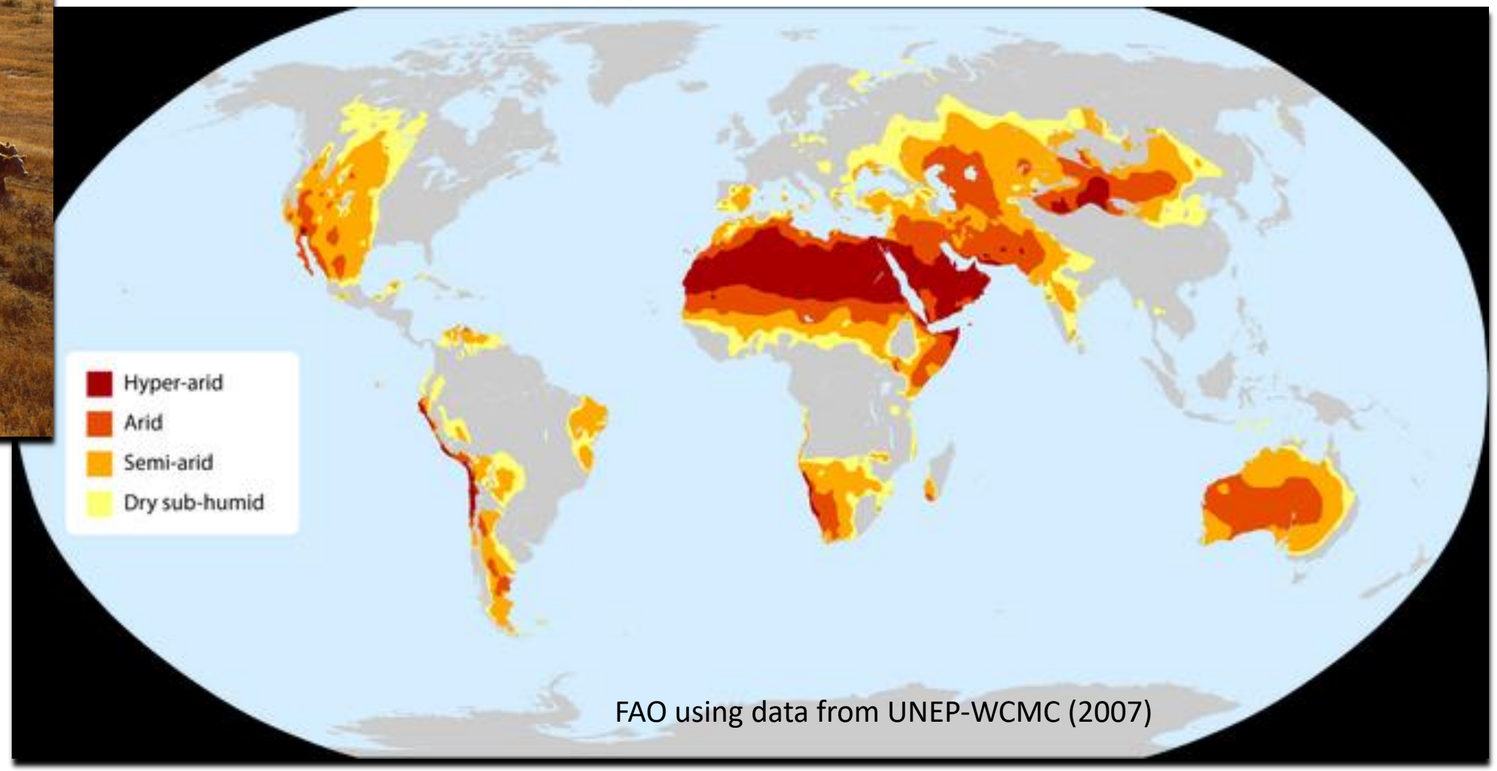
# G20 MACS International Virtual Experts Meeting on Promoting Sustainable Agriculture Development in Drylands

USDA Science
"Cultivating Scientific Innovation"

UNITED STATES
DEPARTMENT OF
AGRICULTURE

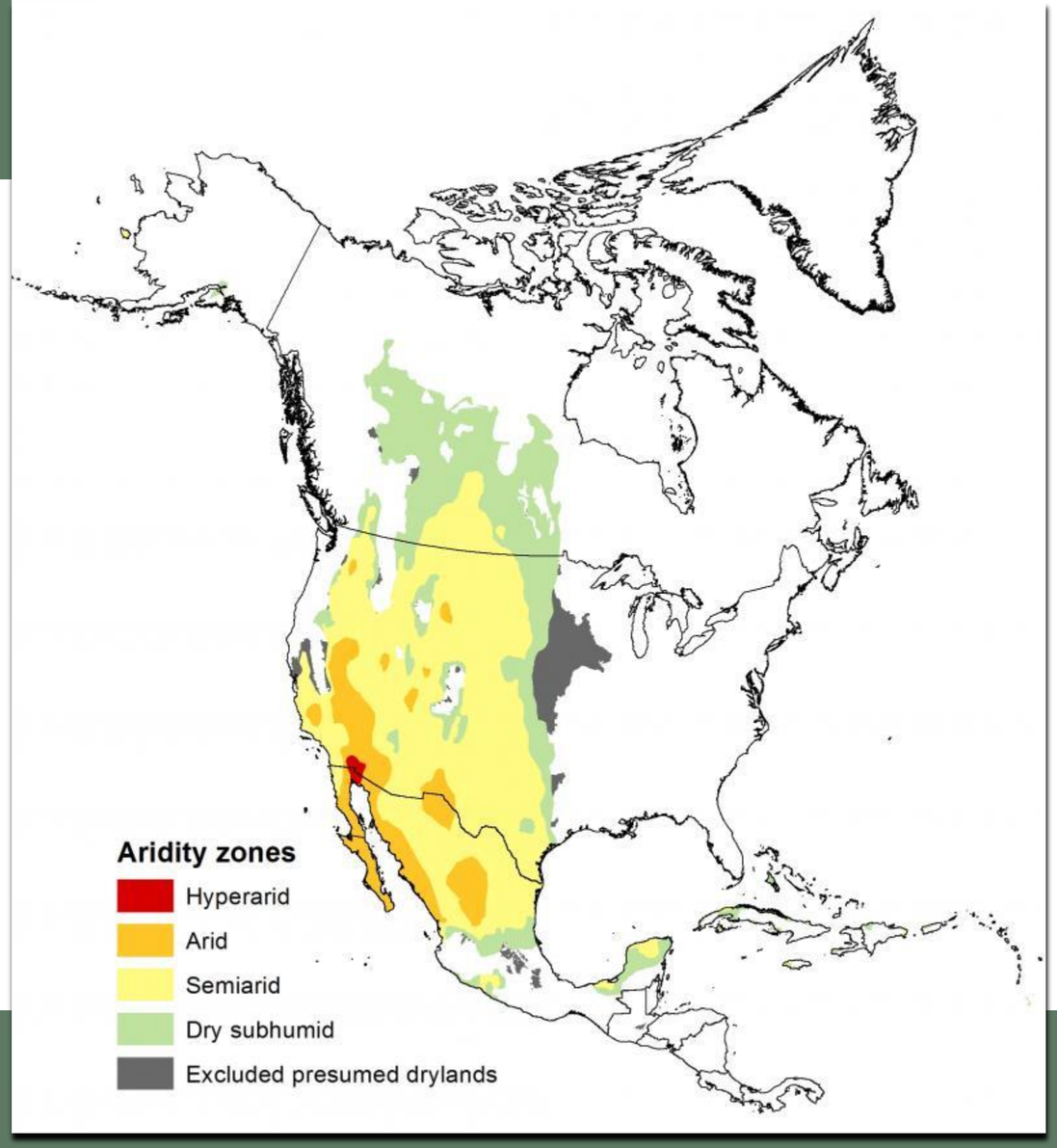
USDA

Photo by Jack Dykinga




FAO using data from UNEP-WCMC (2007)

Farmers, ranchers and agricultural sector partners must have access to **a wide-range of tools and resources** in order to overcome complex challenges in drylands.

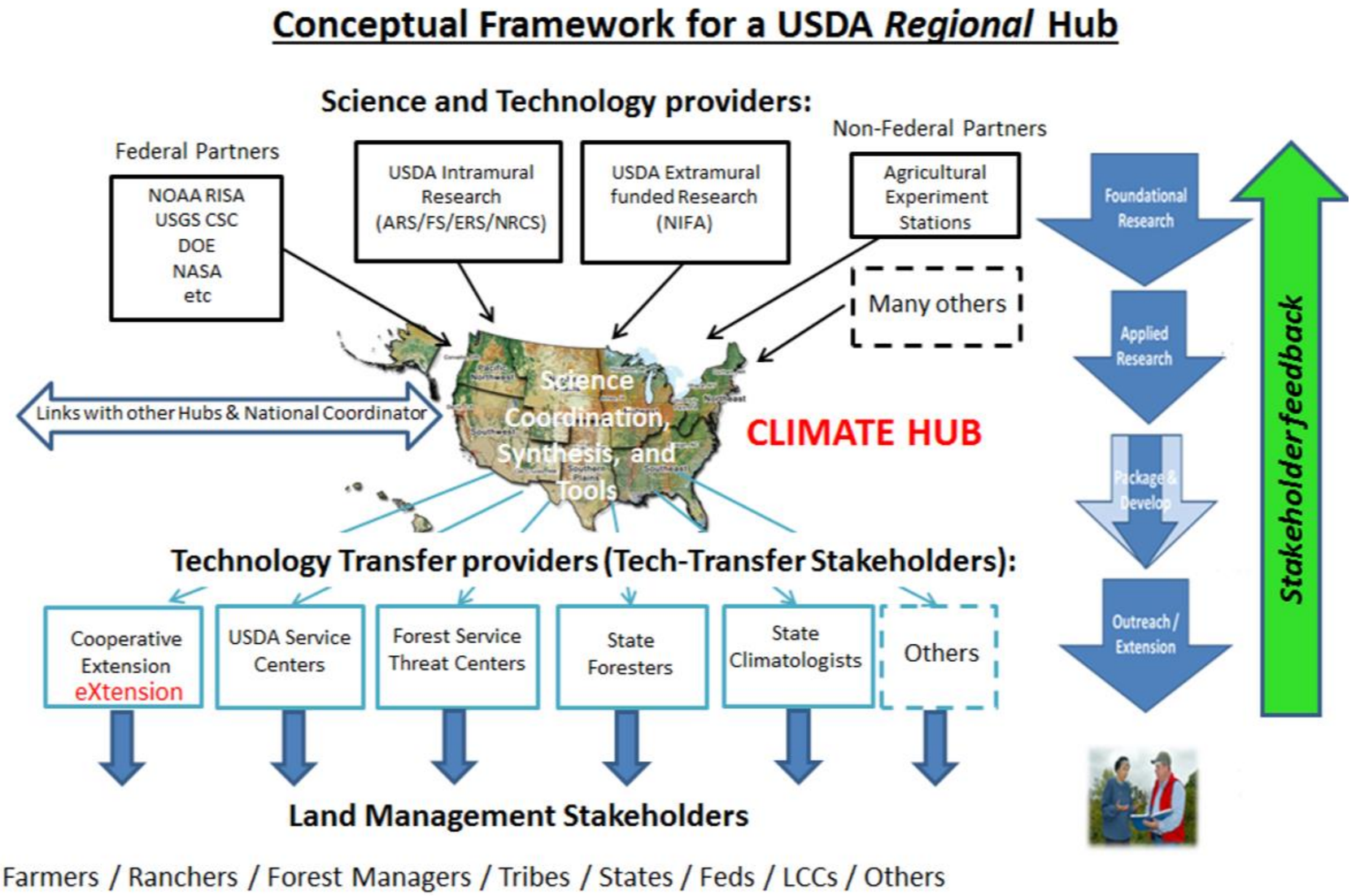




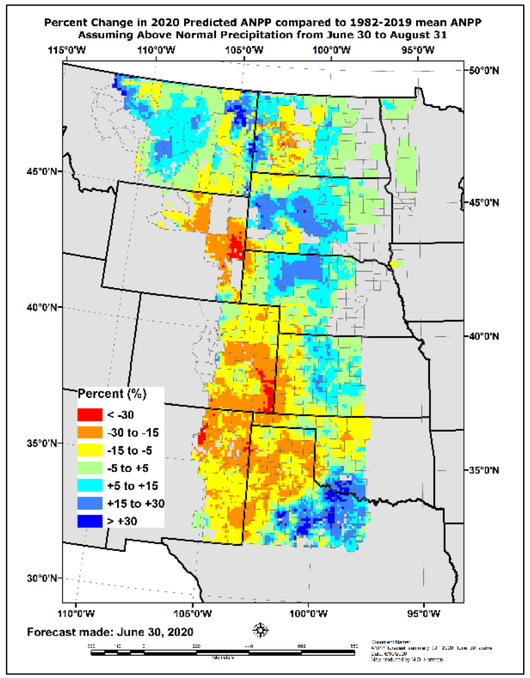
Texas panhandle dust storm, 1930's

# Collaboration

One example:

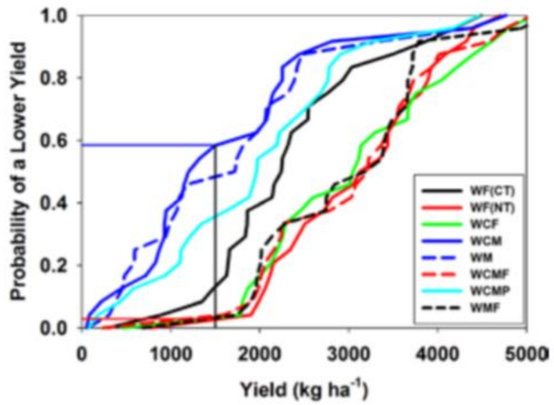


# Recent research & outreach highlights

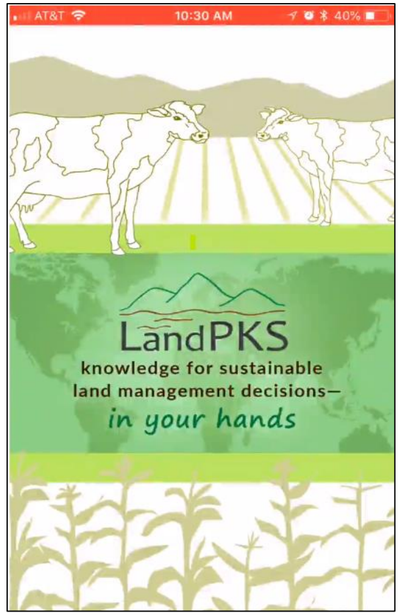



**Grassland Production Forecast**

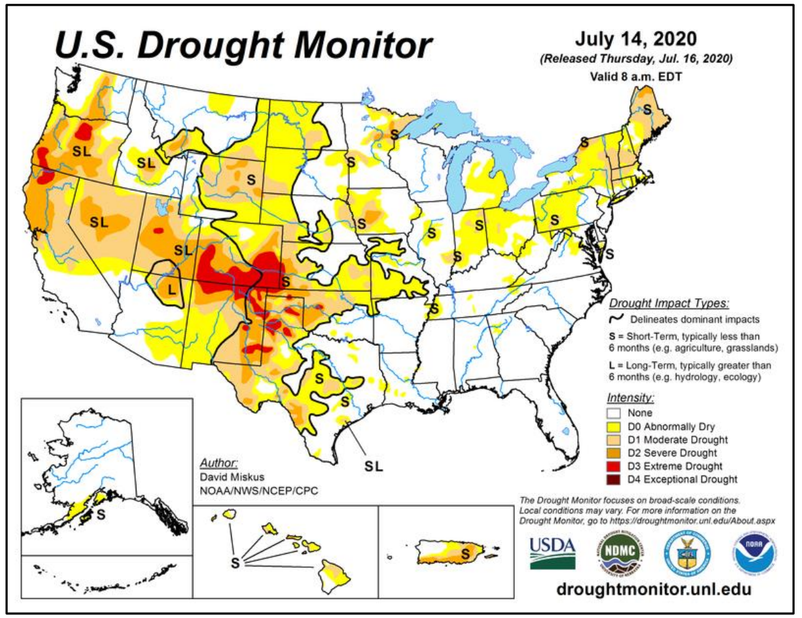
**Plant Materials Release Catalog**




Crop rotations and probability of low yield




LandPotential.org




**RHEM Web Tool** Rangeland Hydrology and Erosion Model Web Tool

→ Providing farmers, ranchers, and agricultural sector partners **access to a wide-range of tools and resource to enable sustainable agriculture and science-based and data-driven decision-making**

# THANK YOU

# &

# STAY CONNECTED!

**@USDAScience**

# APPENDIX

## Recent examples of collaborative work with USDA, arranged by the seven topic areas

1. Plant breeding and better crop selection for improved dryland stress resistant varieties development to enhance productivity

*Advanced breeding methods in drylands*

- Genome-wide transcriptome and physiological analyses provide new insights into peanut drought response mechanisms
  - Bhogireddy, S., Xavier, A., Garg, V., Leyland, N., Arias De Ares, R.S., Payton, P.R. 2020. Scientific Reports. 10:4071. https://doi.org/10.1038/s41598-020-60187-z

- Plant Releases: Forage and Range Research Laboratory, Logan, Utah
  - Staub, Jack, Kevin Jensen, Thomas Jones, Douglas Johnson, Michael Peel, Joseph Robins, Shaun Bushman, Steve Larson, Ivan Mott, Richard Wang, and Blair Waldron. 2016. ARS-176. U.S. Department of Agriculture, Agricultural Research Service, Washington, D.C., 36 pp. https://www.ars.usda.gov/ARSUserFiles/oc/np/FRRLPlantReleases/FRRLPlantReleases.pdf

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# APPENDIX continued

## 2. Optimizing water and/or soil management in drylands

*Resource inventories*

Resource inventories are critical to ascertain the state of the resources from a statistical sampling point of view. In the United States, the Rangeland Hydrology and Erosion Model (RHEM) is used in rangeland National Resource Inventories, where data on plant species cover and production are collected to evaluate hydrology and erosion risk with varying land management scenario**s.** RHEM has been extended for use in Central Asia.

- Hydrology and Erosion Risk Parameters for grasslands in Central Asia
  - Kenneth E. Spaeth, Mark A. Weltz, D. Phillip Guertin, Jiaguo Qi, Geoffrey M. Henebry, Jason Nesbit, Tlektes I Yespolov, Marat Beksultanov (2020) *in* Garik Gutman, Jiquan Chen, Geoffrey M. Henebry, Martin Kappas (Eds) *Landscape Dynamics of Drylands across Greater Central Asia*. Switzerland: Springer, pp 125-141.

- Rangeland Hydrology and Erosion Model (RHEM) web tool https://dss.tucson.ars.ag.gov/rhem/

- Interpreting Indicators of Rangeland Health
  - Pellant, M., P.L. Shaver, D.A. Pyke, J.E. Herrick, F.E. Busby, G. Riegel, N. Lepak, E. Kachergis, B.A. Newingham, and D. Toledo. 2018., Version 5. Tech Ref 1734-6. U.S. Department of the Interior, Bureau of Land Management, National Operations Center, Denver, CO. https://www.blm.gov/download/file/fid/25041

# APPENDIX continued

## 2. Optimizing water and/or soil management in drylands (continued)

*Soil ecology*

- Soil organic matter and microbial community responses to semiarid croplands and grasslands management
  - Rajan Ghimire, Vesh R. Thapa, Amanda Cano, Veronica Acosta-Martinez (2019) Applied Soil Ecology. 141:30-37. https://doi.org/10.1016/j.apsoil.2019.05.002

- Current knowledge and future research directions to link soil health and water conservation in the Ogallala Aquifer region
  - Amanda Cano, Agustín Núñez, Veronica Acosta-Martinez, Meagan Schipanski, Rajan Ghimire, Charles Rice, Charles West (2018). Geoderma 328:109-118. https://doi.org/10.1016/j.geoderma.2018.04.027

- Simulating Soil Organic Carbon Responses to Cropping Intensity, Tillage, and Climate Change in Pacific Northwest Dryland
  - Gollany HT, Polumsky RW.. *J Environ Qual*. 2018;47(4):625-634. https://doi.org/10.2134/jeq2017.09.0374

*Data trends and statistics on farm practices and management*

- Understanding irrigated agriculture
  - USDA Economic Research Service (2017) https://www.ers.usda.gov/amber-waves/2017/june/understanding-irrigated-agriculture/

- Agricultural Resources and Environmental Indicators – esp Ch 1.2 and 3.24
  - Daniel Hellerstein, Dennis Vilorio, Marc Ribaudo (editors) EIB-208, U.S. Department of Agricutlure, Economic Research Service, May 2019 https://www.ers.usda.gov/webdocs/publications/93026/eib-208.pdf?v=7388.6

# APPENDIX continued

## 3. Pests and diseases challenging animal and plant health in drylands

*Early Warning Strategies for vector-borne diseases*

- Big data–model integration and AI for vector-borne disease prediction
  - Peters, D. P. C., D. S. McVey, E. H. Elias, A. M. Pelzel-McCluskey, J. D. Derner, N. D. Burruss, T. S. Schrader, J. Yao, S. J. Pauszek, J. Lombard, and L. L. Rodriguez. 2020. Ecosphere 11(6):e03157. 10.1002/ecs2.3157 https://doi.org/10.1002/ecs2.3157

*Reducing risk of Vesicular Stomatitis Virus (VSV)*

- Reducing the Risk of Equines Contracting Vesicular Stomatitis Virus (VSV) in the Western United States
  - Dannele E. Peck, Will K. Reeves, Angela M. Pelzel-McCluskey, Justin D. Derner, Barbara Drolet, Lee W. Cohnstaedt, Dustin Swanson, D. Scott McVey, Luis L.Rodriguez, Debra P.C. Peters. 2020. Journal of Equine Veterinary Science 90: 103026 https://doi.org/10.1016/j.jevs.2020.103026

*Cotton viruses*

- Molecular insight into cotton leaf curl geminivirus disease resistance in cultivated cotton *(Gossypium hirsutum)*
  - Syed Shan-e-Ali Zaidi, Rubab Zahra Naqvi, Muhammad Asif, Susan Strickler, Sara Shakir, Muhammad Shafiq, Abdul Manan Khan, Imran Amin, Bharat Mishra, M. Shahid Mukhtar, Brian E. Scheffler, Jodi A. Scheffler, Lukas A. Mueller and Shahid Mansoor (2020) Plant Biotechnology Journal 18: 691-706. https://doi.org/10.1111/pbi.13236

# APPENDIX continued

## 4. Scenarios for climate smart livestock systems in drylands

The USDA Climate Hubs support climate smart livestock systems in drylands via research and science synthesis (e.g. precision ranching and supply-chain options), tool development and provision (e.g. forage estimates, localized drought alerts, crop loss economic assessment, dust monitoring and mitigation) and convening stakeholders (e.g. drought monitor workshops for service agencies and producers).

- Heritage Cattle and Precision Ranching Research highlighted in the Sustainable Southwest Beef Project: https://southwestbeef.org/
- Cattle, conservation, and carbon in the western Great Plains
  - John S. Sanderson, Curtis Beutler, Joel R. Brown, Indy Burke, Teresa Chapman, Richard T. Conant, Justin D. Derner, Mark Easter, Samuel D. Fuhlendorf, Grady Grissom, Jeffrey E. Herrick, Daniel Liptzin, Jack A. Morgan, Rachel Murph, Chris Pague, Imtiaz Rangwala, David Ray, Renee Rondeau, Terri Schulz and Tim Sullivan (2020). Journal of Soil and Water Conservation 75:5A-12A https://doi.org/10.2489/jswc.75.1.5A
- Vulnerability of grazing and confined livestock in the Northern Great Plains to projected mid- and late-twenty-first century climate
  - Justin Derner, David Briske, Matt Reeves, Tami Brown-Brandl, Miranda Meehan, Dana Blumenthal, William Travis, David Augustine, Hailey Wilmer, Derek Scasta, John Hendrickson, Jerry Volesky, Laura Edwards, Dannele Peck (2017. Climatic Change https://doi.org/10.1007/s10584-017-2029-6
- Informing grazing practices on rangelands
  - https://www.climatehubs.usda.gov/hubs/southwest/topic/drought-vulnerability-assessment-inform-grazing-practices-rangelands-0
- Cattle Heat Stress Alerts: https://www.ars.usda.gov/plains-area/clay-center-ne/marc/docs/heat-stress/main/

# APPENDIX continued

## 5. Innovative technology adoption to enhance resource use efficiency through systems approach for better climate adaptability in drylands

### *Grass-Cast – Grassland Productivity Forecast*

Grassland Productivity Forecast is a tool that translates seasonal precipitation outlooks into a grassland outlooks for ranchers, helping them anticipate how much grass might grow out on native grasslands/rangelands to improve management decisions.

- *https://grasscast.unl.edu*
- Flexible stocking with Grass-Cast: A new grassland productivity forecast to translate climate outlooks for ranchers
  - Peck, Dannele; Derner, Justin; Parton, William; Hartman, Melannie; Fuchs, Brian (2019) Western Agricultural Economics Association 17 http://ageconsearch.umn.edu/record/287342/files/WEF17_1FlexibleStocking.pdf

### *Land PKS – Land Potential Knowledge System*

The Land Potential Knowledge System is a free mobile phone app to assess land info (e.g., soil and ecological site info), land cover, and land management. It is a global tool that has been focused on drylands.

- https://landpotential.org/
- ARS video: *https://www.youtube.com/watch?v=ODymv3nWbH0*

# APPENDIX continued

## 5. Innovative technology adoption to enhance resource use efficiency through systems approach for better climate adaptability in drylands (continued)

*North American Drought Monitor*

The NADM is a cooperative effort between drought experts in Candad, Mexico and the United States to monitor drought across the continent on an ongoing basis. Funded in part by the USDA, the drought monitor reports changes in drought conditions and USDA relies on the drought monitor for farmer assistance programs.

- https://droughtmonitor.unl.edu/nadm/Home.aspx

*Farmer experimentation and extension support*

- Cover crops on dryland wheat? Challenge Accepted!
  - https://www.nrcs.usda.gov/wps/portal/nrcs/detail/or/newsroom/stories/?cid=nrcseprd1291630

*Adaptation strategies to changing climatic conditions*

- Vulnerability of crops and croplands in the US Northern Plains to predicted climate change
  - Wienhold, B.J., Vigil, M.F., Hendrickson, J.R. et al.. Climatic Change 146, 219–230 (2018). https://doi.org/10.1007/s10584-017-1989-x

# APPENDIX continued

6. High and low-tech innovative farming solutions to enhance resilience of small-scale farmers (both pastoral and crop based)

- Climate Hub Adaptation Workbook -- includes semiarid production in Colorado and Texas
  - https://www.climatehubs.usda.gov/hubs/topic/adaptation-resources-agriculture-case-studies-using-adaptation-workbook

- Dust Mitigation Handbook
  - Smarik, S., S. Aney, A. Boes, D. Brown, D., Dubois, B. Edwards, E. Elias, M. Eve, R. Steele, N. Webb, M. Wilson, G. Zwicke, 2019. Las Cruces, NM: U.S. Department of Agriculture. https://dust.swclimatehub.info/
  - Webinar: http://www.conservationwebinars.net/webinars/introducing-a-one-stop-resource-for-wind-erosion-air-quality-and-dust-mitigation