Collaborative Adaptive Rangeland Management (CARM):

Evaluating a transformative research methodology to adapt to agroecosystem complexity

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This study describes and evaluates Collaborative Adaptive Rangeland Management (CARM), a novel methodology for interdisciplinary, transformative research in complex agro-ecosystems. CARM aims to build management-science partnerships and improve environmental and social outcomes by engaging stakeholders in a structured, deliberative and experimental processes of learning and decision making.

We ask: 1) What factors facilitate and challenge collaborative adaptive management?
2) What are the implications for CARM success moving forward?

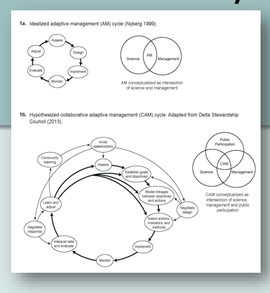


Figure 1: Hypothesized Adaptive Management and Collaborative Adaptive Management cycles

Summary: Collaborative Adaptive Rangeland Management

- 10 year Collaborative Adaptive Management project (Fig. 1) started in 2012 at Central Plains Experimental Range, Nunn, Colorado, USA, a US Department of Agriculture Long-Term Agroecosystem Research (LTAR) Network site in the shortgrass steppe ecosystem.
- 11 stakeholders and a team of scientists manage yearling cattle for beef production, grassland diversity and bird conservation.
- Outcomes are compared to Traditional Rangeland Management (same system stocking rate but 1/10 stocking density) used by local ranches with season-long, continuous grazing (Fig. 2).

- Decisions include pasture sequence (what order a pasture is grazed or rested), when to move cattle between pastures and vegetation management actions (e.g. prescribed burning).
- Decisions based on monitoring data and stakeholders' local knowledge.
- ~224-244 yearling cattle graze 10 130- ha pastures mid-May to October.
- Researchers measure outcomes on grassland birds, vegetation composition and structure, and cattle production.

Scan to watch video

Or visit: https://spark.adobe.com/video/iU413odrqzwGN

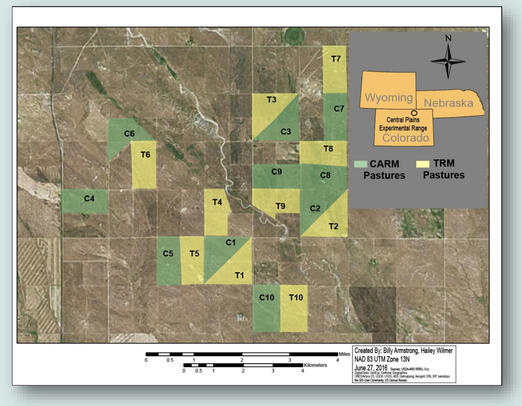


Figure 2: Twenty 130-ha pastures are paired based on soils, ecological sites, topography and plant communities. One of each pair was randomly assigned to the Collaborative Adaptive Rangeland Management (CARM) treatment and its pair to the TRM treatment. The 10 CARM pastures are shown in green, denoted by "C" and a pasture number, and 10 paired 130-ha Traditional Rangeland Management (TRM) pastures are shown in yellow, "T" and number. TRM pastures are managed under a continuous, season-long (mid-May to early October) grazing with the same moderate ranch-scale, growing season stocking rate using yearling steers as CARM pastures. During the first three grazing seasons, stakeholders chose to rotate a single large herd of cattle through the CARM pastures, moving the herd based on vegetation and cattle behavior monitoring triggers. The group planned to graze 8 of 10 pastures each year, reserving 2 pastures for rest (no grazing) as emergency feed during drought.

Trade-offs & complexities challenge decision-making and foster learning

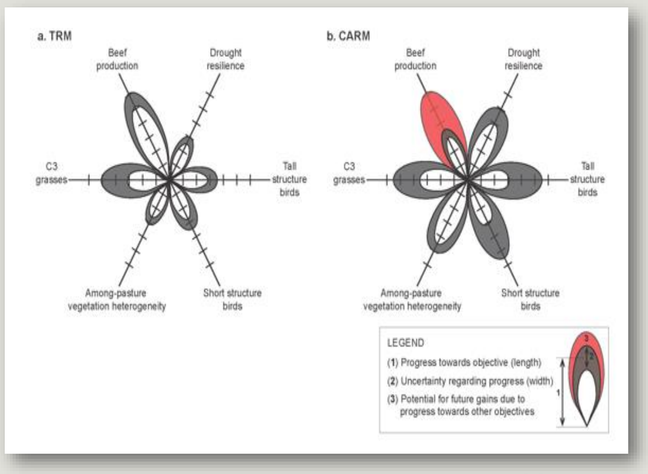


Figure 3. Hypothesized progress toward (length of petal) and uncertainty surrounding (width of petal) multiple rangeland management objectives under TRM (a) and CARM (b) after 2 years of treatments. Red petal (b) depicts potential for future gains in beef production due to improvements in vegetation composition and drought resilience in the longer term (5-10 years).

Spatiotemporal trade-offs in objectives

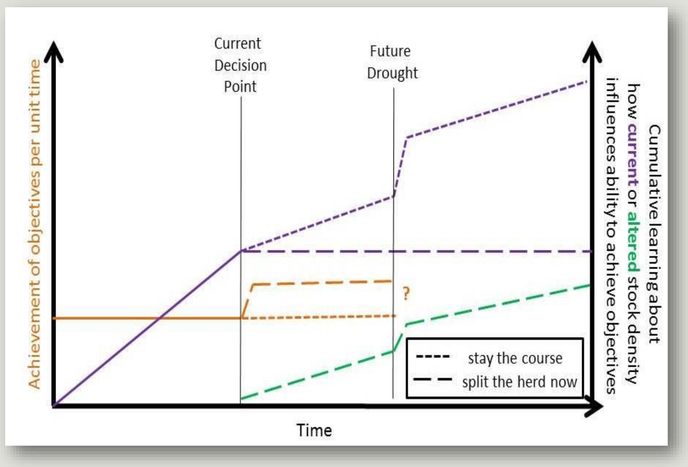


Figure 4. Learning-doing and learning-learning tradeoffs. The decision to alter a management strategy within CARM may improve the system's ability to achieve objectives (e.g., improve cattle weight gain in the short term; orange lines) but will also remove opportunities to learn about longer-term outcomes of the current management strategy (e.g., performance of current strategy during drought; purple lines). At the same time, altering a management strategy will create learning opportunities related to the new, revised strategy (green line).

Trade-offs between learning and doing

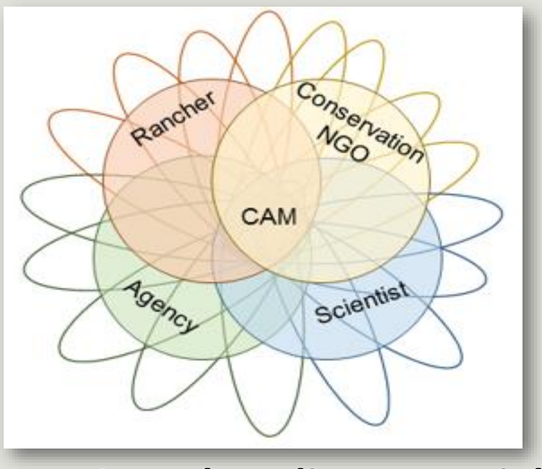
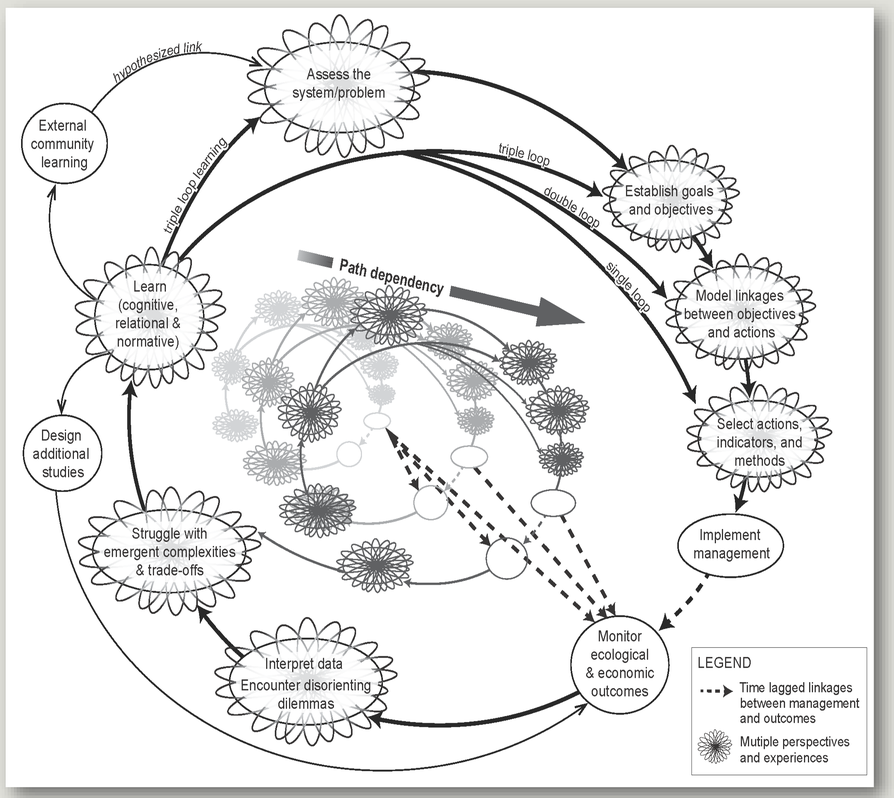


Figure 5. Collaborative Adaptive Management (CAM) conceptualized as an encounter of multiple individual mental models (ellipses) and social worlds (circles) leading to the creation of a new, shared domain of interaction.

Complex, diverse social worlds

Revised model of Collaborative Adaptive Management process



- CAM is complex, non-linear process better represented by a learning-doing spiral than a circle.
- Multiple-loop relational and normative learning processes inform and depend upon single-loop, cognitive learning about ecological processes and outcomes.
- Management decisions made early condition decisions and learning opportunities encountered later (path dependency).
- Stakeholder input is internal to learning-doing spiral. Existing working knowledge and co-produced knowledge inform data collection, interpretation, and application, and management decisions.
- Time lags and complex trade-offs impede fully "closing the loop" (Figs. 3 & 4).
- Public participation is not singular, but an intersection of many mental models and social worlds (Fig 5).

(Fernandez-Gimenez et. al, *in review)*

Recommendations

1. Co-develop goals, objectives, management strategies and monitoring indicators in an inclusive manner, involving stakeholders in each iterative step.
2. Accelerate social learning by providing opportunities for participants to develop understanding and respect for each other's worlds, ways of learning, and knowledge. Invite non-scientists to present and discuss their interpretations of scientific data.
3. Make social learning an explicit objective, and develop a common understanding of what kinds of evidence supports conceptual change for different stakeholders.
4. Anticipate and discuss spatial, temporal, and learning-doing trade-offs. Recognize path dependency in management.

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To learn more

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