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**Modern Agricultural Science in Transition:  
A Survey of U.S. Land-Grant  
Agricultural and Life Scientists**

By

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**SUMMARY REPORT**  
**Modern Agricultural Science in Transition:**  
**A Survey of U.S. Land-Grant Agricultural and Life Scientists**

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**Introduction**

The 2015 Modern Agricultural Science in Transition Survey is a continuation of a larger study of the research orientation, productivity and attitudes of agricultural and life science researchers – specifically tenure-track faculty members – at land-grant universities. Funded by grants from the USDA’s National Research Initiative Competitive Grants Program and the National Science Foundation, *The Rate and Direction of Agricultural Research at U.S. Land-Grant Universities* project includes random and representative surveys of agricultural and life science faculty in 1979, 1989, 1995, 2005 as well as the most recent 2015 survey.

Similar to the Goldberger et al. (2005) report, this Summary Report analyzes the current state of the land-grant agricultural research system and the attitudes, background, productivity and research performance of its current scientists. Specifically, the report summarizes the survey responses of agricultural and life science faculty regarding demographic characteristics, educational background and academic appointments, allocation of time across different activities, sources of research funding, important factors for selecting research topics, research collaboration and outputs, linkages between universities and private industry, and attitudes regarding reward systems and incentives. Where appropriate, we include comparisons to the 2005 responses. However, more detailed analysis of trends and individual respondents over time is left for future studies.

We hope that the 2015 Summary Report is of interest to agricultural and life science faculty and staff, leaders and administrators at land-grant universities, and state and federal legislators, as well as broader audiences. The responses provide important insights into the attitudes, productivity, background and experiences of land-grant agricultural researchers, and therefore represent a valuable resource in ongoing discussions about the funding, research and goals of agricultural and life science departments in land-grant universities.

The major findings in this report include:

- **Faculty demographic shifts** – in 2015, women make up more than 26% of agricultural and life science faculty, versus 19% in 2005; an aging of the faculty is evident, with 58% of the respondents over the age of 55 – compared with 38% in 2005 – with a mean age of 55 for the sample.
- **Research time:** The proportion of faculty time dedicated to research continues to fall, from 51% in 1995 to 47% in 2005 to 42% in 2015. Administrative work has been the main work area soaking up the decline in research time.

- **Research productivity:** In terms of published scholarly articles production grew by 20% relative to previous study rounds.
- **Commercial engagement:** Engagement with commercialization activities, such as inventions and patents, remains relatively low, with 60% of respondents reporting none over the previous five years and most of the rest reporting low levels. Correspondingly, only one in twelve scientists reported a patent issued in the past 5 years, and one in twenty received any royalty income from previous inventions or patents. Overall, royalty income accounts for less than 1% of research budgets in our sample, while public support accounts for more than 75% of research budgets.
- **Research topic choices:** When asked about the criteria shaping their choice of research topics, *enjoyment of research area*, *scientific curiosity*, and *importance to society* continue to lead the way for agricultural and life science faculty, while commercialization motives scored at the bottom. These results on choice of topic remains unchanged from those in previous surveys in 1995 and 2005.
- **Collaborations:** Although mostly focused on colleagues in their department and at other universities, faculty report a high level of research collaboration, and 65% received research funding from commodity groups, industry partners or foundations during the past five years.
- **Wages:** Most faculty experienced real wage declines over the previous five years, with 75% experiencing nominal wage increases that did not keep up with inflation and 50% receiving wage increases that were less than half of the 10% cumulative increase in consumer prices between 2011 and 2015.

## Data and Methods

Similar to the 2005 survey, the 2015 sample frame includes all tenure-track faculty scientists in agricultural and life science departments at land-grant universities. We culled faculty names from university web directories to create the sample frame. From the sample frame, we randomly selected a sample of 2,972 scientists who were sent a web-based survey with follow-up paper-mail reminders, following the procedure laid out in Dillman (2000). There were 1,181 respondents who answered at least one survey question, representing a response rate of 39.7%. We exclude 46 respondents from the sample since they had not been actively engaged in research within 5 years of the survey.

Response rates did vary somewhat by discipline, from a high of 42% among plant scientists (the largest discipline represented) to only 28% among agricultural engineering scientists (the smallest discipline). We are, however, confident that our data do not exhibit response rate bias. Table 1 shows regressions of the response rate by university on three characteristics of the universities: faculty size of the agricultural college, total university research funding, and total full-time university student enrollment. As shown there is no hint of any significant difference in response rates by university characteristics. Other tests by discipline and gender similarly show insignificant regressions and coefficients, suggesting no significant response rate bias.

**Table 1**  
**Response Rate Bias Tests by University**

VARIABLE	(1) Full Sample	(2) Panel	(3) Random Sample
Total Ag. Faculty	0.0213 (0.1370)	-0.250 (0.2610)	0.050 (0.1500)
Total Research Funding	-0.000005 (0.0001)	0.000174 (0.0002)	-0.000014 (0.0001)
Student Enrollment	0.00013 (0.0019)	-0.00327 (0.0036)	0.00010 (0.0020)
Constant	0.408*** (0.0336)	0.590*** (0.0654)	0.380*** (0.0369)
Observations	52	51	52
R-squared	0.001	0.042	0.003
F-Stat (3, 48)	0.02	0.69	0.04
Prob > F	0.997	0.564	0.989

*Notes.* Standard errors in parentheses. All variables in thousands. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

### **Academic Appointment Indicators**

The distribution of the sample of agricultural and life scientists by academic discipline is shown in Figure 1. Plant Sciences, which includes agronomy, entomology, horticulture, plant pathology, and other related departments, represents 33% of faculty respondents. The next largest category is Social Sciences at 17% (e.g., agricultural economics, rural sociology), followed by Environmental Sciences at 16% (e.g., conservation biology, fisheries, wildlife ecology) and Animal Sciences at 12%. The remaining 22% are scattered across Biological Sciences (8%), Food and Nutrition Sciences (8%), Agricultural Engineering Science (5%), and Other (1%).

Figure 1. Percentage Distribution for Academic Discipline, U.S. Land-Grant Agricultural Scientists, 2015

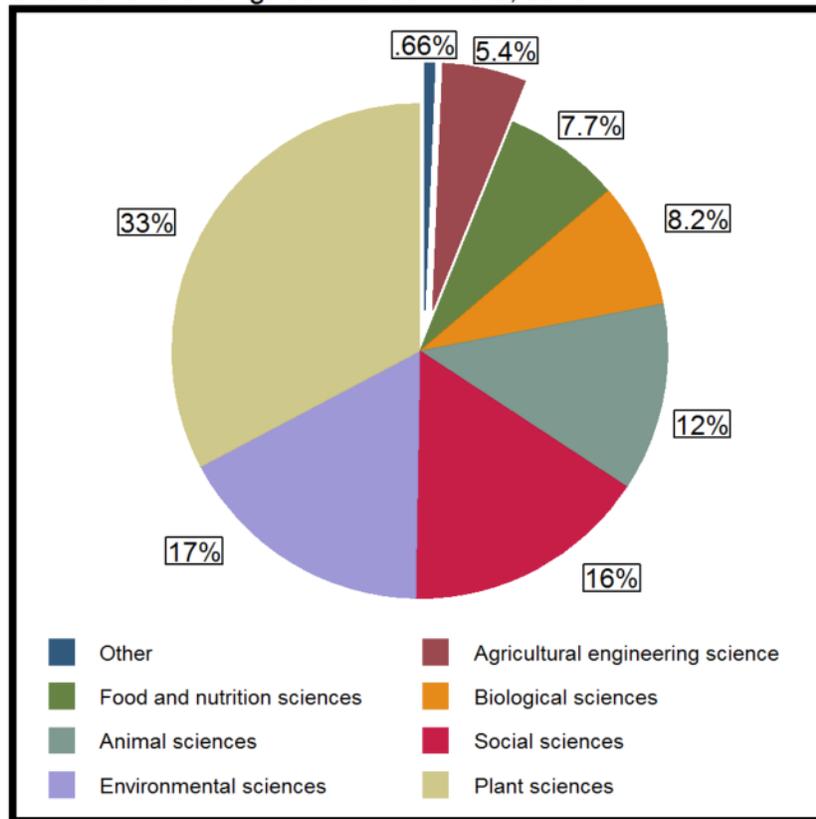


Table 2 reports the distribution of the sample by academic rank, tenure status and appointment length. Nearly 60% of the sample are full professors, while 22% are associate professors and 14% are assistant professors. A vast majority of the sample (81%) has academic tenure. Nearly half (47%) has a 12-month academic appointment while another 39% have 9-month appointments, and only 11% have 10- or 11-month appointments. Despite the growing debate around adjunct and part-time positions, non-tenure-track scientists represent only 6.1% of the sample, up only slightly from the 2005 survey when this group represented 4.5% of the sample.

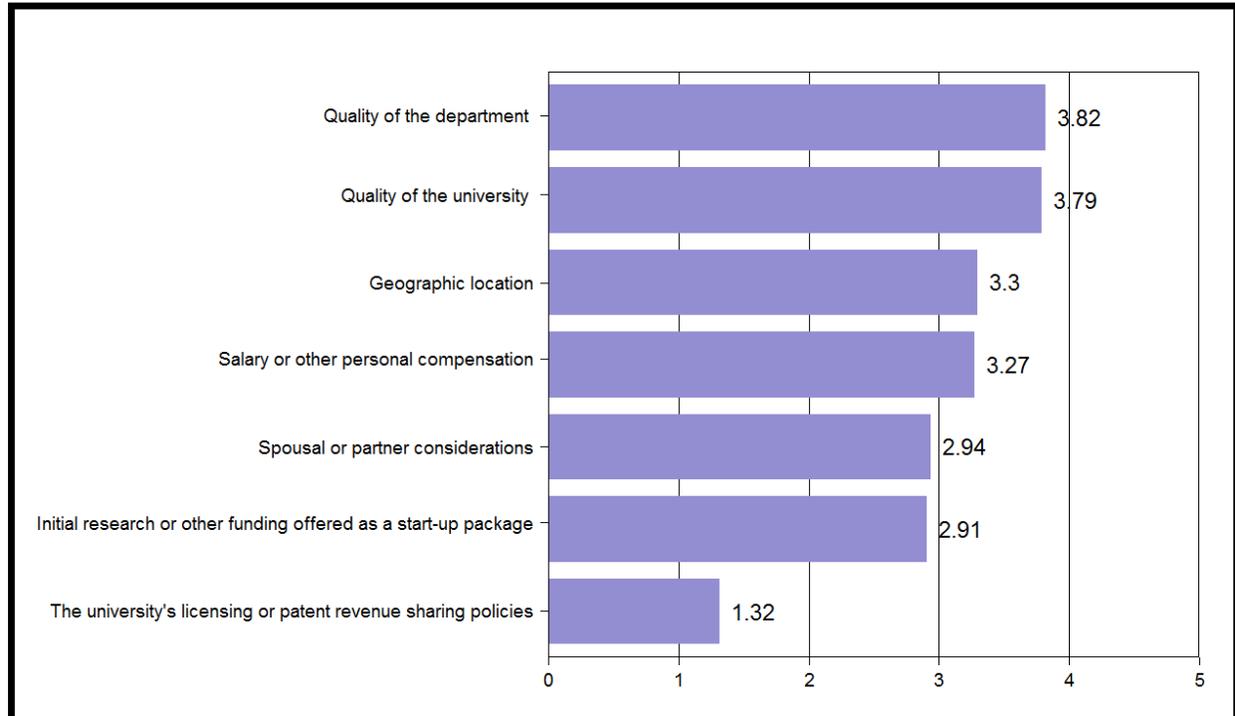
**Table 2. Percentage Distributions for Academic Appointment Variables, U.S. Land-Grant Agricultural Scientists, 2015**

Variable	Percentage
<b>Rank</b>	
Assistant professor	14.1
Associate professor	21.5
Full professor	60.1
Other	4.4
TOTAL	100.0
<b>Tenure Status</b>	
Tenure-track with tenure	80.8

Tenure-track without tenure	13.3
Non-tenure-track	5.9
<b>TOTAL</b>	<b>100.0</b>
<b>Appointment Length</b>	
9-month	38.9
10-month	2.1
11-month	8.9
12-month	47.1
Other	3.0
<b>TOTAL</b>	<b>100.0</b>

The survey asked respondents to rank the importance of various factors in choosing their current academic positions over other employment opportunities. Figure 2 displays the mean scores of seven factors on a scale from 1 (“Not Important”) to 5 (“Very Important”). The quality of the department and university ranked the highest at 3.82 and 3.79, respectively, followed by geographic location, and salary or other personal compensation. The university’s licensing or patent revenue sharing policies were ranked significantly lower than any other category, with a mean score of only 1.32. These order and mean ranks are almost identical to the 2005 summary report, indicating that in this realm respondents had stable preferences over the past decade.

Figure 2. Mean Scores for Importance Attributed by Respondents to Various Factors in Choosing Current Academic Position, U.S. Land-Grant Agricultural Scientists, 2015\*



\* Means are reported on a scale from 1 (“Not Important”) to 5 (“Very Important”).

## Demographic Profile

Demographic characteristics are displayed in table 3. Males make up 74% of the sample agricultural and life science faculty, which is, however, less than the 2005 sample when males made up 81% of faculty. High percentages of males are seen in the Agricultural Engineering Sciences (83%), Animal and Plant Sciences (both 79%). Higher percentages of women are in Food and Nutrition Sciences (49%), Biological and Environmental Sciences (31% and 29%). Faculty in agricultural and life sciences are also an aging population: 58% are 55 years of age or older, up from just 34% in 2005. Overall, the average age of the 2015 sample is 55 years compared with 51 years in 2005. This shift probably reflects budget constraints that land-grant institutions have faced in hiring new faculty over the past decade.

**Table 3. Percentage Distributions for Selected Demographic Variables, U.S. Land-Grant Agricultural Scientists, 2015**

Variable	Percentage
<b>Gender</b>	
Male	74.3
Female	25.7
TOTAL	100.0
<b>Age<sup>a</sup></b>	
Under 45	19.0
45 to 54	23.1
55 or over	57.9
TOTAL	100.0
<b>Community Background<sup>b</sup></b>	
Farm	19.4
Rural area (but not a farm)	12.8
Small town or city (pop. under 50,000)	21.7
Suburban area	19.4
Medium-sized city (pop 50,000-250,000)	10.9
Large city (pop. 250,000 or more)	15.9
TOTAL	100.0
<b>Farm Origins<sup>c</sup></b>	
Farm	13.4
Non-farm	86.6
TOTAL	100.0

<sup>a</sup> Ages range from 29 to 82. Mean age is 55.

<sup>b</sup> When respondent was 16 years old.

<sup>c</sup> A respondent is considered to have farm origins if his or her father was a farm worker, tenant, owner, or manager when the respondent was 16 years old.

Just over half (54%) of the sample is from a farm, rural area or small town (population under 50,000), while the other 46% is from suburban areas and larger cities. Using the occupation of a respondent's father as a proxy for farm origins, only 13% of the sample has a farming background. These figures continue the trend from previous surveys, which reveal a decreasing share of land-grant scientists from farm origins.

As shown in table 4, approximately 79% of land-grant agricultural and life science faculty received their Ph.D.'s from land-grant universities, slightly less than the 84% reported in 2005. However, similar to the 2005 survey, 37% of them have some postdoctoral experience, and 22% have some post-Ph.D. non-academic employment experience (these numbers were 35% and 23% in 2005, respectively).

**Table 4. Educational Background, Postdoctoral Experience, and Non-Academic Employment, U.S. Land-Grant Agricultural Scientists, 2015**

Variable	Percentage
Ph.D.-Granting Institution	
Land-Grant University	78.8%
Non-Land-Grant University	21.2%
TOTAL	100.0%
Postdoctoral Experience	
Yes	82.3%
No	17.7%
TOTAL	100.0%
Post-Ph.D. Non-Academic Employment	
Yes	21.8%
No	78.2%
TOTAL	100.0%

### Time Allocation

The survey asked respondents to report the total amount of time they spend working and the division of that time on various research, teaching administration and related activities. Table 5 presents the mean percentage responses for *Actual Conditions of Employment, Research Tasks* and *Research Orientation*. On average, land-grant agricultural and life scientists, on average, dedicate the most amount of time to research (42%), followed by teaching (29%), extension and outreach (13%) and administration (13%). Consistent with previous trends, the area that has seen the largest increase since 2005 is administration, which went up from 9.5% in 2005 to 12.8% in 2015. It appears that the increase in administrative work is associated with reduced research and teaching, as these categories decreased from 45.5% to 42%, and 30.5% to 29.0%, respectively, between 2005 and 2015. This decline in research time and growth in administrative efforts extends an increasing trend from the 1990s, which was the focal point of our previous published work on the theme of 'making time for science' (Barham et al., 2014; Prager et al. 2015).

**Table 5. Mean Percentages for Time Allocation Variables, U.S. Land-Grant Agricultural Scientists, 2015**

Variable	Mean Percentage
Actual Conditions of Employment (% of total time)	
Research	42.0
Teaching	29.0
Administration	12.8
Extension and Outreach	13.4
Other	2.8
TOTAL	100.0
Research Tasks (% of total research time)	
Research grant proposal preparation	20.8
Administration of current research grants	21.1
Actual research work, inc. writing and publication	58.1
TOTAL	100.0
Research Orientation (% of total research time)	
Basic research	33.0
Applied research	58.7
Development	8.3
TOTAL	100.0

On average, the majority of time allotted to research is dedicated to *actual research work*, including writing and publication (58%). *Research grant and proposal preparation*, and *administration of current research grants*, make up another 21% each. Around 59% of total scientist research time is dedicated to *applied research*, followed by *basic research* (33%) and *development* (8%). However, research orientation differs greatly by discipline. Biological scientists dedicate the majority of their time to *basic research* (73%), while Social Scientists spend the most time in *applied research* (74%). In addition, Agricultural Engineering Scientists dedicate a significant portion of their time to *development*—more than any other agricultural and life scientists—at roughly 18% (over 10% more than the average).

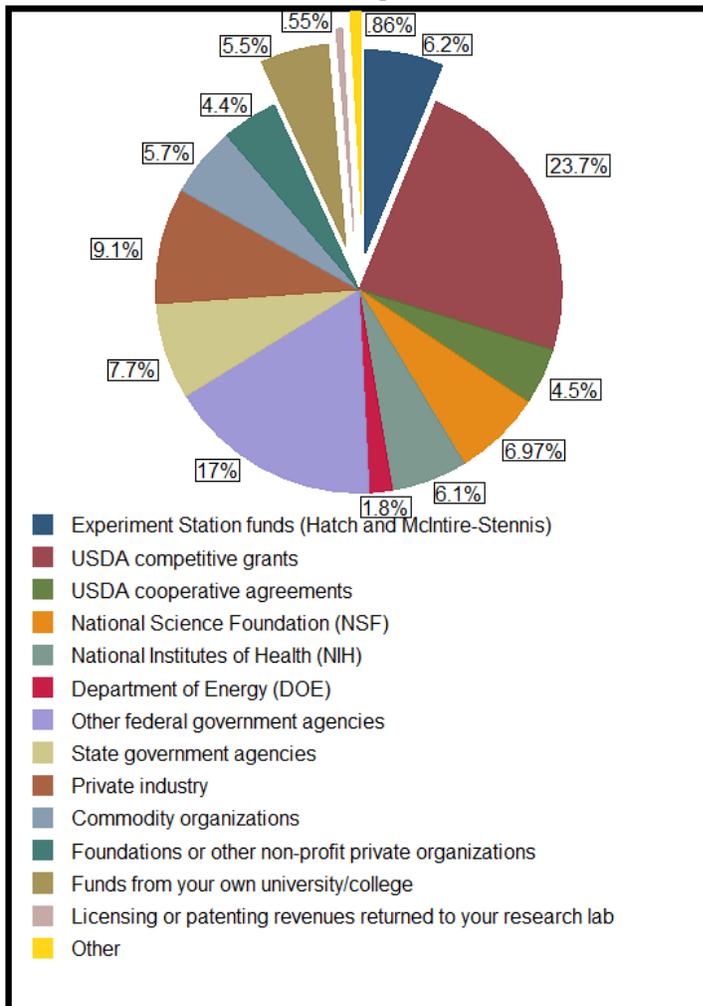
### **Research Funding**

On average, scientists in the sample have a current annual research program budget of \$271,533 (median of \$100,000) and an average annual research program budget between 2011 to 2015 of \$291,080 (also with a median of \$100,000). In terms of median annual research budgets, Food and Nutrition Scientists and Agricultural Engineering Scientists have the highest median budgets at \$150,000 and \$129,400, respectively, while Social Scientists have a median budget of only \$60,000.

Figure 3 shows sources of research funding for respondents; specifically, the percentage of average annual budget over the past 5 years—excluding overhead and indirect costs—that comes from various sources. USDA funds make up about 28%, while non-USDA federal funding (e.g.,

National Science Foundation, National Institutes of Health, and Department of Energy) accounts for nearly one-third (32%). At around 9%, *private industry* is another important source of research funds, as are *state government agencies* at approximately 8% of scientist’s budgets. *Commodity organizations, foundations and non-profit organizations, and scientists’ own universities and colleges* each contribute roughly 5% to research funding. *Licensing revenues from commercialization of patents and other innovations* account for less than 1% of total research budgets. Across broad categories, public research funds (federal, state, and university-owned funds) account for about 75% of research funds, while private sources account for about 25%. This split across broad funding sources is the same as the one found in the 2005 survey.

Figure 3. Percentage Distribution for Research Funding Sources, U.S. Land-Grant Agricultural Scientists, 2015\*

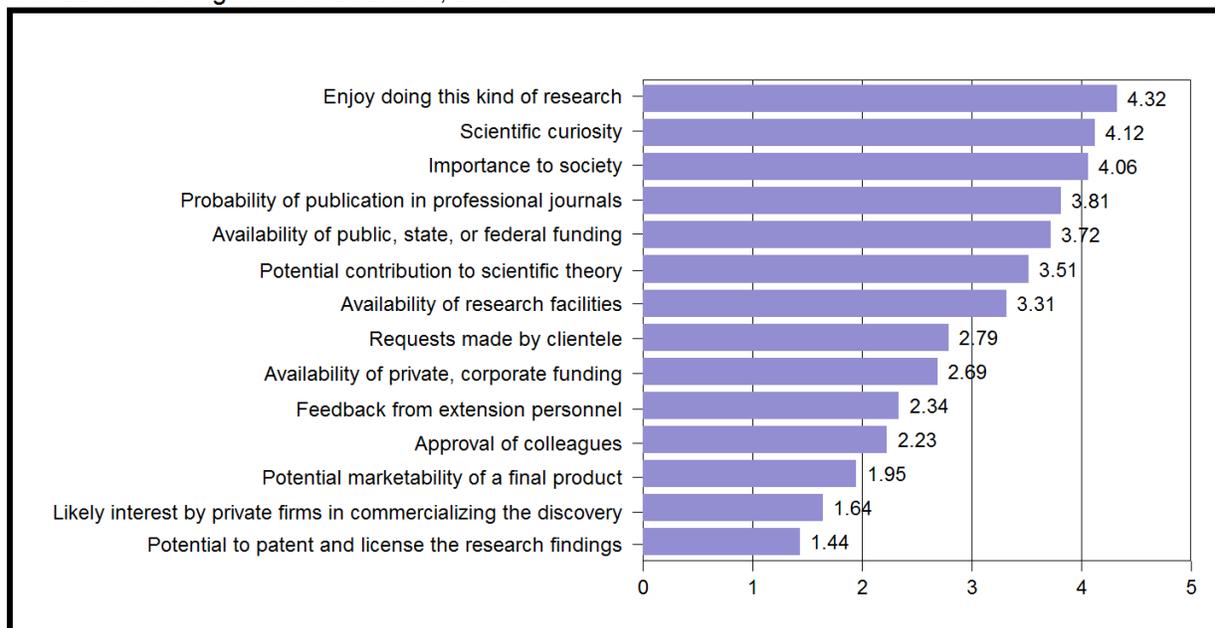


\* Respondents were asked about their funding sources over the past five years.

## Criteria for Research Problem Choice

Figure 4 presents the mean scores for the importance attributed by land-grant scientists to various criteria for selecting which research problems to investigate. Similar to 2005, the three most important criteria (and the only choices with mean scores above 4 in both 2005 and 2015 surveys) are *enjoyment in doing this kind of research*, *scientific curiosity*, and *importance to society*. *Availability of funding*, *probability of publication in professional journals*, and *potential contribution to scientific theory* are the next most important criteria. The least important criteria – all with scores under 2 – are *potential marketability of a final product*, *likely interest by private firms in commercializing a discovery*, and *potential to patent and license research findings*. This latter category was the lowest scoring criteria in both the 2005 and 2015 surveys, suggesting that patenting and licensing potential is not a major determinant of research problem choice.

Figure 4. Mean Scores for Importance Attributed by Respondents to Selected Criteria for Problem Choice, U.S. Land-Grant Agricultural Scientists, 2015



\* Mean scores are reported on a scale from 1 ("Not Important") to 5 ("Very Important").

## University-Industry Linkages

Table 6 reports the percentage of land-grant agricultural scientists who report various types of relationships with private industry. Despite the fact that—as shown above—private industry is a substantive source of research funding, very few scientists have other relationships to private industry. For example, only 6.5% have exclusive consulting agreements with private businesses and 5.6% serve on a scientific advisory board of a business. Less than 2% serve on boards of directors of businesses, as officers or executives, or own equity in private businesses related to their own research.

**Table 6. Percent of Respondents Reporting Various Types of Relationships with Private Industry, U.S. Land-Grant Agricultural Scientists, 2015**

	Percentage
Exclusive consulting agreement with a private, for-profit business	6.5
Serve on a scientific advisory board of a private, for-profit business	5.6
Serve on the board of directors of a private, for-profit business	1.9
Serve as an officer or executive of a private, for-profit business	1.4
Equity owner in a private, for-profit firm related to own research	1.7

### **Research Outputs**

Agricultural scientists in the 2015 sample appear to be more productive than in 2005, in terms of the number of published journal articles and abstracts in the last five years. In 2005, land-grant agricultural researchers published, on average, 12.3 journal articles compared with 15.8 in 2015, and 12.0 abstracts compared with 14.6 in 2015. This might be a reflection of an older faculty profile, and also increased levels of collaboration discussed below.

As shown in Table 7, respondents in 2015 published another 7.3 bulletins and reports, 1.7 book chapters, but very few books. Besides publications, in the past year agricultural scientists shared their research and production through approximately 3.6 academic conferences, and 1.3 presentations at other universities. They also presented reasonably frequently to farm organizations (2.8), commodity groups (1.3), non-profit or citizen groups (1.2), private industry (1.0), one's own department (0.6) and in the rest of university (0.7). As in 2005, explicitly commercial outputs among scientists are relatively rare, with an average of only 0.5 invention disclosures among respondents in the past five years, 0.3 patent applications, 0.2 patents issued, 0.1 patents licensed out, and 0.2 products on the market.

**Table 7. Means for Various Research Outputs, U.S. Land-Grant Agricultural Scientists, 2015**

Research Output	Mean
Publications (past five years)	
Journal articles	15.8
Sole or jointly authored books	0.2
Edited books	0.2
Book chapters	1.7
Abstracts	14.6
Bulletins and reports	7.3
Presentations (past year)	
Own department	0.6
Own university (outside own department)	0.7
Other universities	1.3
Academic conferences	3.6
Farm organizations	2.8
Extension staff	1.0
Commodity groups	1.3
Non-profit or citizens groups	1.2
Private industry	1.0
Other	
Commercial Outputs (past five years)	
Invention disclosures	0.46
Patent applications	0.34
Patents issued	0.21
Patents licensed out	0.14
Products under regulatory review	0.05
Products on the market	0.23
Start-up companies founded	0.07

In general, Agricultural Engineering scientists are the most likely to participate in commercialization activities. However, the Plant scientists and Food and Nutrition scientists have the highest average number of products on the market with 0.44 and 0.48, respectively. On the other hand, Social Scientists are the least likely to produce commercial outputs of any kind.

Table 8 presents additional information about various forms of respondents' involvement in research commercialization. A substantial majority of 69% of scientists in the 2015 sample expect that their own research will contribute to the development of new technologies within the next 10 years (this number was roughly equivalent in 2005 at 72%). On the other hand, only 15% have submitted an invention disclosure within the past five years, and 14% have applied for a patent. Roughly 8% actually had a patent issued in the last five years, 5% had a patent licensed out, 6% had a product on the market and 5% received some royalty income from patents that

resulted from their own research. Only about 4% have founded start-up companies within the past five years, and less than 2% had products under regulatory review. It is also noteworthy that the vast majority of faculty, about 60% of respondents, reported none of these forms of commercialization activities over the past five years.

**Table 8. Percent of Respondents Reporting Various Forms of Research Commercialization, U.S. Land-Grant Agricultural Scientists, 2015**

Form of Research Commercialization	Percentage
Expectation that own research will contribute to the development of new technologies that will be used in agriculture, food, fiber, or other private industries within next 10 years	68.9
Received royalty income from patents on the outputs of own research	5.3
Submitted invention disclosure(s) (past five years)	15.0
Applied for patent(s) (past five years)	13.6
Had patent(s) issued (past five years)	8.0
Had patent(s) licensed out (past five years)	5.3
Had product(s) under regulatory review (past five years)	1.6
Had product(s) on the market (past five years)	6.4
Founded start-up company(ies) (past five years)	4.1

### Research Collaboration

Land-grant agricultural and life scientists responded to a series of questions regarding the extent to which they collaborated with other colleagues in the past year, including colleagues in academia as well as farmers, groups, private industry organizations, and government agencies (see Table 9). Similar to the 2005 results, a large majority collaborated on a research project with colleagues in their own departments (87%), in other departments at their universities (83%) and in the same discipline at other universities (79%). These percentages, however, are larger than the 2005 results, where the respective percentages were 81, 72 and 67. Collaboration on research projects with scientists in private industry, extension staff farmers and farm organizations, government agencies and non-profit and citizen groups also increased since 2005, indicating an overall trend of greater collaboration. The least amount of research collaboration is with non-profit and citizen groups, and farmers and farm organizations.

In addition to collaboration on research projects, many of these partnerships led to specific products, such as a paper or patent. A large majority coauthored a paper or filed a patent with colleagues in their own departments (69%), with colleagues in the same discipline at other universities (64%), and with colleagues at other departments in the same university (57%). Furthermore, 36% of the sample coauthored a paper or patent with colleagues in other disciplines at other universities, 15% with scientists in private industry, 26% with extension staff, and 24% with government agencies. As with collaboration on research projects, these numbers have mostly increased since 2005.

**Table 9. Percent of Respondents Reporting That They Collaborated on a Research Project or Coauthored a Paper or Patent with Selected Individuals During the Previous Year, U.S. Land-Grant Agricultural Scientists, 2015**

	Collaborated on a Research Project	Coauthored a Paper or Patent
Colleagues in your department	87.2	68.5
Colleagues in other departments at your university	82.8	56.5
Colleagues in your discipline at other universities	78.6	63.8
Colleagues in disciplines other than yours at other universities	48.7	36.0
Scientists in private industry	36.5	14.8
Farmers or farm organizations	33.8	3.5
Extension staff	45.8	25.8
Non-profit or citizens groups	21.2	6.0
Government agencies	43.1	24.1

### Reward System and Real Wage Trends

We asked land-grant scientists to evaluate the influence of 12 factors on promotion and tenure in their respective academic departments. The importance applied to these factors was nearly identical to the 2005 survey. Table 10a reports the mean responses on a scale from -2 (“Strong Negative Influence”) to +2 (“Strong Positive Influence”). On average, all factors have positive scores, indicating that respondents view them as having positive influences on promotion and tenure. However, there is great variation in the mean scores by category, ranging from very high influence of publications at 1.77 to a negligible influence of 0.26 for participation in consulting activities.

The top three factors influencing promotion and tenure are the same as 2005, and in the same order, with all receiving scores of over 1.5 in both 2005 and 2015 surveys. These are: *publication of many refereed journal articles*, *amount of grant and contract money brought in*, and *publication of high quality refereed journal articles* (in that order). The only other factor to receive a mean score of over 1 in 2015 is *teaching evaluations* (1.04). The factors viewed as having the least amount of influence were *responsiveness to the needs of farmers and other clientele* (0.47), *licensing deals* (0.44) and *consulting and advisory work with the government, foundations or private industry* (0.26).

**Table 10.a Mean Scores on Items Measuring Respondents' Opinions about the Influence of Various Factors on Promotion and Tenure, U.S. Land-Grant Agricultural Scientists, 2015 \***

Item	Influence on Promotion and Tenure
Publication of many refereed journal articles	1.77
Amount of grant and contract money brought in	1.75
Publication of high quality refereed journal articles	1.67
Teaching evaluations	1.04
Good relations with colleagues and supervisors	0.88
Successful patenting of research results	0.64
Contributions to departmental and/or university administration	0.61
Publication of experiment station or extension bulletins	0.55
Extension evaluations	0.54
Responsiveness to the needs of farmers and other clientele	0.47
Licensing deals	0.44
Consulting for, or advisory work with, the government, foundations, or private industry	0.26

\* Means are reported on a scale from -2 (“Strong Negative Influence”) to +2 (“Strong Positive Influence”).

When asked to respond to factors that influence salary development, the top three categories are the same as with promotion and tenure (see Table 10b). However, another important factor emerges: outside offers. The fourth most important influence on salary development is *outside offers from academic institutions* (1.21), followed by *outside offers from non-academic institutions* (0.73). Factors that have the least influence on salary development include *licensing deals* (0.40), *extension evaluations* (0.38), and *responsiveness to the needs of farmers and other clientele* (0.36).

**Table 10.b Mean Scores on Items Measuring Respondents’ Opinions about the Influence of Various Factors on Salary Development, U.S. Land-Grant Agricultural Scientists, 2015 \***

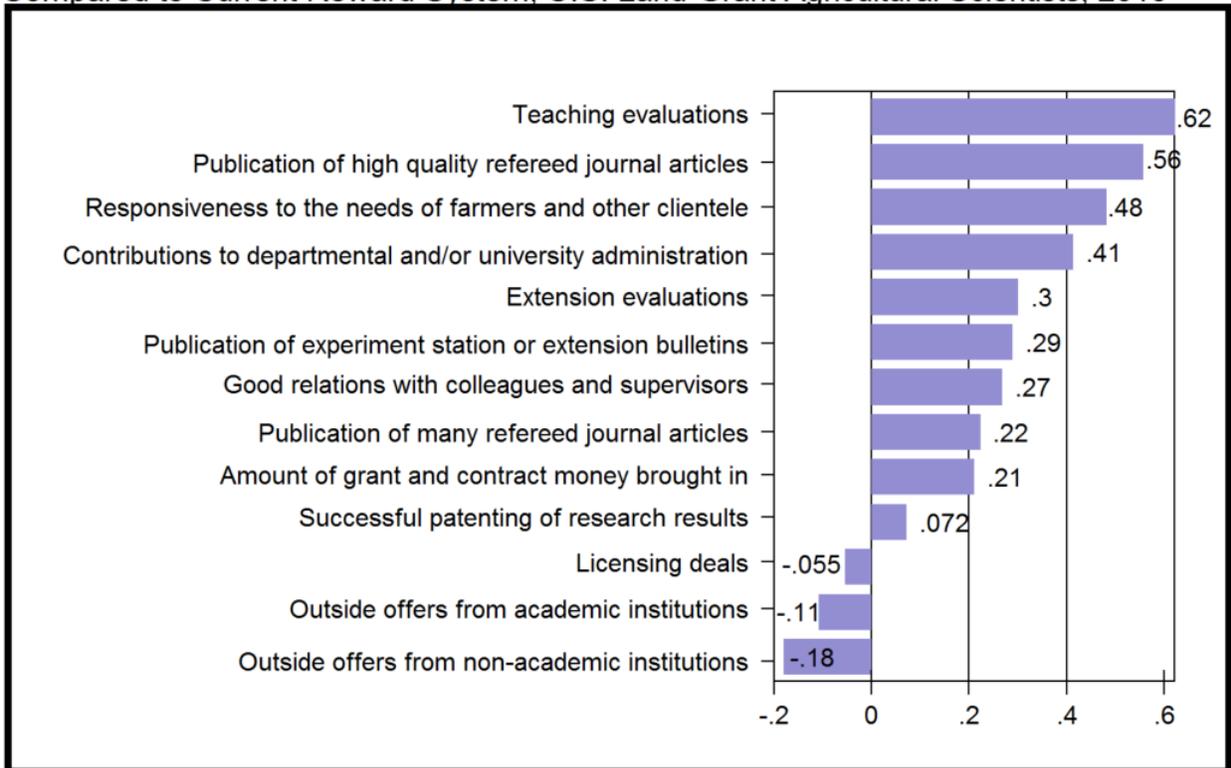
Item	Influence on Salary Development
Amount of grant and contract money brought in	1.44
Publication of high quality refereed journal articles	1.38
Publication of many refereed journal articles	1.37
Outside offers from academic institutions	1.21
Outside offers from non-academic institutions	0.73
Teaching evaluations	0.70
Contributions to departmental and/or university administration	0.59
Good relations with colleagues and supervisors	0.58
Successful patenting of research results	0.53
Publication of experiment station or extension bulletins	0.47
Licensing deals	0.40
Extension evaluations	0.38
Responsiveness to the needs of farmers and other clientele	0.36

\* Means are reported on a scale from -2 (“Strong Negative Influence”) to +2 (“Strong Positive Influence”).

Land-grant scientists were asked the weight that, in their opinions, *should* be placed on various factors compared with the current reward system. These results are shown in Figure 5. *Teaching evaluations* emerge as the factor that respondents believe should have the most influence on promotion, tenure and salary relative to the actual reward system, in both 2005 and 2015. This is followed by *publication of high quality refereed journal articles* and *responsiveness to the needs of farmers and other clientele*. Again, this is the same top three as in 2005, with the same order. Interestingly, respondents mentioned three categories they would place slightly *less* weight on compared to the current reward system: *licensing deals* (-0.055), *outside offers from academic institutions* (-0.11) and *outside offers from non-academic institutions* (-0.18).

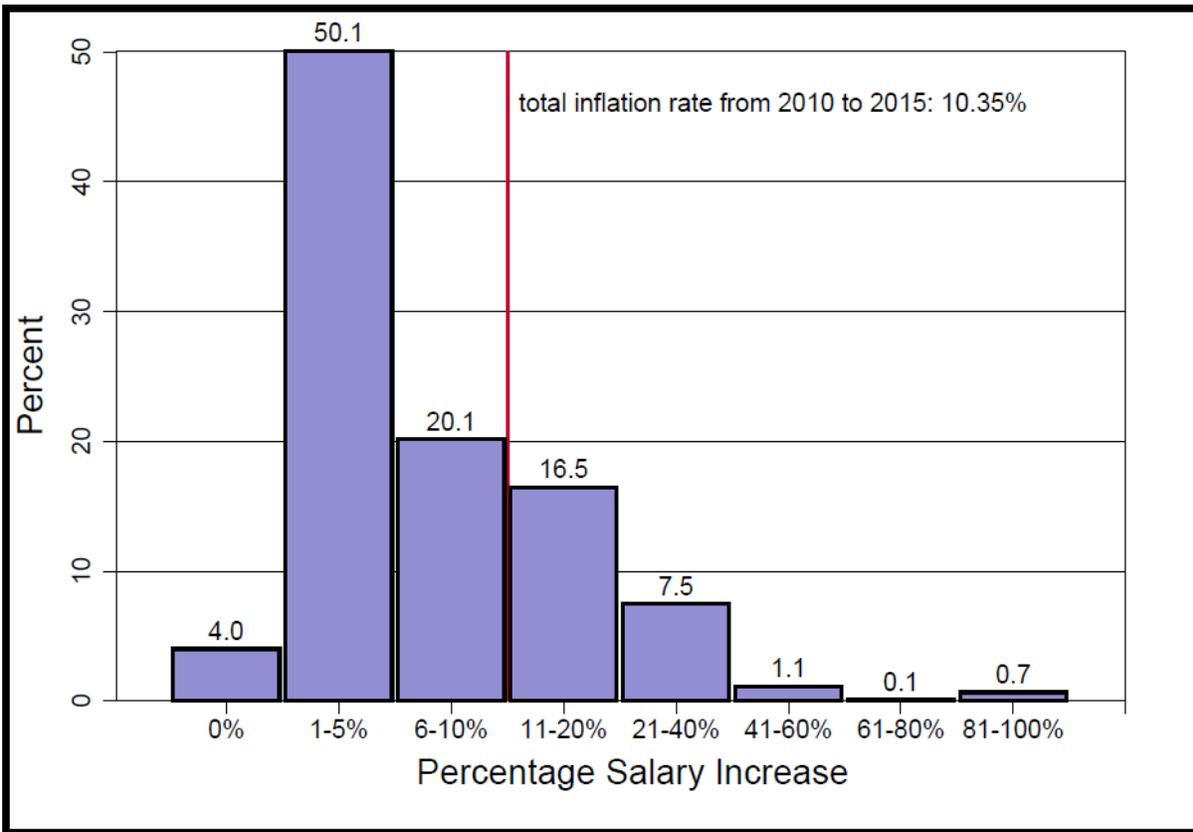
Respondents were also asked to report on changes in their base salary over the previous five years. Figure 6 reports the percentage increase in base salary by various percent intervals. During those five years, the consumer price index (CPI) rose by a cumulative percentage of just over 10%, while about ¾ of the respondents experienced base salary increases of under 10%. Moreover, 54% of respondents received base salary increases of less than half of the rise in the CPI. In other words, **more than half of the faculty experienced at least a 5% decline in real wages and 75% experienced a real wage decline**. On average across the whole sample, the average base salary increase was 9.2% or just under the CPI change, but most of that increase in base salary was captured by a relatively small percentage of the respondents. This outcome is consistent with a situation where retentions to match outside offers may be displacing regular salary exercises as a way of rewarding performance. In our sample, 20% of respondents reported no salary exercise at their university in the past 5 years, and more than half reported 2 or less.

Figure 5. Mean Scores for Amount of Weight that Should be Place on Various Factors Compared to Current Reward System, U.S. Land-Grant Agricultural Scientists, 2015 \*



\* Mean scores are reported on a scale from -2 ("Much Less Weight") to +2 ("Much More Weight").

**Figure 6: Percentage Increase in Faculty Base Salary During the Past 5 Years, 2015**



### **Opinions about Issues Facing Land-Grant Universities**

Respondents were also asked questions related to linkages between public research universities and private industry. Table 11 reports mean scores of respondents' views concerning these linkages on a scale from 1 ("Strongly Disagree") to 5 ("Strongly Agree"). In general, land-grant agricultural scientists appear to agree to some extent that *linkages between public research universities and private companies should be strengthened* (3.28), and that *funding from corporations is necessary because public research funds are no longer adequate* (3.71). However, there is also concern about *restrictions on researchers that come from corporate funding* (3.77), and that *research may become too oriented towards the needs of industry* (3.36). Despite these concerns about restrictions, on average, agricultural scientists report experiencing few barriers to the pursuit of their research interests (2.54). Regarding open source platforms, agricultural scientists are strongly in favor of such innovations and feel they can *strengthen the potential for researchers to freely exchange ideas and enhance access to necessary scientific resources* (3.90). Open source journals tend to be readily available (3.75), but open source inventions such as seeds, enzymes, algorithms, machines and other technologies are not as available (3.04).

**Table 11. Mean Scores on Items Measuring Respondents' Views on Linkages Between Land-Grant Universities and Private Industry, U.S. Land-Grant Agricultural Scientists, 2015**

Item	Mean Score on a Scale from 1 (“Strongly Disagree”) to 5 (“Strongly Agree”)
Linkages between public research institutions and private companies should be strengthened to make research more relevant to the needs of economic agents, such as firms and farmers.	3.28
The openness of communication between scientists often suffers when private industry funds research in university or government research labs.	3.53
There is reason to be concerned about restrictions on researchers that often come with corporate funding of land-grant research, such as delays in publications or keeping trade secrets	3.77
Because of private firm interests, I have experienced barriers to the pursuit of my research due to restrictions on the sharing of ideas and materials.	2.54
Open source provision of articles and inventions can strengthen the potential for researchers to freely exchange ideas and enhance access to the scientific resources they need for successful research.	3.90
Open source journals are readily available for researchers in my discipline to use.	3.75
Open source inventions such as seeds, reagents, enzymes, algorithms, machines, and technologies are readily available for researchers in my discipline to use.	3.04
If linkages between researchers in land-grant universities and private industry continue to increase, public research will become too oriented to the needs of industry.	3.36
Increased corporate sponsorship of research in land-grant universities is necessary because public research funds are no longer adequate.	3.71

Table 12 reports mean scores of respondents' views regarding the “star system”, a reward structure in which a handful of very accomplished researchers who bring in large amounts of funding receive income and other forms of compensation that are well above their peers. On average, respondents weakly agree that *universities must compete to hire and retain accomplished scientists by paying “star” scientists increasingly higher salaries* (3.37); however, on average, the mean score of whether they agree that it *becomes more important to reward those scientists who attract the largest amounts of external funding* is only 3.02, a neutral score. Respondents' mean response to the statement of whether their *universities are moving towards a*

*star system* is 3.69, slightly down from the 3.80 number in 2005, but is still indicative of departments being perceived as pursuing greater compensation of “star” scientists.

**Table 12. Mean Scores on Items Measuring Respondents’ Views on the “Star System” at Land-Grant Universities, U.S. Land-Grant Agricultural Scientists, 2015**

Item	Mean Score on a Scale from 1 (“Strongly Disagree”) to 5 (Strongly Agree)
As public funding of universities decreases, it becomes more important to reward those scientists who attract the largest amounts of external funding.	3.02
My university is moving toward a reward system in which very accomplished researchers, or “star” scientists who bring in large amounts of external funding, receive salaries well above those of their peers.	3.69
Because universities have to compete to hire accomplished scientists, they have no choice but to pay “star” scientists increasingly higher salaries than other scientists.	3.37

## Conclusions

This report on the 2015 Modern Agricultural Science in Transition Survey identifies some major trends at US land-grant institutions that could be of value to faculty and staff, deans and other university administrators, and public and private decision-makers beyond the university. Some of the outcomes are quite positive in terms of productivity and potential for improving the scientific contribution of university researchers, while others are troubling with respect to their potential effects on morale and scientist effort. Also, noteworthy across the time period is the consistency of many faculty attitudes and activity patterns with respect to doing science mostly for the joy of discovery and not for commercialization purposes.

Some of the positive trends include:

- A growing representation of women among agricultural and life science faculty and an upcoming demographic bulge of retiring faculty that could allow even more room for deepening diversity of agricultural and life science faculty.
- Faculty research production in terms of published scholarly articles grew across the time period, despite a further decline in ‘time for science’ and an increase in faculty time spent on administrative tasks.
- Faculty continue to be motivated to conduct research in order to advance science and contribute to society, while interest and participation in commercialization activities

remain relatively low among most faculty, and of minor importance for most of those active in any commercialization activities.

- Correspondingly, faculty collaboration with colleagues in their departments, in other departments on campus, and with colleagues at other campuses is highly valued and grew relative to previous years. Moreover, collaboration with private industry on research continues to be important to many faculty, and this is probably where more private sector connections are forged rather than on commercialization activities.

The negative trends include:

- Faculty time spent on administrative work, research grant competitions, and other compliance measures continue to reduce the time they have to pursue science.
- Most faculty have experienced real wage decreases between 2011 and 2015, and over half lost 5% of their base salary in real terms despite a growing US economy as a whole in those years.
- Compensation increases at land-grant institutions are concentrated more on ‘star scientists’, and the perceptions of respondents on that trend are ambivalent. While faculty recognize the importance of holding onto high producing colleagues, respondents view the overall compensation strategy negatively. Relatedly, they view the lack of support for compensation based on teaching contributions as a problem.

Among the most consistent findings over time is the overall support of agricultural and life science faculty for the pursuit of scientific discovery based on the open exchange of ideas and innovations. This sentiment is evident across many of the questions and indicators and is reflected in terms of an active engagement with the private sector and innovation for society but relatively little engagement with the commercialization of intellectual property rights and minimal support for those activities playing a major role in the promotion and reward system of the university. Moreover, the role of commercialization in the direct funding of faculty research remain persistently small – with the vast majority of faculty receiving nothing toward their labs from licensing or patent royalties – and about 75% of their funds from public sources.

We hope that the findings in this report contribute toward a revitalized dialogue about ways to encourage continued scientific discovery and societal contributions from agricultural and life science faculty at Land-grant institutions. Our repeated survey data demonstrate the fundamental commitment of faculty to these outcomes and institutional processes that can best sustain them.

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