

Project Description: A National Grazingland Information System: Expanding GlobalRangelands.org Through A Grazingland Thesaurus and Mobile Content Access

Project Background

Ecologically and economically sound management of America's grazing lands rests in the hands of well-informed land managers with access to applicable information of the highest quality. The development of systems to organize and deliver available knowledge to support adaptive management has been identified as one of the grand challenges to maintaining resilient grazingland systems (Bestelmeyer and Briske 2012, Herrick and Sarukhán 2007, Karl et al. 2012). Conservation planners, technical specialists, land managers, and other grazingland stakeholders need to quickly locate and access relevant information from reference materials like conservation practices, handbooks, manuals, reports and scientific literature (Karl et al. 2012) in the office and in the field. Currently, grazingland professionals use their own individual systems for finding, storing, and accessing these materials (Herrick and Sarukhán 2007). Such ad hoc approaches are inefficient for professionals who need to keep abreast of relevant resources and for organizations that need to quickly and widely disseminate important information as it becomes available. Most grazingland professionals do not have the time to surf the internet looking for relevant resources (Hutchinson and Ruyle 2000). More significantly, improvised approaches to finding applicable reference materials are inadequate to meet the information needs of grazingland management in a changing world (Herrick and Sarukhán 2007, Karl et al. 2012, Peters et al. 2012).

While many reference materials relevant to grazingland management exist digitally, the process of discovering them poses several significant challenges. These materials are spread across the internet and finding either a specific reference or a set of references relevant to a topic is tedious, time-consuming, and cumbersome. General internet searches only report documents related to the search terms with no reference to their quality or relevance to a specific situation (Herrick and Sarukhán 2007). Likewise, search functions on most agency websites perform free text searching for entered terms and have little structure or relevance to the results. This problem is commonly known in information retrieval as a “relevance” or “recall” problem – i.e., the value of the results is not evaluated by how well the results meet the need of the user but by how well the query matches (Schütze et al. 2008). For example, a search for “utilization monitoring” on the NRCS website returns over 300 results, mostly related to livestock waste use, with a few results related to grazingland management. Discovery of grazing information faces poor recall by current information systems.

In some cases, similar or the same reference materials exist in multiple locations. For example, the NRCS *National Range and Pasture Handbook* (Butler et al. 2003) can be found on multiple NRCS websites, each providing a separate copy of the document. Interagency references such as *Interpreting Indicators of Rangeland Health* (Pellant et al. 2005), can be found duplicated on the websites of each respective agency. While duplication is a virtue for making it easier to find items, such examples obviously pose challenges for maintaining consistency and updating resources. Users are also required to exhibit judgement on which of the multiple items is the best, current, or most appropriate.

The challenge of finding good information to support rangeland management is a longstanding problem which prompted rangeland extension specialists and librarians from 19 western land-grant universities in 2002 to initiate an organization which became the Rangelands Partnership. Working with technology experts, the Rangelands Partnership has created comprehensive and specialized collections and resources including research publications,



decision-making tools, and training materials for sustaining the world's vast rangelands (Hutchinson et al. 2011). The Global Rangelands portal (<https://GlobalRangelands.org>) was created and is maintained by the Rangelands Partnership to provide public and private land



managers, researchers, extension professionals and the public with information and tools needed for informed decision-making and sustainable management of grazinglands (Hutchinson et al. 2011). Global Rangelands provides a search interface linking to over 12,000 journal

articles, websites, databases, reports and other reference materials.

Web-based information systems, such as the Global Rangelands portal, attempt to curate high-quality information about grazingland management to make searching for reference materials more efficient and complete. However, a portal like GlobalRangelands.org, has limitations that hinder its value in the increasingly information-rich and mobile world of grazingland professionals. First, search portals that aggregate diverse sources of grazingland information typically only link to materials and do not provide offline access. And while access to resources via the internet is necessary for this linking to occur, many grazingland professionals work in remote regions where internet access is not readily available. Thus, it is necessary that content discovered via a search platform be able to be downloaded and made available offline.

A second limitation is that relevant resources within search portals have not been consistently tagged for easy search and retrieval, yielding incomplete and irrelevant search results. Search portals have advantages over general internet search technologies because they use a controlled vocabulary (i.e., a thesaurus) or ontology that explicitly defines keywords and their relationships. The entire document or sections within the document can be then tagged with terms from the thesaurus to increase consistency, relevance, and ability to find applicable information. Formalized ontologies and hierarchically structured thesauri have been shown to greatly improve the relevance of search results over search engines that lack this approach (Pinheiro and Moura 2004). Thus, an information access system built around a grazingland-specific thesaurus could dramatically improve the relevancy of search results and could perform more efficiently and completely than a general search of the internet.

Currently, three thesauri of agricultural terms and a fourth coordinating resource are available for use in developing an information access system for grazingland management:

- 1) U.S. National Agricultural Library's Agricultural Thesaurus (NALT)
(<https://agclass.nal.usda.gov/>, over 135,000 terms)

- 2) United Nations Food and Agriculture Organization's (FAO) AGROVOC (<http://aims.fao.org/standards/agrovoc>, over 34,000 terms in 29 languages)
- 3) Center for Agriculture and Biosciences International's (CABI) CAB Thesaurus (<https://www.cabi.org/cabthesaurus/>, over 140,000 terms in 10 languages)
- 4) FAO's Global Agricultural Concept Scheme (GACS, http://aims.fao.org/global_agricultural_concept_scheme_gacs) coordinates the conceptual meaning between these three thesauri, and contains consistent definitions for the 10,000 most common terms from each.

However, the available thesauri for tagging content do not contain enough detail on grazingland practices and management to be useful. Many of the terms in the Society for Range Management's Glossary (Bedell 1998) do not appear in any of the three thesauri. Terms that do appear may be tied to concepts that are not grazing related. For example, the term "utilization" in GACS references economic production potential or use of wood products. Thus, a targeted thesaurus for grazinglands is crucial to build a useful, modern, and efficient grazingland information access system.

To meet the grand challenge of delivering accurate, relevant, and timely information to grazingland professionals, a new approach is needed for efficiently discovering, locating, and saving handbooks, technical notes, and other reference materials (Bestelmeyer et al. 2012, Karl et al. 2012). This new approach must be built on a grazingland-specific thesaurus and developed in a way that leverages existing internet resources while recognizing the offline nature of grazingland management work. We propose to develop and implement a grazingland thesaurus within the Global Rangelands platform, identify and tag a core set of contemporary grazing reference materials, and make that information available via a newly designed online portal and mobile application.

Project Objectives

We will leverage the considerable expertise and resources of the Rangelands Partnership, developers of the suite of GlobalRangelands.org websites, to improve the effectiveness of finding and delivering key grazingland management information from technical guides, handbooks, manuals, and reference materials for conservation planners and other land managers. Rangelands Partnership teams led by Dr. Jason Karl and Mr. Jeremy Kenyon of University of Idaho (UI) and Dr. George Ruyle and Ms. Jeanne Pfander of University of Arizona (UA), will:

- 1) Develop a grazingland thesaurus for classifying grazingland management information resources for whole documents and sections within documents.
- 2) Identify a core set of grazingland management resources (e.g., NRCS handbooks, guides, manuals, practices documents, reference literature), either already in GlobalRangelands.org or to be added.
- 3) Use the newly developed grazingland thesaurus to tag these resources and create a specific collection of grazingland resources in the Global Rangelands portal.

- 4) Create a web-based, mobile application with online/offline capabilities that provides a search interface for discovering and delivering relevant grazingland resources and information based on user queries.

Project Methods

Grazingland Thesaurus Development

We will begin by developing a relevant vocabulary for grazingland management using rapid ontology development methodologies (De Nicola and Missikoff 2016) used for producing a clear and application-specific taxonomy. The process involves 1) identifying relevant terms, 2) defining those terms as a glossary, 3) building the glossary into a taxonomy, and 4) defining the relationships between taxonomical terms for future use in a formal, published ontology. The project leaders at the UI and UA will work with state extension specialists and other range experts through a series of meetings and video conferences to identify and define terms for the thesaurus.

To identify appropriate rangeland and grazing terminology, we will review a series of glossaries and term lists published by various organizations. These include the USDA NRCS's glossary in the *National Range and Pasture Handbook* (Butler et al. 2003), the Society for Range Management's *Glossary of Terms Used in Range Management* (Bedell 1998) and the crowd-sourced keyword list developed by the Rangelands Partnership. These resources build on numerous previous glossaries for grazing (De V. Booysen 1967, Allen et al. 2011), range monitoring and assessment (Karl et al. 2012), range management (Bryant et al. 1978), soil (Soil Conservation Society of America 1982), and others.

We have identified the GACS as the foremost vocabulary resource for agricultural information. GACS is an international working group, now under the umbrella of the Global Open Data for Agriculture and Nutrition (GODAN) initiative, aiming to combine the NALT, CABI, and AGROVOC into a single database as a linked data service (FAO, 2017). From a cursory search of the first 25 terms listed in the 1998 SRM glossary, terms such as "animal unit month" and "air-dry weight" do not currently appear. Curiously, "animal unit" is defined in the U.S. Code of Federal Regulations (25 CFR §161.1 2012) but does not appear in the NALT. There clearly is a gap for terminology relating to rangeland practices, environments, and conditions.

Next, the UI/UA teams will condense the existing glossaries and eliminate redundancies. We will identify places of overlap with GACS, defaulting to the GACS terms where appropriate. In the first year, we will hold a workshop as part of the annual meeting of the Rangelands Partnership to explore the meaning and purpose of the terms in the condensed glossaries and to build the terms into a hierarchical list, or taxonomy. Workshop participants will work to find categories, groupings and relationships among terms.

This hierarchy is critical to improving search and retrieval of documents in the proposed application. A hierarchical structure enables inference, i.e., the process of determining a relationship between a lower and higher order term. For example, a cow could also be labeled "ruminant." A simple index might tag a paragraph/section with the term "cow" or "cows", and a

user would then only find paragraphs tagged with that word. A taxonomy allows for the design of a flexible retrieval process to find not just terms tagged with “cow”, but also those with “ruminant”, given the ruleset that specifies a cow as a specific type of ruminant. More complex processing and search and retrieval functions become possible with structure, without requiring indexing of every possible term. This will allow us to index more quickly and pass the labor of indexing related terms to the system. This is why the GACS tool was developed and why we seek to align with them.

Where it is not possible to align with GACS, we will consult with GODAN personnel on how best to express the remaining terms for mutual benefit. We will improve and formalize the taxonomy, following the guidelines provided in NISO standard Z39.19-2005 (National Information Standards Organization 2010). Finally, we will structure the taxonomy as an ontology, using the VocBench tool (Stellato et al. 2017), also used in the production of AGROVOC and CABI vocabularies.

Selection of Core Grazingland Content

Members of the Rangelands Partnership will work with their state NRCS staff, Extension specialists, ranchers and other grazingland professionals to identify state-specific resources to be included in this project and provide a list of documents to be made available through GlobalRangelands.org. UI/UA team members will coordinate the identification of selected federal documents, technical handbooks, and associated documents that also apply. All content not already in GlobalRangelands.org will be added.

If content is available in print but not yet digitized, the team at the University of Idaho will digitize content according to FADI Guidelines, with appropriate Dublin Core metadata (Federal Agencies Digitization Initiative, 2018). Print and digitized content will be returned to the partner university for deposit in their institutional repository. The digitized content will be sent to the UA Rangelands Partnership technical team for inclusion in the Global Rangelands collections.

The result will be a database of digital content identified specifically for use in the Grazingland Information System and mobile application. During the Rangelands Partnership annual meeting in the first year, we will review the database to identify missing or difficult to obtain content. After the Rangelands Partnership meeting, the teams at UA and UA will follow up to locate and, if necessary, digitize the missing content.

Content Indexing

The groundwork for indexing content will begin in the first year of the project with the development of a custom-built interface that allows indexers to select blocks of text, or full sections, then tag it with vocabularies/taxonomies (provided by GACS web-service endpoint), grazing practice, and geographic location.

Starting in year 2, UI and UA teams will begin indexing selected content based on the available ontology terms. Team members at both UI and UA will divide documents and begin working through them, applying lowest-order terms from the taxonomy that are appropriate to the

paragraph or multi-paragraph section in the document. If only higher-order terms are applicable, that will be considered appropriate for the content. Entries will be stored in a custom section or special collection of the Global Rangelands database that provides indexing to the mobile grazing application.

Application Development Methods:

By the end of our first year of work, the UI and UA teams will begin the user interface and user experience (UI/UX) design process, iteratively developing mockups and wireframes for the mobile grazing application, based on feedback from stakeholders and end-users. In the remainder of year 1 and year 2, the UA team will develop a stand-alone, HTML5/Javascript mobile-friendly web application that will have back-end access to the Global Rangelands database, as well as special query functionality that will search for vocabularies and/or ontologies, as well as geographic locations, attributed at the sub-document level (e.g. sentences, paragraphs, sections). End users will be able to quickly scan snippets of text within documents, based on keyword, grazing practice types, and geographic location. The application will utilize HTML5 web-workers, local-cache, and other offline technologies to enhance the functionality of the application while offline. In the second year, we will deploy the beta version of the application to selected users to identify software bugs, UI/UX issues, and obtain general feedback for improvements. Then, we will launch to a broader audience by the beginning of the third year.

Application Testing and Deployment

In year 3, we will begin a phase of application testing and refinement, first with participants in the Rangelands Partnership, and then with a broader group of users from each state. Testing will include not only evaluation of the application itself, but also the operation of the thesaurus and content indexing by the relevance and completeness of search results. Following initial testing and potential refinement, we will host a final workshop of the Rangelands Partnership participants to develop training materials and coordinate training activities in each member's state. Finally, the participating Rangelands Partnership members will host a demonstration and training for the application and available content in their state. These trainings will target interested producers, NRCS and land management agency staff, and Extension specialists.

Geographic Location and Size of Project or Project Area

The Rangelands Partnership consists of range specialists, extension professionals, librarians, and IT experts from universities throughout the West and Great Plains regions. The proposed work covers the geographic range represented by the participants in the Rangelands Partnership. The grazingland ontology will be focused on the needs of stakeholders in the U.S., but applicable worldwide.

Current Members
of the Rangeland
Partnership



EQIP Eligible Producer Participation

The Grazingland Information System is being proposed to put high quality and relevant information in the hands of those who make management decisions on rangelands. Our project efforts are in concert with the goals of the NRCS Environmental Quality Incentives Program (EQIP) which aims to help agricultural producers confront production challenges while conserving natural resources. Extension specialists in the Rangelands Partnership will involve producers and land managers in identifying core resources to include in the system and in development and evaluation of the Grazingland Information System online interface and mobile application. Most of the participants of outreach activities related to this project will be aimed at informing EQIP eligible producers and land management professionals, including NRCS staff and Technical Service Providers.

Extension specialists in the Rangelands Partnership enjoy close relationships with producers in their states and will convey stakeholder input to the project team for creation of the Grazingland Information System. Extension activities will engage producers in developing the grazingland thesaurus, identifying key resources, and testing the mobile app. Rangeland Extension Specialists from the UI, UA, Washington State University, Colorado State University, and the University of Hawaii at Manoa, have been central to the development of this proposal. This team of extension specialists have specifically pledged to include evaluation of the grazingland online information portal and mobile app in their extension activities. We estimate that these extension events will involve a minimum of 70 EQIP eligible producers.

Project Action Plan and Timeline

Action/Milestone	Year 1				Year 2				Year 3			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
<i>Project coordination meetings among Rangelands Partnership</i>												
Grazingland Thesaurus Development												
<i>Develop relevant search vocabulary for grazingland mgmt.</i>												
<i>Initial workshop to define terms and taxonomy</i>												
<i>Coordination with NAL, AGROVOC, GACS</i>												
Selection of Grazingland Content												
<i>Partnership members work with NRCS and others to identify state-specific resources to include</i>												
<i>Coordinate and upload content into GlobalRangelands.org</i>												
Content Indexing												
<i>Develop interface to select and tag segments within documents</i>												
<i>Index selected content with grazingland thesaurus</i>												
Online Interface and Application Development												
<i>Design online interface and mobile application</i>												
<i>Develop and construct online and mobile application</i>												
<i>Beta testing and refinement</i>												
Testing and Deployment												
<i>Test information tools with Rangelands Partnership members</i>												
<i>Develop training materials and coordinate training activities</i>												
<i>Final deployment and trainings in member states</i>												

Project Management:

The project will be led by the UI College of Natural Resources and University Libraries in collaboration with the UA's College of Agriculture and Life Sciences and University Libraries. The project managers, listed below, will direct the development of the Grazingland Information System online portal and mobile app. They will convene and attend five working meetings of the Rangelands Partnership; one meeting per year will be in conjunction with the Society for Range Management's annual meeting, the other two meetings will be held in year one and year three of the grant.

Project Directors

Dr. Jason Karl is UI Associate Professor and holds the Harold Heady Endowed Chair of Rangeland Ecology. He has extensive experience developing information access systems and grazingland conservation practices through previous work with the USDA-ARS Jornada Experimental Range. Dr. Karl created the LandscapeToolbox.org family of websites that deliver manuals and other content on rangeland monitoring. Dr. Karl also developed JournalMap.org, a map-based search engine for agriculture and ecology literature.

- Dr. Karl will oversee the project by working closely with Co-Directors at UI and UA to accomplish project goals and objectives. He will also participate in developing the ontology and identifying relevant grazingland management content to include in the Grazingland Information System. He will also serve as faculty advisor to the UI graduate student on the proposed project.

Jeremy Kenyon is a UI Research Librarian and Associate Professor. He has extensive experience in natural resources and environmental science information as well as digital information management and data stewardship and curation. He serves as the current Chair of the Rangelands Partnership and holds two Master's degrees, including one in Library and Information Science.

- Mr. Kenyon will serve as Co-Project Director and work closely with Dr. Karl in project oversight. This will include monitoring progress toward meeting project objectives, reporting progress, and ensuring timely communication among all project team members. Kenyon will also oversee UI's contributions to ontology development, content selection, and content tagging. He will also facilitate communication about the project within the Rangelands Partnership.

Dr. George Ruyle is a UA Professor and a Range Extension Specialist. He also holds the Marley Endowed Chair for Sustainable Rangelands Stewardship and is Co-Director for the Natural Resource Users Law and Policy Center. Dr. Ruyle was one of the originators of the Rangelands Partnership and has more than 30 years of experience in all aspects of rangeland management, with emphasis on inventory and monitoring programs.

- Dr. Ruyle will serve as UA Co-Project Director and work closely with Co-Project Director Pfander in project oversight. Dr. Ruyle will also provide input into the development of the grazingland thesaurus and selecting core resources. He will also

facilitate testing of the Grazingland Information System and mobile tool with stakeholder groups in Arizona.

Jeanne Pfander is a UA Associate Librarian providing support to the UA College of Agriculture and Life Sciences. She has many years of active participation in the Rangelands Partnership and the United States Agricultural Information Network. She holds a master's degree in library science and graduate certificate in digital information management.

- Ms. Pfander will serve as UA Co-Project Director and work closely with Dr. Ruyle in project oversight. This will include monitoring progress toward meeting project objectives, reporting progress, and in ensuring timely communication among project team members. In addition, she will help develop the grazingland ontology and identify digital copies of relevant Arizona grazingland handbooks and other publications for inclusion in the information system. She will facilitate communication among the Rangelands Partnership and other library professionals.

Grazingland Content Specialists

Several members of the project team have extensive experience in grazingland management and understand information needed from management of pastures and rangelands. These team members will make necessary contributions to the definition of terms, and relationships among terms in the thesaurus. Grazingland content experts will also be important to identify and review key grazing resources for inclusion in the information system and app.

- **Dr. Karen Launchbaugh** is Professor of Rangeland Ecology at the UI with an extensive background in grazing management. Dr. Launchbaugh has worked with the Rangelands Partnership for more than 15 years and has led several key projects to make grazing resources available to land managers including the [Range Science Information System](#).
- **Dr. April Hulet** is a UI Assistant Professor of Rangeland Management and Idaho Rangeland Extension Specialist. Dr. Hulet has extensive research and outreach experience focused on principles of rangeland management and restoration. As an extension specialist she works closely with ranchers and land managers throughout Idaho.
- **Dr. Elise Gornish** is a UA Range Extension Specialist in the School of Natural Resources and the Environment. Her current research includes addressing restoration and weed management strategies that mitigate effects of climate change and designing financially and logistically feasible restoration strategies.
- **Mr. Eric Winford** is the Associate Director of the UI Rangeland Center. He works extensively with landowners and managers in Idaho and Washington. He has an M.S. degree in geography and natural resources and extensive experience bringing teams together to accomplish goals and projects

- **State Rangeland Extension Specialists** in the Rangelands Partnership are essential to the project because of their understanding of grazingland management and connection to stakeholders. These extension professionals will be involved in identifying thesaurus terms and key grazingland resources (e.g., technical guides, conservation practice handbooks, experiment station bulletins) in their state and/or area of practice. Extension specialists attend yearly meetings of the Rangelands Partnership where activities for the development of the Grazingland Information System will be conducted. Rangeland Extension Specialists will also discuss the Grazingland Information System and mobile app in meetings with stakeholders in their states. In these meetings, they will gather stakeholder input on thesaurus terms, relevance of key resources, and usability of the online information system and mobile app.

Library and Information Specialists

A team of librarians are included in this project to ensure that an effective thesaurus is developed, assist in finding core grazingland information, direct digitizing of and archiving of these resources and ensure the information in these resources is appropriately tagged and categorized. The IT members of this team will be key to create effective formats for access online and develop the application for mobile devices. Members of this team will also ensure geospatial parameterization for the search and retrieval process.

- **Dr. Barbara Hutchinson** is a Program Manager in the UA School of Natural Resources and the Environment and directs the Arizona technical team in the Rangelands Partnership. She was key to the creation of the Rangelands Partnership and is involved in guiding the organization and facilitating communication among members. Dr. Hutchinson has more than 25 years of experience in developing web tools for the dissemination of scientific information related to rangeland management.
- **Mr. Matt Rahr** is the Director of the Communications and Cyber Technologies Unit in the UA College of Agriculture and Life Sciences. Mr. Rahr oversees IT operations for the College's 10 academic schools and units, Cooperative Extension Service, and manages a team of web developers, graphic designers, videographers, classroom technologists, and IT infrastructure engineers. Mr. Rahr provides a College-wide strategic vision for IT and cyber infrastructure adoption in academic, research, and extension areas.
- **Mr. Yan Han** is a Full Librarian in the Office of Digital Innovation and Stewardship at the University of Arizona Libraries. Mr. Han has considerable expertise in digital content management having collaborated with the Rangelands Partnership in the development of the Society for Range Management journal repository collection.
- **Mr. Erik Radio** is an Assistant Librarian in the Office of Digital Innovation and Stewardship at the UA Libraries. Mr. Radio holds a master's in Library and Information Science with a focus on metadata, ontologies, semiotics, linked data, and information architecture.

- **Ms. Beth Hendrix** is a UI Reference and Instruction Librarian and Assistant Professor with support to the UI College of Agriculture and Life Sciences. She works extensively in managing collections of agricultural materials and conducting outreach to state extension personnel.
- **Mr. Bruce Godfrey** is the UI Geographic Information System Librarian and Assistant Professor. He manages the UI geospatial data repository, and has extensive experience with digital information management, geographic information, and data curation.
- **Mr. Evan Williamson** is the UI Digital Infrastructure Librarian and an Assistant Professor. His work involves digital collections and archives management, digital preservation, manipulation of metadata across repositories and use of thesauri, ontologies, and classification tools.
- **Web Developer/Designers** in the UA Communications and Cyber Technologies Team, will build the technical infrastructure for the proposed National Grazingland Information System. Drawing on the knowledge gained in the development of the GlobalRangelands.org suite of websites and underlying database consisting of multiple collections, the Web Developer will design a new sitemap and interface, implement the design into a mobile-responsive website, expand the underlying database, and build an admin interface for key personnel to populate with tagged content and metadata records
- **Librarians in the Rangelands Partnership** will contribute to the ontology/thesaurus development. They will help to identify core grazingland content relevant to their states and tag these resources with terms in the grazingland thesaurus. They will also attend annual meetings and conference calls for the development and testing of the thesaurus.

Stakeholder Participants

Developing an effective Grazingland Information System to improve land management decisions will require significant input from those who regularly make management decisions on pasture and rangelands. Therefore, we have created an approach that will include stakeholder input throughout the development of our proposed Grazingland Information System.

- The **Altar Valley Conservation Alliance (AVCA)** in Arizona will participate as a stakeholder group throughout the project to ensure the selected grazingland resources and system developed to access them are relevant to the needs of ranchers and other land managers. Key AVCA staff members will participate in regular meetings and provide input on an ongoing basis. They will test various iterations of the system as it is developed, involving their Science Advisory Committee and Community members in system reviews. Through their communications outlets, they will inform others about the project and the availability of the grazingland information system. AVCA will contribute 96 hours of in-kind support per year for three years.
- The **Noble Research Institute** in Ardmore, Oklahoma is planning several workshops and trainings for producers, NRCS employees, technical service providers, and extension educators in the next few years. In these workshops the Noble Institute will highlight the

Grazingland Information System and app for mobile devices, if this proposal is funded. Through these workshops, the information system online interface and mobile application will be assessed and potential value for grazingland management will be discussed.

Project Deliverables/Products:

Benefits are both short-term (capture and delivery of relevant materials online and with a mobile app) and long-term (an effective thesaurus for effectively tagging and presenting grazingland management content). Project deliverables include: 1) a unique, re-usable grazingland thesaurus/ontology, 2) a tagged document collection uploaded into and available from GlobalRangelands.org, and 3) a mobile-friendly interface for accessing specific, detailed, and credible range and grazing management information.

Additionally, we will present the grazingland thesaurus work and mobile application at the annual meetings of the Society for Range Management and National Grazing Lands Coalition in years 2 and 3. We will notify the NRCS technical contact prior to these presentations and develop a final fact sheet for NRCS use in public settings. Working through the Extension Specialists in the Rangelands Partnership, we will host a series of closing workshops at the conclusion of the project to introduce and provide training on the mobile application to NRCS personnel, technical service providers, producers, and other grazingland professionals. We will notify the NRCS technical contact prior to these workshops.

Benefits or Results Expected and Transferability:

The primary goal of this project is to increase access to actionable information about grazinglands to improve management decisions. We will identify important technical references (from NRCS and other sources), develop a searchable information system, and make information available through an internet portal and an application for mobile devices. The tools we develop will save time for land managers and producers by putting information at their fingertips in the office and in the field.

The Rangelands Partnership includes extension professionals who work with land managers and producers throughout the western U.S. Workshops and outreach activities of extension educators will ensure that our tools are customized to the “on the ground” needs of producers, managers, and agricultural advisors. In the final year of this project, extension specialists will host demonstration and training sessions in their states introducing the online portal and mobile app to producers, NRCS and land management agency staff, and technical service providers.

A final expected benefit of information tools we develop is that they will be maintained and improved well beyond the life of this grant. The Rangelands Partnership is a stable organization that has functioned successfully for more than 15 years. In this time, we have migrated our information to newer and more effective platforms for web content management. These upgrades required extensive revision of our sites to create the current Global Rangelands portal making information more easily updated and accessible for mobile devices. Our organization of rangeland extension professionals, librarians, and IT specialists has navigated significant changes

in web technology and we expect to continue to adapt to future changes to provide information and tools for sustainable land management.

Project Evaluation:

We will quantify the value of our thesaurus/ontology for relevant content by tracking the number of terms unique to the Grazingland Information System compared to AGROVOC. We will also track the number of technical documents selected for use in our information system.

We will evaluate outputs of our work through interactions with stakeholders throughout the project. The thesaurus will be developed and tested by extension professionals who work extensively with grazingland managers. These extension professionals in the Rangelands Partnership will also conduct surveys and workshops with grazingland stakeholders to evaluate prototypes of our internet portal and mobile device application. We will also ask producers in our field workshops if the technical documents we are tagging and making available in GlobalRangelands.org are relevant and useful. We will inquire if the format and information in our information system is easily accessed, specific, detailed, and credible range and grazing management information.

We will track the number of people involved in workshops to develop and evaluate usability of our information portal and mobile app. We will also request information on the background and experience of participants to estimate the number of EQIP eligible producers involved in our workshops. We will track several internet metrics including visits to our internet information portal, the source and characteristics of these visits, and number of downloads of the application. From this information we will track early adoption of our outputs and assess how well we are referred to by other sites.

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Assessment of environmental impacts:

The goal of this project is to develop an information system that supports conservation planning and management activities in U.S. grazinglands. This is entirely a digital project, and will have no direct or indirect physical, chemical, or biological impacts on the environment.