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Conducting Randomized Controlled Trials in Agricultural Programs: Methodology and Best Practices

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Abstract

Randomized Controlled Trials (RCTs) have gained prominence as a robust and credible research design for evaluating the impact of agricultural programs. This article delves into the methodology and best practices involved in conducting RCTs in agricultural contexts. It provides a comprehensive overview of key steps in designing and implementing RCTs, discusses challenges specific to agricultural settings, and highlights the importance of proper randomization, sample selection, data collection, and statistical analysis. The article also emphasizes ethical considerations and the potential for generating valuable insights to inform evidence-based agricultural policies.

Introduction

Randomized Controlled Trials (RCTs) have emerged as a powerful tool in agricultural research, enabling rigorous assessment of the impact of interventions, policies, and programs. By applying the principles of experimental design, RCTs offer the opportunity to establish causal relationships between interventions and outcomes, thereby contributing to evidence-based decision-making in agriculture. This article aims to guide researchers, policymakers, and practitioners through the process of conducting RCTs in agricultural programs, elucidating key considerations, challenges, and best practices.

Methodology

2.1 Experimental Design and Randomization: Central to the RCT methodology is the random assignment of subjects to treatment and control groups. In agricultural programs, the choice of experimental units (e.g., farmers, households, plots) and the manner in which they are randomly allocated can significantly influence the internal validity of the study. Stratified randomization may be employed to ensure balanced representation across key characteristics, such as agro-ecological zones or socio-economic status.

2.2 Sample Selection: Selecting an appropriate sample size is critical to the statistical power and generalizability of RCT findings. In agricultural contexts, factors such as the heterogeneity of farming practices, geographical diversity, and seasonal variations must be considered. Calculating sample size requires a balance between precision and practicality, accounting for potential attrition and ensuring adequate statistical power to detect meaningful effects.

2.3 Treatment Implementation: The implementation of agricultural interventions must be carefully planned and executed to ensure fidelity to the intended treatment. Researchers should establish protocols for delivering inputs, training, or information, while accounting for potential spillover effects between treatment and control groups. Monitoring and quality control mechanisms are essential to maintain the integrity of the intervention and mitigate any unforeseen challenges.

Data Collection

3.1 Baseline and Endline Surveys: Agricultural RCTs necessitate comprehensive data collection to capture relevant indicators before and after the intervention. Baseline surveys provide a snapshot of the initial conditions, enabling researchers to account for pre-existing differences between treatment and control groups. Endline surveys measure the outcomes of interest and help assess the impact of the intervention. Surveys should be designed with care, incorporating validated instruments and language suitable for the target population.

3.2 Data Sources and Measurement: In addition to surveys, RCTs in agricultural settings can benefit from leveraging secondary data sources, such as remote sensing data, satellite imagery, or weather records. These sources provide valuable context and enable more nuanced analyses. Outcome variables should be well-defined and aligned with the objectives of the agricultural program, encompassing indicators like crop yields, income, food security, and adoption of innovative practices.

Analysis and Interpretation

4.1 Causal Inference: The primary advantage of RCTs is their ability to establish causal relationships between interventions and outcomes. Statistical techniques, such as difference-in-differences and propensity score matching, facilitate the identification of treatment effects. Properly designed RCTs minimize selection bias and confounding factors, enhancing the credibility of the findings.

4.2 Subgroup Analysis: Agricultural programs often target diverse populations with varying characteristics. Subgroup analysis allows researchers to explore heterogeneity in treatment effects across different segments of the population. Factors like gender, land size, or access to resources may influence the impact of interventions, necessitating careful examination and reporting of subgroup results.

Challenges and Considerations

5.1 Seasonal Variability: Agricultural activities are strongly influenced by seasonal fluctuations, which can pose challenges in designing and conducting RCTs. Researchers must consider the timing of interventions and data collection to account for these variations. Strategies such as

staggered implementation and multiple rounds of data collection may be employed to address seasonal effects.

5.2 Attrition and Dropouts: High attrition rates in longitudinal studies are common in agricultural contexts due to mobility and other socio-economic factors. Researchers should implement strategies to minimize attrition, such as offering incentives, establishing rapport with participants, and employing advanced statistical techniques to handle missing data.

5.3 Ethical Considerations: Respect for the rights and well-being of participants is paramount in agricultural RCTs. Informed consent should be obtained, and any potential risks or benefits of participation clearly communicated. Researchers must navigate complex ethical dilemmas related to withholding treatments from control groups and ensure that interventions are justifiable from a moral standpoint.

Implications and Policy Relevance

RCTs in agricultural programs hold immense potential for informing evidence-based policies and interventions. Rigorous impact evaluations contribute to a deeper understanding of effective strategies to enhance agricultural productivity, livelihoods, and food security. The adoption of RCT findings by policymakers can lead to more targeted and efficient allocation of resources, ultimately benefitting farmers and rural communities.

Conclusion

Conducting randomized controlled trials in agricultural programs demands meticulous planning, rigorous execution, and thoughtful analysis. By adhering to established methodology and best practices, researchers can generate robust evidence of intervention impacts, paving the way for informed decision-making in the agricultural sector. While challenges specific to agricultural contexts exist, the potential for generating actionable insights underscores the value of RCTs in shaping a sustainable and prosperous future for rural communities.

References

1. Laraia BA, Siega-Riz AM, Gundersen C. Household food insecurity is associated with self-reported pregravid weight status, gestational weight gain, and pregnancy complications. *J Am Diet Assoc.* 2010;110:692–701.
2. Seligman HK, Laraia BA, Kushel MB. Food insecurity is associated with chronic disease among low-income NHANES participants. *J Nutr.* 2010;140:304–310.
3. de Onis M, Frongillo EA, Blossner M. Is malnutrition declining? An analysis of changes in levels of child malnutrition since 1980. *Bull World Health Organ.* 2000;78:1222–1233.
4. Ocansey, R. T. A., Nyawornota, V. K., Adamba, C., Tay, D. A., Musah, K., Nyanyofio, O. C. N., & McCole, D.T. (2023). Promoting development of entrepreneurial skills of youth in Ghana through a structured sport intervention program. *Frontiers in Education*, 11, 1135084.
5. The Kenya Food Security Steering Group. *The impact of rising food prices on disparate livelihoods groups in Kenya*. Nairobi, Kenya: World Food Programme (WFP); 2008
6. Hoag, D. (2005). Economic principles for saving the Cooperative Extension Service. *Journal of Agriculture and Resource Economics*, 30(3), 397–410.
7. McCole, D. T., Malete, L., Tshepang, T., Ocansey, R., Mphela, T., Maro, C., Adamba, C., and Kazi, J. (2022). Can youth sport spark job creation in Africa? Using a sport-based intervention to nurture future entrepreneurs. *Gateways: International Journal of Community Research and Engagement*, 15(2).

8. Kezar, A. J., Chambers, T. C., & Burkhardt, J. C. (2005). Higher education for the public good: Emerging voices from a national movement. San Francisco, CA: Jossey-Bass.
9. King, D., & Boehlje, M. (2000). Extension: On the brink of extinction or distinction. *Journal of Extension*, 38(5), Article 5. Retrieved from <http://www.joe.org/>
10. Mansbridge, J. (1998). On the contested nature of the public good. In W. Powell & E. Clemens (Eds.), *Private action and the public good* (pp. 3–19). New Haven, CT: Yale University Press.
11. Culbertson, M. J., McCole, D. T. & McNamara, P. E. (2014). Practical Challenges and Strategies for Randomized Control Trials in Agricultural Extension and Other Development Programs. *Journal of Development Effectiveness*, 6(3), 284-299. DOI: 10.1080/19439342.2014.919339
12. Malete, L., McCole, D., Tshepang, T., Ocansey, R., Mphela, T., Maro, C., Adamba, C., and Kazi, J. (2019). Effects of a multiport-sport PYD intervention program on life skills and entrepreneurship in youth athletes. *Journal of Sport & Exercise Psychology*, 41(1), 77-88.
13. Marginson, S. (2007). The public/private division in higher education: A global revision. *Higher Education*, 53, 307–333.
14. Marginson, S. (2012). The “public” contribution of universities in an increasingly global world. In B. Pusser, K. Kempner, S. Marginson, & I. Ordorika (Eds.), *Universities and the public sphere: Knowledge creation and state building in the era of globalization* (pp. 7–26). New York, NY: Routledge.
15. Mayes, M. (1992). Status of agricultural research programs at 1890 land-grant institutions and Tuskegee University. In R. D. Christy & L. Williamson (Eds.), *A century of service: Land-grant colleges and universities, 1890-1990* (pp. 53–58). New Brunswick, NJ: Transaction.
16. McCole, D. T. & Vogt, C., (2011). Informing sustainability decisions: The role of parks, recreation, and tourism scholars in addressing unsustainability. *Journal of Park and Recreation Administration*. 29(3), 38-54.
17. McDowell, G. R. (2001). *Land-grant universities and extension into the 21st century: Renegotiating or abandoning a social contract*. Ames, IA: Iowa State University Press.
18. McMahon, W. W. (2009). *Higher learning, greater good: The private and social benefits of higher education*. Baltimore, MD: Johns Hopkins University Press.
19. Peters, S., Jordan, N., Alter, T., & Bridger, J. (2011). The craft of public scholarship in land-grant education. *Journal of Higher Education Outreach and Engagement*, 8(1), 75–86.
20. Plastina, A., & Fulginiti, L. (2012). Rates of return to public agricultural research in 48 US states. *Journal of Productivity Analysis*, 37(2), 95–113.
21. Pusser, B. (2006). Reconsidering higher education and the public good: The role of public spheres. In W.G. Tierney (Ed.), *Governance and the public good* (pp. 11-28). Albany, NY: SUNY Press.
22. McCole, D. T. & Holecek, D., & Popp, A. (2014). Understanding the travel behaviors of wine tourists in Michigan’s Leelanau Peninsula. *The Northern Grapes News*, 3(3), pp. 3-6.
23. Pusser, B. (2002). Higher education, the emerging market, and the public good. In P. Graham & N. Stacey (Eds.), *The knowledge economy and postsecondary education* (pp. 105-126). Washington, D.C.: National Academy Press.
24. Pusser, B., Kempner, K., Marginson, S., & Ordorika, I. (2012). Introduction and overview of the book. In B. Pusser, K. Kempner, S. Marginson, & I. Ordorika (Eds.), *Universities and the public sphere: Knowledge creation and state building in the era of globalization* (pp. 1–6). New York, NY: Routledge.
25. Rhoads, R.A. (2011). The US research university as a global model: Some fundamental problems to consider. *Interactions: UCLA Journal of Education and Information Studies*, 7(2), Article 4. Retrieved from: <http://escholarship.org/uc/item/8b91s24r>.
26. Rhoads, R.A. (1998). *Freedom’s web: Student activism in an age of cultural diversity*. Baltimore, MD: Johns Hopkins University Press.
27. Samuelson, P.A. (1954). The pure theory of public expenditure. *The Review of Economics and Statistics*, 36(4), 387-389.
28. Slaughter, S., & Rhoades, G. (2004). *Academic capitalism and the new economy: Markets, state and higher education*. Baltimore, MD: Johns Hopkins University Press.
29. Stiglitz, J.E. (1999). Knowledge as a public good. In I. Kaul, I. Grunberg, & M. Stern (Eds.), *Global public goods: International cooperation in the 21st century* (pp. 308-325). New York, NY: Oxford University Press.
30. Taylor-Powell, E., Jones, L., & Henert, E. (2003). Enhancing program performance with logic models. Retrieved March 1, 2012, from the University of Wisconsin–Extension website: <http://www.uwex.edu/ces/lmcourse/TFHES>.
1. 27. Task Force on Higher Education and Society. (2000). *Higher education in developing countries: Peril and promise*. Washington, DC: The World Bank.
31. McCole, D. T., Iretskaia, T. A., Perry, E. E., Suh, J., & Noyes, J. (2022). Park Design Informed by Stated preference choice: Integrating user perspectives into the development of an off-road vehicle park in Michigan. *Land*, 11(11), 1950..
32. Alston, J. M., Wyatt, T. J., Pardey, P. G., Marra, M. C., & Chan-Kang, C. (2000). *A meta-analysis of rates of return to agricultural R&D—Ex pede Herculem*. Washington, DC: International Food Policy Research Institute.
33. Anderson, J. R. (2007). *Agricultural advisory services* [Background paper for the World Development Report 2008]. Retrieved from http://siteresources.worldbank.org/INTWDRS/Resources/477365-1327599046334/8394679-1327599874257/Anderson_AdvisoryServices.pdf
34. Berry, W. (1977). *The unsettling of America: Culture and agriculture*. San Francisco, CA: Sierra Club Books.
35. Bogue, E. G., & Apter, J. (2000). *Exploring the heritage of American higher education: The evolution of philosophy and policy*. Westport, CT: Oryx Press.

36. Lee, J. -H., McCole, D., Holecek, D. (2020). Exploring winery visitors in the emerging wine regions of the north central United States. *Sustainability*, 12(4), 1642.
37. Bowen, H. R. (1977). Investment in learning: The individual and social value of American higher education. Baltimore, MD: Johns Hopkins University Press.
38. Calhoun, C. (1998). The public good as a social and cultural project. In W. Powell & E. Clemens (Eds.), Private action and the public good (pp. 20–35). New Haven, CT: Yale University Press.
39. Collins, C. S. (2011). Higher education and global poverty: University partnerships and the World Bank in developing countries. Amherst, NY: Cambria Press.
40. Collins, C. S. (2012). Land-grant extension as a global endeavor: Connecting knowledge and international development. *The Review of Higher Education*, 36(1), 91–124.
41. Creswell, J. W. (2003). Research design: Qualitative, quantitative, and mixed methods approaches. Thousand Oaks, CA: Sage. United Nations. (2008). Trends in sustainable development—Agriculture, rural development, land, desertification and drought. New York, NY: Department of Economic and Social Affairs of the United Nations.
42. McCole, D. T., Bobilya, A., Holman, T., Lindley, B. (2019). Benefits of summer camp: What do parents value? *Journal of Outdoor Recreation, Education and Leadership*, 11, 239-247.
43. Waddington, H., Snilstveit, B., White, H., & Anderson, J. (2010). The impact of agricultural extension services. International Initiative for Impact Evaluation. Retrieved August 1, 2012, from <http://www.3ieimpact.org/systematicreviews/>
44. World Bank. (2007). World development report 2008: Agriculture for development. Washington, DC: Author.
45. Worthen, B.R., Sanders, J.R., & Fitzpatrick, J.L. (2004). Educational evaluation: Alternative approaches and practical guidelines (3rd ed.). Boston, MA: Allyn & Bacon.
46. Yin, R. (2003). Case study research: Design and methods (3rd ed.). Thousand Oaks, CA: Sage.
47. Young, C. W. (2001). Background for developing a system of Hispanic-serving land-grant colleges. San Antonio, TX: Hispanic Association of Colleges and Universities.
48. Weiser SD, Tuller DM, Frongillo EA, Senkungu J, Mukiibi N, Bangsberg DR. Food insecurity as a barrier to sustained antiretroviral therapy adherence in Uganda. *PloS one*. 2010;5:e10340.
49. Weiser S, Palar K, Hatcher A, Young S, Frongillo E, BAL . Food insecurity and health: A Conceptual Framework. In: Ivers L, editor. *Food Insecurity and Public Health*. Boston, MA: CRC Press; 2014. In Press.