Zachary S. Brown

North Carolina State University

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Professional Appointments and Affiliations

Associate Professor, Dept. Agricultural and Resource Economics, NC State	June 2020–present
Assistant Professor, Dept. Agricultural and Resource Economics, NC State	Jan. 2014–May 2020
Economist, Organization for Economic Cooperation and Development (OECD)	Aug. 2011–Dec. 2013

Affiliations:

Faculty Affiliate, Global One Health Academy, NC State	Dec. 2023–present
Faculty Affiliate, Center for Science & Technologies for Phosphorus Sustainability, NC State	Sept. 2023–present
Faculty Affiliate, Center for Environmental and Natural Resource Economics and Policy (CEnREP), NC State	Jan. 2014–present
Executive Committee Member, Genetic Engineering & Society (GES) Center, NC State	Jan. 2014–present

Education

Institution	Fields	Degree	Year
Duke University Durham, NC, USA	Environment (Environmental & resource economics)	PhD	2011
Lawrence University Appleton, WI, USA	Mathematics-economics Minor in government	BA	2005

Research and teaching fields

Primary: Resource economics and bioeconomics
Secondary: Environmental, development and behavioral economics

Peer-Reviewed Research Publications

1) A. Alsdorf, Reisig, D., **Brown, Z.**, Ferraro, G., & Rejesus, R. (2024). *Enhancing non-Bt corn refuge based on corn grower and seed dealer surveys*. Journal of Integrated Pest Management, 15(1).
2) B. Hollingsworth, Cho, C., Vella, M., Roh, H., Sass, J., Lloyd, A. L., **Brown, Z. S.** (2024). *Economic optimization of Wolbachia-infected Aedes aegypti release to prevent dengue*. Pest Management Science.
3) C. Cho, **Brown, Z. S.**, Gross, K., Tregeagle, D. (2024). *Developing Practical Measures of the Price of Pesticide Resistance: A Flexible Computational Framework with Global Sensitivity Analysis*. Journal of the Agricultural and Applied Economics Association.
4) M. S. Jones, **Brown, Z. S.** (2023). *Food for thought: consumer welfare implications of irreversible, landscape-scale biotechnologies*. Food Policy, 121, 102529.
5) **Brown, Z. S.** (2022). *Distributional policy impacts, WTP-WTA disparities, and the Kaldor-Hicks tests in benefit-cost analysis*. Journal of Environmental Economics and Management, 102654.
6) Nelson, K. P., Parton, L. C., & **Brown, Z. S.** (2022). *Biofuels policy and innovation impacts: Evidence from biofuels and agricultural patent indicators*. Energy Policy, 162, 112767.
7) Coffey, E. R., Mesenbring, E. C., Agao, D., Alirigia, R., Begay, T., Moro, A., Oduro, A., **Brown, Z. S.**, Dickinson, K.L., & Hannigan, M. P. (2021). *A glimpse into real-world kitchens: Improving our understanding of cookstove usage through in-field photo-observations and improved cooking event detection (CookED) analytics*. Development Engineering, 100065.

8) **Brown, Z. S.**, Connor, L., Rejesus, R. M., & Yorobe Jr, J. M. (2021). *Landscape-level feedbacks in the demand for transgenic pesticidal corn in the Philippines*. Ecological Economics, **180**.
9) Carrière, Y., **Brown, Z.**, Aglasan, S., et al. (2020). *Crop rotation mitigates impacts of corn rootworm resistance to transgenic Bt corn*. Proceedings of the National Academy of Sciences, 117(31), 18385-18392.
10) P. S. Jørgensen, C. Folke, P. J. G. Henriksson, K. Malmros, A. Zorzet, **Living with Resistance Project**[1] (2020). *Coevolutionary Governance of Antibiotic and Pesticide Resistance*. Trends in Ecol. & Evol, **35**(6): 484-494.
11) M. S. Jones, J. A. Delborne, J. Elsensohn, P. D. Mitchell, **Z. S. Brown** (2019). *Does the US public support using gene drives in agriculture? And what do they want to know?* Science Advances, **5**(9): aau8462.
12) Y. Carrière, **Z. S. Brown**, S. Downes, G. Gujar, G. Epstein, C. Omoto, N. Storer, D. Mota-Sanchez, P. S. Jørgensen, S. P. Carroll (2019). *Governing evolution: A socioecological comparison of resistance management for insecticidal transgenic Bt crops among four countries*. Ambio, **49**: 1-16.
13) K. L. Dickinson, M. Dalaba, **Z. S. Brown**, R. Alirigia, E. Coffey, E. Mesenbring, M. Achazanaga, D. Agao, M. Ali, E. Kanyomse, J. Awaregya, C. A. Adagenera, J. B. Aburiya, B. Gubillla, A. R. Oduro, M. Hannigan (2018). *Prices, Peers, and Perceptions (P3): Study Protocol for Improved Biomass Cookstove Project in Northern Ghana*. BMC Pub. Health.
14) **Living with Resistance Project**[1] (2018). *Antibiotic and pesticide susceptibility and the Anthropocene operating space*. Nature Sustainability, **1**: 632-641.
15) M. Dalaba, R. Alirigia, E. Mesenbring, E. Coffey, **Z. S. Brown**, M. Hannigan, C. Wiedinmyer, A. Oduro, K. L. Dickinson (2018). *Liquified Petroleum Gas (LPG) Supply and Demand for Cooking in Northern Ghana*. EcoHealth, **15**(4):716-728.
16) D. Miteva, **Z. S. Brown** (2018). *Impact of land tenure insecurity on investment: Evidence from northern Uganda*. The Ghanaian Journal of Economics, **6**(1): 21-42.
17) F. Gould, **Z. S. Brown**, J. Kuzma (2018). *Wicked Evolution: Can We Address the Sociobiological Dilemma of Pesticide Resistance?* Science. **360**(6390): 728-732.
18) **Z. S. Brown** (2018). *Voluntary programs to encourage compliance with refuge regulations for pesticide resistance management: evidence from a quasi-experiment*. American Journal of Agricultural Economics. **100**(3): 844-867.
19) J. Kuzma, F. Gould, **Z. S. Brown**, et al (2018). *A Roadmap for Gene Drives Workshop: Research and Governance Needs in an Institutional Analysis and Development Systems Context*. Journal of Responsible Innovation, **5**(sup1).
20) P. D. Mitchell, **Z. S. Brown**, N. McRoberts (2018). *Economic Issues to Consider for Gene Drives*. Journal of Responsible Innovation, **5**(sup1).
21) **Z. S. Brown,** R. A. Kramer (2018). *Preference Heterogeneity in the Structural Estimation of Efficient Pigovian Incentives for Insecticide Spraying to Reduce Malaria*. Environmental and Resource Economics. 170(1): 169-190.
22) D. Miteva, R. A. Kramer, **Z. S. Brown**, M. D. Smith (2017). *Spatial patterns of market participation and resource extraction: Fuelwood collection in northern Uganda*. American Journal of Agricultural Economics, **99**(4): 1008-1026.

[1] Group coauthorship

23) D. Kim, **Z. S. Brown**, et al. (2017). *The value of information in decision-analytic modeling for malaria control in East Africa*. Risk Analysis, **37**(2): 231-244.
24) **Z. S. Brown**, R. A. Kramer, D. Ocan, C. Oryema (2016). *Household perceptions and subjective valuations of indoor residual spraying programs to control malaria in northern Uganda*. Infectious Diseases of Poverty, **5**:100.
25) **Z. S. Brown**, W. Oueslati, J. Silva (2016). *Links between urban structure and life satisfaction in a cross-section of OECD metro areas*. Ecological Economics, **129**: 112-121.
26) **Z. S. Brown** and N. Johnstone (2014). *Better the devil you throw: Experience and support for pay-as-you-throw waste charges*. Environmental Science & Policy, **38**: 132-142.
27) **Z. S. Brown**, N. Johnstone, I. Haščič, L. Vong, F. Barascud (2013). *Testing the effect of defaults on the thermostat settings of OECD employees*. Energy Economics, **39**: 128-134.
28) **Z. S. Brown**, K. Dickinson, and R. A. Kramer (2013). *Insecticide resistance and malaria vector control: The importance of fitness cost mechanisms in determining economically optimal control trajectories*. Journal of Economic Entomology, **106**(1): 366-374.
29) M. F. Bellemare, **Z. S. Brown** (2010). *On the (Mis)Use of Wealth as a Proxy for Risk Aversion*. American Journal of Agricultural Economics, **92**(1): 273-282.

Book Chapters, Reports and Policy Briefs

1) Council for Agricultural Science and Technology (2024). Applications, Benefits, and Challenges of Genome Edited Crops. Issue Paper 74. CAST, Ames, Iowa. Available at: https://www.cast-science.org/publication/applications-benefits-and-challenges-of-genome-edited-crops/
2) Ahmad, J. Baltzegar, J. **Z. S. Brown**, et al. (2022). Gene Drives in Agriculture: Risk Assessment and Research Prioritization. NC State Genetic Engineering & Society Center Workshop Report. Available at: https://go.ncsu.edu/ges-gene-drive-workshop-white-paper
3) **Z. S. Brown**, M. Jones, J. Mumford (2019). *Chapter 10: Economic Principles and Concepts in Area-Wide Genetic Pest Management*. In: The Economics of Integrated Pest Management for Insects. CABI.
4) EPA Scientific Advisory Panel 2018 Meeting Report on *Resistance to Lepidopteran Pests to Bacillus thuringiensis (Bt) Plant Incorporated Protectants (PIPs) in The United States*, Federal Docket ID EPA-HQ-OPP-2017-0617.
5) **Z. S. Brown**, L. Carter, F. Gould (2018). *An Introduction to the Proceedings of the Environmental Release of Engineered Pests: Building an International Governance Framework*. BMC Proc. 12(Suppl 8):10
6) **Z. S. Brown** (2017). *The Economics, Regulation and International Implications of Gene Drives in Agriculture*. *Choices*, Quarter 2.
7) **Z. S. Brown**, B. Alvarez, N. Johnstone (2015). *Tender instruments: programme participation and impact in australian conservation tenders, grants and volunteer organisations*. OECD Environment Working Papers, No. 85. OECD Publishing.
8) L. Trasande, **Z. S. Brown** (2015). *Addressing environmental risks for child health*, in Promoting health, preventing disease: the economic case. Eds: D. McDaid, F. Sassi, S. Merkur. World Health Organization, Open University Press, Maidenhead, UK.
9) **Z. S. Brown** (2014). *Greening Household Behaviour: Cross-Domain comparisons in environmental attitudes and behaviours using spatial effects*. OECD Environment Working Papers, 70. OECD Publishing.

10) Y. Serret, **Z. S. Brown**, N. Johnstone (2013). Greening Household Behaviour: Overview from the 2011 Survey. *OECD Studies on Environmental Policy and Household Behaviour*, OECD Publishing. [Edited book, authored three chapters.]
11) **Z. S. Brown** (2013). *Background information on the assessment of alternatives to DDT*. Technical report for the Stockholm Convention Secretariat. *UNEP/POPS/POPRC.7/INF/19*
12) J. Silva, **Z. S. Brown** (2013). *More than the Sum of their Parts: Valuing Environmental Quality by Combining Life Satisfaction Surveys and GIS Data*. OECD Statistics Working Papers, 2013/1, OECD Publishing.

Working Papers (drafts available on request)

Ferraro, G., **Z. S. Brown**, D. Reisig. Norm-based messaging in agricultural extension: A pilot experiment in pesticide resistance and drainage management.

Yao, S., J. S. Baker, **Z. S. Brown**. Dynamic Decision Making of Agrivoltaics in California's Central Valley.

Cho, C., **Z. S. Brown**, D. M. Kling, L. C. Gatiboni, J. S. Baker. Evaluating Optimal Farm Management of Phosphorus Fertilizer Inputs with Partial Observability of Legacy Soil Stocks.

Chen, L., **Z. S. Brown**, R. Rejesus, C. Boyer, J. Larson. Dynamically optimal cover crop adoption.

Z. S. Brown, K. L. Dickinson, M. Dalaba, R. Alirigia, E. Coffey, E. Messenbring, D. Agao, M. Hannigan, A. R. How social learning shapes demand for environmental health technologies: a multi-level clean cookstove experiment in northern Ghana.

S. Aglasan, **Z. S. Brown**, Y. Carriere, B. K. Goodwin, M. Carroll, G. Head, S. P. Carroll, P. S. Joregensen. Large-scale spatiotemporal linkages in corn rootworm damage to transgenic Bt corn.

K. L. Dickinson, **Z. S. Brown**, M. Dalaba, R. Alirigia, E. Coffey, E. Messenbring, D. Agao, M. Hannigan, A. R. Oduro. Prices, Peers, and Perceptions: Field experiments on improved cookstove adoption in Ghana.

Major Funding

Principal Investigator

Research Triangle International, University Faculty Scholars Program. "Quasi-experimental evaluation and communication of pesticide-related population health effects of genetically engineered crop adoption in US agriculture." Timespan: 2023-2024 academic year (scholarly leave award). Amount: $111,256

National Institute of Food and Agriculture, Exploratory Research Program. "Assessing Public Perceptions of Gene Drives for Invasive Species and Pest Control." Timespan: 2017-2019. Amount: $100,000.

Co-Investigator

Bezos Center for Sustainable Protein at NCSU (subgroup focused on consumer insights). Principal Investigators: Rohan Shirwaiker and William Aimutis. Timespan: 2024 – 2029. Amount: $30M

Science and Technology for Phosphorus Sustainability (STEPS, NCSU). "Dynamic Farm-Scale Management of Legacy P under Limited Information: A Partial Observability Markov Decision Problem." Principal Investigator: Justin Baker. Timespan: Oct 2023 – May 2025. Amount: $162,000

National Institute of Food and Agriculture, Critical Agricultural Research and Extension. "Exploring Conditional Cooperation to Increase Non-Bt Refuge Corn Compliance." Principal Investigator: D. Reisig, NCSU Dept. of Plant Pathology and Entomology. Timespan 2021-2024. Amount: $300,000

National Institute of Food and Agriculture, Crop Protection and Pest Management. "Improving Bt resistance management through yield comparison of Bt and non-Bt hybrids." Principal Investigator: D. Reisig, NCSU Dept. of Plant Pathology and Entomology. Timespan 2021-2024. Amount:

National Science Foundation, National Research Traineeship Program. "Agricultural Biotechnology in Our Evolving Food, Energy & Water Systems (AgBioFEWS)." Principal Investigator: F. Gould, NCSU Dept. of Plant Pathology and Entomology. Timespan: 2018-2023. Amount: $3 million.

National Institutes of Health, Clean Cooking Implementation Science Network. "Prices, Peers, and Perceptions: Opportunities for Scaling Up LPG Adoption in Northern Ghana." Principal Investigator: Principal Investigator: K. L. Dickinson, University of Colorado at Denver. Timespan: 2015-2019. Amount: $80,000.

National Science Foundation, Economics Program. "Collaborative Research: Prices, Peers, and Perceptions: Field Experiments on Technology Adoption in the Context of Improved Cookstoves." Principal Investigator: K. L. Dickinson, University of Colorado at Denver. Timespan: 2015-2019. Amount: $500,000.

National Institute of Food and Agriculture, Specialty Crops Research Initiative: Sustainable Strategies to Manage Spotted Wind Drosophila in the United States Fruit Crops. Principal Investigator: H. Burrack, NCSU Dept. of Plant Pathology and Entomology. Timespan: 2015-2020. Amount: $6.7 million.

Teaching (since 2014)

ECG 716: Environmental and Natural Resource Economics II (PhD level, 2016-2023)

ECG 715: Environmental and Natural Resource Economics I (PhD level, Fall 2021)

ECG 563: Applied Econometrics (MS level, Fall 2021)

ECG 515: Environmental and Natural Resource Policy (MS level, 2014-2016, 2019)

GES 591: Integrated Socioecological Systems Modeling (GES PhD Program, 2014-2021)

Guest lectures in eight other environmental science, agricultural economics and global health courses and training programs at NC State and Duke University.

Doctoral Student Committees

Chaired or co-chaired

Shiyue Yao (current, Co-chair J. Baker)
Chanheung Cho (current, Co-chair J. Baker)
Khalid Alwuhaib (current, Co-chair H. Fell)
Le Chen (2022, Assistant Professor, tenure-track. UT Knoxville), Co-chair R. Rejesus
NCSU ARE Carlson Dissertation Award
Mike Jones (2020, Assistant Prof., Univ. of AK Anchorage), Co-chair R. Rejesus
SAEA 2020 Outstanding Dissertation Award Recipient
NCSU Keller and ARE Carlson Dissertation Awards
Kelly Nelson (2019, Economic Research Service)
Lawson Connor (Assistant Professor, tenure-track, Univ. AK), Co-chair R. Rejesus
Fox Weng (Wells Fargo), Co-chair D. Pelletier

Committees

Caroline Thompson (current, Chair: R. von Haefen)
Yiqing Liu (current, Chair: R. von Haefen)
Avery Dobbins (current, Chair: R. von Haefen)
Logan Richardson (current, Forestry & Environmental Resources, Chair: Erin Sills)
Ahn Kim (Chair: H. Fell)
Tim Choi (Chair: M. Morrill)

Wizaso Munthali (Chair: Erin Sills)
Ruixue Wang (Chair: Rod Rejesus)
Serkan Aglasan (Assistant Prof. tenure-track, Univ. AZ, Chair: Barry Goodwin)
Brandon Hollingsworth (Biomathematics, Chair: Alun Lloyd)
Amanda Clayton (RTI, Chair: Melinda Sandler Morill)
Kelsey Hample (Furman University, tenure-track, Chair: Bob Hammond)
Natasha James (US Forest Service, Chair: Erin Sills)
Moon Joon Kim (Duke Kunshun University, Chair: Roger von Haefen)
Marwa Salem (RTI, Chair: Roger von Haefen)
Jin Qin (Chairs: Ivan Kandilov, Roger von Haefen)
Yu Wu (Forestry & Environmental Resources, Chair: Erin Sills)

Dissertation

The Economics of Malaria Vector Control (2011)
Committee: R.A. Kramer (chair), M.F. Bellemare, K. Koelle, P. Peretto, M.D. Smith

Honors and Awards

2012 AAEA Outstanding Doctoral Dissertation Award
2011 Outstanding Article, American Journal of Agricultural Economics (with Marc Bellemare)
2009 Peccei Prize, International Institute for Applied Systems Analysis (IIASA), Vienna, Austria

Professional and University Service

Leadership Team, PhD Fellowship Program in *Agricultural Biotechnology in Our Evolving Food, Energy and Water Systems* (AgBioFEWS). NSF-funded National Research Traineeship Grant (2018-2024).

Ad-hoc Member, Scientific Advisory Panel on Resistance in Lepidopteran Pests to Bacillus thuringiensis (Bt) Plant Incorporated Protectants, U.S. Environmental Protection Agency (2018).

Chair, Organizing Committee, Graduate Education Symposium on Forging Integrated Expertise (2018).

Co-Editor (with L. Carter, F. Gould, 2018). Environmental Release of Engineered Pests: Building an International Governance Framework. BMC Proc. 12(suppl 8).

Executive Committee (2014-present), Genetic Engineering & Society Center, NC State University

Chair, Organizing Committee, OECD-funded workshop on Environmental Release of Engineered Pests: Building an International Governance Framework (Fall 2016)

Referee for the following:
Agriculture and Human Values
American Journal of Agricultural Economics
Environmental and Resource Economics
Canadian Journal of Economics
Current Opinion in Environmental Sustainability
Health Economics
Journal of Agricultural and Resource Economics
Journal of the Association of Environmental and Resource Economists
Journal of Environmental Economics and Management
Journal of Theoretical Biology
Land Economics
National Academies of Sciences, Engineering and Medicine
National Science Foundation

Pest Management Science
Philosophical Transactions of the Royal Society B: Biological Sciences
PLOS Biology
PLOS Computational Biology
Proceedings of the National Academy of Sciences (PNAS)
Resources, Conservation and Recycling
Science
Sustainability Science

Professional Affiliations

Association of Environmental and Resource Economists (AERE)
Applied and Agricultural Economics Association (AAEA)
Entomological Society of America (ESA)

Conference Presentations and Invited Seminars

2024 Iowa State University Economics Department, Invited Seminar Presenter
AAEA Annual Meeting, Invited Panel (New Orleans, DC)
AERE Summer Conference (Washington, DC)
Duke Center on Risk Workshop Invited Participant, 'International Monitoring for Solar Radiation Management'
NCSU-KIETS Cross-College Climate Conversations: Climate's Impact on Infectious Diseases, Invited Panelist

2023 Triangle Resource and Environmental Ecnomics (TREE) Seminar Presenter
NCSU - NSF Center for Integrated Pest Management Seminar Presenter
AAEA Annual Meeting (Washington, DC)
Atlanta Conference on Science and Technology Policy

2022 Duke Center on Risk Workshop, 'Risky Global Technologies and their Governance' (Jackson Hole)
Gordon Research Conference on 'Genetic Biocontrol' (Ventura)

2021 HATCH Multistate NC1034 Multi-state Conference: Advances in Agricultural Tech. (remote)
WHO technical consultation on the use of economics in insecticide resistance management for malaria vector control (remote)
University of Connecticut, Dept. of Economics: IO, Environmental, and Law Economics Seminar Series (remote)
AERE Summer Conference (remote)

2020 AERE Summer Conference (remote)
HATCH Multistate NC246: Arthropod pests in corn (Madison, WI; remote)

2019 BIOECON (Wageningen University, The Netherlands)
AAEA Annual Meeting (Atlanta, GA)
Invited participant, Bioeconomics Project, Corteva Agriscience (Atlanta, GA)
Invited seminar in Louisiana State University, Department of Agricultural Economics & Agribusiness (Baton Rouge, LA)

2018 Entomological Society of America (Vancouver, Canada)
EPA Scientific Advisory Panel review of Bt refuge policies and regulations (Washington, DC)
World Congress of Environmental and Resource Economists (Gothenburg, Sweden)

2017 BIOECON (Tilburg University, The Netherlands)
NSF-SESYNC Workshop on "Living with Resistance" (Annapolis, MD)

2016 OECD Cooperative Research Program on Biological Resources in Agriculture (Paris, France)
AAEA Annual Meeting (Boston, MA)
AERE Summer Conference (Breckenridge, CO)
NSF-SESYNC Workshop on "Living with Resistance" (Annapolis, MD)
Invited seminar in University of Richmond Economics Department (Richmond, VA)

2015 Atlanta Conference on Science and Innovation Policy (Atlanta, GA)
AAEA Annual Meeting (San Francisco, CA)
AERE Summer Conference (San Diego, CA)
NIMBioS Investigative Workshop on Malaria-Leishmania Co-infection (Knoxville, TN)
Economics and Management of Risk in Agriculture and Natural Resources (Destin, FL)
Invited seminar in Forestry and Environmental Resources Dept. at Virginia Tech (Blacksburg, VA)

2014 CU Environmental and Resource Economics Workshop (Vail, CO)
World Congress of Environmental and Resource Economists (Istanbul, Turkey)
Invited talk for the OECD Environment Directorate (Working Party on Integrating Environmental Economics and Policy)

2013 EAERE Summer Conference (Toulouse, France)
UKNEE envecon 2013 (The Royal Society, London)

2012 EAERE Summer Conference (Prague, Czech Republic)
Journées Louis-André Gérard-Varet in Public Economics (Marseille, France)

2011 Invited talk for the 7th meeting of the Stockholm Convention Persistent Organic Pollutant Review Committee (POPRC)
AERE Summer Conference (Seattle, WA)

2010 "Parasite to Prevention" with Malaria Journal (Edinburgh, Scotland) – Poster
EcoHealth Meetings (London, UK) – Poster
Applied and Agricultural Economics Association Annual Meeting (Denver, CO)
World Congress of Environmental and Resource Economists (Montreal, Canada)
Economics and Management of Risk in Agriculture and Natural Resources (Destin, FL, USA)

2009 Economics and Management of Risk in Agriculture and Natural Resources (Galveston, TX, USA)