

NCCC-170 Accomplishments Report

Project/Activity Number: NCCC-170

Project/Activity Title: Research Advances in Agricultural Statistics

<https://www.nimss.org/projects/18798>

Project/Activity Duration: 10/01/2021 - 09/30/2026

Date of Report: 08/24/2022 (permission granted for a 2-week extension from the report due date of 08/17/2022 or 2 months after the annual meeting)

Period Covered by this Report: 06/01/2021 - 06/30/2022

Annual Meeting Dates: 06/16/2022 - 06/17/2022

Participants:

- 1) Nora M. Bello, The Ohio State University, bello.69@osu.edu
- 2) Guilherme J. M. Rosa, University of Wisconsin-Madison, grosa@wisc.edu
- 3) Julia Piaskowski, University of Idaho, jpiaskowski@uidaho.edu
- 4) Susan L. Durham, Utah State University, susan.durham@usu.edu
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- 11) Jarad Niemi, Iowa State University, niemi@iastate.edu
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- 13) Alexander E. Lipka, University of Illinois at Urbana-Champaign, alipka@illinois.edu
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- 16) Kathleen M. Yeater, USDA-ARS, kathleen.yeater@usda.gov
- 17) Clark Kogan, Washington State University, clark.kogan@wsu.edu
- 18) Carla L. Goad, Oklahoma State University, carla.goad@okstate.edu
- 19) Aaron K. Rendahl, University of Minnesota, rend0020@umn.edu
- 20) Robert J. Tempelman, Michigan State University, tempelma@msu.edu
- 21) Bruce A. Craig, Purdue University, bacraig@purdue.edu
- 22) Daniel E. Runcie, University of California-Davis, deruncie@ucdavis.edu

Brief Summary of Minutes of Annual Meeting: Meeting minutes attached.

Accomplishments:

- 1) **Outputs: Workshops, short courses.**

A total of 13 workshops and short courses were delivered by members of NCCC-170 during this period. Both professional audiences and delivery venues spanned domestic

and international settings. A selected subset of workshops and short courses is listed below for illustration purposes. Member co/authors are highlighted in bold.

- a) Invited Short Course on Mixed Models, 2021 American Dairy Science Association (Virtual) Annual Meeting. Co-instructors: **Rob Tempelman**, Michigan State University, **Bruce Craig**, Purdue University and **Nora M. Bello**, The Ohio State University. July 14, 2021. Virtual platform.
- b) Workshop/course: What They Forgot to Teach You About R (online). Instructor: **J. Piaskowski**, University of Idaho Carpentries, co-taught with Brianna Siple and Yesol Yesol Sapozhnikov, March 1-10, 2022. <https://imci-idaho.github.io/2022-03-01-WhatTheyForgot/>
- c) Invited Training: “Sampling Planning: Why does it matter?” Feed the Future Innovation Lab for Food Safety Training Sessions: Cambodia Project. Presenter: **Nora M. Bello**, The Ohio State University. Virtual platform. October 25-26, 2021.
- d) Invited Workshop: “Regression and Classification Applied to Precision Agriculture”. 2022 Conference on Applied Statistics in Agriculture and Natural Resources. Presenter: **Guilherme J. M. Rosa**, University of Wisconsin-Madison. Utah State University, May 16, 2022.
- e) Invited Short Course: Mixed Models in Quantitative at the 26th Summer Institute in Statistical Genetics, University of Washington, Seattle - WA. Presenter: **Guilherme J. M. Rosa**, University of Wisconsin-Madison (online; co-taught with Dr. Bruce Walsh). July 19-21, 2021
- f) Invited Short Course: Statistical Modeling in Animal Breeding and Genetics. Sao Paulo State University (UNESP) - Jaboticabal, Brazil. August 09-13, 2021. Presenter: **Guilherme J. M. Rosa** (online course)
- g) Invited Short Course: Principles of Data Science Applied to Livestock. University of Padova, Padova, Italy. Presenter: **Guilherme J. M. Rosa** (co-taught with Dr. Joao Dorea) Sept 13-17, 2021.
- h) Workshop: Experimental design and analysis of plant breeding trials. **H.P. Piepho**, KWS, Einbeck, Germany, 29-31 March 2022.

2) Presentations:

A total of 24 presentations were delivered by members of NCCC-170 during this period to a varied professional audience. Delivery venues were both domestic and international. A selected subset is listed below for illustrative purposes.

- a) Invited talk: “Statistics for Reproducible Research in Companion Animal Nutrition”. Presenter: Nora M. Bello. Invited talk at the Companion Animal Symposium: Experimental Design and Statistics Applied to Companion Animal Nutrition, at the American Society of Animal Science (ASAS) and Canadian Society of Animal Science (CSAS) Annual Meeting and Trade Show. Virtual platform. July 15, 2021.

- b) Invited Podcast: “Statistical Principles for Pig Research: Myths and Facts” <https://www.swineit.com/blog/statistical-principles-in-pig-research-facts-and-myths-dr-nora-bello> Presenter: Nora M. Bello. Swine-it Podcast Show, hosted by Dr. Laura Greiner and Dr. Marcio Goncalves. Virtual Platform. June 21, 2021
- c) Invited talk: “Combining Big Data Analytics and Omics Techniques to Improve Beef Cattle Selection and Production”. Presenter Rosa, G. J. M. II International Livestock Studies Congress, Antalya, Turkey. Oct 29-30, 2021.
- d) Invited talk: “Deep Neural Network Applied to Genome-Enabled Prediction of Complex Phenotypic Traits: Why Its Performance Has Been Limited So Far?”. Presenter: Rosa, G. J. M. Conference on Applied Statistics in Agriculture and Natural Resources, Logan, Utah. May 17, 2022.
- e) Invited Panel: “The Changing Landscape of Academic Statistical Collaboration”. Presenter: BA Craig. International Conference on Advances in Interdisciplinary Statistics and Combinatorics, Greensboro, North Carolina. October 21, 2021.
- f) Invited talk: “AG2PI Agricultural Genome to Phenome Initiative: Shared Data Science Across Crop and Livestock Communities”. Presenter: J. Clarke. INFORMS Annual Meeting, Anaheim, California, October 24-27, 2021.
- g) Invited Panel “Challenges and Opportunities of Agricultural Statistics in The Big Data Era”. Presenters: J. Clarke and B. A. Craig. Conference on Applied Statistics in Agriculture and Natural Resources, May 17, 2022.
- h) Invited paper: “Using genetic relationships to improve the design and analysis of animal science studies”. *Presenter: Tempelman, R.J. 56th Annual Meeting of the Brazilian Society of Animal Science. Virtual platform. August 19, 2021.*

3) Books and Book Chapters:

- a) **Rosa, G. J. M.** Quantitative Methods Applied to Animal Breeding. In: Encyclopedia of Sustainability Science and Technology. Meyers, R. A. (Editor). New York: Springer, 2022.
- b) **Piaskowski, J & Price, W.** Incorporating Spatial Analysis into Agricultural Field Experiments. Gitbook (2022): <https://idahoagstats.github.io/guide-to-field-trial-spatial-analysis/>
- c) Casanoves, Fernando; **Raúl E. Macchiavelli**, Mónica Balzarini, Julio Di Rienzo (2022). Modelos no lineales mixtos: aplicaciones en InfoStat. Digital Book, PDF. Córdoba: Grupo InfoStat, 2022. ISBN 978-987-27045-1-3

4) Other Project-related Activities: awards, grants

Members of NCCC-170 served as principal investigators, co-principal investigators or collaborators for 17 grant awards active during the funding period totaling over \$ 20.7 million. Funding sources included federal agencies such as the National Science Foundation, the US Department of Agriculture (USDA), the US Agency for International

Development (USAID) and the National Institute of Health (NIH), as well as private organizations and intramural academics. Most grant awards were interdisciplinary in nature, and in several cases, involved multiple academic institutions. A selected subset of grant awards is listed below for illustrative purposes. Member co/authors are highlighted in bold.

- a) U.S. Department of Agriculture – National Institute of Food and Agriculture (AFRI), “A Coordinated Innovation Network for Advancing Computer Vision in Precision Livestock Farming. PI: Juan Pedro Steibel (Michigan St Univ.), Co-PI **Guilherme J. M. Rosa** among others. USDA FACT-CIN, \$1,000,000, Duration July 15 2021 – July 14 2026.
- b) U.S. Agency for International Development (USAID) Feed the Future Innovation Laboratory on Food Safety at Purdue University. Project title: “Reducing foodborne pathogen contamination of vegetables in Cambodia: Innovative research, targeted interventions and impactful Cambodian-led engagement”. Lead investigators: Jessie Vipham, Animal Sciences and Industry, Kansas State University; and Paul Ebner, Department of Animal Sciences, Purdue University. co-PI: **Nora M. Bello**. Timeline: 2020-2024. Award #: 21-0968, F.00048684.02.087. \$ 760,000
- c) USDA NIFA (2020-68012-31824). Consortium for Cultivating Human and Naturally reGenerative Enterprises (C-CHANGE), 1 Sep 2020 to 31 Aug 2024 Role: Co-PI \$10,000,000 (**Jarad Niemi**)
- d) USDA AFRI, **Clarke, J.** National Agricultural Producers Data Cooperative: Designing a Strategic Framework for Increasing Production and Driving Innovation, \$499,421, 10/01/21–03/31/2023. Role: Principal Investigator
- e) U.S. Department of Agriculture – National Institute of Food and Agriculture (AFRI), Conference grant circumscribed to jump-start and relaunch the Conference on Applied Statistics in Agriculture and Natural Resources. The conference was held at Utah State University, Logan, Utah on May 16-19, 2022. PI: **Xin Dai**, Utah State University; co-PIs: **Bruce Craig**, Purdue University, **Guilherme Rosa**, University of Wisconsin-Madison, **Robert Tempelman**, Michigan State University and **Nora M. Bello**, The Ohio State University. Timeline: 2022. Award #: 2022-67022-36954. \$ 22,575. Note of clarification: It was explicitly stated that the long-run maintenance of this conference, beyond its 2022 relaunch, would not involve a direct commitment from the NCCC-170, though individual members may choose to engage in organization and delivery of the conference.

Also listed below are professional awards conferred to members of the NCCC-170 during the reporting period.

- a) NCCC-170 was awarded the 2021 American Society of Agronomy (ASA) Presidential Award in November 2021. The ASA Presidential Award is “given to an individual or team who have influenced agronomic sciences or crop production practices so greatly that the impact of their efforts on future science will be enduring.”

- b) Award: Kellett Mid-Career Award, University of Wisconsin-Madison, 2021. \$75,000 (to Guilherme J. M. Rosa)
- c) 2022 Iowa State University Interdisciplinary Team Research Award (to C-CHANGE team including Jarad Niemi)
- d) Award: Holling Family Teaching Excellence Award Program. Sustained Excellence in Teaching and Learning. University of Nebraska-Lincoln. May 6, 2022. \$5,000 (to Kathy Hanford)

5) Milestones: Implementation and dissemination efforts? Benchmarking?

- a) Nora M. Bello. Invited Podcast: “Statistical Principles for Pig Research: Myths and Facts” <https://www.swineit.com/blog/statistical-principles-in-pig-research-facts-and-myths-dr-nora-bello> Swine-it Podcast Show, hosted by Dr. Laura Greiner and Dr. Marcio Goncalves, June 21, 2021.
- b) J. Piaskowski and W. Price: website launched: <agstats.io> with content focused on agricultural statistical education.
- c) J. Piaskowski, Community Leader of Statistical Education, American Society of Agronomy (November, 2020 - November, 2021).
- d) BA Craig. Part of the team who developed a hybrid seminar course on systematic reviews in agriculture and the environment. Part of an AFRI NIFA grant titled “FACT: An Innovative Cyber-Framework Integrating Public/ Private Data for Evidence-Based Recommendations.” Involved students at Purdue University and University of Wisconsin-Madison. Will be including students from the Ohio State University next year.
- e) J Clarke. Chair, AgBioData working group on Data Federation. Part of an NSF RCN award “Reimagining a sustainable data network to accelerate agricultural research and discovery.” September 2021-August 2024. https://www.nsf.gov/awardsearch/showAward?AWD_ID=2126334
- f) Refer also to listing of workshops and short courses (i.e. bullet 1 above), presentations (i.e. bullet 2 above), and books (i.e. bullet 3 above).

Impacts:

- The accomplishments listed in this report, namely, workshops, short courses, presentations, book, book chapters, publications and in general, a diverse dissemination media, collectively speak to the influence of the NCCC-170 amongst the community of statisticians serving food and agriculture research programs, as well as to their relevance to collaborative research teams at their home institutions and beyond.
- Said accomplishments illustrate how members of the NCCC-170 working both jointly and individually enhanced research capacity and fostered the continuing professional education of the scientific community at both domestic and international scopes. This, in turn, demonstrates a broad reach of impact of NCCC-170, ranging from local institutions to worldwide. Such broad impact is directly aligned with the global scope of agriculture and food production.

- Accomplishments also demonstrated a variety of methodological developments that directly address problems unique to current food and agricultural research. Developments were further supported by modern software implementations.
- Selected publications and grant awards focused on the role and know-how of collaboration. Panel discussions articulated and evaluated emerging challenges to agricultural statistics. Taken together, these initiatives support the mentoring of upcoming agricultural statisticians and provide a foundation to educate other statisticians and administrators involved in the faculty evaluation process.

Publications:

A total of 123 scientific publications were authored or co-authored by NCCC-170 members during the reporting period. Publication venues spanned a wide range of scientific domains and included the Proceedings of the National Academy of Sciences, the PloS and BMC series, Journal of Dairy Science, Journal of Animal Science, Frontiers in Genetics, Frontiers in Veterinary Medicine, Frontiers in Agronomy, Crop Science, HortScience, Journal of Ecology, Evolutionary Applications, Stat, Biometrical Journal, Journal of Food Protection, Food Packaging and Shelf, Journal of Apicultural Research, G3 Genes/Genomes/Genetics, Journal of Animal Breeding and Genetics, Theoretical and Applied Genetics, and Agrosystems, Geosciences & Environment, to name a few. A selected subset of publications is listed below for illustrative purposes. Member co/authors are highlighted in bold.

- a) Ribeiro, L. A. C., Bresolin, T., **Rosa, G. J. M.**, Casagrande, D. M., Danes, M. A. C. and Dórea, J. R. R. Disentangling data dependency using cross-validation strategies to evaluate prediction quality of cattle grazing activities using machine learning algorithms and wearable sensor data. *Journal of Animal Science* 99(9): 1-8, 2021.
- b) Tepedino VJ, Parker FD, and **Durham SL** (2022) Mixed diapause duration in cohorts of four species of *Osmia* bees (Megachilidae) along an elevation and temperature gradient in Northern Utah (USA). *Journal of Apicultural Research*. DOI: 10.1080/00218839.2022.2042049
- c) Griffith, E. H., **Sharp, J. L., Bridges, W. C., Craig, B. A., Hanford, K. J., and Stevens, J. R.** “The academic collaborative statistician: research, training, and evaluation,” *Stat* 2022 <https://doi.org/10.1002/sta4.483>.
- d) Lewis, M, Stock, M., Black, B., Drost, D., and **Dai, X.** (2021). Improving Snapdragon Cut Flower Production through High Tunnel Season Extension, Transplant Timing, and Cultivar Selection. *HORTSCIENCE* 56(10):1206–1212.
- e) Taghouti, M.; García, J.; Ibáñez, M.A.; **Macchiavelli, R.E.**; Nicodemus, N. (2021) Relationship between Body Chemical Composition and Reproductive Traits in Rabbit Does. *Animals* 2021, 11, 2299. <https://doi.org/10.3390/ani11082299>
- f) Poudel, P., **N. M. Bello**, D. Marburger, B. F Carver, Y. Liang and P. D. Alderman*. 2022. “Ecophysiological modeling of yield and yield components in winter wheat using hierarchical Bayesian analysis”. *Crop Science* 62(1): 358-373. <https://doi.org/10.1002/csc2.20652>

- g) Brethauer, D. K., Sharma, A., Vogel, J. G., Miller, D. L., & **Santen, E. v.** (2021). Longleaf pine seedling growth and survival: effects of season and intensity of simulated prescribed burning. *Forest Ecology and Management*, 502. doi:10.1016/j.foreco.2021.119719
- h) Dogan, O., Stratton, J., Arciniega, A., **Clarke, J.**, Tamplin, M., Bianchini, A., and Wang, B. Quantitative modeling of the survival of *Listeria monocytogenes* in soy sauce-based acidified food products. *International Journal of Food Microbiology*, 370: 109635. June 2022
- i) Lawrence-Dill, C., Allscheid, R., Boaitay, A., Bauman, T., Buckler, E., **Clarke, J.**, Cullis, C., Dekkers, J., Dorius, C., Dorius, S., Ertl, D., Homann, M., Hu, G., Losch, M., Lyons, E., Murdoch, B., Navabi, Z.-K., Punnuri, S., Rafiq, F., Reecy, J., Schnable, P., Scott, N., Sheehan, M., Sirault, X., Staton, M., Tuggle, C., Van Eenennaam, A., and Voas, R. Ten Simple Rules to Ruin a Collaborative Environment. *PLoS Computational Biology*, 18(4): e1009957. <https://doi.org/10.1371/journal.pcbi.1009957>
- j) Wilson, H., V. Bremer, G. Erickson, T. Carr, **K. Hanford**, A. Watson, T. Klopfenstein, J. MacDonald. Digestion characteristics and prediction of digestible energy and total digestible nutrients in beef cattle finishing diets containing traditional and by-product lipid sources. *Applied Animal Science*. 2021. 7:377–387. <https://doi.org/10.15232/aas.2020-02131>
- k) Estee Y Cramer, Evan L Ray, Velma K Lopez, Johannes Bracher, Andrea Brennen, Alvaro J Castro Ri- vadeneira, Aaron Gerding, Tilmann Gneiting, Katie H House, Yuxin Huang, Dasuni Jayawardena, Abdul H Kanji, Ayush Khandelwal, Khoa Le, Anja Muhlemann, **Jarad Niemi**, [256 other authors], Nicholas G Reich. (2022) “Evaluation of individual and ensemble probabilistic forecasts of COVID-19 mortality in the US” *Proceedings of the National Academy of Sciences*, 119(15), e2113561119. <https://doi.org/10.1073/pnas.2113561119>
- l) Adam Martin-Schwarze*, **Jarad Niemi**, and **Philip Dixon**. (2021) “Joint modeling of distances and times in point-count surveys.” *Journal of Agricultural, Biological, and Environmental Statistics*. 26, 289-305. <https://doi.org/10.1007/s13253-021-00437-3>
- m) Hensley, C., K.R. Brye, M.C. Savin, L.S. Wood and **E.E. Gbur** (2021). Earthworm density differences among tallgrass prairies over time in the Ozark Highlands. *Agrosystems, Geosciences & Environment*. 4:e20136.
- n) Fernandes SB, Zhang KS, Jamann TM and **Lipka AE** (2021). “How Well Can Multivariate and Univariate GWAS Distinguish Between True and Spurious Pleiotropy?” *Frontiers in Genetics*: 11:1747 doi: 10.3389/fgene.2020.602526.
- o) **Piepho, H.P.**, Boer, M., Williams, E.R. (2022): Two-dimensional P-spline smoothing for spatial analysis of field trials. *Biometrical Journal* **64**, 835-857.
- p) **Piepho, H.-P., and Madden, L. V.** 2022. How to observe the principle of concurrent control in an arm-based meta-analysis using SAS procedures GLIMMIX and BGLIMM. *Research Synthesis Methods*. 1-8. doi:10.1002/jrsm.1576 .
- q) Larson, K.J., Bundy, A.N., Kuntz, T., Hur, J., **Yeater, K.M.**, Casperson, S., Brunelle, D.C. and Roemmich, J.N., 2022. Effect of a maternal high fat diet with vegetable

- substitution on fetal brain transcriptome. *The Journal of Nutritional Biochemistry*, p.109088. <https://doi.org/10.1016/j.jnutbio.2022.109088>
- r) **Runcie, D.E.**, Qu, J., Cheng, H., and L. Crawford. (2021). MegaLMM: Mega-scale linear mixed models for genomic predictions with thousands of traits. *Genome Biology* 22(1), 1-25.
 - s) Dunn, Bruce L., Stephen Stanphill, and **Carla Goad** (2021). Branching Response of Poinsettia 'Orange Spice' to a Combination of Pinching, No Pinching, and Atrimmec, *HortScience*, 56(10). <https://doi.org/10.21273/HORTSCI16105-21>
 - t) Perttu RK, Ventura BA, **Rendahl AK** and Endres MI. Public Views of Dairy Calf Welfare and Dairy Consumption Habits of American Youth and Adults. *Front Vet Sci.* 8:693173 (August 2021). doi:10.3389/fvets.2021.693173
 - u) Khanal, P., and **R.J. Tempelman**. 2022. The use of milk Fourier transform mid-infrared spectroscopy to diagnose pregnancy and determine spectral regional associations with pregnancy in US dairy cows. *Journal of Dairy Science* 105(4):3209-3221.