2016

Multidisciplinary Research and Extension Team Evolution: Processes, Outcomes, and Strategies

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Published December 1, 2016

Agricultural & Environmental Letters

Commentary

Multidisciplinary Research and Extension Team Evolution: Processes, Outcomes, and Strategies

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Core Ideas

- Decision makers in production agriculture synthesize information from multiple disciplines.
- Research and extension institutions mainly deliver information from a primary discipline perspective to decision makers.
- Government and academia recognize the importance of multidisciplinary research and extension teams.
- Developing successful multidisciplinary research and extension teams is challenging.
- There are no proven metrics yet to measure goal achievement or models that support growth.

Abstract: Team-based research is not an innovative concept; however, the current models of team research are based principally on self-formed teams with a defined duration. Current trends seem to point toward the development of administratively designed multidisciplinary teams. Although this seems logical, minimal guidelines exist to aid in team development or evaluate team outcomes. Critical processes in a team-based research atmosphere have not been identified, much less described, and strategies for successful implementation have not been proposed. The strength of this approach can be summarized as a unified focus during the course of problem definition and solution. Many trade-offs and obstacles are apparent with a broad-based focus. Chief obstacles and barriers include sustaining the balance between remaining small in size and focused on a problem while fitting into the departmental culture. Internal administrative support is mandatory for building a successful multidisciplinary research team. The required interdependence of multidisciplinary team research requires administrators, as well as peers, to recognize the positive value of each contribution.

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Agric. Environ. Lett. 1:160042 (2016)
doi:10.2134/ael2016.10.0042

Received 11 Oct. 2016.
Accepted 4 Nov. 2016.
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In production agriculture, a myopic focus on one aspect of business can lead to recurring financial crises. For example, corn (*Zea mays* L.) producers focused on maximizing yield per acre can find themselves in financial stress during several years of low corn prices. Likewise, cattle producers focused on genetic improvements that increase the pounds of calf weaned per cow may find themselves with oversized cows that no longer fit the production environment. This type of narrow goal may lead to biases in the decision analysis that result in vulnerability to market swings and climatic risks. Similarly, we in academia can fall prey to focusing on only a single symptom when solving production problems by providing information guided through a single discipline.

Spetzler et al. (2016) defined a comfort zone megabias as "the tendency to drag a problem into our comfort zone and solve the problem that we know how to solve, rather than solving the problem that actually needs to be solved." Production agriculture is complex, with decisions synthesized from multiple disciplines. Unfortunately, research and extension institutions can be guilty of furthering this bias among agricultural decision makers by delivering information from a perspective that is influenced largely by a single primary discipline.

Objectives

A logical question to ask is, how do we equip our land-grant institutions to consistently provide the best solutions to multidisciplinary problems? This paper focuses on this question from the perspective of a multidisciplinary team of three individuals hired as a forced-team or administratively designed research and extension team at a US land-grant institution in the summer of 2014. The fundamental objectives from our perspective of the challenges and opportunities for multidisciplinary teams were (i) to identify and outline team processes and (ii) to recommend strategies needed for

administratively designed research and extension teams to be successful.

Background

Most often, research teams have been developed to address time-sensitive issues in business, social work/public health, and medicine (Stokols et al., 2008). However, such teams usually address activities with specific objectives and defined timespans. These disciplines have the capability to provide much more rapid results than is common in the agricultural sciences. Multidisciplinary, team-based research is a new approach to the historic university model, which has been built on independent thinking and research within narrowly defined disciplines. Only in the last 25 years have authors in the literature accepted team-based research as unique.

Team-based research can take several forms. Rosenfield (1992) presented one of the first categorizations of the cross-disciplinary research approach. He specifically defined (i) unidisciplinary, (ii) multidisciplinary, (iii) interdisciplinary, and (iv) transdisciplinary approaches to team-based research. The major difference in the team-based descriptions is the depth of the research approach to answer common challenges. This is especially the case for agricultural science fields, which encompass biological, chemical, and economic aspects, as well as additional social components.

From a team-based perspective, unidisciplinary research is self-explanatory. Broad examples of these common types of collaborations may be as simple as dividing responsibilities for project data collection, activity management, and sample analysis. The other definitions of team-based research are not as readily distinguishable. Multidisciplinary teams may have varied academic backgrounds and training, but the soft skills are complementary. Conversely, interdisciplinary teams have varied backgrounds and training, but the talents, disciplinary perspectives, and commitment may not necessarily be complementary. Interdisciplinary teams are characterized by respect among disciplines and collaboration where necessary but not with the view of establishing a new quasi-discipline to address a particular problem (Janssen and Goldsworthy, 1996). Transdisciplinary research has additional social, economic, political, and environmental aspects that synthesize and develop new concepts that lead to the development of quasi-disciplines.

Team Categories

Put simply, there are two types of team-based research groups. These are self-formed teams and forced teams, although a case could be made for a hybrid team with a combination of self-formed and forced-team members. Self-formed teams are the most common type and have served as the model for team-based research. These teams are most often developed to answer or respond to a defined, predetermined goal or issue. They tend to be activity specific with a defined sunset date that is common with grants. Once these teams have completed their objective, they either continue with a new activity, disband, or modify the structure to respond to a new issue. Many self-formed teams are also quite large. They are organized by one or more individuals who go on to actively participate in the team pursuits and developments of products.

Minimal information exists on the creation, formation, and development of forced teams. These teams are formed by an administrator who does not intend to participate in the day-to-day activities once the team is set up and functioning. Assignment to the team may be done on a voluntary basis, in the sense that people volunteer to participate, or on a forced basis in the sense that they are told they have to participate. Overall, the administrative goal for creating a research team with a specific focus is to attract significant funding to address specific stakeholder needs.

Defining Our Team

Our team is best described as a multidisciplinary group with a shared vision of achieving common goals and a commitment to creating options that bring about the best solution. The shared vision for team-based research and extension programming is ultimately developed through the combination and contribution of team members' talent, obligation, and commitment. Talent encompasses the sum of soft skills contributed by each team member. Most important among these, at least in the early stages of our development, have been skills related to communication, leadership, and creativity. Obligation to the shared vision by each team member is enhanced through the unique contributions from each team member's disciplinary perspective and participation during the "futuring" or visioning processes (Sobrero, 2004). Commitment can be expanded to include the overall commitment to create, criticize, and complete, in addition to the assumed physical participation.

In the sense that our multidisciplinary team was formed through a planned hiring process, our team was administratively designed. Each team member applied and accepted their individual position with the knowledge that expectations were to actively participate in and contribute to multidisciplinary team efforts. Therefore, our team most closely represents a voluntary basis formation.

Sustainable Multidisciplinary Research and Extension Teams

A sustainable framework for multidisciplinary research and extension teamwork at a land-grant institution must simultaneously consider the professional needs of the individuals involved in the team and the resulting impacts of the work being done on society as a whole. The institution must collectively act to encourage such work while supporting the individuals as professionals within their own discipline. Sustainability will require cooperation across the institution on a number of levels. To begin to address these issues, the team members developed

the SWOT (Strengths, Weaknesses, Opportunities, and Threats) diagram (Fig. 1) to compile a perspective of the challenges and opportunities to utilize multidisciplinary teams to achieve research and extension goals at a land-grant institution.

Strengths

Multidisciplinary team members must be problem oriented, focused on combining disciplines to find the best solutions (Janssen and Goldsworthy, 1996). For teams such as ours, formed through a team hiring process, these characteristics can be controlled through job descriptions and applicant screening.

Furthermore, our collective experience communicating with agricultural producers in extension programs provided a unified outward focus during the problem definition and solution process. Each team member has an appointment in extension service that fully justifies this effort. Communication skills, commitment to a team problem-solving approach, and a positive attitude toward multidisciplinary work are all strengths that help sustain ongoing research and extension efforts.

Surowiecki (2004) identified diversity of training, independent thinking, and a defined voting structure as three principle characteristics of effective research groups. Others have noted that teams function better when hierarchy is avoided (Janssen and Goldsworthy, 1996). To date, our team has avoided hierarchy issues, which has led to lengthy, but effective brainstorming sessions characterized by open communication.

Weaknesses

Many weaknesses associated with multidisciplinary team research and extension efforts can be summarized by the word *complexity*. Each team member must work out balancing the individual program with their disciplinary paradigm. While the multidisciplinary team may function well, university funding and faculty reputation are still largely determined by discipline. This can catalyze counterproductive influences that drain energy, time, and focus away from the desired problem-solving approach.

Furthermore, multidisciplinary teams must create accessibility between members since team members are usually not housed in the same building. Research has shown that proximity encourages collaboration because it allows informal communication to increase. This provides additional opportunities to create a sense of ownership and commitment to a project (Kraut et al., 1988). Team members housed in different buildings or even on different floors or corridors of the same building are less likely to have informal communication opportunities. For our team, open and frequent communication has overcome this situation somewhat, but we communicate face-to-face primarily through formally scheduled meetings.

Opportunities

Multidisciplinary research tends to facilitate the development of an end-user perspective, characterized by greater consultation with stakeholders who could benefit from the research (Janssen and Goldsworthy, 1996). Our unified extension approach to defining the problems, as well as providing outreach with the solutions, puts us in strong position to compete in this space. This has been evident with our multiple-funded Sustainable Agriculture Research and Education (SARE) projects and consistent collaborations with extension educators and their

Strengths	Weaknesses
• Problem oriented • Outward focus • Production systems approach • Communication skills • Brainstorming skills • Attitude • No hierarchy • Experience • Education • Commitment	• Time commitment • Complexity • Disciplinary paradigms • Accessibility • Funding • Lack of prioritization • Counter-productive influences
Opportunities	**Threats**
• Development of user perspective and greater consultation with stakeholders is possible • Support system development • Collective planning of research, seminars, and outreach events • Discovery of new scientific principles • Development of new methodologies • High impact, high reward • Many journals now publish papers with a multidisciplinary focus	• Funding for commodity production systems research is limited – current funding opportunities are more focused on ecology • University evaluation system – lack of an appropriate recognition and rewards system • Departmental culture and University disciplinary organization • Inadequate metrics • Team size

Fig. 1. SWOT (Strengths, Weaknesses, Opportunities, and Threats) diagram of multidisciplinary, team-based research from an administratively designed team.

constituents. This situation leads to opportunities in collective planning of research, seminars, workshops, and other outreach events.

In addition, many journals now publish papers with a multidisciplinary focus. Opportunities to publish multidisciplinary research create incentives to explore high-impact, high-reward research work that could lead to new scientific principles and methodologies.

Threats

A recent funding push toward more solution-focused interdisciplinary research creates opportunities. However, most of these opportunities are currently focused in the area of ecology. Relatively few interdisciplinary or multidisciplinary funding opportunities are available for commodity-based production systems research. Furthermore, these systems approaches are expensive and take multiple years to produce usable results, so multiyear funding commitments are critical to their success.

Land-grant universities are organized by disciplines, creating barriers to evaluating and rewarding multidisciplinary research and extension team efforts. Academic departments create their own culture for evaluating promotion and tenure, with inadequate metrics that consistently undervalue multidisciplinary work. Multidisciplinary teams tend to grow large, with individual team members receiving little credit within the system for participation and team leaders reaping rewards for their leadership that is correlated with the team's size. Our core team is small and focused, but the reward incentive is to grow large so that our leadership qualities become the visible metric on which to measure contributions.

We have found that our small team size and ability to overcome lack of proximity to be important factors that stimulate effective brainstorming and productivity. This is consistent with the observations of Dunbar et al. (1995), who identified four members as the ideal team size. DeMatteo et al. (1998) suggested that the first tradeoff in team size was that as team size increases, individual motivation decreases. They attributed this to the viewpoint that smaller teams have greater individual control, whereas individuals on larger teams do not view their contributions to be as important. The second tradeoff was that rewarding smaller teams served the same purpose as individual rewards but also encouraged group collectiveness as a functional unit rather than as competing individuals.

Team growth is incentivized by the reward structure of funding opportunities that values large, diverse teams working across multiple disciplines and universities. One of the first steps to address this threat would be to secure smaller levels of internal and external support that could be used as the investment to leverage more significant funding. This would allow formation of a hybrid team whereby interdisciplinary team members could be added to increase the capacity to compete for higher levels of funding. Thus, the smaller, focused multidisciplinary team would remain with its central focus.

Conclusions

The evolution, equipping, and evaluation of an integrated, multidisciplinary, team-based extension and research program is complex. Research and extension institutions must work to address realistic team-based research involving multiple disciplines. A focused three- to four-member multidisciplinary team working closely can form an effective core to lead these efforts. In addition, administrative support from each team member's home department is mandatory for building a successful multidisciplinary team. The necessary interdependence of multidisciplinary team research requires that administrators also recognize the positive value of each member's contribution and not view them as a service providers to other team members.

Acknowledgments

Funding for this team-based contribution is supported by Hatch Project 1007541 "Economical Systems for Integrated Crop and Livestock Production" approved on 1 Oct. 2015.

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