

Wyoming's Aging Agricultural Landscape: Demographic Trends Among Farm and Ranch Operators, 1920–2007

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On the Ground

- Across the United States, farmers and ranchers are getting older, and fewer young operators are entering the agricultural workforce than in the past.
- We statistically and cartographically explored demographic trends among farm and ranch operators in Wyoming to see if and how the agricultural community was aging.
- Census records indicate that Wyoming's agricultural community is in fact aging, and that the relative proportions of younger operators are dwindling rapidly.
- With a changing local agricultural community, we face risks associated with loss of local knowledge, loss of tradition, and loss of investment that stem from a deep-rooted sense of place.
- We face a fundamental challenge in inspiring young agriculturalists to take up residence in the state to help replace those of retirement age.
- This might be accomplished through shifts in education, public policy, economic incentives, or through targeted cultivation of personal connections to the land.

Keywords: US Census of Agriculture, farm operators, High Plains, agricultural demographics, aging farmers, land management.

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The agriculture of the United States, including both farming and ranching, has experienced dramatic social and economic shifts over the last century. The family farms that once dotted the landscape and employed nearly half the US work force have been replaced by large, often mechanized, operations supported by a mere 2% of the country's work force.^{1,2} Concomitantly, the number of farms has dropped 63% since 1900 and farm size has increased by 67%. Despite this increase in size, however, current farmers and ranchers continue to struggle to maintain economically viable enterprises. Since 1930 the proportion of farms that had off-farm income has more than tripled²—a reflection of more lucrative opportunities elsewhere.

An Aging Agri-Social Landscape

The physical and economic challenges of farming are reflected in the farm operators themselves, who make up an aging community nationwide. Over time, fewer and fewer young operators have taken up land-based occupations, and the USDA³ reports that over half of all operators are over the age of 55. These are changes not in the practical, mechanical, or earth-bound facets of agriculture, but in the social fabric of agriculture. This is the fabric that holds together the individual operators, their families, and their support networks. Here we have adopted the term “agri-social” to create a distinction between the human and nonhuman dimensions of agriculture, and to speak specifically to this social fabric.

An aging agri-social landscape has been documented at various scales and in various geographic locations for decades.^{4–7} Our interests were in whether these trends held true for the High Plains of the American West, where large tracts of working land continue to dominate much of the landscape. This research was broadly focused on cultivating landscape-scale stewardship practices that support ecological resiliency without sacrificing the values of regional stakeholders. We

therefore set out to identify geographically widespread, long-term trends among those most directly impacted by our work: farmers and ranchers of Wyoming (Fig. 1). We felt that a clearer understanding of the demographic trends among farm and ranch operators was essential to socially responsible research—research whose goals and recommendations are not at odds with the communities most closely tied to the resources of interest. This work will provide valuable perspective to the agricultural community, community outreach specialists, and legislative executives responsible for bringing policy into practice.

What We Did

We evaluated demographic trends across Wyoming through time. We hoped that this would provide a more comprehensive understanding of current agri-social conditions than we collectively possessed. We also hope that this would shed light on traits of the farming and ranching community that were not necessarily intuitive or accessible, but which should be taken into consideration when planning for meaningful research and partnerships in the region. To do this, we relied on statistics from the US Census of Agriculture, which has been conducted approximately every five years since 1840 by the US Department of Agriculture's National Agriculture Statistics Service (NASS). Agricultural census records for Wyoming have been kept since before Wyoming was even a state, although more detailed information was recorded beginning in 1890, the year Wyoming joined the Union. In early censuses, the structure of the records was not standardized, and over time there has been a trend towards capturing greater and greater amounts of information from census participants. We conducted our analysis on the portion of the data that could be unified: 1940–2007 for county-level data, and 1920–2007 for state-level data.

Technical Details

We chose to represent our findings using cartographic and statistical analysis. We created maps by manually digitizing census records and then joining them to spatial datasets. We then performed cartographic analysis within a geographic information system (GIS) using ArcMap 10.1 and ArcScene 10.1 (ESRI, Redlands, CA). To develop statistical models we manipulated tabular data using RStudio v. 0.97.551 (RStudio, Inc., Boston, MA). We chose to employ least-squares linear regression⁸ as a way to identify how well the proportions of farm and ranch operators could be predicted by time for each of four age classes: ages 34 and younger, ages 35 to 54, ages 55 to 64, and ages 65 and greater. Separate regression models were fitted for each class. For county-level statistics we used nonparallel multiple linear regression⁸ (Unpublished manuscript, T. G. Gregoire) to develop models that made use of all available observations, while simultaneously producing county-level estimates, effectively increasing sample size and reducing residual standard error. Here, the primary predictor, time (census year), was supported by 22 indicator variables

corresponding to county names, and 22 interaction variables (time × indicator). For state-level statistics we used simple linear regression to model each age class independently, although the number of age classes was expanded to include 1) ages 24 and younger, 2) each nine-year bracket from ages 35 through 64, and 3) ages 65 and older. We chose to examine changes in the relative proportions of farm and ranch operators, as opposed to the number of operators, because as agricultural technology has improved and other sources of income have influenced local residents, the number of operators has varied in ways that do not necessarily reflect Wyoming's agri-social health. We also felt that exploring relative proportions would limit confounding economic influences (e.g., changing subsidies, fluctuation in property values, etc.) that might further influence trend analysis.

In addition to modeling the proportions of each age class through time, we also examined the average age of operators through time at both county and state levels, again using nonparallel multiple linear and simple linear models, respectively.

From each model we derived estimates of slope coefficients, estimates of model strength (coefficients of determination; R^2), and determined whether there have been statistically significant changes in the proportions and ages of operators across time. We coerced the results of all regression models into cartographic form to represent large quantities of tabular data in concise visuals (see Fig. 2 for key). Although informative, the results must be interpreted within their context. Farm operator statistics are voluntarily offered by census participants and might have inherent bias in rural areas, in areas where residents are particularly sensitive to public privacy, or in areas where residents are sensitive to cooperation with government employees. Further, the statistics we used represent only principal farm operators. Tertiary operators have not been accounted for in trend analysis. Statistical significance specified in the written text was evaluated with respect to a threshold where $\alpha = 0.05$. In cases of nonparallel multiple linear regression, coefficients of determination correspond to simple linear regression models.

Results

When we examined the proportions of farm and ranch operators within each county we found a predictable pattern of change: the proportion of younger operators has declined with a concomitant increase in the proportion of older operators. This pattern is such that when considering operators across the full range of ages, those at the extremes of working age have experienced the most dramatic shifts. Since the 1940s, all but two of Wyoming's counties (Sweetwater and Natrona) have experienced statistically significant declines among the proportions of operators ages 34 and younger (Fig. 3A). These declines are not as consistent for operators ages 35–54 (Fig. 3B), although the majority of counties show significant declines for this age group as well. The proportion of late-middle-aged operators ages 55–64 (Figs.

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