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## Preview of Award 1010516 - Annual Project Report

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### Cover

Federal Agency and Organization Element to Which Report is Submitted:	4900
Federal Grant or Other Identifying Number Assigned by Agency:	1010516
Project Title:	CNH: Acequia Water Systems Linking Culture and Nature: Integrated Analysis of Community Resilience to Climate and Land-Use Changes
PD/PI Name:	Alexander G Fernald, Principal Investigator Jose A Rivera, Co-Principal Investigator Vincent Tidwell, Co-Principal Investigator John L Wilson, Co-Principal Investigator
Recipient Organization:	New Mexico State University
Project/Grant Period:	09/15/2010 - 09/30/2016
Reporting Period:	09/01/2015 - 08/31/2016
Submitting Official (if other than PD/PI):	Alexander G Fernald Principal Investigator
Submission Date:	07/15/2016
Signature of Submitting Official (signature shall be submitted in accordance with agency specific instructions)	Alexander G Fernald

### Accomplishments

#### \* What are the major goals of the project?

The goals of this project are to understand acequia-moderated linkages between culture and nature and to quantify community survival tipping points. The objective is to quantify the role of acequias in hydrologic buffering, community

resilience, and ecosystem health. The **central hypothesis** is that traditional acequias create and sustain intrinsic linkages between human and natural systems that increase community and ecosystem resilience to climatic and socioeconomic stresses. Two sets of linkages are explored: 1) socioeconomic and cultural acequia linkages within and between communities and uplands; and 2) hydrologic acequia linkages between surface water and groundwater in river valleys and contributing watersheds. The working null hypothesis is that stresses from climate change and population growth will have no appreciable effect on the function, performance resilience, and longevity of agro-enviro-social systems of acequia communities.

The following list highlights major anticipated outcomes of the project. The cited years represent the expected initiation and completion dates. The ambitious proposed outcomes are realistically obtainable due to ongoing successful team cooperation and infrastructure foundations established by NM EPSCoR. The NM EPSCoR project that ended in 2013 treated the topic of NM sources of mountain runoff. The physical infrastructure developed under NM EPSCoR allows this proposed project to address complex questions at multiple spatial scales without a large investment in equipment and materials. This leveraging of a complementary project enables budget allocation for participants with all expertise needed to complete the major outcomes listed below and described in more detail in the proposal text. The NM EPSCoR project that began in 2013, titled *Energize New Mexico*, treats the topic of regional water budgets and continues to complement this study.

a) A system dynamics decision support system, the Rio Grande Water and Society Simulation Model (RGWSSIM), will allow simulations of changes in human and natural systems linked by acequia communities. RGWSSIM will operate on a computer and be accessible to community users. Scenarios will consider climate and economic changes as well as stakeholder-defined impacts such as climate and land use on river/riparian function, trade-offs among competing agricultural practices, and associated economic/environmental consequences of alternative resource management strategies. Years 1-6. **Ongoing**

b) A model of acequia community economic adaptability and resilience that will provide cutting-edge analysis of community economics and resource use. The project will yield entirely new analyses of sociocultural and economic relationships in acequia communities. It will characterize dynamics of changing natural resource use in a multi-cultural setting across multiple temporal and spatial scales. The analysis will address significant recent pressures on acequia communities and provide quantified estimates of community resilience tipping points. The model and analysis will inform the RGWSSIM with functions developed to describe equitable resource sharing and sustainable land use. Years 1-6. **Complete**

c) An integrated multi-model and multi-scale approach to studying hydrologic connections between managed agricultural valleys and associated unmanaged forested watersheds. Applied to this unique setting, the suite of models will provide state-of-the-art advances in two areas of hydrologic research: 1) multiple flow path and residence time analysis of surface-subsurface exchange over small to large spatial scales, and 2) ecohydrologic connectivity analysis of managed and unmanaged human and natural landscapes. Water budget and flow-path analyses will also be used to parameterize and inform the RGWSSIM. Years 1-6. **Complete**

d) Educational programs for K-12, undergraduates, graduate students, teachers, stakeholders, and the general public. K-12 student efforts will tap into NM EPSCoR programs. This project will support undergraduate and graduate college students, importantly at multiple minority-serving institutions. Extension service-directed programs and local community group programming will reach community members as will the New Mexico Acequia Association. The general public had access to a museum exhibit about multiple human and natural aspects of acequia communities. Currently, the ARTS Lab of UNM is documenting the exhibit as a permanent virtual exhibit for posting on a website accessible by the public, The Virtual New Mexico Project. The website will be delivered in 2016. Years 1-6. **Complete/Museum exhibit was completed in summer 2015/Museum exhibit website ongoing**

e) Integrated online atlas with maps of human and natural interactions in the upland to irrigated valley continuum and at multiple scales, including the local, valley, and regional scales. These maps will identify communities, water works, wildlife habitat, biodiversity, wildlife corridors, upland vegetation, grazing areas, hydrology source and sink areas. For policy development, the maps will also show resource scenarios with different impacts as mentioned above based on the system dynamics model outputs and the mapping spatial analysis. Years 3-6. **Ongoing**

f) Peer reviewed articles (at least 14 total with two per senior personnel) addressing the different topics investigated in this research effort and participation in local, national, and international meetings for project results dissemination. Years 2-6. **Ongoing**

Study the Rio Chama basin region in Rio Arriba County to test ideas about the coupling of natural and human systems dynamics. **Complete**

The major goal of this specific component of the CNH Acequia project is to understand the role that small-scale raising of livestock plays in conferring resilience to acequia communities of Northern New Mexico. We seek to assess the conditions and characteristics of small-scale livestock operations and identify livestock-related factors that could trigger future community tipping points. Years 1-6 **Complete**

**\* What was accomplished under these goals (you must provide information for at least one of the 4 categories below)?**

**Major Activities:** The modeling effort has continued to progress despite the loss of the full-time post-doc (who was hired in a full-time faculty position). Ben Turner has continued to work on the modeling effort in his faculty position over the past year, during which time the Alcalde model has undergone another round of testing that has been incorporated into the Sustainability manuscript (this will be ready this summer). Socio-economic tests involved parameter sensitivity analysis on cultural and community variables where data were lacking or nonexistent (i.e., in quantitative form).

**Specific Objectives:** With model sensitivity testing coming to a close and the manuscripts (one for Alcalde, one for Valdez; the Valdez paper is being written by another external collaborator with Dr. Tidwell) being completed, effort is moving toward the forecasting stage of the modeling process.

**Significant Results:** Results showed that the majority of acequia variability resided in absentee decisions, income effects on time spent in agriculture, land-use preferences, and community participation. Additional tests included changes in biophysical parameters (minimum streamflow delivery rate, acequia seepage, winter forage demand per month, feeding months required, and acres required per animal on upland allotments). Results show that influential causal pathways are similar to those shown in the socio-economic tests. The Alcalde model has also been replicated in the Valdez community. The Valdez model has undergone a number of sensitivity tests as well, and has been used in conjunction with an upland watershed runoff model to examine changes in the acequia system based on upland forest scenarios. Results are preliminary but have shown the acequia to be fairly resilient to shocks on the upland watershed characteristics.

**Key outcomes or Other achievements:** A project participant trip to Chile, South America laid a foundation for future activities including: applying for an innovation working group project grant, and a Partnerships for International Research and Education (PIRE) proposal if selected by NMSU as the one proposal to move forward from the institution. A workshop is also being contemplated. These all fall under the category of human natural connections within land irrigation communities.

We have produced seven land-cover data sets for each of the three valleys illustrating the major shifts in land-cover change over time between 1935 and 2014. This is important because land cover/land-use can be impacted by shifts in economics, population, and community structure.

**\* What opportunities for training and professional development has the project provided?**

The project has trained undergraduate, masters, and PhD students. It has provided professional development for field and community hydrologists.

Benjamin Turner is currently an Assistant Professor at Texas A&M, Kingsville and is in relatively limited need of mentoring. Nevertheless, mentoring opportunities were provided as part of the day-to-day conduct of the project when he was a post-doc on the project. Specific engagement included participation on joint efforts in system dynamics modeling, and preparation of manuscripts for publication, materials for presentations at national and international conferences, and responses to funding opportunities.

**\* How have the results been disseminated to communities of interest?**

Steve Guldán, representing the NMSU Agricultural Science Center at Alcalde, completed walking tours of the Alcalde Research Station in September 2015, October 2015, and June 2016. The tours were given to visitors from Ohio State University, students and staff from the Institute of American Indian Arts, and Texas. Also, an NMSU-Alcalde field day took place at the Alcalde Station to 50-150 participants. While giving tours, Steve described the project's goals and results.

"Acequia Hydrology", authored by Fernald, A., C. Ochoa, S. Guldán, and V. Tidwell was presented via a guest lecture in November 2015 to an undergraduate student class at the UNM Los Alamos campus.

Also, project participants have delivered results through various presentations at conferences within the United States and internationally including Alex Fernald, Brian Hurd, Andres Cibils, Jesus Gomez-Velez, Steve Guldán, John Wilson, Bob Sabie, and Carlos Ochoa.

**\* What do you plan to do during the next reporting period to accomplish the goals?**

The project will produce a book that includes chapters of various disciplines that will make research results available and understandable to a wide range of stakeholders in NM. Community irrigation leaders and water managers from other regions will also benefit from the book. The book will also include hydrology results and is anticipated to be published post project, sometime in 2017.

Also, the High Impact Paper will be written based on accomplishments to-date by project participants.

**Supporting Files**

Filename	Description	Uploaded By	Uploaded On
22692_Alcalde_FieldDay.pdf	2016 Alcalde Field Day "Save the Date" card	Alexander Fernald	06/29/2016
Carlos Ochoa _Chile talk 3-15-2016.pdf	In March 2016, Carlos Ochoa disseminated project results via PowerPoint presentation at the 18th Seminar on Water Resources and Environmental Management in Concepcion, Chile.	Alexander Fernald	06/30/2016
Cibils et al _Concepcion Talk_Latest.pdf	In March 2016, Andres Cibils disseminated project results via PowerPoint presentation at the 18th Seminar on Water Resources and Environmental Management in Concepcion, Chile.	Alexander Fernald	06/30/2016
Chile 2016.pdf	In March 2016, Steve Guldán disseminated	Alexander	06/30/2016

Filename	Description	Uploaded By	Uploaded On
	project results via PowerPoint presentation at the 18th Seminar on Water Resources and Environmental Management in Concepcion, Chile.	Fernald	

## Products

### Books

### Book Chapters

### Inventions

### Journals or Juried Conference Papers

Frisbee, M., E.S. Tysor, N.S. Stewart-Maddox, L.M. Tsinnajinnie, J.D. Gomez, J.L. Wilson, D.E. Granger, and B.D. Newman (2016). Is there a geomorphic expression of interbasin groundwater flow in watersheds? Interactions between interbasin groundwater flow, springs, streams, and geomorphology. *Geophysical Research Letters*. 43 (3), 1158-1165. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1002/2015GL067082

Gunda, T., B. Turner, and V. Tidwell (2016). Modeling climate change impacts on a traditional agricultural community in the Southwestern United States. *Water Resources Research*. . Status = SUBMITTED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Raheem, N., S. Archambault, E. Arellano, M. Gonzalez, D. Kopp, J. Rivera, S. Guldán, K. Boykin, C. Oldham, A. Valdez, S. Colt, E. Lamadrid, J. Wang, J. Prince, J. Goldstein, P. Arnold, S. and Martin, E. Dingwell (2015). A framework for assessing ecosystem services in acequia irrigation communities of the Upper Rio Grande Watershed. *WIRES Water*. 2 . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: DOI: 10. 1002/WAT2.1091

Tidwell, V., A. Fernald, J. Rivera, S. Rodriguez, S. Guldán, C. Ochoa, B. Hurd, K. Boykin, and A. Cibils (2016). Investigating acequia irrigation systems using system dynamics: model development, evaluation, and sensitivity analyses to parameter uncertainties. *Sustainability*. . Status = SUBMITTED; Acknowledgment of Federal Support = Yes

### Licenses

### Other Conference Presentations / Papers

Fernald, A., C. Ochoa, S. Guldán, and V. Tidwell (2016). *Acequia Hydrology: Surface Water-Groundwater Interactions in an Irrigated Valley in North-Central New Mexico*. Upper Rio Grande Watershed District Inter-agency Task Force. Los Luceros Ranch, Alcalde, NM. Status = OTHER; Acknowledgement of Federal Support = Yes

Tsinnajinnie, Lani., M.D. Frisbee, and J.L. Wilson (2015). *Are springs important in the post-fire revegetation of semiarid, snow-dominated, mountainous watersheds?*. AGU Fall Meeting. San Francisco, California. Status = OTHER; Acknowledgement of Federal Support = Yes

Hurd, B. (2016). *Climate Change Adaptation Challenges in Small Community Irrigation (Acequia) Systems*. 18th Seminar on Water Resources and Environmental Management. Concepcion, Chile. Status = OTHER; Acknowledgement of Federal Support = Yes

Fernald, A., C. Ochoa, and S. Guldán (2016). *Collaborative Hydrology Research: Main campus, Branch Research*

*Station, Community Members*. 18th Seminar on Water Resources and Environmental Management. Concepcion, Chile. Status = OTHER; Acknowledgement of Federal Support = Yes

Guldan, S., A. Fernald, and C. Ochoa (2014). *Documenting hydrological benefits of traditional acequia irrigation systems: collaborative research in New Mexico, USA*. Congresos de la Universitat Politecnica de Valencia, Irrigation, Society and Landscape. Tribute to Tom F. Glick. Valencia, Spain. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Sabie, R., A. Fernald, and M. Gay (2016). *Estimating land cover in acequia-irrigated valleys using both historical and satellite imagery*. 18th Seminar on Water Resources and Environmental Management. Concepcion, Chile. Status = OTHER; Acknowledgement of Federal Support = Yes

Sabie, R., A. Fernald, and M. Gay (2015). *Estimating land cover in acequia-irrigated valleys using historical aerial imagery*. American Water Resources Association (AWRA). Denver, Colorado. Status = OTHER; Acknowledgement of Federal Support = Yes

Sabie, R., A. Fernald, M. Gay, J. Cruz, B. Turner, A. Lopez-Moreno, and I. Hewitt (2015). *Land Use Assessment of Acequia Irrigated Valleys Using Multi-Date Aerial Imagery*. American Water Resources Association (AWRA). Denver, Colorado. Status = OTHER; Acknowledgement of Federal Support = Yes

Lopez, S.C., A.F. Cibils, U.R. Smedly, S.J. Guldan, A.G. Fernald, and C. Ochoa (2016). *Livestock-raising and acequia irrigation farming in agro-pastoral communities of northern New Mexico, USA*. 18th Seminar on Water Resources and Environmental Management. Concepcion, Chile. Status = OTHER; Acknowledgement of Federal Support = Yes

Wang, C., J.D. Gomez-Velez, and J.L. Wilson (2016). *The importance of capturing topographic variability for modeling flow and transport in mountainous terrains*. New Mexico Geological Society Annual Spring Meeting. Socorro, New Mexico. Status = OTHER; Acknowledgement of Federal Support = Yes

Ochoa, C., S. Guldan, and T. Deboodt (2016). *Upland-valley hydrologic connectivity through surface and groundwater paths*. 18th Seminar on Water Resources and Environmental Management. Concepcion, Chile. Status = OTHER; Acknowledgement of Federal Support = Yes

Wilson, J.L., M.D. Frisbee, J.D. Gomez-Velez, and F.M. Phillips (2015). *Why does the convolution integral method provide systematically biased estimates of watershed residence times?*. AGU Fall Meeting. San Francisco, California. Status = OTHER; Acknowledgement of Federal Support = Yes

## Other Products

### Databases.

*Pydio* is a secure file sharing source that allows invited project participants efficient access to all data and information related to the CNH project.

### Educational aids or Curricula.

Project scope and findings are used as a case study in two classes taught by Carlos Ochoa: 1) Watershed Management and 2) Riparian Ecology and Management. The case study acknowledges the National Science Foundation.

## Other Publications

Markwell, S., J. Rivera, M. Gonzales, and J. Garcia (2016). *The Rio Chama Basin: A Social-Ecological History Linking Culture and Nature*. Edited Volume that can be accessed at the University of New Mexico's (UNM) repository, Lobovault. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Valdez, R. (2016). *The Santa Fe National Forest Land Claims Archive: A Study of Homestead Files and Entryman Applicants 1906-1937*. Research Monograph that can be accessed at the University of New Mexico's repository,

Lobovault. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

**Patents**

**Technologies or Techniques**

**Thesis/Dissertations**

**Websites**

*Watershed - agricultural valley connections*

<http://ecohydrology.oregonstate.edu/project/watershed-%E2%80%93-agricultural-valley-connections>

The page illustrates the project scope and achievements.

**Supporting Files**

Filename	Description	Uploaded By	Uploaded On
raheem et al acequia ES 2014.pdf	A 2015 publication that documents the ecosystem services of the acequias located in the upper Rio Grande bioregion.	Alexander Fernald	06/29/2016
UNM 002A The Santa Fe National Forest Land Claims Archive 1906-1937 by Roberto H. Valdez.pdf	Monograph- The Santa Fe National Forest Land Claims Archive: A Study of Homestead Files and Entryman Applicants 1906-1937	Alexander Fernald	06/29/2016
The Rio Chama Basin_A Social-Ecological History.pdf	Monograph- The Rio Chama Basin: A Social-Ecological History Linking Culture and Nature	Alexander Fernald	06/30/2016
Hurd - Chile (Mar 2016).pdf	In March 2016, Brian Hurd disseminated project results via PowerPoint presentation at the 18th Seminar on Water Resources and Environmental Management in Concepcion, Chile.	Alexander Fernald	06/30/2016

**Participants/Organizations**

**What individuals have worked on the project?**

Name	Most Senior Project Role	Nearest Person Month Worked
Fernald, Alexander	PD/PI	2
Rivera, Jose	Co PD/PI	1
Tidwell, Vincent	Co PD/PI	1
Wilson, John	Co PD/PI	2

<b>Name</b>	<b>Most Senior Project Role</b>	<b>Nearest Person Month Worked</b>
Guldan, Steve	Co-Investigator	2
Arumi, Jose	Faculty	1
Boykin, Kenneth	Faculty	8
Cibils, Andres	Faculty	1
Gomez-Velez, Jesus	Faculty	1
Hurd, Brian	Faculty	2
Ochoa, Carlos	Faculty	1
Phillips, Fred	Faculty	1
Turner, Benjamin	Postdoctoral (scholar, fellow or other postdoctoral position)	2
Garcia, Paula	Other Professional	0
Rosenberg, Adrienne	Other Professional	1
Herrera, Fernando	Technician	2
Cruz, Jose Juan	Graduate Student (research assistant)	8
Gay, Marcus	Graduate Student (research assistant)	6
Lopez, Alejandro	Graduate Student (research assistant)	7
Sabie, Robert	Graduate Student (research assistant)	4
Tsinnajinnie, Lani	Graduate Student (research assistant)	1
Wang, Chao	Graduate Student (research assistant)	8
Ratliff, Jesslyn	Non-Student Research Assistant	2
Rodriguez, Sylvia	Consultant	0

**Full details of individuals who have worked on the project:**

**Alexander G Fernald**



**Email:** fernald@nmsu.edu

**Most Senior Project Role:** PD/PI

**Nearest Person Month Worked:** 2

**Contribution to the Project:** Alexander Fernald is the PI and oversees the CNH Acequia Project and team members. Fernald also contributes to publications.

**Funding Support:** NM EPSCoR

**International Collaboration:** Yes, Chile

**International Travel:** Yes, Chile - 0 years, 0 months, 7 days

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**Jose A Rivera**

**Email:** jrivera@unm.edu

**Most Senior Project Role:** Co PD/PI

**Nearest Person Month Worked:** 1

**Contribution to the Project:** Jose Rivera serves as Co-PI of this NSF grant to NMSU and as the PI of a subaward from NMSU to the University of New Mexico (UNM). Jose completed and submitted all CNH deliverables due from the subaward to UNM.

**Funding Support:** None

**International Collaboration:** No

**International Travel:** No

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**Vincent Tidwell**

**Email:** vctidwe@sandia.gov

**Most Senior Project Role:** Co PD/PI

**Nearest Person Month Worked:** 1

**Contribution to the Project:** Vince Tidwell guides the system dynamics modeling activities and also assists in general project planning.

**Funding Support:** NM EPSCoR

**International Collaboration:** No

**International Travel:** No

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**John L Wilson**

**Email:** jwilson@nmt.edu

**Most Senior Project Role:** Co PD/PI

**Nearest Person Month Worked:** 2

**Contribution to the Project:** John Wilson led mountain hydrologic studies.

**Funding Support:** none

**International Collaboration:** No

**International Travel:** Yes, Chile - 0 years, 0 months, 7 days

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**Steve Guldán****Email:** sguldán@nmsu.edu**Most Senior Project Role:** Co-Investigator**Nearest Person Month Worked:** 2

**Contribution to the Project:** Steve Guldán is assisting with data collection and publications. He also coordinates Alcalde staff assistance on some aspects of field work. Steve also presents project objectives and results as needed at meetings and when giving tours at the Alcalde Science Center.

**Funding Support:** none**International Collaboration:** No**International Travel:** Yes, Chile - 0 years, 0 months, 7 days**Jose Arumi****Email:** jarumi@udec.cl**Most Senior Project Role:** Faculty**Nearest Person Month Worked:** 1

**Contribution to the Project:** Dr. Jose Luis Arumi is currently working on the project 'Water availability in a stressed Andean watershed in Central Chile: Vulnerability under climate variability', funded by the Chilean Sciences Council (Fondecyt) that is a parallel Chilean research project. The creation of a new Water for Agriculture and Mining Resource Center (CRHIAM) is complete and provides the basis of future collaboration among the Acequia Team, the Chilean partners, and the Chilean canal users. Jose Luis Arumi hosted the CNH project participants.

**Funding Support:** Support from his home university**International Collaboration:** Yes, United States**International Travel:** No**Kenneth Boykin****Email:** kboykin@nmsu.edu**Most Senior Project Role:** Faculty**Nearest Person Month Worked:** 8

**Contribution to the Project:** Kenneth Boykin is a research professor participating in collaborative research.

**Funding Support:** none**International Collaboration:** No**International Travel:** No**Andres Cibils****Email:** aciblis@nmsu.edu**Most Senior Project Role:** Faculty**Nearest Person Month Worked:** 1

**Contribution to the Project:** Andres Cibils studies the role of livestock in acequia community resilience and is involved in manuscript development. Andres also contributed a presentation in Concepcion, Chile in March 2016.

**Funding Support:** USDA-NIFA-Hatch #1000985

**International Collaboration:** No  
**International Travel:** Yes, Chile - 0 years, 0 months, 7 days

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**Jesus Gomez-Velez**

**Email:** jdgomez7127@gmail.com  
**Most Senior Project Role:** Faculty  
**Nearest Person Month Worked:** 1

**Contribution to the Project:** Jesus Gomez-Velez led the Rio Hondo modeling effort.

**Funding Support:** New Mexico Tech Geophysical Research Center

**International Collaboration:** No  
**International Travel:** Yes, Chile - 0 years, 0 months, 7 days

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**Brian Hurd**

**Email:** bhurd@nmsu.edu  
**Most Senior Project Role:** Faculty  
**Nearest Person Month Worked:** 2

**Contribution to the Project:** Brian Hurd contributed to collaborative research and Brian is the lead investigator on Socio-Economic Assessment and Analysis.

**Funding Support:** none

**International Collaboration:** No  
**International Travel:** Yes, Chile - 0 years, 0 months, 7 days

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**Carlos Ochoa**

**Email:** carlos.ochoa@oregonstate.edu  
**Most Senior Project Role:** Faculty  
**Nearest Person Month Worked:** 1

**Contribution to the Project:** Carlos Ochoa has participated in several meetings to discuss project findings and publication of results. He contributes to project outreach. Aspects of this project were incorporated into a case study analysis for undergrad and graduate level classes in Watershed Management and Riparian Ecology Management that were taught in the 2015 fall term, (Sept-Dec) and 2016 winter term, (Jan-Mar), at OSU.

**Funding Support:** Oregon Agricultural Experiment Station

**International Collaboration:** No  
**International Travel:** Yes, Chile - 0 years, 0 months, 7 days

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**Fred M Phillips**

**Email:** phillips@nmt.edu  
**Most Senior Project Role:** Faculty  
**Nearest Person Month Worked:** 1

**Contribution to the Project:** Fred Phillips advised on watershed characterization, isotopes, and geochemistry

**Funding Support:** none

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**International Collaboration:** No  
**International Travel:** No

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**Benjamin Turner**

**Email:** benjamin.turner@tamuk.edu

**Most Senior Project Role:** Postdoctoral (scholar, fellow or other postdoctoral position)

**Nearest Person Month Worked:** 2

**Contribution to the Project:** Benjamin Turner is a collaborative researcher who is assisting with the integrated modeling effort.

**Funding Support:** none

**International Collaboration:** No  
**International Travel:** No

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**Paula Garcia**

**Email:** lamorena@lasacequias.org

**Most Senior Project Role:** Other Professional

**Nearest Person Month Worked:** 0

**Contribution to the Project:** Paula Garcia contributed to the project through the New Mexico Acequia Association.

**Funding Support:** NMAA

**International Collaboration:** No  
**International Travel:** No

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**Adrienne Rosenberg**

**Email:** arosen@nmsu.edu

**Most Senior Project Role:** Other Professional

**Nearest Person Month Worked:** 1

**Contribution to the Project:** Adrienne Rosenberg is editing the book that will make research results available and understandable to a wide range of stakeholders in NM as well as community irrigation leaders and water managers from other regions.

**Funding Support:** none

**International Collaboration:** No  
**International Travel:** No

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**Fernando Herrera**

**Email:** fah@nmsu.edu

**Most Senior Project Role:** Technician

**Nearest Person Month Worked:** 2

**Contribution to the Project:** Fernando Herrera tests, calibrates, deploys, and implements hardware designed to collect data at remote sites and provides routine maintenance as well as gathers and delivers raw data to

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researchers. Fernando has also worked on producing a website to disseminate project results as well as future related project results.

**Funding Support:** EPSCoR

**International Collaboration:** No

**International Travel:** No

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**Jose Juan Cruz**

**Email:** cruzjuan@nmsu.edu

**Most Senior Project Role:** Graduate Student (research assistant)

**Nearest Person Month Worked:** 8

**Contribution to the Project:** Jose Juan Cruz collaborates on research involving agricultural water distribution in acequia irrigated valleys in Northern New Mexico.

**Funding Support:** CONACYT (Consejo Nacional de Ciencia Y Tecnologia) INIFAP (Instituto Nacional de Investigaciones Forestales, Agricolas y Pecuarias)

**International Collaboration:** No

**International Travel:** No

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**Marcus Gay**

**Email:** marcusgay71@gmail.com

**Most Senior Project Role:** Graduate Student (research assistant)

**Nearest Person Month Worked:** 6

**Contribution to the Project:** Marcus Gay processed land cover data.

**Funding Support:** EPSCoR

**International Collaboration:** No

**International Travel:** No

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**Alejandro Lopez**

**Email:** arlopez@nmsu.edu

**Most Senior Project Role:** Graduate Student (research assistant)

**Nearest Person Month Worked:** 7

**Contribution to the Project:** Alejandro Lopez is Assisting Dr. Fernald and Dr. Guldán with data research in Northern New Mexico.

**Funding Support:** Some funding provided by the NMSU Alcalde Research Station-Alcalde, NM. Plant and Environmental Sciences

**International Collaboration:** No

**International Travel:** No

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**Robert P Sabie**

**Email:** rpsabie@nmsu.edu

**Most Senior Project Role:** Graduate Student (research assistant)

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**Nearest Person Month Worked:** 4

**Contribution to the Project:** Robert Sabie is involved with collaborative research and is processing land cover data.

**Funding Support:** none

**International Collaboration:** No

**International Travel:** Yes, Chile - 0 years, 0 months, 7 days

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**Lani Tsinnajinnie**

**Email:** lani.tsinnajinnie@gmail.com

**Most Senior Project Role:** Graduate Student (research assistant)

**Nearest Person Month Worked:** 1

**Contribution to the Project:** Lani Tsinnajinnie assisted with field work in El Rito.

**Funding Support:** EPA Star Fellowship; AIGC Stem Loan for Service Fellowship

**International Collaboration:** No

**International Travel:** No

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**Chao Wang**

**Email:** cwang00@nmt.edu

**Most Senior Project Role:** Graduate Student (research assistant)

**Nearest Person Month Worked:** 8

**Contribution to the Project:** Chao Wang participated in Rio Hondo modeling.

**Funding Support:** none

**International Collaboration:** No

**International Travel:** No

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**Jesslyn Ratliff**

**Email:** jesslynr@nmsu.edu

**Most Senior Project Role:** Non-Student Research Assistant

**Nearest Person Month Worked:** 2

**Contribution to the Project:** Jesslyn Ratliff is the Program Coordinator and provides project support for all of the CNH Acequia Team Members.

**Funding Support:** none

**International Collaboration:** No

**International Travel:** Yes, Chile - 0 years, 0 months, 6 days

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**Sylvia Rodriguez**

**Email:** sylrodri@unm.edu

**Most Senior Project Role:** Consultant

**Nearest Person Month Worked:** 0

**Contribution to the Project:** Sylvia Rodriguez is the project consultant from the University of New Mexico (UNM). Sylvia has contributed to co-authored papers and an edited volume in progress.

**Funding Support:** none

**International Collaboration:** No

**International Travel:** No

**What other organizations have been involved as partners?**

Name	Type of Partner Organization	Location
Acequias of El Rito	Other Nonprofits	El Rito area of Northern New Mexico
Acequias of the Rio Hondo	Other Nonprofits	Rio Hondo area of Northern New Mexico
NMSU Alcalde Science Center	Academic Institution	Alcalde, NM
Natural Resources Conservation Service	Other Organizations (foreign or domestic)	United States
New Mexico Acequia Association	Other Nonprofits	Santa Fe, NM
New Mexico EPSCoR	Other Nonprofits	Albuquerque, NM
New Mexico Institute of Mining and Technology	Academic Institution	Socorro, NM
Northern New Mexico Stockman's Association	Other Nonprofits	Taos, NM
Purdue University	Academic Institution	Lafayette, Indiana
Rio Hondo Valley Acequia Association	Other Nonprofits	Taos, NM
Sandia National Laboratories	Other Organizations (foreign or domestic)	Albuquerque, NM
Taos Valley Acequia Association	Other Nonprofits	Taos, NM
Alcalde Acequia Association	Other Nonprofits	Alcalde, NM
UNM Center for Regional Studies	Academic Institution	Albuquerque, NM
UNM Community & Regional Planning Program	Academic Institution	Albuquerque, NM

Name	Type of Partner Organization	Location
UNM Resource Center for Raza Planning	Academic Institution	Albuquerque, NM
US Geological Survey	Other Organizations (foreign or domestic)	United States
USDA Forest Service; Carson National Forest	Other Organizations (foreign or domestic)	Carson, NM
USDI BLM Taos Field Office	Other Organizations (foreign or domestic)	Taos, NM
Univerisity of California, Davis	Academic Institution	Davis, CA
Universidad de Concepcion	Academic Institution	Chile, South America
University of New Mexico	Academic Institution	Albuquerque, NM
Vanderbilt University	Academic Institution	Nashville, TN
County Assessor's Office	State or Local Government	Rio Arriba County
Water for Agriculture and Mining Resource Center (CRHIAM)	Other Organizations (foreign or domestic)	Concepcion, Chile
El Rito Acequia Association	Other Nonprofits	El Rito, NM
El Rito Regional Water and Wastewater Association	Other Nonprofits	El Rito, NM
Environmental Protection Agency	Other Organizations (foreign or domestic)	United States
La Nueve Acequias en el Rio Grande	Other Nonprofits	Northern New Mexico
Long Term Ecological Research Network	Other Organizations (foreign or domestic)	North America
Los Alamos National Laboratory	Other Organizations (foreign or domestic)	Los Alamos, NM

#### Full details of organizations that have been involved as partners:

##### Acequias of El Rito

**Organization Type:** Other Nonprofits

**Organization Location:** El Rito area of Northern New Mexico



**Partner's Contribution to the Project:**

Facilities  
Collaborative Research

**More Detail on Partner and Contribution:** A. de la Otra Vanda, A. Madre, A. Alire. A. del Monte, and A. del Jaral

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**Acequias of the Rio Hondo**

**Organization Type:** Other Nonprofits  
**Organization Location:** Rio Hondo area of Northern New Mexico

**Partner's Contribution to the Project:**

Facilities  
Collaborative Research

**More Detail on Partner and Contribution:** La Cuchilla ditch, A. de Los Prando, A. de San Antonio, Canoncitos ditch north, Canoncitos ditch south, A. de Atalaya, A. Madre del Llano, A. de La Plaza

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**Alcalde Acequia Association**

**Organization Type:** Other Nonprofits  
**Organization Location:** Alcalde, NM

**Partner's Contribution to the Project:**

Collaborative Research

**More Detail on Partner and Contribution:**

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**County Assessor's Office**

**Organization Type:** State or Local Government  
**Organization Location:** Rio Arriba County

**Partner's Contribution to the Project:**

In-Kind Support

**More Detail on Partner and Contribution:** Levi Valdez provided land parcel data to Graduate Student for use in the study of Rio Arriba County land- use change 1935-2012

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**El Rito Acequia Association**

**Organization Type:** Other Nonprofits  
**Organization Location:** El Rito, NM

**Partner's Contribution to the Project:**

Collaborative Research

**More Detail on Partner and Contribution:**

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### **El Rito Regional Water and Wastewater Association**

**Organization Type:** Other Nonprofits

**Organization Location:** El Rito, NM

**Partner's Contribution to the Project:**

Collaborative Research

**More Detail on Partner and Contribution:** Juan Garcia provided interview to Graduate Student regarding El Rito farm and ranch economy.

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### **Environmental Protection Agency**

**Organization Type:** Other Organizations (foreign or domestic)

**Organization Location:** United States

**Partner's Contribution to the Project:**

Collaborative Research

**More Detail on Partner and Contribution:** William Kepner and Anne Neale helped to develop biodiversity metrics.

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### **La Nueve Acequias en el Rio Grande**

**Organization Type:** Other Nonprofits

**Organization Location:** Northern New Mexico

**Partner's Contribution to the Project:**

Facilities

Collaborative Research

**More Detail on Partner and Contribution:** A. de Alcalde, A. de la Canova, A. Ancon, A. San Rafael del Guique, A. Madre del Bosque, A. de Los Chicos, A. Garcia, A. del Medio, A. Rinconada Isla

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### **Long Term Ecological Research Network**

**Organization Type:** Other Organizations (foreign or domestic)

**Organization Location:** North America

**Partner's Contribution to the Project:**

Collaborative Research

**More Detail on Partner and Contribution:**

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### **Los Alamos National Laboratory**

**Organization Type:** Other Organizations (foreign or domestic)

**Organization Location:** Los Alamos, NM

**Partner's Contribution to the Project:**

Collaborative Research

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**More Detail on Partner and Contribution:** Brent Newman assisted in El Rito studies.

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#### **NMSU Alcalde Science Center**

**Organization Type:** Academic Institution

**Organization Location:** Alcalde, NM

**Partner's Contribution to the Project:**

In-Kind Support

Facilities

Collaborative Research

**More Detail on Partner and Contribution:** Steve Guldán, a Co-Investigator, assists with data collection and publications. Steve also hosts tours of the NMSU Alcalde Science Center to deliver project objectives and results.

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#### **Natural Resources Conservation Service**

**Organization Type:** Other Organizations (foreign or domestic)

**Organization Location:** United States

**Partner's Contribution to the Project:**

Collaborative Research

**More Detail on Partner and Contribution:** Rewa Charles serves as an end user for biodiversity metrics.

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#### **New Mexico Acequia Association**

**Organization Type:** Other Nonprofits

**Organization Location:** Santa Fe, NM

**Partner's Contribution to the Project:**

Collaborative Research

**More Detail on Partner and Contribution:**

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#### **New Mexico EPSCoR**

**Organization Type:** Other Nonprofits

**Organization Location:** Albuquerque, NM

**Partner's Contribution to the Project:**

Collaborative Research

**More Detail on Partner and Contribution:** The physical infrastructure developed under NM EPSCoR allows this proposed project to address complex questions at multiple spatial scales without a large investment in equipment and materials. This leveraging of a complementary project enables budget allocation for participants with all expertise needed to complete the major outcomes listed below and described in more detail in the proposal text. The NM EPSCoR project that began in 2013, titled Energize New Mexico, treats the topic of regional water budgets and continues to complement this study.

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**New Mexico Institute of Mining and Technology****Organization Type:** Academic Institution**Organization Location:** Socorro, NM**Partner's Contribution to the Project:**

Collaborative Research

**More Detail on Partner and Contribution:**

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**Northern New Mexico Stockman's Association****Organization Type:** Other Nonprofits**Organization Location:** Taos, NM**Partner's Contribution to the Project:**

Facilities

**More Detail on Partner and Contribution:**

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**Purdue University****Organization Type:** Academic Institution**Organization Location:** Lafayette, Indiana**Partner's Contribution to the Project:**

Collaborative Research

**More Detail on Partner and Contribution:** Marty Frisbee worked closely with the team on field work, modeling and interpretation and wrote papers. Marty is a former project post-doc. Noah Stewart-Maddox is a former project undergraduate who assisted in El Rito studies.

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**Rio Hondo Valley Acequia Association****Organization Type:** Other Nonprofits**Organization Location:** Taos, NM**Partner's Contribution to the Project:**

Collaborative Research

**More Detail on Partner and Contribution:**

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**Sandia National Laboratories****Organization Type:** Other Organizations (foreign or domestic)**Organization Location:** Albuquerque, NM**Partner's Contribution to the Project:**

Collaborative Research

**More Detail on Partner and Contribution:**

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**Taos Valley Acequia Association****Organization Type:** Other Nonprofits**Organization Location:** Taos, NM**Partner's Contribution to the Project:**

Collaborative Research

**More Detail on Partner and Contribution:**

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**UNM Center for Regional Studies****Organization Type:** Academic Institution**Organization Location:** Albuquerque, NM**Partner's Contribution to the Project:**

Collaborative Research

**More Detail on Partner and Contribution:**

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**UNM Community & Regional Planning Program****Organization Type:** Academic Institution**Organization Location:** Albuquerque, NM**Partner's Contribution to the Project:**

Collaborative Research

**More Detail on Partner and Contribution:**

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**UNM Resource Center for Raza Planning****Organization Type:** Academic Institution**Organization Location:** Albuquerque, NM**Partner's Contribution to the Project:**

Collaborative Research

**More Detail on Partner and Contribution:**

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**US Geological Survey****Organization Type:** Other Organizations (foreign or domestic)**Organization Location:** United States**Partner's Contribution to the Project:**

Collaborative Research

**More Detail on Partner and Contribution:**

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**USDA Forest Service; Carson National Forest**

**Organization Type:** Other Organizations (foreign or domestic)

**Organization Location:** Carson, NM

**Partner's Contribution to the Project:**

Facilities

Collaborative Research

**More Detail on Partner and Contribution:** Allowed access to grazing allotment livestock records.

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**USDI BLM Taos Field Office**

**Organization Type:** Other Organizations (foreign or domestic)

**Organization Location:** Taos, NM

**Partner's Contribution to the Project:**

Facilities

**More Detail on Partner and Contribution:** Allowed access to grazing allotment livestock records.

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**Univerisity of California, Davis**

**Organization Type:** Academic Institution

**Organization Location:** Davis, CA

**Partner's Contribution to the Project:**

Collaborative Research

**More Detail on Partner and Contribution:** Douglas Tolley is a research assistant who conducted field measurements, provided results synthesis, and contributed to prepared papers.

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**Universidad de Concepcion**

**Organization Type:** Academic Institution

**Organization Location:** Chile, South America

**Partner's Contribution to the Project:**

Collaborative Research

Personnel Exchanges

**More Detail on Partner and Contribution:**

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**University of New Mexico**

**Organization Type:** Academic Institution

**Organization Location:** Albuquerque, NM

**Partner's Contribution to the Project:**

Collaborative Research

**More Detail on Partner and Contribution:**

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**What other collaborators or contacts have been involved?**

Nothing to report

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**Impacts****What is the impact on the development of the principal discipline(s) of the project?**

Project researchers have provided a major contribution to irrigation community natural and human connections via the Valencia Conference, have submitted papers, are producing a book, and are working on additional papers.

**What is the impact on other disciplines?**

Impact on other disciplines include surface groundwater connections, water systems interconnectivity, hydrology, groundwater and mountain front recharge, as well as sociology of irrigation community governance.

**What is the impact on the development of human resources?**

Graduate and undergraduate opportunities are being taken advantage of by underrepresented groups. Graduate students have research training at three research universities in New Mexico in different disciplines.

**What is the impact on physical resources that form infrastructure?**

Nothing to report.

**What is the impact on institutional resources that form infrastructure?**

Nothing to report.

**What is the impact on information resources that form infrastructure?**

Nothing to report.

**What is the impact on technology transfer?**

Nothing to report.

**What is the impact on society beyond science and technology?**

Beyond science and technology, policy makers will be informed by study results that are widely disseminated via the High Impact Paper and book.

The book will make CNH research results available and understandable to a wide range of stakeholders in NM as well as community irrigation leaders and water managers from other regions.

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**Changes/Problems****Changes in approach and reason for change**

Nothing to report.

**Actual or Anticipated problems or delays and actions or plans to resolve them**

Nothing to report.

**Changes that have a significant impact on expenditures**

Nothing to report.

**Significant changes in use or care of human subjects**

Nothing to report.

**Significant changes in use or care of vertebrate animals**

Nothing to report.

**Significant changes in use or care of biohazards**

Nothing to report.