Nature-friendly" and "climate-friendly" certifications could offer advantages to pastoral products.

Conclusion: A Framework for Pastoral Resilience

Pastoral resilience must integrate tradition and innovation to face climate uncertainty.

- ✓ Requires **ecological, economic, cultural, and technological integration**
- ✓ Traditional knowledge remains vital but must be combined with modern science
- ✓ Pastoral systems serve as biodiversity treasures + natural climate buffers
- ✓ With proper support, they can ensure **sustainable livelihoods & preserve cultural heritage**

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