Union of Concerned Scientists

FACT SHEET

Counting On Agroecology

Why We Should Invest More in the Transition to Sustainable Agriculture

HIGHLIGHTS

Today's farms and ranches produce abundant food, fiber, and fuel, yet many also contribute to air and water pollution, climate change, biodiversity loss, public health problems, and other societal challenges. Agroecology promises solutions, but this science of managing lands to boost the health of farms, ranches, and surrounding environments is underfunded and understudied. A new analysis by UCS and partners indicates that just 15 percent of funding granted by the U.S. Department of Agriculture in 2014 for research and education incorporated any element of agroecology. The agency devoted even less funding to projects emphasizing agroecological research or implementation. The lack of a focused investment in research accelerating the transition to sustainable agriculture threatens the nation's food system.

Across the United States, farms and ranches produce vast quantities of food, fiber, and fuel that are available at relatively affordable prices. This abundance is a measure of success, yet it often comes at the expense of the environment, public health, and even long-term agricultural productivity (Liebman and Schulte 2015; Steffen at al. 2015; Kremen and Miles 2012). Many fields are planted with the same crop year after year, subjected to frequent and intensive mechanical soil disruption to suppress weeds and incorporate crop residues, and left bare when not in production. Such practices can erode, pollute, and in other ways degrade the soil. Similarly, large amounts of fertilizer are often applied to maximize productivity, but much of it either is lost via surface runoff or groundwater leaching, leading to toxic algal blooms and aquatic dead zones, or escapes to the atmosphere, where it contributes to climate change.

The combination of heavy herbicide use with the widespread planting of herbicide-resistant crops is another problem. This has led to the evolution of herbicide-resistant "superweeds," the drifting of herbicides onto neighboring farms, and new challenges for certified organic systems and other farms producing crops that are not resistant to herbicides. Intensive pesticide use has also raised concerns about the environmental impacts and human health risks of exposure to these chemicals (Shelton et al. 2014; Hayes et al. 2011).

Taken together, these issues point to the urgent need to enhance the sustainability of agriculture. The good news is that studies have shown that agroecological systems, which feature farming practices that work with nature, can provide long-term environmental benefits while maintaining productivity (Davis et al. 2012). But maximizing the potential of such systems requires investment, particularly in research and technical assistance for farmers. Current levels of investment are not meeting this need.

© Keefe Keeley, Savanna Institute

Vulcan Farm in Illinois (above) grows more than 50 species and 400 varieties of perennial crops. As a Savanna Institute Case Study Farm, agroecological research conducted here is shared at "field days" for farmers across the region. Scaled-up USDA research and education programming would help more farmers learn about the benefits of agroecological systems.

© Liz Carlisle

More than 20 different crops rotate through fields at Vilicus Farms in Montana, while pollinator-friendly border plantings between each crop plot help promote biodiversity. More federal funding and policy support are needed to refine these and other agroecological practices and help farmers adapt them to different regions, climates, and farming challenges.

A Classification System for Sustainable Farm Practices

As evidence of the impacts of industrial farming on the environment and society mounts, there is growing attention to the need to redesign the food system. As part of this effort, one internationally recognized leader in the field of agroecology established a framework for classifying agricultural practices based on their potential to make the system more sustainable (Gliessman 2014). Practices are grouped in five "levels," ranging from incremental to transformative.

Level 1 practices focus on increasing efficiency to improve the sustainability of farms and food production. Due to such efforts, many farmers today need fewer off-farm inputs—fertilizers, pesticides, water, and energy—to maintain productivity. Waste reduction at the farm and during processing also prevents the unnecessary overuse of limited resources. Improved crop and animal-product yields are also hypothesized to improve production efficiency. Such advances can serve as important steppingstones to a more sustainable food system, although farmers who adopt them typically still rely on high-risk or limited resources.

Level 2 efforts substitute less-damaging inputs and practices for those that currently pose the highest risks. For example, many farmers replace chemical fertilizers with compost and cover crops, adopt nonchemical pest-control strategies, or till fields less frequently. Organic farming systems commonly use substitutes for the most harmful inputs. As at Level 1, such measures reduce agriculture's environmental impact but leave intact the underlying input-dependent and biologically simplified model of farming.

Level 3 efforts integrate agroecological practices to enhance complementary interactions in food and farming systems to meet food needs while providing additional environmental and public health benefits (Ponisio et al. 2015; Gliessman 2014; Kremen and Miles 2012). This science of managing lands to boost the health of farms, ranches, and surrounding environments embraces systemic approaches to designing and managing sustainable food systems, from farm production to food distribution. Farms managed with Level 3 practices, such as complex crop rotations and crop and animal diversification, can improve the health of the soil, reduce pests, support pollinators, and mitigate climate change, while avoiding the negative environmental footprint common to industrial farming systems (Gliessman 2014; Kremen and Miles 2012; Reganold et al. 2011).

Level 4 systems reinforce connections between producers and consumers to address the interdependence of agriculture and society (De Schutter 2014; Gliessman 2014). These relationships can be supported through policies and incentives that engage communities and businesses in sustainable operations. Robust sustainability can be achieved when the agroecological practices of Level 3 are combined with Level 4 socioeconomic supports to result in products that consumers value, demand, and can access.

Level 5 systems fully develop and integrate the agroecological practices of Level 3 and the alternative market relationships of Level 4 to support a global sustainable food system grounded in social change. This level represents the final stage of conversion in the classification system.

Public Investment for the Public Good

Given the urgent need to change agricultural practices, what is the role of federal funding in supporting agricultural research? And how well does the United States do in supporting the transition to a more sustainable agricultural system?

Historically, the United States has been an international leader in investing public resources in agricultural innovation for the public good. In 1862, President Lincoln established the U.S. Department of Agriculture (USDA), which he referred to as "The People's Department" (Vilsack 2012). The same year, the Morrill Land Grant College Act established the network of colleges and universities that still receive dedicated federal support and collaborate with the USDA to tackle agricultural problems (Ramaswamy 2015). In 1914, the Smith-Lever

Extension Act created the extension service, mandated "to aid in diffusing . . . useful and practical information on subjects relating to agriculture" (Smith-Lever Act 1914). These investments exhibit a commitment to supporting agriculture for societal benefit.

Agroecology aligns with the USDA's longstanding mission to serve the public interest. Agroecological research demonstrates that it is possible to maintain farm productivity and profitability while reducing negative impacts on the environment and society. However, more research is required to optimize this approach for widely ranging environmental conditions and enterprises. Public support for agroecology is particularly important because its practices tend to reduce the need for many goods and services sold by private industry to farmers, leaving this research area neglected by private-sector investment.

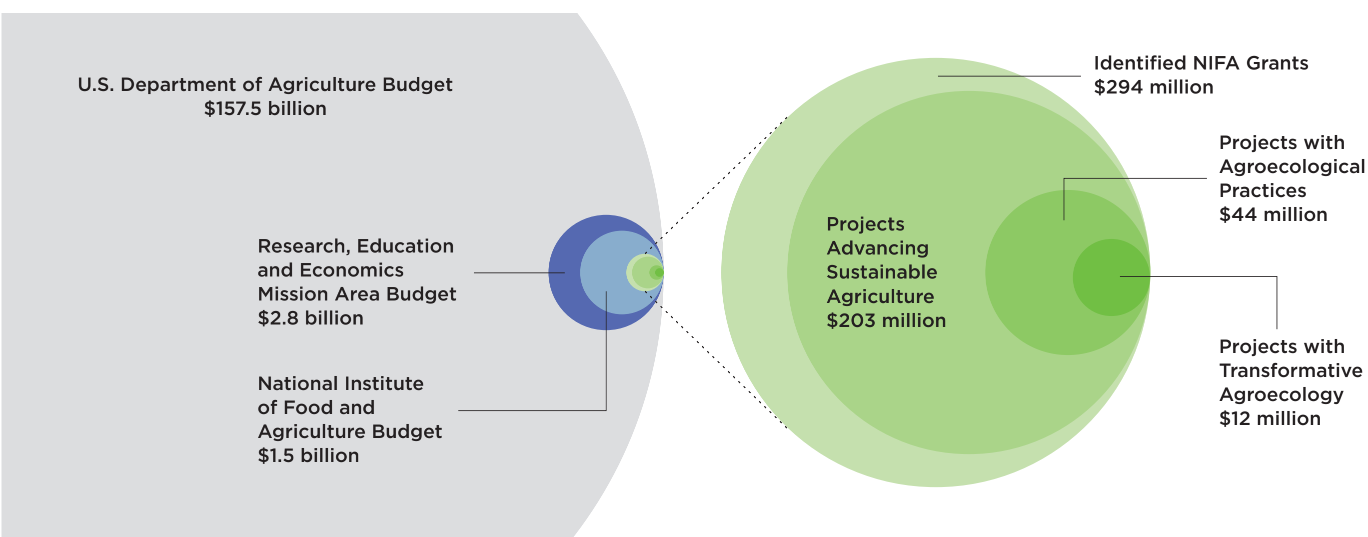
Today, the United States maintains the tradition of public support for agricultural research primarily through the USDA's Research, Education, and Economics (REE) mission area, which is "dedicated to the creation of a safe, sustainable, competitive U.S. food and fiber system and strong, healthy communities, families, and youth." Two agencies, the Agricultural Research Service (ARS) and the National Institute of Food and Agriculture (NIFA), receive the majority of the funding to implement this mission for REE. The ARS is the principal in-house research agency, while NIFA supports competitive research, education, and extension programs within land-grant colleges, universities, and partner organizations. Thus, NIFA provides funding and leadership that can guide innovation throughout the nation's agricultural research and education institutions.

However, funding from the USDA to pursue agroecological research has been limited, despite the agency's stated commitment to advancing sustainable agriculture. In 2014, the REE mission area as a whole had a total budget of $2.8 billion, a fraction of the USDA's annual budget of $157.5 billion (USDA 2015). NIFA's total budget, including both operational costs and grant funding, typically accounts for about half of the REE budget.

Current Agroecology Funding Is Inadequate

A 2015 study by UCS and partners analyzed NIFA-funded projects initiated in 2014 to assess the share supporting agroecological education according to the classification system described above (see the figure) (DeLonge, Miles, and Carlisle 2015). Of the total funds analyzed ($294 million), at most 15 percent ($44 million) funded projects that even considered the agroecological practices in Level 3. To put this amount into perspective, the total sum for analyzed projects containing any Level 3 practices represented just 1.5 percent of the full REE budget. NIFA allocated the largest portion of this

Agroecology Funding in the Context of Total USDA Budget, 2014



Competitive extramural research and education funding for transforming agricultural systems is just a tiny fraction of federal funding. The lack of a focused investment in this area threatens the nation's food and farming system.

NOTE: Identified NIFA grants represent competitive extramural grants awarded by NIFA with a start date of 2014 and retrieved from the public USDA Current Research Information System database (*http://cris.csrees.usda.gov/Welcome.html*). Projects advancing sustainable agriculture include any practice in Levels 1-4 and include projects focused exclusively on increasing crop yields ($50 million). Projects with agroecological practices include at least one Level 3 component; projects with transformative agroecology contain at least one practice in Level 3 and Level 4.

agroecology-related funding to projects focused on mitigating climate change, with less going to projects that included such agroecological practices as crop rotation, diversification—including incorporation of non-crop plants and perennials—and supporting biodiversity.

A similar amount of funding went to projects providing socioeconomic supports at Level 4 (14 percent of analyzed funding; $41 million). However, an exceptionally small amount (4 percent of analyzed funding; $12 million) went to projects pairing socioeconomic supports to agroecological field practices in a way that could realistically encourage a transition to sustainable food systems.

Our analysis further found that the USDA dedicated the largest share of all analyzed funds to practices that can promote incremental sustainability but fall far short of a transformative, agroecological approach. About 35 percent of analyzed funds ($105 million) went to projects working to increase efficiency—Level 1—mainly by increasing yields or decreasing pesticide use. At Level 2, significant funds supported efforts to replace harmful inputs or practices with better alternatives (23 percent of analyzed funds; $69 million), for example, by introducing ecological pest management, adopting alternative fertilizers, planting cover crops, and reducing tillage.

> ***Funding for sustainable agriculture and agroecology continues to be entirely inadequate, given the need for profitable, ecologically sustainable farms and ranches.***

Recommendations for Capitalizing on Agroecology's Benefits

While investment in Level 1 and Level 2 activities is pertinent, the transition to sustainable food systems requires a holistic integration of the complete range of practices appropriate to the relevant climate and agricultural products. Overall, funding for sustainable agriculture and agroecology continues to be entirely inadequate, given the need for profitable, ecologically sustainable farms and ranches (Ponisio et al. 2014; Carlisle and Miles 2013; Lipson 1997). USDA leadership and support are all the more critical because the private sector largely lacks a profit incentive to invest in this area.

We recommend the following actions:

- The USDA, particularly through NIFA and the ARS, should use its authority and budget to prioritize and scale up holistic agroecological research, extension, and education programming. Systems-based research requires significant support over several years, so consistent priorities and substantial awards are essential. The USDA should encourage projects that maximize public benefit through knowledge sharing and cooperation.
- Land-grant colleges and universities, as well as the extension service, should expand research, education, and extension programming on agroecology and sustainable food systems, and they should foster the exchange of agroecological knowledge. To enable large-scale change, programs should seek to combine agroecological practices with socioeconomic support mechanisms.
- Congress should significantly increase funding to the USDA and partner agencies for agroecological research, and it should do so through the annual budget and appropriations process. A concentration on systems-based research that brings together ecological and socioeconomic sustainability is vital.

REFERENCES

Carlisle, L., and A. Miles. 2013. Closing the knowledge gap: How the USDA could tap the potential of biologically diversified farming systems. *Journal of Agriculture, Food Systems, and Community Development* 3(4):219–225.

Davis A.S., J.D. Hill, C.A. Chase, A.M. Johanns, and M. Liebman. 2012. Increasing cropping system diversity balances productivity, profitability and environmental health. *PLoS ONE* 7(10):e47149. doi:10.1371/journal.pone.0047149.

DeLonge, M.S., A. Miles, and L. Carlisle. 2015. Investing in the transition to sustainable agriculture. *Environmental Science & Policy*, forthcoming. doi:10.1016/j.envsci.2015.09.013.

De Schutter, O. 2014. The transformative potential of the right to food. United Nations General Assembly.

Gliessman, S.R. 2014. Agroecology: The ecology of sustainable food systems. Third Edition. Boca Raton, FL: CRC/Taylor & Francis Group.

Hayes, T.B., L.L. Anderson, V.R. Beasley, S.R. de Solla, T. Iguchi, H. Ingraham, P. Kestemont, J. Kniewald, Z. Kniewald, V.S. Langlois, E.H. Luque, K.A. McCoy, M. Mu oy-de-Toro, T. Oka, C.A. Oliveira, F. Orton, S. Ruby, M. Suzawa, L.E. Tavera-Mendoza, V.L. Trudeau, A.B. Victor-Costa, and E. Willingham. 2011. Demasculinization and feminization of male gonads by atrazine: Consistent effects across vertebrate classes. *The Journal of Steroid Biochemistry and Molecular Biology* 127(1):64–73.

Kremen, C., and A. Miles. 2012. Ecosystem services in biologically diversified versus conventional farming systems: Benefits, externalities, and trade-offs. *Ecology and Society* 17(4):40.

Liebman, M., and L.A. Schulte. 2015. Enhancing agroecosystem performance and resilience through increased diversification of landscapes and cropping systems. *Elementa: Science of the Anthropocene* 3(1):000041.

Lipson, M. 1997. Searching for the" O-word": Analyzing the USDA current research information system for pertinence to organic farming. Santa Cruz, CA: Organic Farming Research Foundation.

Ponisio, L.C., L.K. M'Gonigle, K.C. Mace, J. Palomino, P. de Valpine, and C. Kremen. 2015. Diversification practices reduce organic to conventional yield gap. *Proceedings of the Royal Society of London B: Biological Sciences* 282(1799):20141396.

Ramaswamy, S. 2015. "The Morrill Act: 153 years of innovations for American agriculture." Blog post, July 2. Online at *http://blogs.usda.gov/2015/07/02/the-morrill-act-153-years-of-innovations-for-american-agriculture*, accessed September 17, 2015.

Reganold, J.P., D. Jackson-Smith, S.S. Batie, R.R. Harwood, J.L. Kornegay, D. Bucks, C.B. Flora, J.C. Hanson, W.A. Jury, D. Meyer, A. Schumacher Jr., H. Sehmsdorf, C. Shennan, L.A. Thrupp, and P. Willis. 2011. Transforming U.S. agriculture. *Science* 332(6030):670–671.

Shelton, J. F., E.M. Geraghty, D.J. Tancredi, L.D. Delwiche, R.J. Schmidt, B. Ritz, R. Hanson, and I. Hertz-Picciotto. 2014. Neurodevelopmental disorders and prenatal residential proximity to agricultural pesticides: The CHARGE study. *Environmental Health Perspectives* 122(10):1103–1109.

Smith-Lever Act. 7 U.S. Code 34. (1914). Online at *http://uscode.house.gov/statviewer.htm?volume=38&page=372*, accessed September 17, 2015.

Steffen, W., K. Richardson, J. Rockström, S.E. Cornell, I. Fetzer, E.M. Bennett, R. Biggs, S.R. Carpenter, W. de Vries, C.A. de Wit, C. Folke, D. Gerten, J. Heinke, G.M. Mace, L.M. Persson, V. Ramanathan, B. Reyers, and S. Sörlin. 2015. Planetary boundaries: Guiding human development on a changing planet. *Science* 347(6223):1259855. Online at *www.sciencemag.org/content/347/6223/1259855*, accessed September 17, 2015.

U.S. Department of Agriculture (USDA). 2015. FY 2016 budget summary and annual performance plan. Washington, DC. Online at *www.obpa.usda.gov/budsum/fy16budsum.pdf*, accessed September 16, 2015.

Vilsack, T. 2012. "Secretary's column: 'The peoples' department: 150 years of USDA.'" Blog post, May 11. Online at: *http://blogs.usda.gov/2012/05/11/secretarys-column-the-peoples-department-150-years-of-usda*, accessed September 17, 2015.

Union of Concerned Scientists

FIND A FULLY REFERENCED VERSION ONLINE: **www.ucsusa.org/agroecologyfunding**

The Union of Concerned Scientists puts rigorous, independent science to work to solve our planet's most pressing problems. Joining with citizens 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) 843-3785

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

WEB: www.ucsusa.org

PRINTED ON RECYCLED PAPER USING VEGETABLE-BASED INKS