Union of Concerned Scientists

FACT SHEET

Opportunities, Obstacles, and Needs Surrounding Public Support for Agroecology

A Survey of Scientists

HIGHLIGHTS

Agroecology has tremendous support among scientists, but according to a survey conducted by the Union of Concerned Scientists, numerous obstacles prevent them from undertaking sustainable agriculture research and communicating their findings to farmers and the public. Agricultural research programs, including many of the competitive grant programs managed by the US Department of Agriculture (USDA), should receive more funding and direct a larger portion of their resources toward agroecology. The USDA and universities, including land grant universities, could further strengthen the field of sustainable agriculture by prioritizing an interdisciplinary approach and emphasizing the social, health, and equity components within research, extension, and education efforts.

Agroecology examines farming challenges in the context of ecosystems and societies, providing insights into how agricultural practices can work with ecological processes to improve outcomes for farmers, the environment, and the public (Gliessman 2016). There is growing evidence that agroecological solutions can maintain or improve farmers' profits while delivering environmental benefits, such as lower rates of soil erosion and water pollution (Mulik 2016; Mulik 2017). Further, research suggests that agroecology may hold solutions that simultaneously address challenges related not only to food, but also to energy and water (DeLonge and Basche 2017). In light of this promise, an increasing number of scientists have called for additional public funding and support for this research (UCS 2017). However, despite the potential of agroecology, numerous obstacles limit the widespread implementation of agroecological research and practice (Miles, DeLonge, and Carlisle 2017; DeLonge, Miles, and Carlisle 2016; UCS 2015).

To better understand the opportunities and obstacles surrounding agroecology, the Union of Concerned Scientists conducted a confidential online survey of researchers and other professionals in the field of sustainable agriculture. The survey, which was taken by 176 qualified experts (those holding an advanced degree), contained 28 multiple-choice and open-ended questions pertaining to respondents' experiences soliciting funding for and conducting agroecological research.[1] The survey respondents represented a wide geographic range of the agricultural science community and reported working within diverse positions at various institutions and career stages (see the table on p. 2). This report presents key results about scientists' perceptions of public support for

Organic Seed Alliance

Diversified farms function best when crop varieties are bred and practices are tailored to local soils, climates, pests, and other conditions. Here, participants from a Northern Organic Vegetable Improvement Collaborative (NOVIC) training on plant breeding take a look at an organic onion field trial in Montana.

Key Characteristics of Agroecology Survey Participants

Category	Subgroup	Participants (%)
Region	Southwest (including CA)	20
	Southeast	20
	Midwest	19
	Pacific Northwest (including AK)	16
	Northeast	16
	Outside of the US	5
	Northern Plains	3
Employer	Land grant university	54
	Non–land grant public college or university	15
	Nonprofit organizations	15
	Private industry	14
	Local, state, or federal government agency	9
Number of years in field	0–10	45
	11 or more	55

The Union of Concerned Scientists conducted a confidential online survey of researchers and other professionals in the field of sustainable agriculture. Qualified respondents all held an advanced degree and included 176 individuals representing a wide range of geographical regions, institutions, and career stages.

agroecological research, highlighting opportunities for progress, financial and political obstacles, and federal policy recommendations.

Defining Sustainable Agriculture and Agroecology

The first step toward identifying opportunities for progress in and obstacles to sustainable agriculture research is understanding how scientists who are engaged in this research understand the scope of their work. For example, *agroecology* has been defined in numerous ways, ranging from applied agricultural ecology concerned with environmental externalities of the industrial agricultural system, to a transdisciplinary science, practice, and social movement that aims to drive food systems toward greater ecological sustainability and social equity (Altieri 1995; Gliessman, Garcia, and Amador 1981; Montenegro de Wit and Iles 2016). In our survey, we asked respondents to provide their own definitions of *sustainable agriculture*, and we then analyzed these based on a framework developed by Gliessman (2016). The framework categorizes *sustainable agriculture* into several levels: increasing efficiencies to reduce the use of agrochemical inputs (Level 1); substituting more sustainable inputs and practices into farming systems (Level 2); redesigning farming systems based on ecological principles to maximize ecosystem services (Level 3); reconnecting producers to consumers to support a socioecological transformation of the food system (Level 4); and redesigning the global food system based on ecological restoration, social justice, and equity (Level 5).

Our analysis of respondents' definitions indicated that 24 percent met the standards of Level 5, demonstrating strong support for a vision of agroecology as a socially transformative force. Moreover, 8 percent of definitions met the criteria for Level 4 (stressing the need to reconnect producers and consumers), 38 percent reflected the need for adoption of agroecological farming practices (as in Level 3), 6 percent focused on the need to improve farms by substituting better practices and inputs into current systems (Level 2), and 23 percent of definitions were characterized primarily by the objective to increase efficiency (Level 1). More specifically, a significant number of respondents referenced equity (41 percent), economic viability (34 percent), human health (18 percent), and regenerative practices (18 percent).[2] These findings revealed that many scientists understood the field of sustainable agriculture to be interdisciplinary—or even transdisciplinary[3]—and capable of addressing farming practices, improving natural resource sustainability and human well-being, and solving real-world problems, such as persistent inequities related to the food system.

The Case for Public Agroecological Research Support

Public funding for agricultural research has a strong history in the United States (Pardey et al. 2015) but has declined in recent decades, particularly compared to private funding (SoAR 2017). The lack of public funding for agricultural research and development has had consequences, because

> ***Many scientists understood the field of sustainable agriculture to be capable of improving natural resource sustainability and human well-being.***

public and private support has tended to fund different research areas (Clancy, Fuglie, and Heisey 2016). The private sector generally invests in research leading to processes and products that can provide profits for investors, while the public sector funds more foundational research and development that can reduce reliance on purchased inputs, promote ecosystem services, or result in innovations that cannot easily be commercialized. Therefore, for agroecology, the private sector is is likely not an effective or adequate substitute for publicly funded research. A recent analysis has shown that agroecological research currently receives relatively limited financial support from public funding agencies (DeLonge, Miles, and Carlisle 2016). Recognizing the misalignment between research needs and dollars invested, we examined the case for a reformed public funding structure that addresses obstacles to conducting transformative agroecological research.

Our survey highlighted several specific concerns that build on the above points and further the case for public support for agroecological research:

Scientists confirmed that a *lack of public research funding* for sustainable agriculture and agroecology is a significant barrier to their work. Survey findings indicated that most scientists (84 percent) considered the lack of research funding to be an important obstacle.

Many scientists reported that it has become *increasingly challenging to obtain funding*, with substantial resources devoted annually to seeking funding and with public funds coming up short. Many respondents (44 percent) stated that acquiring funding for sustainable agriculture research has become more difficult during their careers. This trend was particularly pronounced for scientists who have been in the field for 11 or more years (for 58 percent of these scientists, acquiring funds has gotten harder, and for 20 percent, it has gotten much harder). The challenge of securing funding includes large time investments by scientists, with more than 15 percent estimating that they spend more than a quarter of their time writing funding proposals, a task performed among their many other essential responsibilities, such as teaching, mentoring, and conducting research. As one respondent noted: "The amount of work required to keep a pipeline of proposals is totally out of proportion to the funding amount and duration. It would be more efficient to ask people to put the serious effort in less frequently." Furthermore, a large proportion of respondents (36 percent) noted that they have stopped applying to funding programs on which they used to rely, due to low funding rates or changes in research direction. One respondent shared that given low funding rates, "it is very discouraging to spend the huge amounts of time required to submit federal grant applications, for a very tiny chance of getting any payoff."

Tracy Robillard/NRCS Oregon

Agroecology can improve the effectiveness of conservation farming practices such as using cover crops, which can build soil health and reduce water pollution. Field days such as this one in Corvallis, OR, are a critical way to both demonstrate outcomes and train farmers.

A large majority of scientists indicated that *"entrenched financial interests"* are barriers to their research, confirming the need for independent sources of research funding. Compared with several other obstacles (including "lack of research funding"), "entrenched financial interests" rose to the top, with 89 percent of respondents citing it as important or very important. Moreover, 49 percent of scientists specifically reported that "conflicts of interest related to private sector funding" pose a substantial obstacle to sustainable agriculture research. These conflicts of financial interests may negatively influence the integrity of research; for example, 16 percent of respondents reported experiencing pressure from funders to change their research direction.[4] More generally, a majority (53 percent) of scientists believed that sustainable agriculture research entails challenging relationships with agricultural stakeholders, potentially including funders, administrators or other colleagues within universities, farm or industry groups, and other local organizations.

Scientists believed that *publicly funded research programs should emphasize several aspects of agroecology*. In particular, many respondents considered transformative, socially relevant aspects of agroecology to be integral to sustainable agriculture, yet they noted that these elements are often overlooked. Scientists felt that to promote this research, agroecology (74 percent), interdisciplinary aspects (71 percent),

Aaron Price

Grasslands, such as this multi-generation rotationally grazed range in north central Nebraska, provide enormous value by supporting livelihoods, protecting biodiversity and wildlife, reducing water pollution, and storing carbon in soils. However, increased funding for regionally-appropriate agroecological research is needed to continue to develop and improve management practices that deliver the best outcomes.

broader public benefits such as ecosystem services (75 percent), and human dimensions and decisionmaking (67 percent) should be referenced more in the US Department of Agriculture's (USDA) requests for applications (RFAs). The consensus around the interdisciplinary and human decisionmaking aspects of agroecology indicated the need to substantively incorporate social sciences into sustainable agriculture research to bring about transformative change. As one scientist emphasized: "Decision science and economics are often given lip service only, whereas in the real world they play absolutely crucial roles in determining the adoption of sustainable agriculture practices. I would like to see more proposals that focus on, rather than marginalize, these social sciences elements of sustainable agriculture." Currently, despite interest, sufficient resources to effectively enable this work do not exist. In the words of one scientist: "For sustained programs, for the time it takes to build relationships, develop priorities, questions and protocols, to train community based researchers, and to use research as a policy tool—there just isn't the support. We would need $100,000 grants, not $3,000 grants that raise the profile of an issue but go nowhere towards solving it." Another scientist commented: "One often must veil interdisciplinary work as multiple projects that fall squarely in the disciplines, in order to prove their worth. This, in the end, undermines the real benefit of interdisciplinary work that has the potential to illuminate a whole that is greater than its parts."

Scientists maintained that *agroecology must be encouraged beyond USDA competitive grant RFAs*. Many respondents noted that the explicit mention of agroecological principles in RFAs would not go far enough to promote this type of research, indicating a need for broader recognition of agroecology from funding agencies and institutions. Regarding sustainable agriculture buzzwords, one scientist noted, "Even if RFAs include these words, the grant reviewers or agencies might not be favorable to these types of projects," suggesting that changes to the review process may be equally if not more important in encouraging agroecology.

Opportunities and Obstacles for Sustainable Agricultural Research

Beyond the need for additional public financial support for sustainable agriculture and agroecology, several obstacles may affect the ability of scientists to productively engage in such research (Miles, DeLonge, and Carlisle 2017). The results of our survey revealed numerous obstacles but also identified a few noteworthy opportunities.

***The size and scope of funding available for some specific areas of research are not satisfactory*, according to respondents**, especially for interdisciplinary (73 percent), on-farm (73 percent), and community-based (64 percent)

> *"[Community-based research] requires having a team and people with skills beyond research, such as facilitation, communications, cultural and racial competencies, etc."*
>
> — Survey Respondent

research. Respondents indicated that these areas would benefit from additional opportunities for smaller grants that are widely available through a more streamlined application process, and for pilot projects or regionally focused research. As one scientist noted: "Small-budget projects that emphasize simple field methods and farmer-participatory and farmer-initiated research can yield great benefits for small sums. . . . The large awards leave no funds for smaller institutions or farmer groups to obtain modest grants to test or develop great ideas." Another respondent pointed out that "[p]art of increasing sustainability of agriculture is returning to geographically diverse production and peri-urban production of perishable commodities. But it is hard for those of us outside major production areas to compete for national funding." Scientists noted that on-farm and community-based research are essential if a goal of the field is to inspire broader change: "If farmers can see sustainable agriculture working for them economically while solving problems they have with soil tilth and drainage, they are much more likely to adopt sustainable practices than if we keep shoving information in their faces from farms in other areas using practices that are difficult to apply to different types of farming conditions. We have to tailor solutions to groups operating under similar conditions (political, social, and environmental)."

***The lack of long-term support* is problematic for agroecology, which requires complex research.** In addition to reporting a need for grant funding for small and short-term projects, a large majority of respondents (69 percent) stated that it is also important or very important to increase the duration of research grants.[5] While research grants in the biophysical sciences typically last three to five years, agroecological research poses unique demands, with a longer period required for field trials to demonstrate impact. One scientist commented: "Any work related to sustainable agriculture takes more than 3 years to create benefits, impacts, and changes. In decisions, mindset, and behavior. All issues related in sustainable agriculture are linked as a system, and it takes more resources and funding to identify collaborators who can promote and support complicated projects." Another respondent specifically suggested that "[d]uration is key. You cannot come to a conclusion in research on a sustainable agricultural approach in the customary 3-year program. It takes 5 years minimum and a decade is more conclusive." As one scientist emphasized, "Agriculture is different than other industries."

***Lack of attention to social justice and racial equity* was cited as an important issue that may limit the expansion of agroecological systems.** A large proportion of respondents noted that it is important or very important to explicitly reference social justice (67 percent) and racial equity (58 percent) in USDA RFAs. This suggestion fits into the wider vision of agroecology as the foundation for a global food system grounded in equity, participation, democracy, and justice (Gliessman 2016), which, as noted earlier, was echoed by many of the respondents' definitions of sustainable agriculture. One scientist noted that the need to confront these issues is often accentuated during on-farm research, since farmworkers are frequently undocumented immigrants from vulnerable backgrounds and researchers are commonly white and well-educated: "This situation allows that perverted dynamics of privilege and power happen all the time, where the researchers go, collect the data, then analyze it . . . and then publish and gain prestige, while the farmworkers' situation remains mainly the same. . . . Science is far from being neutral." While these dynamics have no easy solutions, a more intentional approach to addressing patterns of inequality within the food system is necessary. One starting place could be to provide more support for scientists undertaking research that considers such issues and that engages a broader set of stakeholders, including community members. And as one respondent noted, such research has additional needs: "[Community-based research] requires having a team and people with skills beyond research, such as facilitation, communications, cultural and racial competencies, etc."

Scientists are often *unable to effectively communicate their research findings* outside of academic circles. Respondents indicated dissatisfaction with their ability to engage with policymakers and to conduct media and public outreach. For example, more than three-quarters (76 percent) of survey respondents considered policy engagement important, while only 28 percent reported that it is part of their job. Common areas of dissatisfaction related to policy engagement opportunities included a lack of rewards and recognition

Edwin Remsberg/USDA-SARE

Diversifying agroecosystems at the landscape scale is key to achieving the best environmental and social outcomes. Here, cover crops are planted alongside the Chesapeake Bay in Oxford, MD, where they serve as a buffer and help prevent water pollution.

from employers (45 percent) and research communities (41 percent), as well as limited support from their institutions (41 percent). Further, 17 percent of respondents reported having been discouraged from engaging with policymakers on issues related to their research. As one scientist noted: "It is frustrating that there is so much fear and silence about policies that we should organizationally be advocating for. There is a lot of cowardice over losing research funding or employment for engaging in policy, and a lot also geared toward fear of having your science disrespected because you engage in policy processes. The Universities systematically play a role in these fears, and it needs to stop." Similarly, respondents expressed dissatisfaction with opportunities for media and public outreach—particularly with the amount of time (44 percent) and training (37 percent) for and institutional recognition (35 percent) of these activities—and highlighted the importance of extension programs to expand agroecological practices. One respondent commented: "There should be some requirement . . . of having researchers publish publicly available and easy-to-find information in language that the general public can understand on their findings and conclusions."

However, scientists agreed that *there is widespread interest in sustainable agriculture research*, including interdisciplinary, farmer-driven, and community-based research. Scientists reported strong interest from their students and colleagues in much of this research. Only 3 percent and 12 percent of respondents, respectively, felt that the number of students and colleagues willing to participate in interdisciplinary research is a barrier, and these numbers were only slightly higher for on-farm or farmer-participatory research. Such findings are encouraging, especially given other recent recommendations that public universities engage in more transdisciplinary research and community partnerships (APLU 2017). Furthermore, only 32 percent of scientists felt that lack of public interest is a barrier to their work, suggesting that the broader public has been relatively supportive of their research.

Scientists also agreed that *agroecology has the potential to be scaled up*, confirming that experts in the field see the transformative potential of sustainable agriculture practices. Only 29 percent of respondents considered the scalability of agroecological practices to be an obstacle to their research, suggesting that a more agroecologically based food system is realistic.

Challenges within Existing USDA Research Programs

Given the strong case for more funding for agroecological research, and with a better understanding of both the opportunities and barriers perceived by scientists, what could the USDA do to encourage positive change? Our survey revealed several possible ways to strengthen existing programs, including key competitive research programs managed by the National Institute of Food and Agriculture.

Sustainable Agriculture Research and Education (SARE) program: The SARE program is relatively small (funding for the 2017 fiscal year totals $27 million[6]), but it fills a niche by supporting on-farm and farmer-participatory sustainable agriculture research that is not always possible with other USDA grants. Our survey indicated that on-farm research is an area with particularly high demand, with 73 percent of respondents dissatisfied with the amount of available funding. In addition, many scientists pointed to the need for more small grants that can support regionally tailored research, a type of grant common within the SARE program. Yet despite the importance of the program, many researchers noted that they have not recently competed for SARE grants because funding rates are so low.[7]

Organic Agriculture Research and Extension Initiative (OREI) and Organic Transitions (ORG) programs: As the market share for certified organic foods has grown, demand for research specific to organic systems has also expanded. Research that takes place on certified organic farms or farms transitioning to organic is especially critical, and such research typically advances agroecology (DeLonge, Miles, and Carlisle

2016). However, despite the urgent need for this research, resources are limited for the two primary organic research programs (Schonbeck, Jerkins, and Ory 2016). In fiscal year 2017, these programs, OREI and ORG, were authorized at $20 million and $4 million, respectively, and neither program has guaranteed funding. Responding to the survey, many scientists expressed concerns about the limited funding available for these programs.[8]

Agriculture and Food Research Initiative (AFRI): The AFRI program is the USDA's flagship research program and serves a wide variety of needs within agricultural research. Because this program represents the largest pool of available funds for competitive agricultural research ($375 million in fiscal year 2017), it is within this program that many of the general concerns raised in this survey may be best addressed. These concerns include not only the need for additional funding, but also the need for grants of a longer duration. The latter can tackle some of the more complex research questions.

Recommendations and Conclusions

This survey of scientists working in the field of sustainable agriculture emphasizes the need for more public support for research and highlighted several specific needs. Based on analysis of these findings, we recommend the following:

Within the Research, Education, and Economics Mission Area at the USDA, emphasize the social and economic aspects of food system sustainability in research programs and RFAs. Agroecological science has the potential to establish a more sustainable food system. This achievement, however, will require the field to make more space for effective community-based and social science research that addresses persistent inequities, such as those related to gender, race, institutions, income, and geographies.

Ensure that grants are available at a variety of scales to serve a range of research needs. Larger and longer-term grants, beyond the typical three- to five-year grant cycle, are necessary to sustain complex field experiments and demonstrate the systemic impact of agroecological practices. At the same time, invest in small and short-term funding opportunities with more streamlined application processes for focused, site-specific reesearch, including seed grants for pilot projects.

Emphasize outreach and extension within existing USDA competitive grant programs, and improve training and support for media and public outreach within universities. Streamline communication between research and extension activities so that research findings may be easily communicated with farmers, policymakers, and the wider community.

Increase funding for interdisciplinary and agroecological research within USDA research programs, particularly for key programs with a history of funding such research, including SARE, OREI, ORG, and AFRI. Such public investments can help relieve scientists of the pressure from entrenched financial interests and other constraints.

Overall, our analysis suggests that there are several steps that the USDA, public and land grant universities, and Congress can take to boost agroecology. Given the growing evidence that agroecological research and development can offer solutions that benefit the environment, farmers, and the public, increased federal funding and stronger support for agroecology are well justified and of vital importance.

Marcia DeLonge *is a senior scientist in the UCS Food and Environment program.* ***Tali Robbins*** *is a campaign associate in the program.* ***Andrea Basche*** *was a Kendall Science Fellow in the program.*

ACKNOWLEDGMENTS

This report was made possible in part through the generous support of the Grantham Foundation for the Protection of the Environment, the TomKat Foundation, and UCS members. For their thoughtful reviews and feedback during the development of the survey, the authors would like to thank Kristal Jones, PhD (National Socio-Environmental Synthesis Center, University of Maryland); Angie Carter, PhD (Michigan Technological University); Gabrielle Roesch-McNally, PhD (Northwest Climate Hub); and Linda Prokopy, PhD, and the Natural Resources Social Science Lab (Purdue University). The authors would also like to thank Kanika Gandhi, MPA (National Sustainable Agriculture Coalition); Lindsey Haynes-Maslow PhD, MHA (North Carolina State University), and Jasmin Gonzalez (formerly UCS) for their helpful input and reviews. At UCS, the authors particularly thank Mike Lavender and Gretchen Goldman, PhD, for their help in developing and refining this report. Organizational affiliations are listed for identification purposes only. The opinions expressed herein do not necessarily reflect those of the organizations that funded the work or the individuals who reviewed it. UCS bears sole responsibility for the report's contents.

ENDNOTES

1 *The survey was reviewed by four doctoral scientists as part of the internal development process. The survey was also submitted to and approved by Western IRB, an independent company accredited to perform institutional review board services. The Union of Concerned Scientists circulated the survey to UCS Science Network members with relevant expertise and forwarded the survey to several active listservs with interests pertaining to sustainable agriculture and agroecology. Respondents were encouraged to share the survey with other interested and qualified colleagues. Responses from those who did not meet the listed qualifications of holding an advanced degree (master's or doctorate) and having academic or professional experience related to sustainable agriculture were not considered. Respondents were not required to reply to all questions.*

2 *Less frequently, definitions focused on specific features of sustainable farming systems, such as climate change mitigation (8 percent), local food systems (6 percent), and organic practices (3 percent).*

3 *Both interdisciplinary and transdisciplinary fields relate to more than one area of knowledge. Interdisciplinary work synthesizes knowledge from two or more fields, whereas transdisciplinary work has been defined as more specifically integrating "the natural, social and health sciences in a humanities*

context, and transcend[ing] their traditional boundaries" (Choi and Pak 2006). In agroecology, transdisciplinary work entails incorporating elements of both practice and collective action, which may facilitate the transition from practice adoption on individual farms to larger landscape-level change (DeLonge and Basche 2017).

4 *Scientific integrity may also be a concern within the USDA: A recent survey of USDA scientists found that a small but significant number of scientists had experienced pressure from external entities (29 scientists, or 2 percent of respondents) or department officials (42 scientists, or 3 percent of respondents) to alter their work for reasons other than technical merit (OIG 2017).*

5 *There were more respondents who considered increasing the duration of grants to be important or very important (69 percent) than there were respondents who considered increasing the maximum funding amount per grant to be important or very important (56 percent).*

6 *By comparison, the total USDA budget for FY2017 was approximately $149 billion, whereas the Research Education and Economics Mission Area was about $3.1 billion (around half of which was allocated to National Institute of Food and Agriculture) (USDA 2017).*

7 *Eight scientists specifically noted that they have previously applied to SARE but have abandoned that program due to the low funding rate or apparent research direction of the program.*

8 *Scientists specifically noted that they have previously applied to OREI (2) or ORG (2) but have abandoned those programs due to their low funding rates or apparent research directions.*

REFERENCES

Altieri, M.A. 1995. *Agroecology: The science of sustainable agriculture,* second edition. London: Intermediate Technology Publications Ltd.

Association of Public and Land-Grant Universities (APLU). 2017. *The challenge of change: Harnessing university discovery, engagement, and learning to achieve food and nutrition security*. Washington, DC. Online at *www.aplu.org/library/the-challenge-of-change/File*, accessed August 27, 2017.

Choi, B.C., and A.W. Pak. 2006. Multidisciplinarity, interdisciplinarity and transdisciplinarity in health research, services, education and policy: 1. Definitions, objectives, and evidence of effectiveness. *Clinical and Investigative Medicine* 29(6):351.

Clancy, M., K. Fuglie, and P. Heisey. 2016. U.S. agricultural R&D in an era of falling public funding. Online at *www.ers.usda.gov/amber-waves/2016/november/us-agricultural-rd-in-an-era-of-falling-public-funding*, accessed August 27, 2017.

DeLonge M.S., and A. Basche. 2017. Leveraging agroecology for solutions in food, energy, and water. *Elementa: Science of the Anthropocene* 5:6. doi:10.1525/elementa.211.

DeLonge, M.S., A. Miles, and L. Carlisle. 2016. Investing in the transition to sustainable agriculture. *Environmental Science & Policy* 55:266–273.

Gliessman, S.R. 2016. Transforming food systems with agroecology. *Agroecology and Sustainable Food Systems* 40(3):187–189. doi:10.1080/21683565.2015.1130765.

Gliessman, S.R., R.E. Garcia, and M.A. Amador. 1981. The ecological basis for the application of traditional agricultural technology in the management of tropical agro-ecosystems. *Agro-Ecosystems* 7(3):173–185. doi:10.1016/0304-3746(81)90001-9.

Miles, A., M.S. DeLonge, and L. Carlisle. 2017. Triggering a positive research and policy feedback cycle to support a transition to agroecology and sustainable food systems. *Agroecology and Sustainable Food Systems* 41(7):855–879.

Montenegro de Wit, M., and A. Iles. 2016. Toward thick legitimacy: Creating a web of legitimacy for agroecology. *Elementa: Science of the Anthropocene* 4:115. doi:10.12952/journal.elementa.000115.

Mulik, K. 2017. *Rotating crops, turning profits: How diversified farming systems can help farmers while protecting soil and preventing pollution.* Cambridge, MA. Online at *www.ucsusa.org/RotatingCrops.*

Mulik, K. 2016. *Subsidizing waste: How inefficient US farm policy costs taxpayers, businesses, and farmers billions.* Cambridge, MA. Online at: *www.ucsusa.org/subsidizingwaste.* Office of Inspector General (OIG). 2017. *Survey of USDA scientists regarding scientific integrity: Methodology, analysis, and results.* Washington, DC: US Department of Agriculture. Online at *www.peer.org/assets/docs/usda/4_20_17_USDA_IG_scientist_survey.pdf.*

Pardey, P.G., C. Chan-Kang, J. Beddow, and S.P. Dehmer. 2015. Long-run and global R&D funding trajectories: The U.S. farm bill in a changing context. *American Journal of Agricultural Economics* 97(5):1312–1323.

Schonbeck, M., D. Jerkins, and J. Ory. 2016. *Taking stock: Analyzing and reporting organic research investments, 2002–2014*. Santa Cruz, CA: Organic Farming Research Foundation. Online at *http://ofrf.org/taking-stocking-analyzing-and-reporting-organic-research-investments-2002-2014*, accessed August 27, 2017.

Supporters of Agricultural Research Foundation (SoAR). 2017. *Retaking the field: Strengthening the science of farm and food production.* Online at *http://supportagresearch.org/wp-content/uploads/2017/03/SoAR_Retaking_the_Field_Vol_2.pdf,* accessed August 27, 2017.

Union of Concerned Scientists (UCS). 2017. *Scientists call for public investment in agroecological research.* Cambridge, MA. Online at *www.ucsusa.org/our-work/food-agriculture/solutions/advance-sustainable-agriculture/scientists-call-public-investment-agroecology.*

Union of Concerned Scientists (UCS). 2015. *Counting on agroecology: Why we should invest more in the transition to sustainable agriculture.* Cambridge, MA. Online at *www.ucsusa.org/agroecologyfunding.*

US Department of Agriculture (USDA). 2017. *USDA FY 2018 budget summary*. Washington, DC. Online at *https://www.usda.gov/our-agency/about-usda/budget,* accessed August 27, 2017.

Union of Concerned Scientists

FIND THIS DOCUMENT ONLINE: www.ucsusa.org/AgroecologySurvey

The Union of Concerned Scientists puts rigorous, independent science to work to solve our planet's most pressing problems. Joining with people across the country, we combine technical analysis and effective advocacy to create innovative, practical solutions for a healthy, safe, and sustainable future.

NATIONAL HEADQUARTERS
Two Brattle Square
Cambridge, MA 02138-3780
Phone: (617) 547-5552
Fax: (617) 864-9405

WASHINGTON, DC, OFFICE
1825 K St. NW, Suite 800
Washington, DC 20006-1232
Phone: (202) 223-6133
Fax: (202) 223-6162

WEST COAST OFFICE
500 12th St., Suite 340
Oakland, CA 94607-4087
Phone: (510) 843-1872
Fax: (510) 451-3785

MIDWEST OFFICE
One N. LaSalle St., Suite 1904
Chicago, IL 60602-4064
Phone: (312) 578-1750
Fax: (312) 578-1751

WEB: www.ucsusa.org