

Supporting the Research Practices of Agricultural Scientists:

Oregon State University's Ithaka Report

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“Food is the handshake between rural and urban.” - Dan Arp, Dean of the College of Agricultural Sciences, Oregon State University

Introduction

Academic libraries serve many user groups with different levels of expertise and varying disciplinary backgrounds. Learning about the needs of specific user groups within the academic community and analyzing the similarities and differences of how those user groups conduct research, communicate with their disciplinary peers, and seek and manage information provides the library with valuable data for making decisions about collections, services, and spaces. An opportunity for exploring the research behaviors and needs of Oregon State University's College of Agricultural Sciences (CAS) faculty arose in late 2015. The non-profit consulting and research group Ithaka S+R contacted OSU Libraries to see if we would participate in a national study involving 18 land grant institutions plus the National Agricultural Library to examine both local and national research and publishing trends among agricultural researchers.

Ithaka S+R regularly conducts and facilitates studies on the research behaviors of faculty members to develop insights about the evolving needs of the academic community. Previously,

they have conducted studies on the research behaviors of faculty in the fields of art, art history, chemistry, and theology. Examples of past findings include confirmation that scholars' information discovery preferences have dramatically changed in the wake of the transition to online discovery and reading platforms; that scholars need more support in the areas of research dissemination and data management; and that disciplines rooted in solitary research practices are quite different from those that work in lab or team-based environments (Long & Schonfeld, 2013).

Previous additional research studies have shed light on the research practices and information seeking behaviors of faculty members. Some studies have taken a broad view of faculty research behaviors without a focus on the library's interaction with these behaviors, whereas others have more narrowly explored faculty behaviors through the lens of available library resources and services. An example of a broad exploration of faculty research behaviors is a series of interviews conducted by Falciani-White (2016), which revealed that "research" was not a discrete behavior, but rather was integrated across the various teaching and service aspects of faculty members' careers, was rarely approached in a linear way, and involved not only formal information seeking behaviors, but also included less formal social and environmental scanning activities. More library-centric examples include the work by Currie and Monroe-Gulick (2013), who observed the sources faculty used across disciplines, and found that science faculty at their institution relied more heavily on the journal literature than researchers in other disciplines, and that their library did not subscribe to 60% of the journals cited by researchers in the sciences. Another example comes from Macedo-Rouet et al. (2012), who found that science

faculty had little training in information seeking tasks, such as using library databases, and relied on relatively unsophisticated search techniques.

The specific library research behaviors of agricultural faculty have also been explored, most notably by Kuruppu and Gruber (2006) at Iowa State University. Through interviews and focus groups, they found that like other researchers in the sciences, agricultural researchers relied heavily on journal article literature. They used the PubMed and AGRICOLA databases for most of their searching, but used relatively simple search strategies, rarely interacted directly with librarians, and valued convenience in information seeking, even if the resulting information was of lower quality. In Simonsen's (2015) more recent review of the literature on agricultural researchers' information needs, she noted some of the unique aspects of the work of agricultural researchers that impact their research behaviors, such as the reality that extension researchers often work remotely and have less direct contact with library services, and that agricultural researchers sometimes need to disseminate their work to non-academic grower audiences.

While Colleges of Agriculture across the United States share many similar underlying principles, they are also each uniquely defined by their state's history, geography, and climate. Agricultural researchers at Oregon State University work within a wide range of areas that include food sciences, production agricultural systems, freshwater and marine resources, environmental impacts and human health, microbial communities, fundamental genomics, managed landscapes, economics, agricultural education, and statistics. OSU's experiment stations and extension programs are distributed throughout the state of Oregon and focus on supporting Oregon's major crops, management of working landscapes, integrated pest

management strategies, and working with small farms (Oregon State University, College of Agricultural Sciences, 2014).

As part of the Western United States, one of Oregon's underlying agricultural challenges is scarce water resources. Climate change and the need to irrigate for production agriculture greatly impact the research choices made by OSU's agriculture program. Agricultural research choices at OSU are also influenced by Oregon's climate and relatively small population. A unique climate directly influences the top crops produced in Oregon, which include nursery crops, cattle and calves, grass seed, potatoes, hazelnuts, and berries. A relatively small population means that researchers seek ways to establish niche specialty crops that can make Oregon competitive in an international market.

This report will discuss the research and publishing behaviors, along with the research challenges facing members of Oregon State University's CAS faculty. This report will include an explanation of the methods used in this exploration, a discussion of the findings, and potential applications of these findings at OSU. However, the findings from this local report will also be incorporated as part of a larger body of work published by Ithaka S+R exploring the research behaviors of agricultural faculty from across the United States.

Sample, Methods, and Analysis

Institutional Context

Oregon State University is a large, high research activity, land, sea, sun and space grant, university in the Pacific Northwest region of the United States. Because OSU is a land-grant university, part of its mission includes an extension service that serves communities throughout the state, from the densely populated western region to the sparsely populated coastal, central, and eastern regions of the state. Two researchers conducted the interviews at this site. One of the researchers is a mid-career, tenured librarian with a research background in the field of horticulture. The other researcher is an early career, pre-tenure librarian with a research background in the field of instructional technology and learning sciences.

Sample

There were fifteen participants in this study: three assistant professors, seven associate professors, and five full professors, one of whom was Emeritus. Of the three extension-based researchers, one had achieved the rank of associate and two were full professors. The sample represented ten departments within the CAS and included Agricultural Education, Animal and Rangeland Sciences, Applied Economics, Biological and Ecological Engineering, Botany and Plant Pathology, Crop and Soil Science, Environmental and Molecular Toxicology, Food Science and Technology, Horticulture, and Microbiology.

Methods & Analysis

Using the same semi-structured interview protocol all nineteen teams involved in the study used, the Oregon State University team interviewed fifteen researchers affiliated with the CAS. Interview questions covered a range of topics related to participants' research workflows

and information behaviors (see Appendix A for the questions). OSU Institutional Review Board approval was granted for this study. The data was transcribed by an independent contractor and analyzed by the two researchers using a quasi-constant comparative method (Glaser & Strauss, 1967) with a deductive approach. After coding the data independently, the two researchers came together and discussed the themes found in the data. They discovered that while there were some themes that were readily apparent to both, because of experience and background differences, they diverged on some of the themes.

Findings

Across the disciplinary diversity that this sample represented, unifying themes could be seen throughout the interviews. These unifying themes were based on the researchers' shared work as part of a community of practice. As Etienne and Beverly Wenger-Trayner (2015) define it, a community of practice is the coming together of a group of people for learning within a specific domain. For most academics it is the discipline around which their identity centers (Kogan, 2000), in reference to their values, knowledge, and culture of practice (Henkel, 2000).

For example, when discussing future challenges, while each interviewee had their own specific framing based on their research area, they displayed their larger community connections in discussing issues such as funding, global warming, lack of water, and food production. One participant, whose research focuses on ecohydraulics, framed their future challenges within their engineering context, saying:

So I think about the idea that we're supposed to be producing more food for our growing population, but we've got less and less resources. So that, of course, is why engineering's important, is because we can find ways, I think, to make processes more efficient, but Ecological Engineers take this perspective that's more holistic than Monsanto.

Even with the specific disciplinary focus, another participant was able to sum up the sentiment shared across the participants stating, “But agriculture is going to have to save the world, and so we have to be innovative and we have to be successful in feeding the world as the population on this planet grows even further.”

The values and culture of the larger disciplinary system clearly play a role in connecting these researchers to a community of practice they believe will have global impacts. In the following sections the four unifying themes of publishing decisions, access to research findings, barriers to access, and systems thinking will be discussed while taking into consideration the unique community of practice of these agricultural science researchers.

Publishing Decisions

Faculty are expected to publish the results of their research projects in order to establish their place in the shared conversation of their community of practice, as well as to document the work they have done so that others can build on it. While all faculty must publish, a variety of factors go into faculty members' decisions about where to publish. The following sub-themes of *community based*, *impact factor*, and *peer review* emerged in our analysis of what shapes CAS faculty members' decisions about where to publish.

Community based

When asked about what factors they thought about when making publishing decisions, the perceptions of their community of practice was the most influential factor. One participant observed, “My choice of publications is - where are my cohort of researchers and people going to read it.” Another participant placed discipline ahead of impact factor when choosing a publication, “So impact factor is something that I look at, but it’s not [the] main driver - more on discipline. I’m looking [at] discipline.” A participant who was an extension faculty member reiterated this stating, “I did not pick them for that [impact factor]. I picked them for the audience.” For yet another participant knowing what journals PubMed indexed factored into decision making because PubMed was where their community of practice would be able to find their work. They said:

For instance, I’m trying to publish in a journal. They are available on PubMed because I know, even though it’s a limitation with many scientists, but many scientists rely completely on PubMed. And so they will not find my paper if it’s not on PubMed.

Most of those interviewed are collaborating with other researchers outside of their specific domain of study, and thus their community of practice extends into those communities as well. One participant observed “our collaborative circles are getting bigger and bigger and bigger.” The result is that these researchers find their behaviors impacted by other communities of practice. This participant continued,

Like I said, I work with some USDA people and so we go to certain journals like *The Plant Journal*. And then I work with other people that are more up on the biochemistry side and they have different ideas about journals that I'm not so familiar with. I think that's pretty common.

For the researchers in this study, their community of practice extends beyond researchers to the broader non-academic audience they feel accountable to. Writing for this extended non-academic community comes in the form of publishing in industry publications, extension bulletins, domain specific journals, and "where people are going to read it," as well as presenting at grower conferences. One participant commented "If every single ornamental plant breeder has read my paper and a quarter of the nursery researchers have read my paper, then there you go."

Impact factor

While the expectations of their disciplinary community are the central factor in where these researchers decide to publish, it is not the only factor. Though the use of impact factor as a metric for evaluating the quality of a journal is disputed (Bloch & Walter, 2001; Saha, Saint, & Christakis, 2003; Seglen, 1997) it is still a measure that many of our participants looked to when deciding where to publish. A participant who is an assistant professor, observed "...*Genome Research* and *Genome Biology* are ones that I haven't published in yet but are higher impact ones [journals] that are in my area in genomics that I'd be happy to publish in." A participant who is a newly promoted associate professor, commented, "We will publish possibly in *Horticultural Research* with the Nature [Publishing] Group or somewhere with bigger, higher impact,

Theoretical and Applied Genetics, one of these. They have a pretty high impact factor.”

However, a participant who is a full professor and journal editor, pointed out possible generational differences and how a department’s use of impact factor is affecting one of their students seeking tenure at another university. They said:

I do think there's a generational change that's going on there. So I have probably my most successful PhD student who presumably got tenured at the University of Maryland this year. It would be hard to conceive that she wouldn't have. But her department head basically came out and told her that we don't consider any journal impact factor of less than two worthy of consideration in our promotion of tenure procedure, which leaves, of course, my journal out since we're 1.728 or whatever it is right now.

Consistently, researchers noted that the reliance on impact factor is not without issues.

One participant said,

On the one hand I’ve already said I do play this impact factor game. But at the same time I don’t like it at all because it’s artificial. The metrics are doubtful, as we all know, and there are alternative ones – the age factor and so forth. But I don’t like it, especially this sort of mad run for the big prize.

Another commented “you read the research that they have or they're publishing and you see flaws that you don't see on journals with less impact factor but are more reliable in the animal sciences field.”

Peer review

There are many ways to participate in an academic community of practice. Peer review, both formal and informal, has historically been at the core of academic communities of practice (Ziman, 1968). It is the space where community norms of practice and knowledge are created and upheld, and it is the peer review process that gives “scientific authenticity” to works being created (Ziman, 1968). At the individual journal level, it is the peer review process that gives credibility to the works published in that journal. One participant remarked about the rigorous peer review process of a particular journal,

I think that’s why I really like the peer review process. I mean, don’t get me wrong, I’ve had probably twice as many articles rejected the first try than I have had accepted on the first try. But I think that that’s why it’s such a rigorous process. That’s why you can trust in what you read on this in a peer review journal.

Likewise, another participant remarked that “once you go through the [peer review] process people feel oh, yeah, it should be a good paper.”

Because of its centrality within the community, it is not surprising that peer review is also a factor researchers take into account when deciding what journal to publish in. The researchers we interviewed were all looking to publish in journals that had rigorous peer review because it strengthens the perceived quality of the journal and improves the quality of their work. One participant commented, “I look forward to a peer review, because I know it's going to be painful to see it but that the contribution is going to be so much greater if I can try to address these

people's concerns.” For another participant the peer review process is so important that they were willing to pull an article from submission because they felt the review process was not robust enough. They told the following anecdote during their interview:

Participant: And we finally ended up going to the *Journal of Berry Research* for that and being satisfied with that. But before that we went to this other journal that was terrible, and they got back one review that was one line basically that said it is a good paper. And they [the editors] were satisfied with that and were going to publish it. And it was a China-based journal and we didn't realize that at first. And then we retracted our paper. And they chased us around a little bit and said why, why? And we said we aren't satisfied with the process and left it at that.

Interviewer: Because you were seeking more rigor and more feedback in the process?

Participant: Exactly.

The lack of rigorous peer review was continuously cited as a reason that many of the researchers interviewed did not feel that open access journals were very high quality. Those participants who had submitted a manuscript to a PLOS journal found the peer review process to be cursory. One participant who serves as an editor for his society's journal reported finding articles published in *PLOS ONE* that had been rejected by his journal. The lower quality of reviews was attributed to a less strict review process and the large volume of papers received (and accepted) by *PLOS ONE*. One participant noted,

But I also think that many open-source journals – even the somewhat respected ones – have a less stringent peer-review process, for example, *PLOS ONE*. They publish the vast majority of papers they get, so it's a revenue generating machine for the more prestigious ones, *PLOS Biology* and so forth. So I also don't like them for that reason. They have this post peer-review process, but I mean unless it's a really stellar paper, nobody ever comments on anything.

While peer review is a central factor in determining publishing behaviors, it is not without fault. The peer review process is long, and can be arduous for both the reviewer and those doing the reviewing. Multiple participants commented on the “flood of papers” to review, as well as the time it takes to review. One participant discussed how the peer review process can waste the time of the reviewer:

There is this tremendous time wasted in the peer-review process because everybody is trying to jazz up their paper, trying to spin it in a way so they make it broadly appealing so it can go to *Nature* and *Science*. It gets rejected there; then you go one tier lower. You'll go to *PNAS*, and then in my field you go to whatever the *Journal of Bacteriology* and maybe even one or two lower. And so that happens so often, and sometimes you get to be the reviewer along the way – even though they probably wouldn't want you to be the reviewer once you've rejected it once. But you get picked again.

Access to Research Findings

Participants were explicitly asked to discuss how they found and shared research information, and for many participants, issues with either ease or difficulty of access to information cut across several of these interview questions. As has been found previously, similar to less experienced undergraduate researchers, faculty also prefer ease of access to information (Kuruppu & Gruber, 2006). However, because faculty are more involved with knowledge production, the ease of access concerns demonstrated by these participants primarily centered on how others will access their work. The sub-themes in this section refer to the various audiences who might want access to these researchers' work: an *academic audience*, an *open audience*, and a *practitioner audience*.

Academic audience

The underlying assumption for these participants was that the audience for their research findings, particularly those findings published in journals, was other researchers at academic institutions. As a result, they expected that their peers would have access to their work via an institutional subscription. One participant stated, "To me, if you want to read it something in the *Journal of Animal Sciences* and you work in that field in a university, the university you work for is going to have access to that journal."

However, in cases where their peers did not have access to their work, personal connections continue to be an important form of information sharing and a key way that researchers accessed information from others in their community of practice. One participant observed, "I can't think of anybody in this profession who would turn

somebody else down if they wanted some information. I really can't think– even the most annoying, obnoxious people in our profession would say, yeah, sure.” Another form of peer-to-peer sharing came in the form of ResearchGate accounts. Two-thirds of the participants in this study had ResearchGate accounts, although the amount of effort participants put into maintaining their ResearchGate accounts varied. Most participants considered ResearchGate as a tool that made it easy to share their works with other researchers around the world, and several of the participants mentioned actively responding to requests via ResearchGate for articles.

Participants often had a sophisticated understanding of what article sharing restrictions they were supposed to operate under. One participant noted, “I think there's a part of me that understands that every time I submit a journal article I sign a copyright form that says I'm giving it to you.” However, participants chafed under these restrictions. This participant continued, “There's still a part of me that says that you didn't do a damn thing for it... So there's a part of me that says sorry, it's still mine.” As a result, participants continued to use ResearchGate or other less formal platforms such as Facebook or their own personal websites to share articles, because they were more interested in making their research findings accessible than with following publisher restrictions. Another participant commented “I really value access to information, so I illegally post all of my copyrighted stuff on my website – even though I know I'm not supposed to, because I want people to have access to it.” However, the allure of ResearchGate may be

beginning to wear off, and several participants expressed the sentiment that the ResearchGate trend was past its peak or that interest had “petered out.”

Open audience

Another route some participants identified to make research more accessible was through publishing in open access journals. The open access journal these participants most frequently referenced was *PLOS ONE*. However, the *PLOS ONE* model was consistently identified in a negative light both because of a perceived lack of quality and because of the high cost to publish in it. Those who had published in *PLOS ONE*, or who had considered other open access journals, considered the fees associated with the gold open access model to be unjustifiable, especially as they attempted to balance the overall needs of their lab. One participant commented, “[An] open access journal is \$1,500-\$2,000. And, you know, [for] \$2,000 I can run a small experiment. So I'm thinking I can support, maybe, give more money for my undergrad students.”

The use of fees by some gold open access journals confused some researchers, making them unsure about what open access really meant. One participant noted,

so I guess I have trouble with ... a little bit with the definition of open access. So I mean there's certainly online only journals and then ... I don't know, and then there's ones that say they're open access, but then they want you to pay something ridiculous like \$2000 or \$3,000 for open access to the article.

Because these researchers believe their primary audience is other researchers at academic institutions, there were questions about whether making articles open access actually addressed a real need. As another participant observed:

Open-source publishing has gotten completely out of control. It's in the wrong direction, and I don't ... I'm not sure if it really benefits the average person that much that they can access a journal article that is so complex.

Practitioner audience

While these participants did not believe growers would be interested in accessing the research they published in scholarly articles, they did see value in presenting the results of their work in other forums. Some participants mentioned writing extension reports, but most participants needed to be prompted to mention this type of research communication because they did not feel it was the primary or most-valued way for them to present their findings. Unlike Simonsen's (2015) description of agricultural science scholars as producing research information that could be read by multiple audiences, these participants more readily thought of in-person events as forums for sharing research information with non-academic, practitioner audiences.

Several participants took part in grower field days, where growers of a specific commodity such as potatoes, beef cattle, or nursery plants, gathered at experiment stations to learn about new findings and how they could be applied. A participant who was an extension faculty member, described these field days as an opportunity for "growers and field men to come

and see, touch, smell, feel, and hear, what we're doing on this experiment station." However, this participant also noted that some caution was needed when discussing findings with growers:

...it's scary because you're not allowed to think out loud. Folks are quick adapters to information, hugely quick adapters to new information. So you're not allowed to think out loud. You're only allowed to provide research-based information because they are listening to everything you say.

Because these researchers explore questions that can impact the livelihood of their constituents and because growers don't always implement changes in a systematic, scientific way, the researchers also feel responsible for describing how the scientific method works and some of the foundational elements of their research areas. As another participant noted, part of their outreach role was to explain "what DNA is at the most basic level."

Barriers to Access

For faculty members at an institution with relatively robust subscriptions to a wide range of journals, barriers to access for participants' own information needs came less in the form of a lack of access to information, but instead was the result of the difficulty of processing all the information available to them. In addition, because OSU Libraries has sufficient staff to provide services such as data management and an institutional repository, barriers to making their published results more widely available came not in the form of a lack of services, but as a result of their community's preferences and practices for what the published form of their results

should look like. The two sub-themes for this section, *information overload* and *community expectations*, are described below.

Information overload

One barrier to access that participants in this study identified was the large volume of papers currently published. Access to newly published research and the ability to keep up with the literature is a well-recognized source of frustration for researchers because there are always other, more pressing things to do (Pain, 2016). As one participant noted, “I am aware of workflows that would probably behoove me to implement if I had the time.”

Because of the resulting difficulties in choosing what information to access, several participants desired automated tools that could help them keep up with the information in their field in sophisticated ways. One participant found that ResearchGate filled this niche:

You know, the cool new tool that I think is really spectacular is ResearchGate because even – so there are several journals that I get the table of contents sent to me. I don’t find that as useful as things like ResearchGate where it’s really – they’re really functionally linking this information and saying hey, have you seen this? This came out and it’s got – I’m sure it’s just a keyword search but it alerts you when something’s come out in that area.

Similarly, another participant used Faculty of 1000 (F1000) to decide what literature to focus on:

But what I would really like in this forest of literature that's out there that I have a hard time filtering is to have other researchers, including myself, who contributes to that, evaluate papers and then pick the most important ones. I really like Faculty of 1000, even so much that I have my own subscription now because the library doesn't.

But in the absence of more automated tools, another participant continued to use the traditional method of doing the work of keeping up by “clicking through, looking for the keywords, parsing that down to things that seem most relevant – based on what the database produces, based on your keywords – and reading it or skimming it and then looking at references.”

Falciani-White (2016) described faculty information-seeking behaviors as fairly intentional and grounded in traditional models of discovery. Just as in Falciani-White's study, participants in this project gathered information from a combination of traditional routes, such as going to conferences, scanning targeted journal table of contents, and doing searches in databases. One additional way that participants in this study used to keep up with the literature was through their service as journal editors and reviewers. One participant noted that their work as a section editor is one way they are able to keep up with the field and “being the one responsible for sending them [manuscripts] out for review and making a call or a decision if that paper's accepted or not, gives me a lot of opportunity to see what's going on out there.” Another participant who is also an editor for one of their main disciplinary journals, observed that they are able to keep up with about one-third of what is being published in their research niche because of their role as editor.

Community expectations

In contrast few of the participants were aware of OSU Libraries' institutional repository, ScholarsArchive@OSU. If they had heard of ScholarsArchive@OSU, it was because they had received an email asking them to deposit an article they had published. Using ScholarsArchive@OSU to share their works was not appealing to these participants. Their lack of interest was primarily due to the perception that their work would not be easily accessible by their scholarly community if deposited in ScholarsArchive@OSU. Participants did not think of ScholarsArchive@OSU as a solution to any of their access problems, because they did not see it as a system connected with the work of other researchers in their field. Therefore, they did not believe that someone searching for their work would think to look in ScholarsArchive@OSU. In addition, they felt that depositing pre-print manuscripts looked less professional and provided another access barrier to researchers looking for quality published works. One participant compared depositing a pre-print copy of a manuscript to "citing my thesis versus the paper that I'm going to publish from my thesis."

Systems Thinking

CAS researchers approach their work in a unique way because they need to consider not just theoretical questions, but they also need to connect those theories to applications that will impact growers and consumers. This holistic way of thinking also means that research questions must also cross disciplinary boundaries to consider biological, environmental, economic, and political ramifications (Dryland Systems, 2013). One result of this balancing act between theory

and application is that the work these participants do takes place in many research settings. For example, a horticulture researcher may explore the genetics of a particular ornamental plant on a molecular level both in the lab and through computational modeling; conduct pollination crosses in the greenhouse; track how the new plants grow in the field; and monitor issues suppliers and consumers have with the plant once it is finally released.

The practical implications of working in the agricultural sciences are that a researcher must be able to not only conduct research in a variety of settings and move between those settings on a regular basis, but also that researchers must be able to communicate with several different audiences. Their academic audiences are located in both basic and applied science domains. In addition, they need to be able to communicate the practicality of their research to grant agencies, growers, and the general public. Everyone eventually consumes the food and other natural resources produced by the agricultural sector and so the stakes are high for creating products that are safe and also balance larger environmental impacts.

The need to communicate with non-academic audiences is a responsibility not just for those faculty with “extension” officially in their job title, but also for those researchers who must adapt their research agendas to changing public perceptions and economic and environmental needs in order to obtain funding. One participant illustrated these challenges while discussing changes in the way poultry are housed:

For ten years they [the poultry industry] have fought the battle in terms of what’s an appropriate production system. And in no way am I defending one system or the other,

but you cannot do cage poultry anymore in the United States, and they fought it for ten years and lost.

Agricultural researchers must be able to think about a larger system and continually survey a broader landscape to keep up with research techniques and changing public needs.

The ability to think across a variety of systems was also a trait participants sought in their future colleagues and students. One participant desired a “universal scientist”— someone who would bring truly cross-disciplinary skills. This participant described a

...biologist trained in the tradition of physics...a foundation in mathematics. And some at least touch on statistics in computer science while you are learning your fundamentals in the biosciences. Not later as an afterthought, or the experiments aren't just sort of an afterthought. Biology isn't an afterthought. But you're learning these together in sort of the renaissance scientific tradition.

In an increasingly multi-disciplinary field, participants saw the need for researchers who could serve as translators across those domain areas. As this participant went on to observe, with those skills “you know who to collaborate with; you understand what questions to ask.” Without this ability to see how the broader system works, participants were worried that key questions would be unexplored and findings would be misinterpreted.

Conclusions

Academic libraries have multiple responsibilities, including preserving the scholarly works of their community, as well as adapting to changing needs based on the research workflows of their community. Academic libraries at land grant institutions serve a community that extends beyond the university. The OSU Libraries mission statement reflects this by stating that our goal is to, “further the growth of the University, the people of Oregon, and the global scholarly community” (OSU Libraries & Press, 2015, p. 9). While the focus of this study was on the research behaviors of CAS faculty members, because their work intersects with the broader Oregon community, and in some cases with the global community, implications for those communities must be considered when considering implications for our local practice at OSU Libraries based on this study. Implications for the libraries’ role in discovery, access, and dissemination are considered and discussed below.

Issues related to how these participants discovered research sources were noted in the findings and included the process of serving as a peer reviewer, attending conferences, and receiving search alerts either from ResearchGate or other more traditional journal or search alert services. However, the most common route for searching for sources was not discussed in the findings because the comments were so consistently cursory: Participants used very few search tools for discovering sources. Google Scholar was overwhelmingly the search tool of choice, followed by PubMed. Web of Science and 1Search (the library’s discovery layer) each were mentioned only once. As a result of initiating almost all their searches outside of the OSU Libraries’ web environment, these researchers receive few reminders of the value the library provides in ensuring seamless access to paid journal content.

Two implications for consideration are raised as a result of these discovery observations. The first is a call for a closer examination of the longstanding practice of paying for subscription databases when fewer and fewer researchers—presumably the audience most likely to understand their utility—make use of these tools. What role do subscription databases play in an environment where searchers seek a more seamless connection between searching and finding full-text content? What advanced subscription database features might be compelling and useful enough to convince busy researchers to switch to these tools?

The second implication of a non-library specific discovery pathway is the need to promote or highlight the value of both the library's journal subscriptions and the interlibrary loan services the library provides in an increasingly behind-the-scenes way. Discovery and access are highly entwined, especially in searchers' expectations of how the system should work. While libraries include link resolvers in Google Scholar and PubMed, if researchers consistently conduct searches from within the university's IP range, they may never notice the connection to content the library is providing. Are there ways to enhance the messages provided on subscription journal content to make researchers more aware of the seemingly invisible cost of the journal content? In cases where the library does not subscribe to the journal content, how can interlibrary loan services be simplified and promoted so that researchers who are willing to email another researcher or use ResearchGate to message an author, might consider ILL instead? Alternatively, are there community-building aspects of these peer-to-peer sharing practices that the library can highlight and embrace?

One surprising finding about access to content was how few of these participants had comments about gaps in the libraries' collection or suggestions for journal subscriptions. While one participant who had previously worked or studied at much more resource-rich institutions was an outlier, the remainder of the participants felt the publications of their disciplinary communities were well represented by the library's collections. In addition, participants tended to recognize that the needs of the whole university research community needed to be considered when making decisions about the collection. This finding may point to a good alignment of CAS researchers' needs with collection development activities, as well as the success of conversations between the library and departments that have happened over the years as journal cuts have been necessary.

An additional access implication is that libraries or service providers like Ithaka may want to consider evolving ways they can be involved in helping researchers deal with information overload. Several participants commented on the need for an alert service that goes beyond a simple keyword algorithm and that could be more attuned to their research community. Creating an alert tool that combined more nuanced searching with a recommender service could be a valuable addition to researchers' workflows. Several existing tools combine aspects of these desired features (Pain, 2016). One participant in this study subscribed to F1000 with their own funds because of the value they received from the recommendation services. As a simpler way of supporting article recommendations and alerts, OSU Libraries may want to reconsider a subscription to this service.

When considering disseminating the results of their research projects, we found the participants of this study were primarily focused on their academic community. However, because their work as agricultural researchers is situated within the Oregon context, they also felt a responsibility to an Oregon community. The tension between these two audiences becomes important for libraries as we determine how best to use our finite resources. For example, many academic libraries, including OSU Libraries, have attempted to extend the impact of their institution's research by creating and maintaining local institutional repositories. These repositories are viewed by the academic library community as a way to create a local record of the research production as well as a method for providing open access to the research produced at the institution.

These interviews demonstrated that ScholarsArchive@OSU, OSU's local institutional repository, was a tool that was not well understood or valued by the researchers in this study. ScholarsArchive@OSU was not a part of their workflow, not simply because additional work might be required to add their work to this repository, but because it is removed from their community of practice, the community beyond the confines of OSU, that these researchers align with. For most of the researchers interviewed, online spaces such as ResearchGate or their own websites are the preferred online spaces for sharing. Sites such as ResearchGate give researchers opportunities to not only share their work outside of the confines of journal paywalls but also to participate in their community of practice. If this finding is substantiated at the other Ithaka research sites, it behooves the library community to ask hard questions about whether ongoing support of institutional repositories that disconnect researchers from their larger communities of

practice is actually of service to those researchers, or if libraries should pool resources to support or create discipline-based repositories. However, for libraries at land grant institutions, a clearer user base for the university's research outputs may be the local or state community. Collecting and preserving the institution's research outputs with a non-academic audience in mind may create new opportunities for developing a community that makes sense to researchers as well.

Future research is needed at the local level to understand differences in research practices across disciplines, so the library can determine how best to address these cross-disciplinary research needs. Further, given the ongoing financial pressures faced across higher education, continued research is needed to understand how ever-evolving virtual communities, and open research, open access, open data and open science movements impact research practices. The academic library serves an array of audiences. Continuing to ask in-depth questions about the practices and research behaviors of those audiences will enable libraries to find solutions for adapting to changing expectations and needs.

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Appendix A. Interview Protocol

This project seeks to explore the research practices associated with agriculture studies in all of its aspects, including food, the environment, natural resources, and international issues.

We recognize that the field of agriculture is broad and that researchers fall on a disciplinary spectrum that encompasses the sciences, social sciences, economics and business. These researchers explore a wide variety of topics such as but not limited to: agronomy, molecular biology, informatics, remediation of soils for production on earth, cellulosic research for biofuels, nutrient enhancements in food, and the human dimensions of working with youth, rural and urban populations.

Agriculture is an important mission of many public universities and research in the field can be conducted in partnership with industry, NGOs and/or various levels of government.

Research focus

1. Describe your current research focus and how this focus is situated within the broader field of agriculture and the university more broadly.
[Probe for whether/not they see themselves as located firmly within agriculture as a discipline or located across/between disciplines]

[Probe - how much of your work is multi-disciplinary? What does a multidisciplinary project mean to you?]

Research methods

2. What kind of research do you do?
 - a. What kind of research techniques do you use to do this work?
3. What kinds of data does your research typically generate?
4. How do you locate the research literature or outside data (if applicable) you use in your research?
5. Think back to a past or ongoing research project where you faced challenges in the process of conducting the research.
 - a. Describe these challenges.
 - b. What could have been done to mitigate these challenges?
6. How do you keep up with trends in your field more broadly?

[Probe - Does this method work for you? How do you communicate the work you do?]

Dissemination Practices

7. When you publish, where do you typically publish your research in terms of the kinds of publications and disciplines?
 - a. How do your publishing practices relate to either your peers or those typical to your discipline?
8. Have you ever deposited your data or final research products in an institutional or disciplinary repository?
 - a. If so, which repositories and what has been your motivations for depositing? (i.e. required, for sharing, investment in open access principles)
 - b. If no, why not?

Future and State of the Field

9. What future challenges and opportunities do you see for the broader field of agriculture?
[refer back to the definition of agriculture to see if they can situate themselves somewhere in that definition]
10. If I gave you a magic wand that could help you with your research and publication process – what would you ask it to do?

Follow-up

11. Is there anything else about your experiences as a scholar of agriculture and/or the agriculture discipline that you think it is important for me to know that was not covered in the previous questions?