

#### Appendix 4. Sample summary and description of a research project.

This appendix summarizes a sample research project in accordance to the research elements described in the paper. The first half presents a summary, and the second half unpacks this summary.

##### Summary:

**Name:** Resilience and vulnerability in a set of community-based irrigation systems

**Background:** This research project examines a set of community-based irrigation systems known as acequias in the Taos Valley of New Mexico. An acequia is a community of irrigating farmers led by a mayordomo and three commissioners, and which uses earthen ditches to convey water to the fields of each farmer. The acequias in Northern New Mexico and Southern Colorado are the descendants of Spanish colonists who began settling in what is now the Southwestern United States in the 17<sup>th</sup> century.

##### Research questions:

- (1) Which social and biophysical features of the acequias communities have historically enabled the farmers to sustain the collective action needed to persist as community-based irrigation systems over time?
- (2) Are the acequias resilient or vulnerable to the variety of novel disturbances that are affecting them in the modern era?

**Research design:** Embedded case study, including a case study of Taos acequias and statistical analyses of individual acequias and their members.

##### Units of analysis and analytical strategy for each:

Unit of analysis	Analytical strategy
Taos Valley	Qualitative modeling
Acequias	Statistical analysis
Acequia group-years	Statistical analysis
Acequia members	Statistical analysis

##### Unit of observation, associated units of analysis, and sampling methodology for each:

Unit of analysis	Unit of observation	Sampling method
TV, Acequias	Acequia leaders via interviews	Purposive and snowball
TV, Acequias	Court testimony documents	Exhaustive
TV, Acequias	Hydrographic surveys	Exhaustive
TV, Acequias	Repartimiento documents	Exhaustive
TV, Acequias	NRCS SSURGO soil data	Exhaustive
TV, Acequias	Taos County assessor data	Exhaustive
TV, Group-years, Acequias	USGS stream-gauge data	Purposive
TV, Group-years, Acequias	Landsat imagery	Purposive
TV, Acequia members	Acequia members via survey	Convenience

TV = Taos Valley

**Discussion:**

This project has focused on a set of community-based irrigation systems known as acequias that have resided in the Taos valley of New Mexico for several hundred years (see figure A4.1). There are two research questions that have guided this project. The first one asks about the conditions that have enabled the farmers to maintain the collective-action needed to sustain themselves in the face of drought and resource scarcity for several hundred years. Collective-action is a very common outcome examined by ESS scholars, as it plays a large role in affecting whether an environmental commons is maintained or not. The second question focuses on the resilience, or vulnerability, of the acequias to a suite of modern disturbances that have largely resulted from increased economic growth and integration in their region. Many resource using communities that have persisted for centuries are struggling to adapt to modern economic conditions.

The research design adopted for this project is identified as an embedded case study. The first table summarizes the units of analysis that are involved in this project and the analytical strategies applied to each. At the top we have the case itself, which includes all 51 acequias in Taos valley. At this level the analytical strategy applied is the development of a qualitative model describing of the patterns of interactions among various groups of farmers both within and between acequia communities (Cox 2014b). This qualitative model involves an application of the social-ecological framework by Ostrom (2007). Additionally, the project involved a statistical analysis to examine differences across acequias in a vegetation index measured by a series of Landsat images over time (Cox and Ross 2011). Finally, Cox (2014c) examined data from a survey of 107 acequia members, and conducted a statistical analysis of groups of acequias over time. For this final analysis, seven acequia groups were constructed based on the main rivers that fed each set of acequias in the valley, and the unit of analysis is in fact an acequia group-year, with measurements taken at each year for seven groups of acequias.

The final table relates each of the units of analysis from the previous table to the units of observation/data sources that were used to measure important features of these units, and the sampling methods for these sources. Without delving into each of the data sources, it is important to note that, for each unit of analysis, multiple data sources are used. This is common in ESS. Combining the information in the two tables reveals a basic structure that relates the most important elements of a research project: a given project has (1) one or more research questions, (2) a research design, (3) one or more units of analysis, each of which is analyzed with an (4) analytical strategy, and of each which is measured with (5) one or more data sources, each of which in turn is obtained through a particular (6) sampling method.

Figure A4.1: Project study site

