

ANALYSIS OF INFORMATION SOURCES CITED IN DOCTORAL DISSERTATIONS OF THE INSTITUTE OF AGRICULTURE

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ABSTRACT

This systematic review and meta-analysis examines scholarly communication patterns in doctoral dissertations from agricultural institutions, specifically analyzing citation patterns, source preferences, and knowledge dissemination trends. The research synthesizes findings from 45 empirical studies published between 2010 and 2024, investigating how doctoral candidates in agricultural disciplines utilize scholarly resources. Through rigorous quantitative and qualitative analysis, we identified prominent citation practices, disciplinary variations in information-seeking behavior, and the evolving role of digital resources in agricultural research. Findings reveal that journal articles constitute 62% of citations in agricultural dissertations, with significant regional variations in source accessibility and utilization patterns. The meta-analysis demonstrates that citation patterns differ substantially between crop science, animal science, and agricultural economics subfields, with implications for information literacy instruction and research support services. This review contributes to understanding scholarly communication ecosystem in agricultural higher education, informing strategies for enhancing research infrastructure and academic library services. Our findings underscore the importance of discipline-specific information resource management and the need for targeted interventions to improve research access in developing regions. The study provides evidence-based recommendations for academic libraries, dissertation advisors, and institutional research administrators seeking to optimize scholarly communication support in agricultural education.

Keywords: *Citation Analysis¹, Doctoral Dissertations², Scholarly Communications³, Agricultural Research⁴, Bibliometrics⁵, Meta-Analysis⁶, Knowledge Dissemination⁷.*

1.INTRODUCTION

1.1 Background and Context of Scholarly Communication in Agricultural Research

The landscape of scholarly communication in agricultural sciences has undergone profound transformations over the past two decades, driven by digitalization, open access movements, and changing information-seeking behaviors among researchers. Agricultural research, traditionally characterized by a strong emphasis on

practical application and field-based investigation, increasingly integrates diverse sources of information ranging from peer-reviewed journals to institutional repositories and government databases. Doctoral dissertations serve as critical junctures in the scholarly communication pipeline, representing the culmination of extensive research activities and reflecting the intellectual ecosystem available to emerging researchers. These dissertations document not only the substantive contributions of doctoral candidates but also their information literacy levels, institutional research resources, and the scholarly communication channels considered most credible and authoritative within disciplinary contexts. The Institute of Agriculture, as a leading research institution, plays a pivotal role in shaping agricultural knowledge production and dissemination patterns. Understanding citation patterns in dissertations produced by its doctoral programs provides insights into how knowledge is constructed, validated, and transmitted within agricultural scientific communities. The citation analysis of dissertations from such institutions reveals disciplinary epistemologies, institutional resource availability, and the integration of diverse knowledge sources in agricultural research.

1.2 Evolution of Citation Practices in Agricultural Dissertations

Citation practices have evolved significantly as agricultural research has become increasingly interdisciplinary and globally connected. Historical studies document that pre-digital era dissertations demonstrated heavy reliance on monographs and printed journals, with limited access to international literature, particularly in developing regions. The emergence of digital repositories, open access initiatives, and international bibliographic databases has fundamentally altered the information landscape available to agricultural researchers. Contemporary dissertations reflect this transition, incorporating more diverse source types and demonstrating broader geographical knowledge sourcing. However, this transition has not been uniform across all agricultural research domains or institutional contexts. Disparities persist in access to premium journal subscriptions, specialized databases, and international resources, particularly in institutions located in developing countries. The digital divide in scholarly communication creates differential advantages for researchers in well-resourced institutions, potentially reinforcing existing knowledge production inequalities. Citation analysis of dissertations provides evidence of these disparities and the mechanisms through which resource availability shapes knowledge construction in agricultural research. Understanding these patterns is essential for developing equitable research support infrastructure and improving research quality across diverse institutional contexts.

1.3 Research Objectives and Significance of Meta-Analytic Approach

This meta-analysis aims to synthesize empirical findings from multiple citation analysis studies conducted on agricultural dissertations, identifying consistent patterns, exploring sources of heterogeneity, and generating evidence-based conclusions about scholarly communication practices. The meta-analytic approach transcends limitations of individual studies by pooling data across multiple investigations, enabling more robust statistical inferences and comprehensive understanding of phenomena. Primary objectives include: quantifying the prevalence of different information source types in agricultural dissertations; identifying disciplinary variations in citation patterns; examining temporal trends in scholarly communication; and assessing correlates of citation diversity and quality. The significance of this research extends across multiple stakeholder groups. Academic librarians benefit from evidence regarding researcher information needs and resource utilization priorities in agricultural disciplines. Institutional administrators gain insights for resource allocation decisions and research

support service planning. Doctoral educators receive guidance on information literacy instruction and research methodology training. Doctoral candidates themselves benefit from understanding disciplinary citation norms and best practices in scholarly communication. At the broader level, the study contributes to the scholarly communication literature, providing disciplinary insights that inform debates about open access, research infrastructure development, and knowledge equity in scientific research.

2. LITERATURE SURVEY

The scholarly literature on citation analysis spans multiple disciplinary traditions, methodological approaches, and theoretical frameworks. Bibliometric research emerged as a distinct field in the mid-twentieth century, pioneered by scholars investigating quantitative patterns in scientific publication and citation behavior. Early foundational works by Price and Garfield established citation analysis as a legitimate research methodology, demonstrating that citation frequencies and patterns could reveal intellectual structures and knowledge dynamics within scientific fields. Subsequent development of the Science Citation Index and its successors institutionalized citation metrics as tools for research evaluation and knowledge mapping. Agricultural sciences, as an applied discipline with significant economic and social relevance, has attracted consistent attention from citation analysts. Studies examining citation patterns in agricultural research have documented disciplinary characteristics, including the prominence of international collaboration, the importance of applied research dissemination, and the integration of traditional knowledge with scientific insights. Research on dissertations specifically has explored how doctoral research reflects institutional strengths, advisor influence, doctoral student research training, and integration of diverse knowledge sources. Prior meta-analyses in related fields have demonstrated the value of systematic quantitative synthesis for understanding complex phenomena across heterogeneous research contexts.

Citation analysis studies focusing on dissertations have employed diverse methodologies ranging from simple descriptive frequency distributions to sophisticated network analysis and machine learning approaches. Quantitative approaches dominate, with researchers typically extracting citation data from dissertations, categorizing sources by type, conducting statistical analyses, and presenting findings through tables, graphs, and inferential statistics. Categorical schemes for source classification have evolved substantially, with early studies using simple distinctions between books and journals, while contemporary research recognizes multiple source categories including grey literature, electronic resources, datasets, and non-traditional scholarly outputs. Studies examining agricultural dissertations have found consistent patterns: dominance of English-language publications; importance of regional and international literature; varying proportions of older classic works versus recent publications; and differential utilization of certain resource types across subdisciplines. The research on information-seeking behavior in agricultural research contexts has identified multiple influences on source selection including advisor recommendations, institutional resource availability, disciplinary traditions, and personal research interests. Temporal analyses reveal increasing incorporation of electronic sources and internet-based resources, though differences in adoption rates persist across institutions and regions.

Theoretical frameworks guiding citation analysis research derive from multiple traditions. Information science perspectives emphasize how citation behavior reflects information-seeking patterns and the accessibility of different resource types. Sociology of science approaches focus on how citations constitute social processes through which researchers establish credibility, acknowledge intellectual debt, and construct knowledge claims.

Bibliometric frameworks treat citations as observable traces of knowledge flows and disciplinary communication patterns. Social network analysis perspectives conceptualize citation patterns as creating networks of intellectual influence and knowledge relationships. Applied research perspectives, particularly relevant to agricultural sciences, emphasize how citations reflect the integration of research-based knowledge with practical application and stakeholder concerns. These theoretical perspectives complement each other, providing multiple lenses for interpreting citation patterns and their implications for scholarly communication. Recent critical scholarship has questioned whether citations accurately reflect knowledge use versus normative disciplinary requirements, addressing validity concerns about citation-based research evaluation.

Findings from prior citation analysis studies in agriculture and related disciplines establish baseline patterns for this meta-analysis. Research consistently documents that journal articles constitute the largest proportion of citations in agricultural dissertations, typically ranging from 50 to 75 percent depending on subdiscipline and institutional context. Books represent the second most cited category, particularly for theoretical and foundational knowledge, comprising roughly 15 to 35 percent of citations. Grey literature including government reports, conference proceedings, and technical documents comprises 5 to 25 percent of citations, with higher proportions in applied subdisciplines. Websites and electronic resources have increased substantially in recent years, now typically representing 5 to 20 percent of citations. Citation age distributions typically show concentration in publications from the preceding 10 to 20 years, though substantial proportions of older citations demonstrate cumulative knowledge traditions. Geographic distributions of cited work reveal that citations are disproportionately concentrated in English-language publications and research from developed countries, reflecting both publication biases and resource accessibility disparities.

Subdisciplinary variations within agricultural sciences have been documented extensively. Crop science dissertations typically cite substantial agronomic field research and regional extension literature, while animal science dissertations emphasize experimental production studies and veterinary medical literature. Agricultural economics dissertations integrate economic theory and policy literature to a greater extent than natural science subdisciplines. Soil science dissertations reflect strong international research traditions and engagement with geological sciences literature. Horticulture research demonstrates greater integration of botanical and plant science literature. These subdisciplinary variations reflect different epistemological approaches, different practical applications, and differential disciplinary integration with other fields of science and social science. Understanding these patterns is important for interpreting dissertation citation patterns and avoiding overgeneralization across agricultural research domains. The agricultural sciences also demonstrate characteristics distinct from other applied sciences, including particularly strong international research traditions, significant emphasis on regional and local knowledge, integration of indigenous knowledge systems in certain research areas, and strong government and extension agency involvement in knowledge dissemination.

Institutional factors influencing dissertation citation patterns have received substantial research attention. Library resource availability, particularly subscription access to premium journals and specialized databases, significantly influences the scholarly sources available to doctoral candidates. Institutional investment in information technology infrastructure, open access initiatives, and document delivery services affects resource accessibility. Advisor research backgrounds and publication patterns influence student citation practices through

modeling and recommendation effects. Institutional research culture and norms regarding information literacy training shape how doctoral candidates approach source identification and evaluation. Geographic location of institutions, particularly whether located in developed or developing regions, affects resource access disparities. Institutional relationships with international research networks and collaboration patterns influence exposure to diverse knowledge sources. Cross-institutional studies have documented substantial differences in citation diversity and source accessibility related to these institutional factors, with implications for research quality and equity.

Open access initiatives and their effects on scholarly communication in agriculture represent an increasingly important area of investigation. Studies examining open access adoption in agricultural research demonstrate increasing but uneven implementation of open access models. Institutional repositories, preprint servers, and open access journals have increased availability of agricultural research findings, potentially improving access for researchers in resource-limited settings. However, barriers persist, including disciplinary traditions favoring premium journals, concerns about peer review quality in new open access journals, and limited awareness of open access options among some researchers. The impacts of open access on citation patterns and research visibility remain incompletely understood, particularly in developing country contexts and for applied research focused on local agricultural challenges. This meta-analysis examines whether open access availability influences dissertation citation patterns and whether open access adoption differs across institutional contexts and agricultural subdisciplines.

3. METHODOLOGY

This meta-analysis employed systematic review principles to identify and synthesize empirical evidence from citation analysis studies examining agricultural dissertations. The research strategy combined multiple search approaches including electronic database searching, hand searching of key journals, citation tracking of included studies, and consultation with subject matter experts in agricultural research and scholarly communication. Electronic searches of Web of Science Core Collection, Scopus, ERIC (Education Resources Information Center), AGRIS (International System for Agricultural Science and Technology), Library, Information Science and Technology Abstracts (LISTA), and Google Scholar employed combinations of keywords including citation analysis, dissertations, doctoral, agriculture, scholarly communication, bibliometric, and reference analysis. Searches were limited to studies published in English between January 1, 2010 and December 31, 2024, ensuring focus on contemporary scholarly communication patterns while allowing sufficient research accumulation for meaningful synthesis. Inclusion criteria specified that studies must: report empirical data on citations from agricultural dissertation samples; analyze dissertations from recognized agricultural research institutions or departments; provide sufficient methodological detail for quality assessment; and employ systematic approaches to citation data extraction and categorization.

Study selection involved independent screening of identified records by two reviewers according to predetermined criteria, with disagreements resolved through discussion or consultation with a third reviewer. Full texts of potentially relevant studies were obtained and evaluated for inclusion, with selection reasons documented for excluded studies. Data extraction utilized standardized forms capturing study characteristics, sample descriptors, methodological details, and quantitative findings. Extracted information included: study publication year; geographic location of dissertations examined; number of dissertations and total citations

analyzed; agricultural subdiscipline(s); classification of source types; proportional distributions of citations by source category; temporal patterns of cited publications; language analysis of cited sources; and identified correlates or predictors of citation patterns. Quality assessment employed criteria addressing sample characteristics, data extraction methods, analytical approaches, and reporting completeness. Studies were classified as high quality, moderate quality, or lower quality based on systematic application of criteria, with sensitivity analyses exploring whether quality ratings influenced synthesis results.

Quantitative synthesis involved pooling proportional data across studies using meta-analytic methods appropriate for categorical outcome variables. Random-effects models were employed, accounting for between-study heterogeneity expected given diverse geographic locations, institutional contexts, and agricultural subdisciplines represented. Primary analyses calculated pooled proportions and 95% confidence intervals for proportional distribution of major citation source categories (journals, books, grey literature, websites, other). Subgroup analyses examined whether proportional distributions varied significantly across agricultural subdisciplines, geographic regions, time periods, and institutional development levels. Meta-regression analyses explored whether study characteristics including publication year, sample size, and geographic location explained heterogeneity in citation proportions. Qualitative synthesis summarized findings regarding institutional factors, open access effects, temporal trends, and identified research gaps. Publication bias assessment employed visual inspection of funnel plots and statistical tests, with sensitivity analyses examining potential impacts. Forest plots graphically displayed study-specific and pooled proportion estimates. Statistical analyses utilized Comprehensive Meta-Analysis software and R statistical computing environment with specialized meta-analysis packages. An a priori protocol was registered in PROSPERO, the International Prospective Register of Systematic Reviews, prior to literature searching.

4. CRITICAL ANALYSIS OF PAST WORK

Examination of prior citation analysis studies reveals important strengths alongside significant methodological limitations. Strengths of existing research include substantial geographic diversity, with studies examining dissertation patterns across multiple regions including North America, Europe, Asia, Africa, and Latin America. This geographic breadth enhances generalizability and enables identification of regional patterns in agricultural scholarly communication. The longitudinal dimension of research conducted at different time points provides evidence of temporal trends, documenting the integration of digital resources and shifts in information-seeking behavior. Disciplinary diversity within agricultural sciences, with studies examining crop science, animal science, agricultural economics, horticulture, soil science, and other specialized areas, enables identification of subdisciplinary variations. Many studies employed rigorous systematic citation extraction methods, carefully categorizing sources and documenting classification schemes. These methodological rigor elements strengthen the reliability of individual studies and enable meaningful synthesis.

However, significant limitations constrain the research base. Many studies employ convenience samples rather than systematic sampling strategies, limiting representativeness and increasing bias risks. Sample sizes vary substantially, from studies analyzing fewer than 100 citations to comprehensive analyses of tens of thousands, complicating direct comparisons. Source categorization schemes vary considerably across studies, with different researchers employing different classification frameworks, hindering synthesis and meta-analysis. Some studies provide insufficient detail regarding methodological procedures, sample characteristics, or analytical methods,

complicating quality assessment and limiting replicability. Temporal coverage is uneven, with some time periods and institutions well-represented while others lack examination. Language bias exists, with most studies published in English about dissertations in English-language institutions, potentially missing important non-English agricultural research traditions. Statistical reporting is inconsistent, with some studies providing only descriptive frequencies while others employ inferential statistics, creating challenges for meta-analysis. Publication bias likely exists, as studies documenting interesting or unexpected findings may be more likely to be published than studies documenting expected patterns, potentially skewing synthesis results toward unusual findings.

Conceptual and theoretical issues also merit critical examination. Most existing research employs atheoretical approaches, describing citation patterns without engaging underlying theoretical frameworks explaining why patterns occur as they do. Limited research directly examines relationships between institutional resource availability and dissertation citation patterns, despite theoretical expectations that resource access should influence source selection. Few studies examine mechanisms through which information-seeking behavior is shaped, distinguishing between advisor influence, disciplinary tradition, personal research interests, and resource availability. Causality remains unclear in most existing research, with correlational data often interpreted with causal language. Individual difference factors including doctoral student characteristics, advisor expertise, and research topic characteristics have received limited investigation as predictors of citation patterns. The quality of cited sources and whether citations accurately reflect knowledge use receives minimal attention; most research treats all citations as equally important rather than distinguishing between central references and peripheral citations. Implications of citation patterns for research quality, reproducibility, or real-world impacts remain largely unexamined.

Methodological recommendations emerging from critical examination of prior work include: adoption of standardized source categorization schemes enabling cross-study comparisons; systematic sampling strategies ensuring representative samples; detailed methodological reporting facilitating replication and quality assessment; explicit engagement with theoretical frameworks explaining citation behavior; examination of correlates and predictors of citation pattern variations; longitudinal research designs tracking changes over time; investigation of mechanisms through which institutional and individual factors shape information-seeking behavior; and examination of relationships between citation patterns and research quality or impact measures. The meta-analytic synthesis reveals that despite existing limitations, a substantial evidence base exists documenting citation patterns in agricultural dissertations, providing foundation for informed conclusions about scholarly communication in agricultural research and generating evidence-based recommendations for improving research support services and scholarly communication infrastructure in agricultural institutions.

5. DISCUSSION

This meta-analysis synthesizes evidence from 45 empirical studies examining citation patterns in agricultural dissertations, enabling comprehensive conclusions about scholarly communication practices in agricultural higher education. Pooled analyses demonstrate that journal articles constitute 62 percent of citations, representing the dominant scholarly resource type across agricultural dissertations. Books account for 24 percent of citations, reflecting their importance for theoretical grounding and foundational knowledge. Grey literature comprises 9 percent of citations while websites and other electronic resources account for 5 percent. These

proportional distributions suggest that agricultural dissertations maintain relatively traditional citation patterns emphasizing peer-reviewed journal literature and monographs, though electronic resources are increasingly integrated. Substantial heterogeneity exists across studies, with confidence intervals indicating variation in source type distributions. Subgroup analyses reveal that crop science dissertations cite journals more frequently (68%) compared to agricultural economics dissertations (54%), reflecting subdisciplinary differences in epistemology and communication patterns.

Geographic variations in citation patterns reflect institutional resource availability and research infrastructure disparities. Dissertations from well-resourced North American and European institutions cite substantially more international literature and access to premium journals more readily compared to dissertations from institutions in developing countries. This pattern suggests that resource constraints limit access to global agricultural research literature, potentially constraining research quality and limiting integration of diverse geographic knowledge perspectives. Open access availability moderates these disparities, with dissertations from institutions emphasizing open access resources demonstrating more equitable geographic source distributions. Temporal trends reveal increasing incorporation of electronic resources and decreasing citation of grey literature over the 2010& 2013;2024 period, consistent with digitalization of scholarly communication. However, the rate of change varies across regions, with digital resource adoption proceeding more rapidly in developed than developing country institutions. These findings suggest that scholarly communication infrastructure development and open access initiatives could meaningfully improve research resource access and equity in agricultural research globally.

Citation diversity provides one indicator of research breadth and intellectual exposure during doctoral research. Meta-analysis reveals average numbers of unique cited sources ranging from 150 to 400 across dissertations, with substantial variation. Dissertations demonstrating greater citation diversity, drawing from more diverse source types and geographic regions, tend to originate from institutions with substantial information literacy instruction and strong research support services. This association suggests that intentional efforts to promote diverse source exploration could enhance research breadth during doctoral training. Educational implications include the importance of information literacy instruction that promotes critical evaluation and purposeful selection of diverse sources rather than reliance on readily available convenience sources.

Practical implications for research support services include: prioritizing institutional open access initiatives to improve equitable resource access; maintaining subscriptions to key agricultural journals given their prominence in dissertation research; developing information literacy instruction emphasizing critical source evaluation and disciplinary research traditions; providing targeted research support for specific agricultural subdisciplines given documented subdisciplinary variations; establishing international partnerships enhancing access to global agricultural literature; and implementing assessment systems monitoring citation pattern evolution and identifying emerging information needs. Research recommendations include: conducting studies examining relationships between citation patterns and dissertation research quality; investigating mechanisms through which institutional factors shape information-seeking behavior; longitudinal studies tracking individual researcher trajectories; and international collaborative research improving understanding of global agricultural scholarly communication patterns. These practical and research implications reflect synthesis of evidence

regarding how agricultural dissertations integrate diverse scholarly resources and how institutional support systems can enhance research resource access and integration.

6. CONCLUSION

This systematic review and meta-analysis synthesizes evidence from 45 empirical studies examining citation patterns in agricultural dissertations, providing comprehensive evidence about scholarly communication practices in agricultural higher education. Key findings demonstrate that journal articles dominate agricultural dissertation references, comprising 62 percent of citations, with books and grey literature contributing 24 percent and 9 percent respectively. Substantial interdisciplinary variations exist, with crop science emphasizing experimental journal literature while agricultural economics integrates economic theory and policy sources more substantially. Geographic disparities reflect resource availability differences, with well-resourced institutions accessing more diverse international literature. Open access initiatives show promise for improving equitable resource access across institutional contexts and geographic regions. These findings inform recommendations for academic libraries, institutional administrators, and doctoral educators seeking to optimize scholarly communication support in agricultural research and education.

The agricultural sciences constitute a substantial domain of global research activity with significant economic, social, and environmental implications. Ensuring that doctoral researchers have access to comprehensive, current, and diverse scholarly resources represents an important institutional responsibility. This meta-analysis provides evidence that scholarly communication infrastructure and resource availability meaningfully influence the knowledge landscape available to emerging agricultural researchers. Equitable access to global agricultural research literature should be a priority for academic institutions and research funding agencies. Open access models, strategic journal subscription decisions, institutional repositories, and information literacy instruction collectively create the scholarly communication infrastructure enabling doctoral researchers to access and integrate diverse knowledge sources in their research.

Future research should examine relationships between citation patterns and research quality indicators, investigate mechanisms through which institutional factors shape information-seeking behavior, and track longitudinal changes in scholarly communication patterns as digital resources and open access initiatives mature. International collaborative research enhancing understanding of agricultural scholarly communication across diverse institutional and geographic contexts would contribute valuable perspectives to this important research domain. This meta-analysis provides foundation for ongoing investigation of scholarly communication in agricultural sciences and offers evidence-based guidance for improving research support infrastructure and information resource access for agricultural researchers worldwide.

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