Adaptation to Drought:

Rangeland Systems

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tline

Complex rangeland systems

Management challenges in drought

Transforming decision-making

- Needs-based strategies
- Keep Calm and CARM on

Flexibility

Heterogeneity

Survey Says: What works

Projections

source:

angelands

iety for Range
nagement

ght on Rangelands: Effects and
tions

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en access

p://www.sciencedirect.com/science/journal/01900528/38/4

omplex Social-Ecological System

oupled human-natural systems
t multiple scales
omplexity and uncertainty
reclude management Rx
eedbacks mediated by many
nowledges and adaptive actions
esilience: ability to "bounce
ack" and avoid state change
ritiques from social sciences

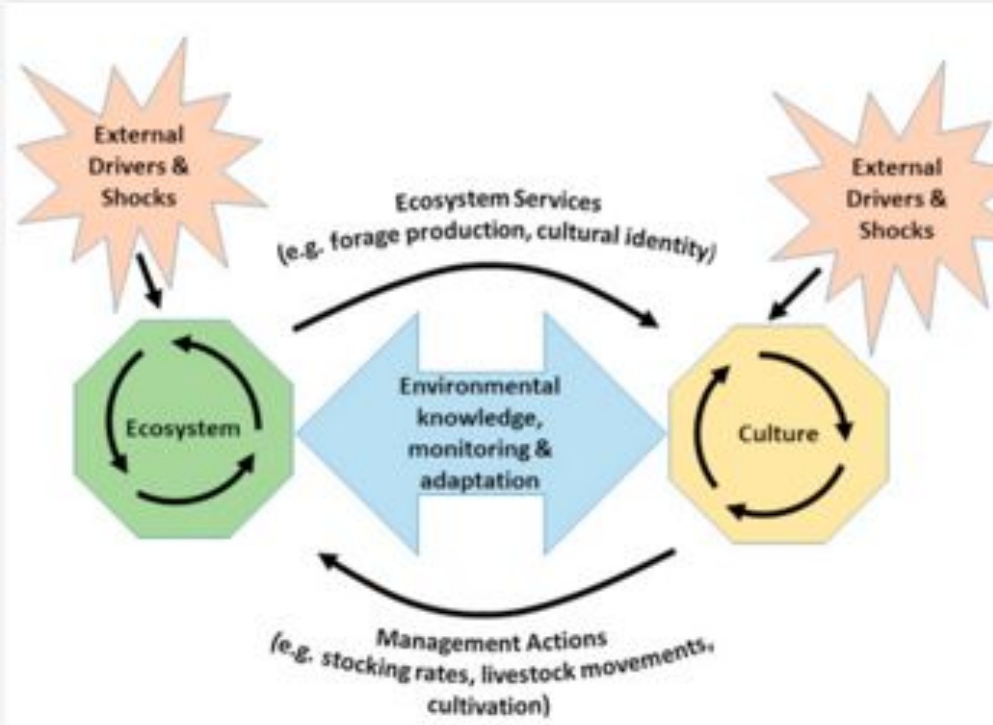
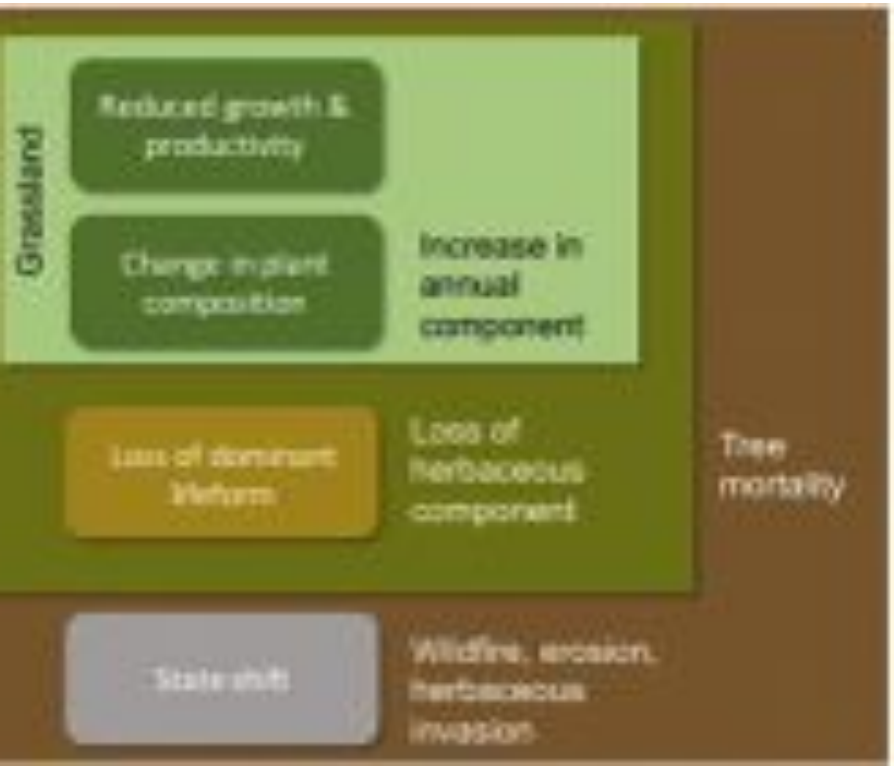


Fig. 1.
Conceptual diagram of a coupled human and natural system (CHANS) with feedbacks mediated
environmental knowledge (including TEK), monitoring and adaptation, adapted from (Verstraete
2009)

(Berkes and Folke, 1998; Glaser 200
Fernandez-Gimenez et al., 2017)

Drought: Management Challenge



osed conceptual framework for considering how more extreme drought
t with climate change may differentially impact rangeland types, based on
n types and their relative abundances.

eshears et al., 2016; Derner and Augustine,
16; Crimmins and McClaran, 2016)

- No two droughts the same
- Limited ability of prediction an reliable seasonal forecasts
- Need for proactive planning
- Time scale:
  - Short term (fencing) vs. long term (plan for state shifts fr grassland to woodland).
- Trees, shrubs, grasses differ in sensitivity to drought

ransforming Decision-Making

daptation to climate and weather impacts, including drought,
ill require:

- continual learning and changes in response to
  multiple types of stresses
  across multiple scales by many actors.

angeland managers in semi-arid and arid rangelands **already**
xperience high levels of weather variability and have
eveloped many effective responses.

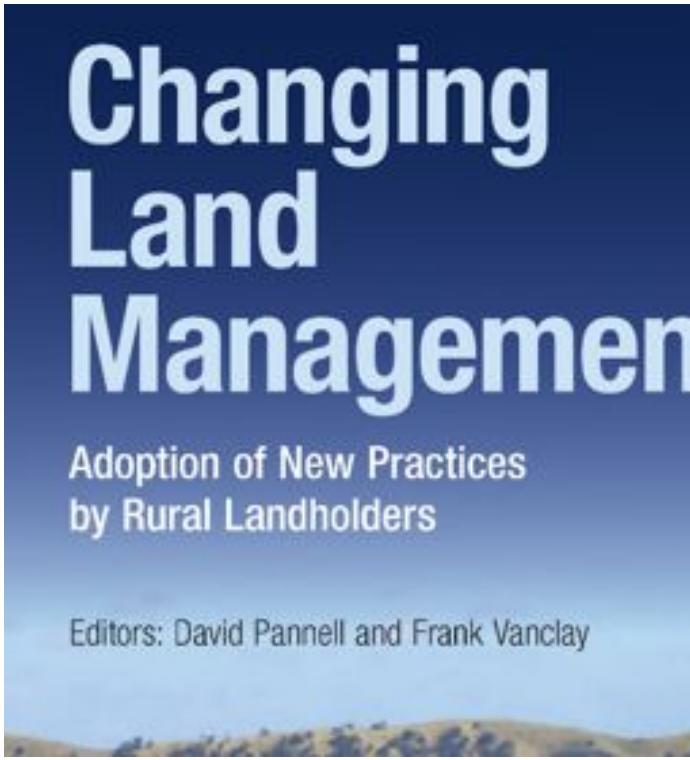
(Coppock, 2011; Adger, 2010; Wilmer et al, 2016)

Transforming Decision-Making

nager success in drought depends **on knowing en to act** under high levels of uncertainty.

nagers are diverse in their perceptions of risk, ls in planning, financial and emotional flexibility d interest in adapting. They come from different ckgrounds. They need tailored adaptation proaches.

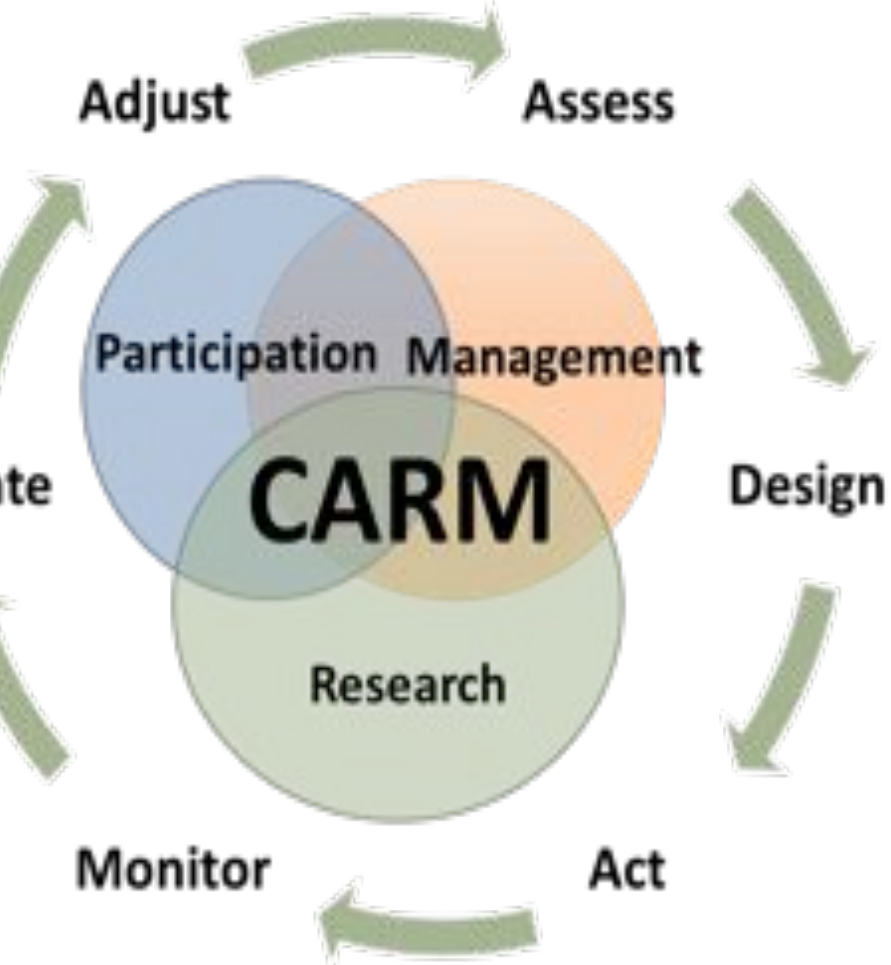
cilitated collaborative learning amongst nagers/stakeholders may assist skill velopment, climate awareness and adoption of mate tools. Expect slow, incremental change.



(Marshall, 2010; Pannel and Vanclay, 2011; Marshall and Smajgl, 2013; Wilmer and Fernandez-Gimenez, 2015)

eep Calm and CARM On:

laborative Adaptive Rangeland Management



- Ongoing 10-year study at ARS research station in Nunn, CO
- Collaboration: Building trust and learn
  - Ranchers
  - Gov't Agencies
  - Conservation NGOs
  - Scientists
- Adaptive management
- Complexity promotes learning, builds t

(Wilmer et al, In review, Fernandez-Gimenez et al, In prep)

exibility strategies

obility: **Move risk and resources across space. Examples: Secure ge/pastures in diverse landscape/topographic positions, or far from one ner.**

orage: **Move risk and resources across time. Examples: Hay/ e storage, grass-banking.**

versification: **Move risk and resources across asset class. ples: Diversified income and agricultural activities, diverse classes (e.g. ing cattle and cow-calf) and species of livestock. Diversification of tock class can enable flexible stocking rate decision-making.**

ooling: **Move risk and resources across organizations/ ehold. Examples: Broad social networks to exchange innovations, , technology, labor, equipment, forage, etc.**

arket exchange: **Market-based adaptation egies. Examples: Insurance-based risk management, non-traditional eting strategies, and forage purchase.**

(Agrawal and Perrin, 2008)

lexibility strategies

Julie Kennedy

eterogeneity for Flexibility

redict it

ack it

se conservative stocking
tes

Flexible stocking

**se inherent spatial
riability**

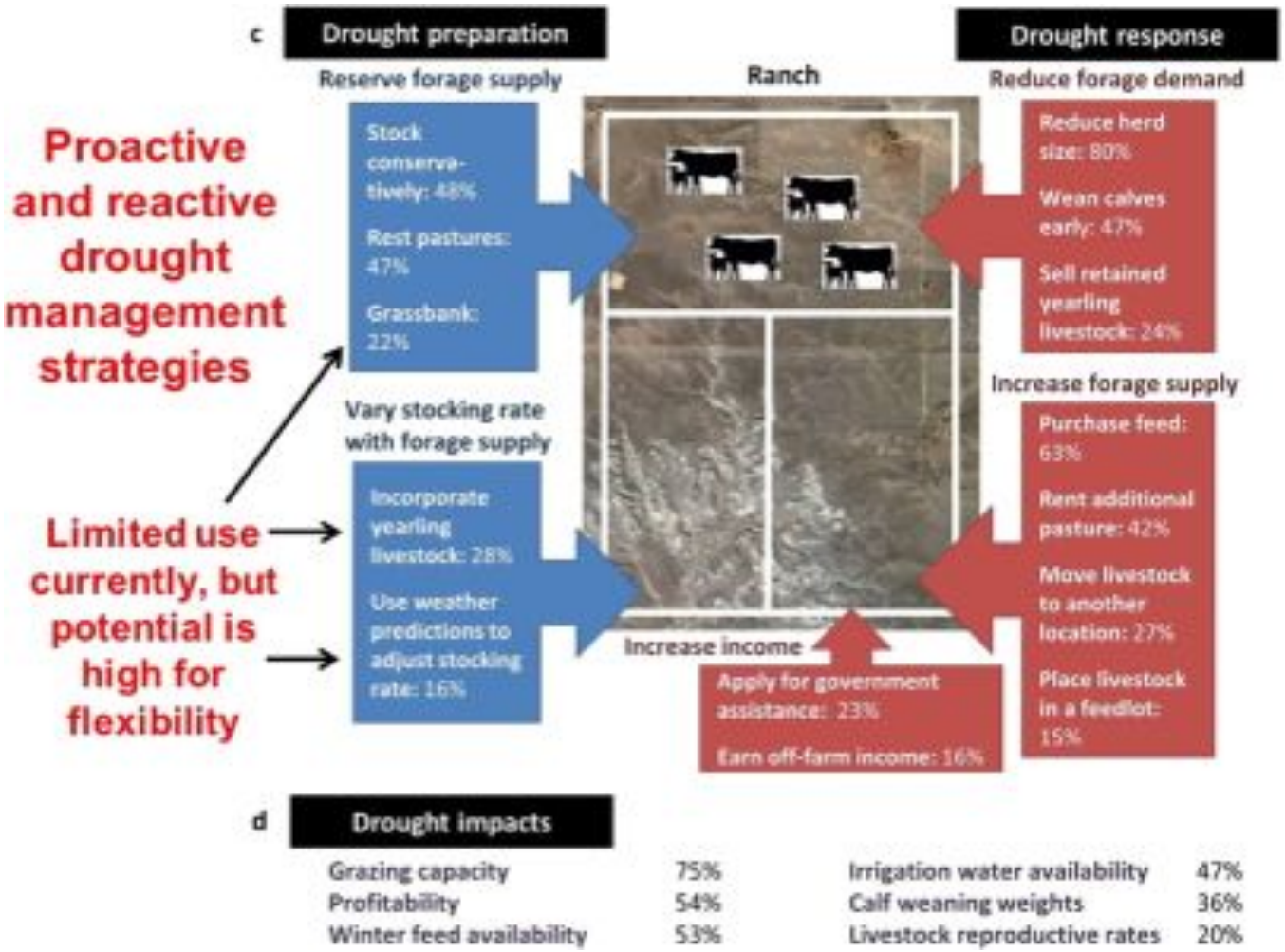
**eterogeneity - basis for
onservation**

(Derner and Augustine, 2016; Fuhlendorph et al, 2001; Tews et al, 2004)

Survey Says:

ought management strategies Wyoming ranches use to balance forage mand with forage supply, reported as the percentage of respondents no use each practice. N=281

(Karlis et al., 2014)



urvey Says:

oactive and reactive strategies for drought impact anagement from the 2011 California Rangeland ecision-Making Survey N=443 (Macon, et al., 2016)

	%
oactive (Preparing for ought)	
Stock conservatively	34
Rest pastures	23
Incorporate yearling cattle	21
Grassbank/Stockpile forage	12
Use weather predictions to adjust stocking	11
Add other livestock types for flexibility	3

Reactive (Responding to drought)	%
Reduce herd size	
Purchase feed	
Apply for government assistance programs	
Wean calves early	
Rent additional pastures	
Move livestock to another location	
Earn additional off-ranch income	
Sell retained yearlings	
Place livestock in a feedlot	
Maintain herd size; allow condition declines	
Add alternative on-ranch enterprise	

rojections

Existing	Potential
Grazing Livestock	
Adaptive grazing management	Collaborative adaptive management
Proactive flexible stocking	Robust contingency drought/deluge planning
Cattle breeds genetically predisposed to graze on uplands or slopes of rugged terrain	Breeds locally adapted to hot and fluctuating weather regimes, or shift in livestock species
Modification of livestock enterprise structure	Shift to new production enterprises emphasizing multiple ecosystem services
Confined Livestock	
Altered pen direction, orientation and slope	Altered design of containment facilities to handle increased frequency of extreme precipitation events
Increased insulation and ventilation in facilities	Genetic changes for greater heat stress tolerance
Shade, sprinkler cooling, high pressure misting, evaporative cooling pads	Geographic shift in primary areas of confined livestock facilities

(Derner et al., in review)

onclusions

omplexity requires adaptive management

- Collaboration makes it happen!

rought poses management challenges but rategies already exist

- Flexibility
- Heterogeneity
- Reactive vs. Proactive

rojected changes require ongoing learning, daptation

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Questions?

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