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Building multifunctionality into agricultural conservation programs: lessons learned from designing agroforestry systems with central Illinois landowners

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Abstract

Since 1985, land retirement has been the primary approach used by the federal government for environmental protection of agricultural landscapes, but increasingly it is being supplemented by conservation initiatives on working lands. This shift logically supports agroforestry and other multifunctional approaches as a means to combine production and conservation. However, such approaches can be complex and difficult to design, contributing to the limited adoption in the USA. To understand and improve the integration of multifunctional landscapes into conservation programs, we worked with 15 landowners in a collaborative design process to build unique conservation plans utilizing agroforestry. We interviewed participants before and after the design process to examine the utility of a personalized design process, applicability of agroforestry to conservation programs and pathways to improve conservation policy. We found that landowners strongly preferred working in person for the design process, and being presented a comparison of alternative designs, rather than a single option, especially for novel systems. Agroforestry was seen as a viable method of generating conservation benefits while providing value to the landowners, each of whom stated they were more inclined to adopt such practices irrespective of financial assistance to do so. For conservation programs, landowners suggested reducing their complexity, inflexibility and impersonal nature to improve the integration of multifunctional practices that appeal directly to the practitioner's needs and preferences. These findings are valuable for conservation policy because they complement previous research theory suggesting the value of working collaboratively with landowners in the design of multifunctional landscapes. Personalized solutions that are developed based on the unique characteristics of the local landscape and the preferences of the individual landowner may be retained beyond a specified payment period, rather than being converted back into annual crop production.

Introduction

Federal conservation programs

Conservation programs have long played an integral role in the USA in promoting environmental benefits on agricultural lands (Table 1). Prior to the 1980s, conservation policy focused primarily on controlling crop surpluses and reducing soil erosion. The movement toward true 'conservation' was established through the 1985 US Farm Bill, which explicitly stated the importance of conservation for purposes other than productivity gains. The bill established numerous conservation programs still present, most notably the Conservation Reserve Program (CRP; Cain and Lovejoy, 2004). The CRP gives farmers annual rental payments for removing land from production and implementing perennial cover to conserve highly erodible lands and promote beneficial biological services. The CRP has historically been the largest funded conservation program, receiving a budget of over $1.5 billion since 1988 (Osteen *et al.*, 2012).

In 1996, the Environmental Quality Incentives Program (EQIP) was developed as the next substantial modern-day agricultural conservation program with a goal of targeting improvements on working lands to 'maximize environmental benefits per dollar expended' (Helms, 2003, p.125). In 2002, the Conservation Service Program (CSP) was established to issue payments to farmers for achieving resource goals on the scale of the whole farm, rather than focusing on a set practice, as is the case with EQIP. The farm bill passed in 2014 created two new programs, the Agricultural Easement Conservation Program (ACEP) and the Regional Conservation Partnership Program (RCPP). The programs represent an effort by the federal government to delegate a more significant role in conservation planning to the

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Table 1. Timeline of noteworthy events related to conservation policy and their implications for the functioning of conservation programs in the USA (Cain and Lovejoy, 2004)

Date	Event	Implication
1935	Establishment of the Soil Conservation Service	First notable program to provide funding to farmers for soil conservation practices
1956	Creation of the Soil Bank in the Agricultural Act of 1956	Moved land into conserving practices to control loss of productivity and surpluses, and despite its removal in 1958, provided many important lessons for proper land retirement programs
1975	Secretary of Agriculture puts out a call to 'plant fencerow to fencerow'	Reversal of many of the conservation gains produced over the previous 40 yr
1985	Conservation is explicitly mentioned for the first time in the Farm Bill passed in 1985	Soil conservation is seen as useful for reasons other than productivity, signaling a changing mindset within the farm bill toward environmentalism
1985	CRP is established	The largest land retirement program to date in funding and acreage and the most impactful in terms of ecosystem services generated
1994	Soil Conservation Service is renamed Natural Resources Conservation Services	Reaffirms the shift to promoting conservation for more than soil and crop productivity alone
1996	EQIP established	The premier working lands program to date is created, signaling the start of movement toward conservation on working lands
2002	CSP established	The first conservation program to reward farmers already using environmentally sound practices
2014	ACEP and RCPP established	Increased roles for local, regional and non-governmental programs in conservation work

ACEP, Agricultural Conservation Enhancement Program; CRP, Conservation Reserve Program; CSP, Conservation Stewardship Program; RCPP, Regional Conservation Partnership Program.

private industry in coordination with the Natural Resource Conservation Service (NRCS) (Reimer, 2015).

In the 21st century, support for conservation programs in the USA has remained relatively stable, but the manner in which programs are carried out is changing. Support has shifted away from land retirement programs, namely CRP, and begun to move toward working lands approaches, primarily EQIP and CSP. The CRP enrollment acreage cap has steadily declined—from 39.2 million acres in 2002 to 32 million acres in 2008 to 24 million acres in 2018 (Coppess, 2017). During that period, funding for working lands programs has gradually increased and now composes the majority of conservation funding, as shown in Figure 1. The 2018 US fiscal year budget included $5.6 billion for conservation programs, with $2.1 billion requested for CRP, $1.5 billion for EQIP and $1.3 billion for CSP (USDA 2017). The shift in policy toward a working lands approach can be attributed to the current expansion of cropland in the USA after decades of decline, following the trends in market prices for major grain crops (Lark *et al.*, 2015). The rise and fall of acres enrolled in CRP displays the difficulty of preserving conservation benefits from long-term land retirement programs (Morefield *et al.*, 2016).

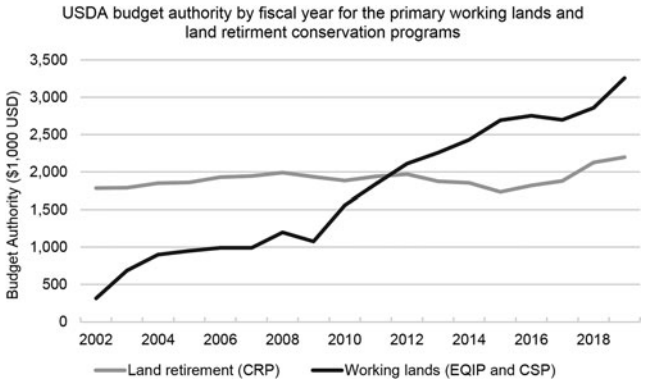

Fig. 1. The budget authority (committed funds of the federal treasury) for fiscal years 2002 through 2018 for the primary three conservation programs grouped by approach: working lands or land retirement (USDA 2017).

Conservation design and planning

Many of the obstacles to ensuring long-term benefits from conservation programs can be traced to their design process and implementation. The current approaches used in CRP and EQIP have been criticized as too complex and inflexible, suggesting a need for an updated multifunctional approach (Dosskey *et al.*, 2012; Reimer and Prokopy, 2014). Both programs utilize a stepwise procedure having a conservationist or landowner identify a resource problem, after which a practice or suite of practices is suggested. There are currently 46 CRP practices listed by the Farm Service Agency (FSA) and 176 conservation practices listed by the NRCS (USDA FSA, 2018; USDA NRCS, 2018), although the number of practices available on a state level may be considerably smaller depending on funding, thus limiting the breadth of options available. The large number of practices present between the two agencies suggests that overlap in functions is likely, which can complicate the selection process for landowners and planners. Many practices, whether for CRP, EQIP or CSP, also aim to achieve a single goal and are criticized for not allowing flexibility in the design process to meet multiple objectives (Dosskey *et al.*, 2012).

Researchers have suggested the use of various design and planning methods to build multiple ecosystem services into the landscape for conservation goals (Ahern, 2006; Dosskey *et al.*, 2012; Opdam *et al.*, 2013; Landis, 2017). One of the most common suggestions is using the US Department of Agriculture (USDA) NRCS National Planning Procedures; a robust, dynamic methodology for designing at numerous scales. The design process involves identifying the problems and resources available to the

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stakeholder, formulating and evaluating alternatives, and implementing and assessing the plan (USDA NRCS, 2014).

Sustainable landscape ecological planning (SLEP) has also been proposed as a promising methodology for conservation development (Ahern, 2006). SLEP is the basis for many components of the NRCS planning procedures, but it additionally attempts to address multiple abiotic–biotic–cultural goals simultaneously using alternative future scenarios that link the present with the future (Dosskey *et al.*, 2012). Final plans are adaptive in implementation, monitoring and education (Ahern, 2006).

Multifunctionality in landscape design methods should also be considered for improving conservation approaches to provide a range of economic, environmental and social functions through a holistic landscape approach (Fry, 2001; Lovell and Johnston, 2009). Selman (2009) promotes the idea of multifunctionality by saying it is fundamental to planning and design through delivery of 'joined-up policy at the landscape scale, where its core property of interconnectivity can be harnessed in ways that produce qualities valued by people' (p.49). The multifunctional landscape framework, the USDA National planning procedures and SLEP all highlight the growing need to modernize decades-old procedures that promote monofunctional solutions for multifaceted issues.

Agroforestry for conservation and production

Conservation practices that combine production and conservation on working lands are poised to increase in popularity given the trends in the farm bills passed in 2002, 2008 and 2014. However, very few practices can provide conservation benefits without substantial tradeoffs in production. Of the multifunctional practices available to landowners, agroforestry may be one of the most promising in achieving these goals simultaneously. Agroforestry gives landowners the ability to produce fruit, nut, wood and timber crops within an existing agricultural system for both profit and conservation (Jose, 2009; Lovell *et al.*, 2018). The use of agroforestry produces a range of environmental benefits which includes improved soil and water quality, carbon sequestration, wildlife habitat and biodiversity (Jose, 2009; Schoeneberger, 2009; Udawatta and Jose, 2012; Montagnini, 2018).

Numerous agroforestry practices are listed in CRP, EQIP and CSP including alley cropping, multi-story cropping, riparian buffers and windbreaks (USDA FSA, 2018; USDA NRCS, 2018). CRP, EQIP and CSP have been fundamental for many landowners in implementing agroforestry practices on their farms, yet their use relative to other customary practices remains low (Moser and Bentrup, 2017). Research has suggested that the inherent complexity in designing these systems and the lack of knowledge and information surrounding them have been significant barriers to their use (Atwell *et al.*, 2010; Mattia *et al.*, 2018). The lack of support tools and information regarding working alongside end users in developing agroforestry systems can limit their expansion and use within federal conservation programs.

Aims of the study

This paper details landowner feedback from two interviews on the use of a collaborative design and planning process of agricultural conservation. We aimed to begin to understand landowners' needs in the design process and their views of conservation programs to understand how programs may be improved. We hypothesized that direct collaboration with landowners to explore multiple design scenarios would supply them with an improved pathway for considering plausible future conservation practices for their property, as well as improving their likelihood of adopting such practices. Results from this study are to be used to help improve the conservation planning and design process with the goal to produce benefits more efficiently within both land retirement and working lands conservation programs.

Materials and methods

Study area

In this study, we worked with 15 landowners in the Upper Sangamon River Watershed (USRW) of central Illinois, an intensively cropped region of the US Corn Belt (Green *et al.*, 2018). The region is dominated by corn and soybeans, totaling 79% land cover in 2017, while wetlands, forests and grasslands accounted for around 9% (USDA NASS, 2012). As a result, the USRW faces soil erosion and water quality concerns typical of those seen throughout the Corn Belt (Keefer and Bauer, 2011).

Conservation programs in Illinois

In Illinois, CRP is the most widely used conservation program by acreage and budget. As of January 2017, a total of 43,598 Illinois farms with 895,814 acres were enrolled in a CRP contract, of which 51,294 acres were located in the USRW (USDA FSA, 2017*b*). The most common CRP practices in the USRW are grass filter strips (11,718 acres), followed by pollinator habitat (6338 acres) and wildlife habitat (4511 acres), all of which are primarily composed of herbaceous species. In 2017, around $162 million in annual rental payments were paid in Illinois (USDA FSA, 2017*a*). In comparison, EQIP receives significantly less funding in Illinois given it is a cost-share program with no annual rental payments, having totaled around $18 million in the 2016 fiscal year (USDA NRCS, 2016). Funding for Conservation Technical Assistance (CTA) in Illinois is also low, receiving a budget of $12.1 million in 2017, down from $17.35 million in 2005 (USDA NRCS, 2017).

Landowner participants

Fifteen participants were involved in the study. Five participants were aged 20–40, six were aged 40–60 and four were aged 60–80. Ten participants were male and five were female. The mean and median land acreage owned were 360 and 125, respectively, with one participant owning 2500 acres. Years of farming experience among the participants ranged from 0 to 44 yr. Five participants' farms consisted of only corn and soybeans, while the others included a selection of other products such as fruits and nuts, flowers, vegetables, livestock and hay. Only five participants' primary income was farming, but all were agricultural landowners in the USRW who had previously been identified by Mattia *et al.* (2018) as medium- to high-potential adopters of agroforestry and similar perennial-based conservation systems. We chose to work with high-potential adopters as they are likely to be the first to use such practices, and will then act as nodes of diffusion for other landowners interested in trying new conservation practices (Rogers, 2003).

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Conservation design and interview process

The research methods used in this study were employed to understand design preferences for agroforestry in central Illinois as well as the design process and conservation programs as a whole. In this paper, we detail the latter, focusing directly on the design process and makeup of conservation programs, while the former is described by Stanek (2018).

This study was conducted in two phases, adapted from Tress and Tress (2003), and is outlined in Table 2. In phase I, a researcher interviewed each participant to begin to build a working relationship, discuss the land and identify interests related to agroforestry design. Interviews, performed from September through October 2016, were semi-structured, 60–90 min long, and conducted at the landowners' properties. The interviews were recorded with landowner permission using both a phone and laptop voice recorder. The interviews were transcribed within 48 h after completion. Researchers used the responses to create three future scenarios to guide conservation designs for landowners. The scenarios focused on production, conservation or cultural components as a means of covering all aspects of land use and needs indicated by landowners.

In phase II of the study, the three scenarios guided the development of three unique designs for each participant's land using a stepwise planning and design process following the landscape ecological planning method described by Ahern (2006). To review the designs, participants were asked to give feedback by mail, and experts in ecology, crop science and forestry were consulted in person. Lastly, each design was visualized in the form of a photo-realistic landscape plan. Designs were mailed to landowners with a supplemental book describing the costs, management, products, timeline, and cultural and environmental benefits of each practice in their designs.

The second interviews were performed in June 2017, from 2 to 6 weeks after landowners received their designs. The interviews, which lasted 90–120 min, were conducted in the same manner as the first set of interviews. Participants were asked a series of questions regarding the utility of the design process, current and previous experiences with conservation programs, the benefits and challenges of integrating conservation practices, and the state of US agriculture as a whole. Several prevalent, repeated themes emerged from landowner feedback in the two interviews and they are detailed in this paper. The entire design and interview process is described in detail by Stanek (2018).

Data analysis

Data were analyzed concurrently with the development of each phase. Audio recordings of interviews were transferred into Audacity (Version 2.1.2), a digital audio editor, for cleaning of the audio files. Interviews were transcribed using Microsoft Word 2016, and transcriptions were transferred into Microsoft Excel 2016 for data cleaning and organization. Quantitative data regarding landowner preferences, motivators and barriers were tabulated and explored in Microsoft Excel 2016. Qualitative data were exported into NVivo 11 Pro, a qualitative data analysis software, for coding and analysis. Themes and landowner preferences regarding the design process and conservation programs were organized and coded using an iterative process. Contextual information about landowners gathered in the first set of interviews was coded; then emerging themes and patterns were coded for using an inductive approach (Thomas, 2006).

Table 2. Timeline of research activities carried out with landowners for the design of conservation plans

Research activity	Date(s)
Letters to landowners asking for participation	July 2016
Interview #1 at landowner's property	September–October 2016
Building designs and supplemental book	November 2016–March 2017
Design feedback from landowners	March 2017
Mailed final designs and information to landowners	May 2017
Interview #2 at landowners' property	June 2017

Results and discussion

The first and second set of interviews with landowners consisted largely of discussions on two topics: the conservation design process and conservation programs. The following sections explore these two topics and examine their relevance toward improving the design process, research objectives and conservation policies. The themes described here were identified as the most commonly occurring in the qualitative analysis and applicable to the scope of this paper; improving conservation design processes and consequently the conservation programs making use of them. These themes do not represent those of every landowner in the study or among the Midwest USA.

The design process

The design process was discussed with landowners through a series of semi-structured questions in the second interview. Of the themes that emerged, four were the most significant in relation to conservation design. These themes are displayed in Table 3 and discussed in detail in the upcoming section. Each offers insight into landowners' values, thoughts and suggestions of when considering the makeup of a successful conservation design process.

Utility of the design process

According to landowners, the most useful aspects of the participatory design process were the conversations during the two interviews and the generation of unique conservation designs. Seven of the 15 landowners found meeting with a research expert during the interviews to be the most useful aspect of the study because it provided a trustworthy source to answer potential design questions. One landowner addressed that opinion in saying the following:

'When we talked the first time it was extremely useful because you were introducing me to the thoughts. Those thoughts never entered my mind. That was extremely helpful just to get my thought process going. Then when [the designs] followed behind…It was very self-explanatory because you had already talked about those things.'

Seven other landowners found the designs to be the most useful as the designs expanded their view of what was possible on their land. This was expressed by one landowner in saying, 'This kind of feedback is valuable to us. We want it to look good, and we want it to produce something and to know that is the kind of trees that will do okay there.' One landowner

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Table 3. Themes and subsequent findings regarding the design process from interviews with landowners

Theme	Summary of landowner views
(1) Utility of the research process	Useful aspects of the design process were the conversations during the two interviews, generating unique conservation designs, and obtaining additional information on conservation practices
(2) Influence of the collaborative design process	Working closely with a designer throughout the design process built knowledge of and enthusiasm for the conservation practices
(3) Preference for working in person	Meeting in person with a landowners improved the trust given to researchers and the subsequent practices being discussed while building a relationship to help inform researchers
(4) Suggestions for improving the design process	More face-to-face time, field days to see the practices being discussed, instructional courses and education materials were suggested to help aid the understanding and adoption of new conservation practices

identified the supplemental book as most useful, although most participants acknowledged its importance in helping them understand the practices used in the designs.

Influence of the collaborative design process

The design process itself, regardless of the designs, had a notable impact on the exchange of knowledge between landowners and researchers. Landowners were asked about working with a landscape designer and how the process influenced their likelihood of using agroforestry. All 15 landowners stated that going through the entirety of the research design process increased the possibility of their using agroforestry practices. Despite the landowners already being determined to be high-potential adopters of such practices, they experienced increased enthusiasm and understanding for using the designs created in the study. Much of the enthusiasm can be traced to the relationship built between the researcher and the landowner throughout the process.

Several landowners emphasized the importance of meeting with someone experienced with agroforestry in helping them understand and accept the legitimacy of the practice. Repeated mentions were made of the value of an 'expert', and without their involvement, the systems 'would be too overwhelming and daunting' and landowners 'would not have time to do the research (themselves)'. Other landowners said they simply would not have been interested without talking to an expert practitioner. In some instances, landowners may have lacked time or resources to learn about practices despite wanting to enroll in a conservation program. Working more directly with landowners serves multiple purposes. It represents a learning tool to expand landowner knowledge of a variety of practices and species that may have previously been unknown. It also gives conservation agents, planners and researchers an opportunity to broaden their views of how practices can be used and help them better understand the needs of landowners (Nassauer and Opdam, 2008; Oliver *et al.*, 2012).

The collaborative nature of this study sheds light on the promise of increasing the transdisciplinary quality of conservation work. The call for bringing together numerous parties with landowners in the conservation realm is not new but it has yet to be fully implemented in any programs (Liu *et al.*, 2007; Reimer, 2015). The likely reason is that it can be quite costly to invest more time into the conservation design and planning process. There are notable examples, though, of programs that have taken on the challenge of working with and educating landowners, conservationists and planners on multifunctional landscape planning using agroforestry. Two such programs that should be considered useful case studies relevant to this research are Australia's Master Tree Grower program (Bauer and Gordon, 2003; Reid, 2017) and the University of Missouri's Agroforestry Academy (Gold *et al.*, 2013).

Preference for working in person

Researchers built trust with landowners by taking the time to meet in person on multiple occasions, rather than conducting the experiment through the mail or electronically. Many landowners stated they would have ignored the study if not given the opportunity to meet with someone in person. Having a researcher visit their land with an open mind was a requirement for landowners, as described by one saying, 'You could understand and implement what I was concerned with. You did not consider my ground a petri dish, and you actually were concerned with it.' Various participants expressed how they are constantly receiving participation requests from research projects, surveys and related materials and they simply do not have time to do them all. Meeting face-to-face with researchers or conservationists is no longer the norm but is arguably now valued even more by landowners.

Previous studies working with farmers echo these sentiments in showing how conservation approaches that incorporate farmers views as 'expert' knowledge and develop collaborative relationships are essential for successful integrated approaches in agriculture (Pannell *et al.*, 2006; Oliver *et al.*, 2012; Williams and Brown, 2014). Additionally, not only do researchers need to value the landowner and their contribution but so too does the broader community (Vanclay, 2004). Public policy regarding conservation programs must actively attempt to work with landowners to avoid developing a mismatch between policy, implementation and impact.

Suggestions for improving the design process

Landowners offered several ideas for improving the conservation design process used in this study. First, they wanted more face-to-face time with other landowners interested in agroforestry or using it already. They felt meeting with people who had already established agroforestry would allow them to ask about management and feasibility of the systems. They suggested a field tour to show the practices before the design process took place and as a way to meet with other interested landowners. According to one landowner, 'If we could do those tours beforehand, that would be extremely useful. Then when you are asking us stuff, we have actually seen it.' Another landowner suggested that with all the new information, '[You] could almost make a class out of this. Spend more time being a teacher and me being a student.' Yet another said they '[I] would have loved for you to have hosted a gathering of your fifteen people for the networking support.'

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Echoing the findings of other studies (Valdivia *et al.*, 2012; Mattia *et al.*, 2018), these suggestions indicate landowners' desire for more information and collaboration. The information needs described by landowners can be delivered through a variety of sources such as tours, classes and informational materials; they should be offered early in the learning process to help landowners decide the suitability and makeup of potential practices (Reid, 2017). Providing these supports will require more resources and money dedicated to conservation, but the supports may pay for themselves. As the understanding of a practice increases, the better it can be managed; and in turn, a higher level of social and environmental benefits is potentially generated relative to using practices that are not understood or managed well.

Conservation programs

The topic of conservation programs comprised much of the conversation during interviews with landowners. The responses from the interview questions regarding federal conservation programs, specifically CRP and EQIP, are organized here into four most prevalent themes and outlined in Table 4. Each theme should be considered in light of how it may apply to the broader, national approach to conservation.

Table 4. Themes and subsequent findings regarding conservation programs from interviews with landowners

Theme	Summary of landowner views
(1) Attitudes toward conservation programs	Attitudes were typically 'poor' and expressed a lack of trust in federal conservation policy and how programs are carried out
(2) Suggestions for improving conservation programs	Programs should be less bureaucratic, be more flexible in practice and offer more tangible value to the landowner beyond financial assistance
(3) Integrating production and conservation	Preferred practices are those that are dual purpose, such as agroforestry, and that can be successful as working lands approaches
(4) Limiting land reversal	Using high-value woody crops may provide greater long-term financial and environmental benefits than using perennial grasses, helping to reduce land reversal

Opinions of conservation programs

Landowner's views of federal conservation programs varied but most landowners expressed some level of dissatisfaction. About half had direct experience with at least one conservation program, typically CRP. Appreciation was expressed for the land rent received, but the value given to the practices on the land itself was usually low. Many saw the practices being implemented to be a 'bunch of weeds' with landowners having little to no interest. Landowner views were often shaped by a single example, or a small subset of nearby examples, of poorly managed CRP land. One landowner expressed the sentiment this way:

'With some [CRPs] they plant them and just go away and then [the contract] just stops. That is a concern because then it goes back to weed again. Then we go back to spraying. Then we have everything with the soil again. To me, it would be more beneficial if we could have something there that would be useful and that people would take care of.'

Properly managing CRP land can be problematic in various ways. Landowners in previous studies have expressed their challenges, which include not living near their CRP lands, not having the ability or equipment to manage them and feeling the cost of management is too high (Allen and Vanderever, 2003). These challenges were raised by landowners in this study as well and suggests a need for increased assistance or flexibility in the management of conservation land. It is important to note that landowners are required to establish a conservation plan to perform periodic management activities for CRP land, but the extent to which this is carried out likely varies.

Landowner views of conservation programs were also associated with a distrust of government involvement. Distrust in government programs and entities, for a variety of reasons, is not uncommon (Atwell *et al.*, 2009; USDA NRCS, 2011) and trust can be rebuilt in time (Lebel *et al.*, 2006). However, this distrust may not be core to the behaviors of landowners. Arbuckle (2013) explained how distrust of the government by farmers in Iowa is generally unfounded, as their research results demonstrated that farmers supported targeted conservation approaches on marginal lands when contacted by natural resource professionals. The targeted approaches were not seen as invasive or intrusive but instead were accepted as a practical approach to implementing conservation. Local and regional efforts carried out by new programs such as ACEP and RCPP may be useful in building more valued, targeted approaches that farmers' trust.

Suggestions for improving conservation programs

Landowners suggested that conservation programs could be improved by being less bureaucratic and allowing for more flexibility, specifically with CRP. One landowner described their frustration with federal conservation programs in this way: 'The bureaucracy end of it frustrates you…[such as] having to fit a cookie cutter model whenever things are not cookie cutter modeled.' This type of sentiment is not uncommon; a movement toward flexibility has previously been found to be a significant factor in successful conservation policy (Schirmer *et al.*, 2012).

To improve program flexibility, conservationists would need the knowledge and technical skills to efficiently produce multifunctional goals, in contrast with the monofunctional objectives of many current practices (Selman, 2009; Dosskey *et al.*, 2012). Such a change will not be easily accomplished, as it requires substantial work to build new regulations, rules and resources, but is a worthwhile pathway to be considered. Added flexibility in the design process allows systems to be customized more closely to farmers' functional needs creating a potential to increase adoption frequency and longevity of practices.

Another way to improve conservation programs mentioned by landowners was to add real economic value to the prescribed practices by allowing for more production components. Despite a potential reduction in ecosystem services from adding in some level of production (Morefield *et al.*, 2016), landowners saw this approach as a route to building more sustainable conservation practices. One landowner explained, 'I do not believe in taking public money to take land out of production…I believe in investing in private land with public money for the good of the public…We need to figure out how to keep in production, not take it out.' These views are not uncommon. The importance of profitability in conservation adoption, whether direct or indirect, is well documented (Atwell *et al.*, 2010; USDA NRCS, 2011). To reduce the long-term cost of conservation programs,

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suggestions have been made for supporting the establishment of practices that can meet conservation goals while being profitable at some point (Naidoo *et al*., 2006; Valdivia *et al*., 2012).

Integrating production and conservation

Landowners saw agroforestry as one plausible approach to integrate production and conservation benefits, but they suggested that without changes to the current programs, such multifunctional goals were unlikely. One landowner illustrated this idea: 'Why not harvest things that you can make money off of while still fulfilling an environmental role? It seems like such a no-brainer.' The landowner was alluding to the potential to harvest crops from CRP lands, which the program currently prohibits to avoid a potential loss of ecosystem services and to prevent 'double-dipping' (making money off the land and rental payments simultaneously). While valid, this argument ignores the rapid rise of working lands approaches such as EQIP and CSP. The concerns for loss of services are mainly with practices using herbaceous species. Woody crops, especially food producing, may react very differently to harvesting, as it is often much less destructive and the level of ecosystem services provided may be unchanged or even improved, such as through increased rates of nutrient sequestration after biomass removal (Adegbidi *et al*., 2001).

Researchers have begun to explore the plausibility of using low-input food producing woody crops on marginal lands for ecosystem services (Lovell *et al*., 2018) and initial results by Wolz *et al*. (2018) show promise within central Illinois. Converting corn–soybean rotations to multi-species alley cropping systems reduced nitrate leaching by 82–91% and annual N_2O fluxes reduced by 25–83%. The study did not compare their results to common land retirement practices though, which remains an under researched topic for woody food producing crops, given that the focus has been primarily on timber and grasses (Naidoo *et al*., 2006; Barraquand and Martinet, 2011). It is unclear if these types of approaches can entirely make up for the loss of CRP land, especially for wildlife habitat, which may be difficult to produce on working lands (Morefield *et al*., 2016).

Limiting land reversal

Promoting practices and specific species that discourage a farmer from reverting conservation land to production may help to improve the long-term benefits of conservation programs (Morefield *et al*., 2016). One landowner discussed this topic in this way: 'Once you get these trees established, you cannot turn [the land] into tillable farmland easily.' Land reversal is a serious concern in conservation programs, specifically CRP.

The most commonly used CRP practices are native and introduced grasses. In 2017, over 58% of the national CRP acreage consisted of some assemblage of grass species (USDA FSA, 2017b). Though grasses are extremely valuable to the environment (Johnson *et al*., 2016), practices using only grasses are the easiest to convert back to crop production. From 2010 to 2013, CRP land in the Midwest USA was converted back to intensive agriculture at an estimated rate of 30%, raising serious concerns about sustained ecosystem services in the region (Newton and Kuethe, 2015; Morefield *et al*., 2016). CRP lands that are moved back into production cease to provide high levels of ecosystem services and many of the accumulated benefits are negated.

The long-term impacts of policies, beyond a 5 or 10 yr period as for CRP, should be considered when investing taxpayer money into farmland for public benefit. Financial assistance to support conservation practices may be better suited to being thought of as an investment in environmental capital. Investments that continue to generate value to the public beyond the initial time of investment should be favored over those with limited return.

Limitations

This study offers useful insights into the design process and implementation of conservation programs but has several limitations that should be considered. First, the participants in this study were concentrated in one region of central Illinois and were a unique subset of operators and landowners. Their ideas and preferences may not reflect those of landowners in different agricultural areas, but they may be an analog given that the USRW is very similar to much of the Midwest USA, where the most intensive agricultural production occurs. Secondly, the study itself was semi-structured to allow landowners a level of freedom in expressing their opinions and preferences for their land. It is not possible to draw statistically significant conclusions from this work: its use should rather be seen as exploratory, a necessary step toward understanding landowners' challenges with conservation programs. Lastly, the design focus here was centered on agroforestry and its design for landowners in central Illinois. Though agroforestry represents only one tool for landowners looking to implement conservation practices, it may be one of the most important systems for implementing and sustaining the goals of working lands conservation. Additional practices and design processes should be considered when considering landowners who are not as willing to adopt innovative practices. No one practice or design process will suit the needs of all. Despite these limitations, the insights detailed by this study allow for future research and policy to consider alternative approaches to improving conservation programs.

Moving forward

The next steps for research on conservation design, especially regarding agroforestry, are to better understand how the conservation and production benefits of adapted design approaches integrating more user-focused systems compare to the practices typically prescribed by conservationists. We plan to expand the breadth of educational tools and training available to foster the development of landowner experts who can begin to employ the use of multifunctional conservation practices. Farmers who employ innovative conservation techniques may present researchers with excellent case study examples of how and why mutually beneficial practices can develop. Conservation practices established and managed without outside funding are 'ideal' as they require no public resources, and are likely to be better cared for given their connection and value to the landowner. Conservationists and researchers should continue to learn from farmers to accommodate the diverse, ever-changing portfolio of conservation needs.

Conclusions

Conservation design, implementation and funding are complex, multi-layered processes and are inextricably linked. They require a well-considered institutional framework for successful implementation and remain a substantial challenge for landowners and conservationists alike, especially when considering multifunctional landscapes. A single study cannot solve each of

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the challenges presented by conservation programs without risking oversimplifying the recommendations stemming from the investigation. For this reason, we focused primarily on the conservation design process to develop improved methods of meeting the growing need for working lands approaches, which appear poised to become the primary tool for delivering conservation benefits in the future.

The lessons learned here demonstrate how the design process in conservation programs can benefit from using a more individualized approach to build long-lasting practices, highly valued by landowners. Given the growing number of information tools available to designers and planners, it is no longer acceptable to promote programs that apply practices based strictly on predetermined designs, a method that can create disconnect between the implementation of a practice and its long-term impact. Spending additional time and money at the beginning of a design process to build systems that are valued by the landowner may help to preserve conservation practices on the land in the face of shifting policies and market prices that are currently challenging the sustainability of land retirement programs.

The feasibility of CRP land is challenged by high crop prices, increased demand for land and a cost-saving mentality on behalf of the federal government (Stubbs, 2014) despite the plethora of ecosystem services they generate (Hansen, 2007; Johnson *et al.*, 2016). The movement toward working lands approaches will likely persist given their apparent economic advantages and should be explored for the unique opportunities they can offer. Working lands conservation shifts much of the responsibility to provide environmental benefits onto the farmer, which may appear at first to be detrimental, but in actuality, could favor the development of genuinely sustainable multifunctional agricultural practices that integrate production goals with conservation goals. Our findings suggest landowners are open to and motivated by the development of design processes that foster these integrations, and they should be examined further to continue working towards solving the complex questions facing conservation design, implementation and funding in the USA.

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References

Adegbidi HG, Volk TA, White EH, Abrahamson LP, Briggs RD and Bickelhaupt DH (2001) Biomass and nutrient removal by willow clones in experimental bioenergy plantations in New York State. *Biomass and Bioenergy* **20**, 399–411.

Ahern J (2006) Theories, methods and strategies for sustainable landscape planning. In Tress B, Tress G, Fry G and Opdam P (eds), *From Landscape Research to Landscape Planning. Aspects of Integration, Education and Application*. Dordrecht, NL: Springer, pp. 119–131.

Allen AW and Vanderever MW (2003) A national survey of Conservation Reserve Program (CRP) participants on environmental effects, wildlife issues, and vegetation management on program lands. Biological Science Report, Geological Survey Fort Collins Science Center Colorado.

Arbuckle JG (2013) Farmer attitudes toward proactive targeting of agricultural conservation programs. *Society & Natural Resources* **26**, 625–641.

Atwell RC, Schulte LA and Westphal LM (2009) Landscape, community, countryside: linking biophysical and social scales in US Corn Belt agricultural landscapes. *Landscape Ecology* **24**, 791–806.

Atwell RC, Schulte LA and Westphal LM (2010) How to build multifunctional agricultural landscapes in the U.S. Corn Belt: add perennials and partnerships. *Land Use Policy* **27**, 1082–1090.

Barraquand F and Martinet V (2011) Biological conservation in dynamic agricultural landscapes: effectiveness of public policies and trade-offs with agricultural production. *Ecological Economics* **70**, 910–920.

Bauer M and Gordon J (2003) *Evaluation of the Agroforestry and Farm Forestry Program: An Assessment of Benefits—Stage 2*. Barton, A.C.T: RIRDC.

Cain Z and Lovejoy S (2004) History and outlook for farm bill conservation programs. *Choices (New York, N Y)* **19**, 37–42.

Coppess J (2017) Historical background on the Conservation Reserve Program. farmdoc daily 7(82). Department of Agricultural and Consumer Economics, University of_Illinois at Urbana-Champaign.

Dosskey M, Wells G, Bentrup G and Wallace D (2012) Enhancing ecosystem services: designing for multifunctionality. *Journal of Soil and Water Conservation* **67**, 37A–41A.

Fry GLA (2001) Multifunctional landscapes—towards transdisciplinary research. *Landscape and Urban Planning* **57**, 159–168.

Gold MA, Cernusca MM and Jose S (2013) Creating the knowledge infrastructure to enhance landowner adoption of agroforestry through an agroforestry academy. Proceedings of the 13th North American Agroforestry Conference, June 19–21, 2013, Charlottetown, Prince Edward Island, Canada:92–96.

Green TR, Kipka H, David O and McMaster GS (2018) Where is the USA Corn Belt, and how is it changing? *Science of The Total Environment* **618**, 1613–1618.

Hansen L (2007) Conservation Reserve Program: environmental benefits update. *Agricultural and Resource Economics Review* **36**, 267–280.

Helms JD (2003) The Evolution of Conservation Payments to Farmers. Compensating Landowners for Conserving Agricultural Land U.C. Davis Community Studies Extension, Davis, CA. pp. 123–132.

Johnson KA, Dalzell BJ, Donahue M, Gourevitch J, Johnson DL, Karlovits GS, Keeler B and Smith JT (2016) Conservation Reserve Program (CRP) lands provide ecosystem service benefits that exceed land rental payment costs. *Ecosystem Services* **18**, 175–185.

Jose S (2009) Agroforestry for ecosystem services and environmental benefits: an overview. *Agroforestry Systems* **76**, 1–10.

Keefer L and Bauer E (2011) Upper Sangamon River Watershed monitoring data for the USEPA targeted watershed study: 2005–2008. ISWS Contract Report 2011-03.

Landis DA (2017) Designing agricultural landscapes for biodiversity-based ecosystem services. *Basic and Applied Ecology* **18**, 1–12.

Lark TJ, Salmon JM and Gibbs HK (2015) Cropland expansion outpaces agricultural and biofuel policies in the United States. *Environmental Research Letters* **10**, 044003.

Lebel L, Anderies JM, Campbell B, Folke C, Hatfield-Dodds S, Hughes TP and Wilson J (2006) Governance and the capacity to manage resilience in regional social-ecological systems. *Ecology and Society* **11**, 19.

Liu J, Dietz T, Carpenter SR, Alberti M, Folke C, Moran E, Pell AN, Deadman P, Kratz T, Lubchenco J, Ostrom E, Ouyang Z, Provencher W, Redman CL, Schneider SH and Taylor WW (2007) Complexity of coupled human and natural systems. *Science* **317**, 1513–1516.

Lovell ST and Johnston DM (2009) Creating multifunctional landscapes: how can the field of ecology inform the design of the landscape? *Frontiers in Ecology and the Environment* **7**, 212–220.

Lovell ST, Dupraz C, Gold M, Jose S, Revord R, Stanek E and Wolz KJ (2018) Temperate agroforestry research: considering multifunctional woody polycultures and the design of long-term field trials. *Agroforestry Systems* **92**, 1397–1415.

Mattia CM, Lovell ST and Davis A (2018) Identifying barriers and motivators for adoption of multifunctional perennial cropping systems by

https://doi.org/10.1017/S1742170518000601 Published online by Cambridge University Press

landowners in the Upper Sangamon River Watershed, Illinois. *Agroforestry Systems* **92**, 1115–1169.

Montagnini F (2018) *Integrating Landscapes: Agroforestry for Biodiversity Conservation and Food Sovereignty*, 1st Edn. Cham, Switzerland: Springer International Publishing.

Morefield PE, LeDuc SD, Clark CM and Iovanna R (2016) Grasslands, wetlands, and agriculture: the fate of land expiring from the Conservation Reserve Program in the Midwestern United States. *Environmental Research Letters* **11**, 094005.

Moser K and Bentrup G (2017) *Agroforestry resources. Agroforestry: Enhancing resiliency in U.S. agricultural landscapes under changing conditions. Gen. tech* (Report WO-96). Washington, DC: USDA Forest Service.

Naidoo R, Balmford A, Ferraro PJ, Polasky S, Ricketts TH and Rouget M (2006) Integrating economic costs into conservation planning. *Trends in Ecology & Evolution* **21**, 681–687.

Nassauer JI and Opdam P (2008) Design in science: extending the landscape ecology paradigm. *Landscape Ecology* **23**, 633–644.

Newton J and Kuethe T (2015) Changing landscape of corn and soybean production and potential implications in 2015. farmdoc daily 5(42). Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign.

Oliver DM, Fish RD, Winter M, Hodgson CJ, Heathwaite AL and Chadwick DR (2012) Valuing local knowledge as a source of expert data: farmer engagement and the design of decision support systems. *Environmental Modelling & Software* **36**, 76–85.

Opdam P, Nassauer JI, Wang Z, Albert C, Bentrup G, Castella J-C, McAlpine C, Liu J, Sheppard S and Swaffield S (2013) Science for action at the local landscape scale. *Landscape Ecology* **28**, 1439–1445.

Osteen C, Gottlieb J and Vasavada U (eds) (2012) Agricultural resources and environmental indicators. USDA-ERS Economic Information Bulletin No. 98. Available at http://dx.doi.org/10.2139/ssrn.2141408.

Pannell DJ, Marshall GR, Barr N, Curtis A, Vanclay F and Wilkinson R (2006) Understanding and promoting adoption of conservation practices by rural landholders. *Australian Journal of Experimental Agriculture* **46**, 1407–1424.

Reid R (2017) Developing farmer and community capacity in Agroforestry: is the Australian Master TreeGrower program transferable to other countries? *Agroforestry Systems* **91**, 847–865.

Reimer A (2015) Ecological modernization in U.S. agri-environmental programs: trends in the 2014 farm bill. *Land Use Policy* **47**, 209–217.

Reimer A and Prokopy LS (2014) Farmer participation in U.S. farm bill conservation programs. *Environmental Management* **53**, 318–332.

Rogers E (2003) *Diffusion of Innovations*, 5th Edn. New York, NY: Free Press.

Schirmer J, Dovers S and Clayton H (2012) Informing conservation policy design through an examination of landholder preferences: a case study of scattered tree conservation in Australia. *Biological Conservation* **153**, 51–63.

Schoeneberger MM (2009) Agroforestry: working trees for sequestering carbon on agricultural lands. *Agroforestry Systems* **75**, 27–37.

Selman P (2009) Planning for landscape multifunctionality. *Sustainability: Science, Practice and Policy* **5**, 45–52.

Stanek E. 2018. *The design and implementation of multifunctional woody polycultures: landowner preferences and pathways to improve agricultural conservation* (Master's Thesis). University of Illinois at Urbana-Champaign, Urbana, IL.

Stubbs M (2014) *Conservation Reserve Program (CRP): status and issues*. Congressional Research Service Report No. 42783. Washington, DC.

Thomas DR (2006) A general inductive approach for analyzing qualitative evaluation data. *American Journal of Evaluation* **27**, 237–246.

Tress B and Tress G (2003) Scenario visualisation for participatory landscape planning—a study from Denmark. *Landscape and Urban Planning* **64**, 161–178.

Udawatta RP and Jose S (2012) Agroforestry strategies to sequester carbon in temperate North America. *Agroforestry Systems* **86**, 225–242.

USDA (2017) Archived USDA budget summaries. Office of Budget and Program Analysis. Available at: https://www.obpa.usda.gov/budsum/budget_summary.html (Accessed 27 April 2018).

USDA FSA (2017*a*) Conservation Reserve Program Monthly Summary—September 2017. Available at https://www.fsa.usda.gov/Assets/USDA-FSA-Public/usdafiles/Conservation/PDF/September2017Summary.pdf (Accessed 21 April 2018).

USDA FSA (2017*b*) CRP (Acres) by County, as of January 2017. Available at https://www.fsa.usda.gov/Assets/USDA-FSA-Public/usdafiles/Conservation/Excel/CRP_COUNTY_PRACTICE.xlsx (Accessed 11 April 2018).

USDA FSA (2018) CRP practices library. Available at https://www.fsa.usda.gov/programs-and-services/conservation-programs/crp-practices-library/index (Accessed 11 April 2018).

USDA NASS (2012) Census of agriculture: Quick stats. Available at https://quickstats.nass.usda.gov (Accessed 27 April 2018)

USDA NRCS (2011) USDA NIFA Conservation Effects Assessment Project (CEAP) fact sheets. Available at http://www.soil.ncsu.edu/publications/NIFACEAP/Factsheet_3.pdf (Accessed 17 April 2018).

USDA NRCS (2014) National Planning Procedures Handbook (NPPH), Edition 1. Available at https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=36483.wba (Accessed 11 April 2018).

USDA NRCS (2016) Environmental Quality Incentives Program (EQIP) farm bill report (FY 2009 through FY 2016). Available at https://www.nrcs.usda.gov/Internet/NRCS_RCA/reports/fb08_cp_eqip.html (Accessed 16 April 2018).

USDA NRCS (2017) Conservation Technical Assistance (CTA) | Report (FY 2005 through FY 2017) | NRCS. [Internet]. Available at https://www.nrcs.usda.gov/Internet/NRCS_RCA/reports/srpt_cp_cta.html.

USDA NRCS (2018) National Conservation Practice Standards. nrcs.usda.gov. Available at https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/technical/cp/ncps/ (Accessed 11 April 2018).

Valdivia C, Barbieri C and Gold MA (2012) Between forestry and farming: policy and environmental implications of the barriers to agroforestry adoption. *Canadian Journal of Agricultural Economics* **60**, 155–175.

Vanclay F (2004) Social principles for agricultural extension to assist in the promotion of natural resource management. *Australian Journal of Experimental Agriculture* **44**, 213.

Williams BK and Brown ED (2014) Adaptive management: from more talk to real action. *Environmental Management* **53**, 465–479.

Wolz KJ, Branham BE and DeLucia EH (2018) Reduced nitrogen losses after conversion of row crop agriculture to alley cropping with mixed fruit and nut trees. *Agriculture, Ecosystems & Environment* **258**, 172–181.

https://doi.org/10.1017/S1742170518000601 Published online by Cambridge University Press