Food Systems Citation Analysis: Trends in an Emerging Interdisciplinary Field

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Abstract: Food systems is an emerging field that draws researchers from food science, economics, nutrition, agronomy, and public health. To gain a better perspective on food systems literature, a citation analysis was performed on four journals covering the topic of food systems—a relatively new discipline in academia. Analyses included the types of works cited, the most commonly-cited journals in this discipline, age of materials cited, geographic location of authors, and types of data cited. The data collected aided the librarians who were tasked with supporting this new area of research and will be used to support the research by assisting students and building appropriate collections.

Resumé: Les systèmes alimentaires sont un domaine récent qui attire les chercheurs en sciences de l'alimentation, de l'économie, de la nutrition, de l'agronomie et de la santé publique. Pour obtenir une meilleure perspective sur la littérature en sciences alimentaires, une analyse des citations en référence a été effectuée dans quatre revues couvrant ce sujet—une discipline académique relativement nouvelle. Les analyses incluent le genre de travaux cités, les revues les plus souvent citées dans cette discipline, l'âge du matériel cité, la location géographique des auteurs, et le type de données citées. Les données collectées ont aidé les bibliothécaires qui ont la tâche de soutenir ce nouveau domaine de recherche, et seront utilisées pour soutenir la recherche en assistant les étudiants et en développant des collections appropriées.

Resumen: Los sistemas alimentarios constituyen un campo emergente que atrae a investigadores de ciencias de la alimentación, economía, nutrición, agronomía y salud pública. Para tener una mejor perspectiva de la literatura sobre sistemas alimentarios, se realizó un análisis de las citas de cuatro revistas que tratan el tema de estos sistemas—una disciplina relativamente nueva en el mundo académico. Los análisis abarcaron tipos de trabajos citados, revistas citadas más comúnmente en esta disciplina, antigüedad de los materiales citados, ubicación geográfica de los autores y tipos de datos citados. Los datos recopilados ayudaron a los bibliotecarios encargados de apoyar esta nueva área de investigación y serán utilizados para apoyar la investigación al ayudar a estudiantes y desarrollar colecciones apropiadas.

Introduction

Food systems is an emerging field of academic study. It focuses on the entire farm-to-table process and has been defined as "the whole array of activities, ranging from input distribution through on-farm production to marketing and processing, involved in producing and distributing food to both urban and rural consumers" (Staatz 2000).

Thus, food systems touches on a number of related fields including agronomy, animal science, economics, marketing, nutrition, and sustainability. Articles on food systems appear in the journals in all of these fields. In addition, a small number of food systems-focused journals have recently emerged, including the 4 that are covered in this study.

As with many citation analysis projects, this one was undertaken in part to better inform collection development activities related to food systems. The wide variety of disciplines represented may not necessarily emphasize the same types of literature. In animal science the journal literature is premier while working papers and conference papers are important to economists and some food systems researchers may rely on government documents.

Citation analysis is a well-established investigational method, falling into the category of bibliometrics (Nicolaisen 2007). In addition to collection development, citation analysis is sometimes done to gain perspective on historical trends. Recent articles on the topic have focused on automated methods (Fransen 2012), the importance of consistency in citation analysis methodology (Hoffmann and Doucette 2012), and the more detailed investigation of research objectives of recent citation analysis studies (Ashman 2009).

Citation analyses that cover a subject area are often done using PhD dissertations but in this case there are very few graduate programs with an emphasis on food systems. They also tend to be new programs and some are limited to more narrow areas such as community or sustainable food systems. Using the citations from food systems journals was a more promising avenue.

Methods

We evaluated the references of researched articles published in the 2012 and 2013 issues of 4 food systems journals:

- *Agroecology and Sustainable Food Systems*
- *International Journal on Food System Dynamics*
- *Journal of Agriculture, Food Systems, and Community Development*
- *Renewable Agriculture and Food Systems*

We located 5 potential journals by searching Ulrich's Periodical Directory and conducting searches on food systems in relevant databases. Of these five, *International Journal of Tropical Agriculture and Food Systems* was eliminated because its focus was too narrow and it was not published with much regularity.

Table 1 – Details on the four journals analyzed

Background Information							Indexing Sources				
Journal	Type of Publisher	Open Access	Country of Publication	Issues/year	Year of 1st issue	Former title	Agricola	CAB	FSTA	Scopus	WOS
Agroecology and Sustainable Food Systems	Commercial	No	USA	8 to 10	2013	Journal of Sustainable Agriculture (1990-2012)	X	X	X		X
International Journal on Food System Dynamics	Not for profit	Yes	Germany	4	2010						
Journal of Agriculture, Food Systems, and Community Development	Academic	No	USA	3 to 4	2010			X			
Renewable Agriculture and Food Systems	Commercial	No	USA	4	2004	American Journal of Alternative Agriculture (1986-2003)	X	X	X	X	X

See Table 1 for additional information about each journal such as dates published and open access status.

Research articles in each issue of the journals were identified, and for each of the items cited in those articles, the following information was noted:

- Category of item (journal article, Web site, working paper, etc)
- Year of publication
- Name of 1st author
- Country of 1st author, if available
- Name of journal, if appropriate
- Name of book, for books and book chapters

The list of categories of items was developed by first brainstorming possible entries and testing the list against random lists of reference from each of the four journals. We began with 28 categories and after the analysis was completed we grouped some like categories together.

Information on some of the journals was able to be exported from Web of Science or Scopus and for the others we used a Google form to input the articles one by one. The process of assigning a category to each citation was simplified a bit by labeling any item with a volume and page range as a journal article. For a number of the cited works, it was necessary to look at the item itself before deciding on the category. It should be noted that our citation analysis yielded only one patent which was included in the "other category."

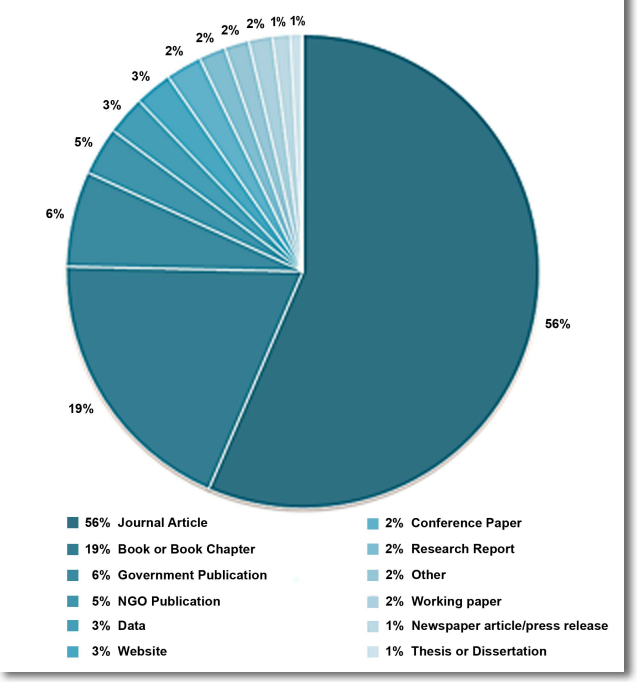
Results and Discussion

In total, this analysis included 11,194 citations from articles in the four journals. Each citation was originally sorted into one of 28 categories, but this list was compressed to 12 for analysis. See Appendix A for a full list of the original and compressed categories. Of these twelve categories, the most-cited was Journal Article (56%) followed by Book or Book Chapter (19%) and Government Publication (6%) (See Figure 1). It should be noted that 44% of the citations were for non-journal-article sources. This is higher than in other disciplines such as food science (Salisbury, Bajwa, and Dillon 2007), atmospheric science (Kaczor 2014), and biology (Miller 2011). While journal articles are certainly important to this discipline, a wide variety of other sources are relevant and necessary to its work.

Indexing Sources

- **Agricola**: Focuses on agricultural and all related disciplines including food and nutrition. The database is international is scope. Publisher: National Agricultural Library (United States), Beltsville, MD USA.
- **CAB Abstracts**: This database includes journals, books, conference proceedings, reports, theses and other kinds of literature published internationally. Publisher: Centre for Agriculture and Bioscience International. Wallingford, England.
- **Food Science and Technology Abstracts (FSTA)**: Worldwide coverage of selected source material from scientific and technical literature relating to food health. Publisher: IFIS Publishing, Reading, England.
- **Scopus**: A large database of abstracts and citation of peer-reviewed literature. Publisher: Elsevier B.V., Amsterdam, The Netherlands.
- **Web of Science (WOS)**: A multidisciplinary science index with more than 100 years of backfiles. Publisher: Thomson Reuters, New York, New York USA and Toronto, Canada.

Figure 1 – Comparison of Categories of Publications Analyzed in the Food Systems Journals



The ten most cited journals in this set ranged from 252 citations (4% of the total journal citations) for *Agronomy Journal* to 73 citations (1% of the total journal citations) for *Science*. All ten most-cited journals are listed in Figure 2. That no single journal received more than 4% of the total journal citations suggests that no single or small set of journal titles comprise the bulk of what is cited in food systems, although most of the top ten journals are related at least broadly to the field of agriculture. Further analysis shows that the most highly cited journals vary widely by the journal doing the citing (See Figure 3). For a list of the top journals cited by each source, see Appendix B. The analysis of citations by journal also shows that some journals cite their own articles more frequently, thus boosting their citation count.

In order to gauge the international scope of food systems research as it is published in these four journals, we recorded both the journals' countries of publication (See Table 1) and the first author's institutional country affiliation for each article studied within those journals. The

Figure 2 – Top Ten Journals Cited in Rank Order

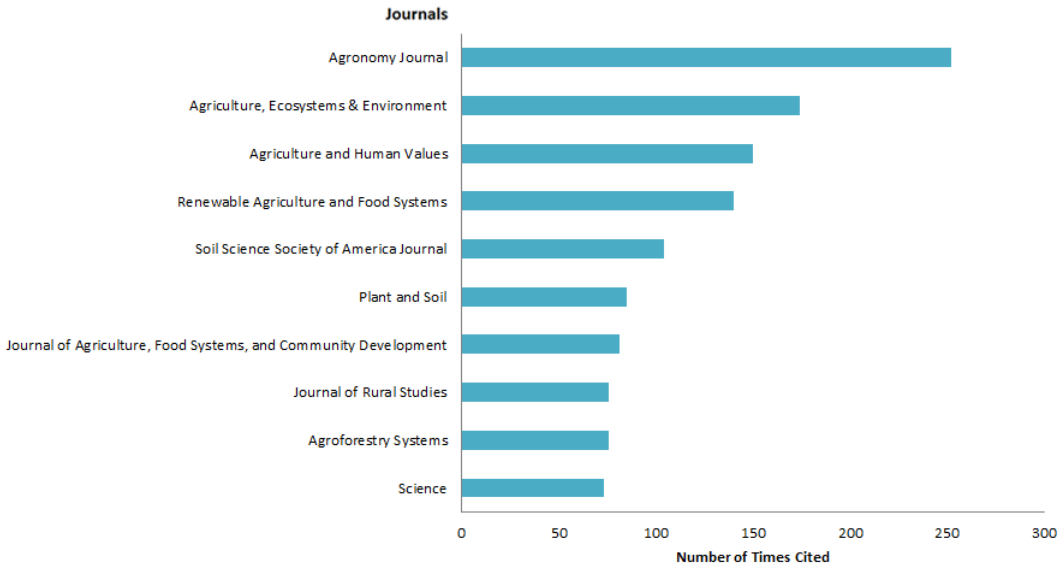
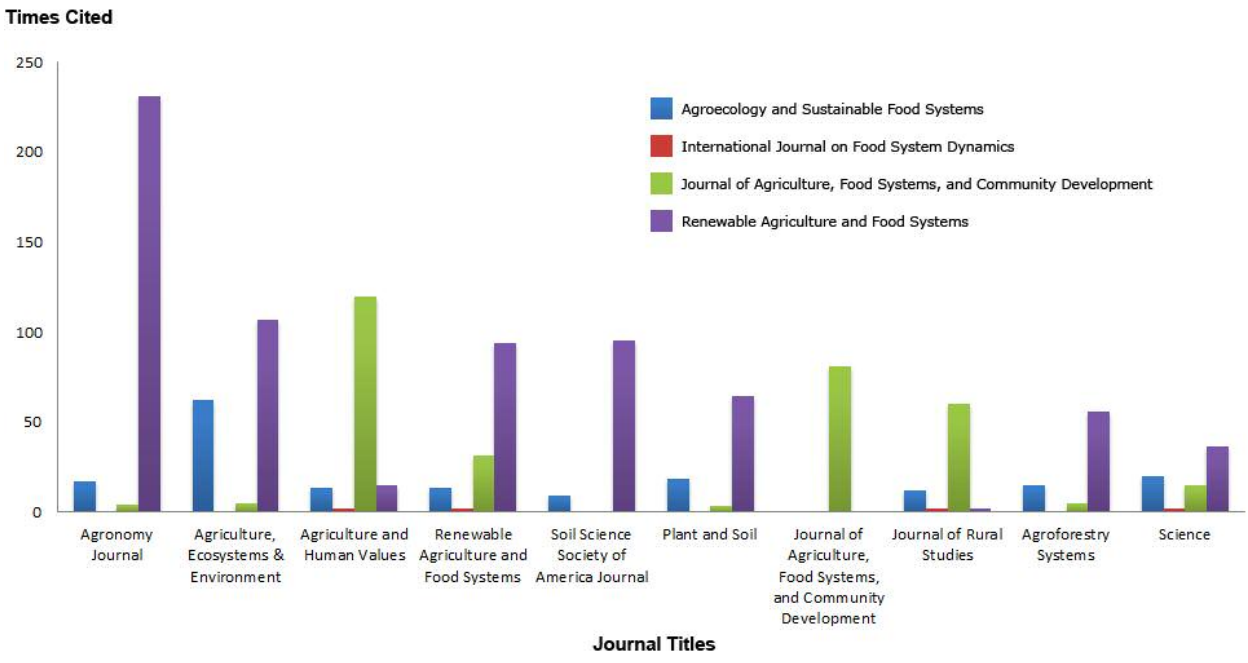


Figure 3 – Top Ten Journals Ranked by Citing Source



results show that the majority (46%) of authors are based in the United States which is not surprising given that three of the four journals are published there and all are published in English. The remaining 44% of the authors spread out among 35 different countries including Canada (7%), Italy (5%), and Germany (5%) (see Table 2).

We also looked at the number of sources cited by each article to determine how many sources are commonly cited in papers in this field. The average results for each of the four journals individually and combined are shown in Table 3. Overall, the average number of references cited per article was 46.

Because food systems is a relatively new discipline, we wanted to assess to what extent the literature it uses is newly generated versus older content. To do this, we calculated the median year of citation for each of the twelve source types in our analysis (See Table 4). These results show that while some older materials may be cited (the oldest citation being a journal article published in 1857), the majority of citations for all types of sources were published within the 10 years preceding (the exception being books which skew just a few years earlier.) This suggests that for collection development purposes, libraries should focus first on current materials and less so on backfiles and older materials.

Data was one category of citations that we wanted to delve into further in order to learn more about the needs of researchers in food systems. The data category in our analysis was comprised of three categories from our original system — Government Data, NGO Data, and Other-Data. Of these three categories, Government Data provided the vast majority (85%) of sources (See Figure 4). Some of the most commonly cited producers of this data were

Table 2 – Country of Institution Affliation of First Authors

Country	Number of Authors	Percentage of Authors
USA	111	46.06%
Canada	17	7.05%
Italy	13	5.39%
Germany	13	5.39%
The Netherlands	7	2.90%
Spain	7	2.90%
India	7	2.90%
Australia	6	2.49%
China	5	2.07%
UK	4	1.66%
Switzerland	4	1.66%
France	4	1.66%
South Africa	3	1.24%
Norway	3	1.24%
Mexico	3	1.24%
Ireland	3	1.24%
Denmark	3	1.24%
Brazil	3	1.24%
Austria	3	1.24%
Nigeria	2	0.83%
Malaysia	2	0.83%
Kenya	2	0.83%
Ethiopia	2	0.83%
Belgium	2	0.83%
The Philippines	1	0.41%
Taiwan	1	0.41%
Sweden	1	0.41%
Slovenia	1	0.41%
Singapore	1	0.41%
Poland	1	0.41%
Japan	1	0.41%
Iran	1	0.41%
Ghana	1	0.41%
Finland	1	0.41%
Costa Rica	1	0.41%
Argentina	1	0.41%
Grand Total	241	

Table 3 – Average Number of References Per Article Cited in the Four Journals

Journal Title	Average Number of Citations Per Article
Agroecology and Sustainable Food Systems	46
International Journal on Food System Dynamics	35
Journal of Agriculture, Food Systems, and Community Development	42
Renewable Agriculture and Food Systems	58
Total	46

Table 4 – Median Year of Citations for 12 Source Types

Age of Sources Cited	
Cited Source Type	**Median Year Cited**
Book or Book Chapter	2004
Conference Paper	2007
Data	2009
Government Publication	2007
Journal Article	2006
Newspaper article/press release	2009
NGO Publication	2007
Other	2009
Research Report	2008
Thesis or Dissertation	2008
Website	2011
Working paper	2005

the United States Department of Agriculture, the United States Census Bureau, and Statistics Canada. Familiarity with these types of sources is a necessity for librarians and information professionals supporting food systems and complements their use of government and NGO publications.

We also did further analysis to break out the types of websites cited and discovered that NGO (35%), Trade (15%), and Government (15%) Internet resources are the most commonly used in this discipline (See Figure 5). This speaks to the importance of non-academic work to food systems research and the interplay between the two. It is also worth noting that a combined 4% of the citations in this analysis were for conference or working papers (See Figure 1). As this discipline grows, this type of gray literature may become more important for rapid dissemination of information and ideas.

The main limitations of the results presented here are a byproduct of food systems being a relatively new and interdisciplinary field. While citation analyses have traditionally been performed on graduate theses and dissertations, we were not able to take this approach because very few food systems PhD programs exists and those that do are too new to have produced many dissertations. There are also no established conferences or societies solely for food systems researchers from which to draw information.

Figure 4 – Distribution of the Three Categories of Data Cited in the Food Systems Journals

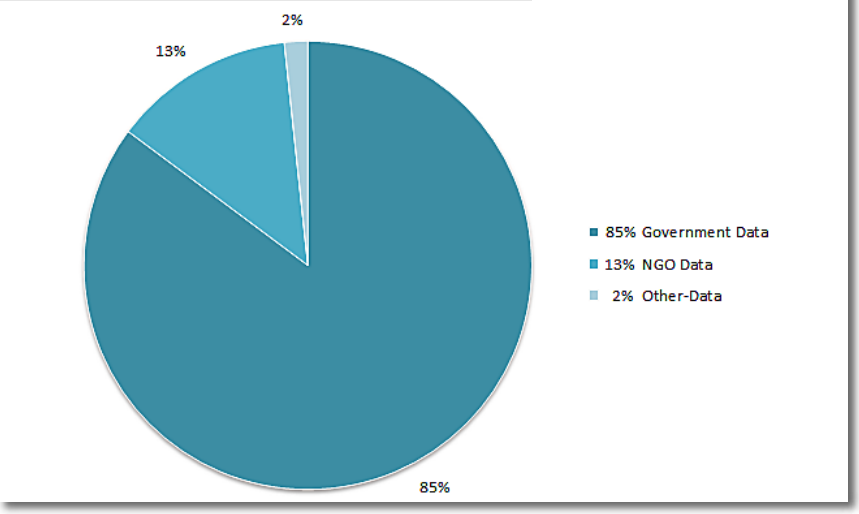
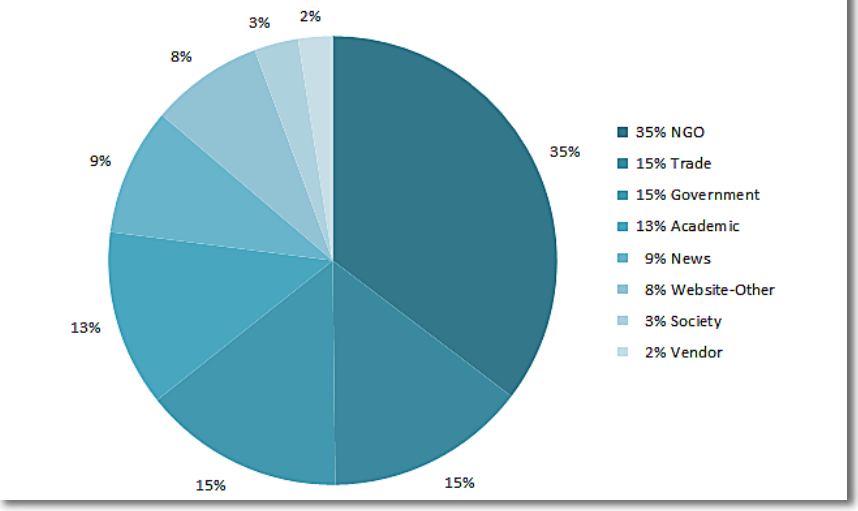


Figure 5 – Distribution of the Websites Cited in the Food Systems Journals



Of the four journals we chose for this analysis, two had former titles that did not include the term "food systems," instead using the terms "sustainable agriculture" and "alternative agriculture." This suggests that earlier research or relevant journals may have been excluded due to overlap in disciplines and changing vocabulary. Further, because food systems is so interdisciplinary, research on this topic is published in a broad range of journals—not just those explicitly focused on food systems. To highlight this point, a title search for the phrase "food systems" in Web of Science produces 633 records from 106 sources ranging from *Journal of Food Science* to *Technological Forecasting and Social Change*.

Conclusions

This citation analysis of four food systems journals provides valuable information for librarians about the resources used by researchers in this emerging field. Few journals focus strictly on food systems, but the numbers will likely grow as the discipline matures and the number of graduate programs grows. It is revealed that authors cite materials from a wide variety of related disciplines including some in the social sciences and that it is acceptable to cite more informal information sources such as Web sites and articles from trade journals. Even among the small number of journals studied here, there is variation among the types of materials cited and the most commonly cited journals.

While journals are the most common type of source cited, books and book chapters represent a significant portion of the citations and use of government documents was also worth noting. The number of citations to data is not large but the importance of government data to this field should be acknowledged. A more traditional citation analysis of dissertations may be useful in the future as graduate programs in food systems become well-established.

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Appendix A: Types of Publications Considered for Analysis

Original Citation Categories

1. Book
2. Book Chapter
3. Conference Paper
4. Government Data
5. Government Publication
6. Journal Article, scholarly
7. Journal Article; trade
8. Magazine Article
9. Book; Manual
10. Newpaper article/press release
11. NGO Data
12. NGO Publication
13. Personal Communication
14. Policy Brief
15. Product Information
16. Research Report
17. Standard
18. Thesis or Dissertation
19. Working paper
20. Website-Academic
21. Website-Government
22. Website-News
23. Website-NGO
24. Website-Society
25. Website-Trade
26. Website-Vendor
27. Website-Other
28. Other

Condensed Category List for Analysis

1. Book or Book Chapter
2. Conference Paper
3. Data
4. Government Publication
5. Journal Article
6. Newpaper article/press release
7. NGO Publication
8. Research Report
9. Thesis or Dissertation
10. Website
11. Working Paper
12. Other

Appendix B: Most Frequently Cited Journals in each of the Four Journals by Journal Title

Figure 6 – Agroecology and Sustainable Food Systems

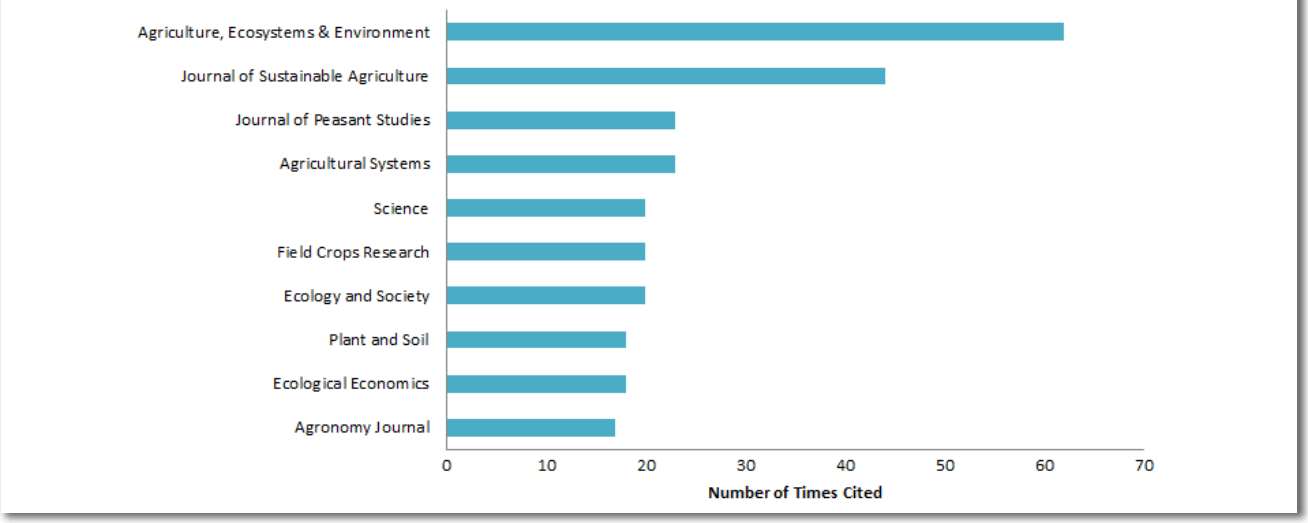

Figure 7 – International Journal of Food System Dynamics

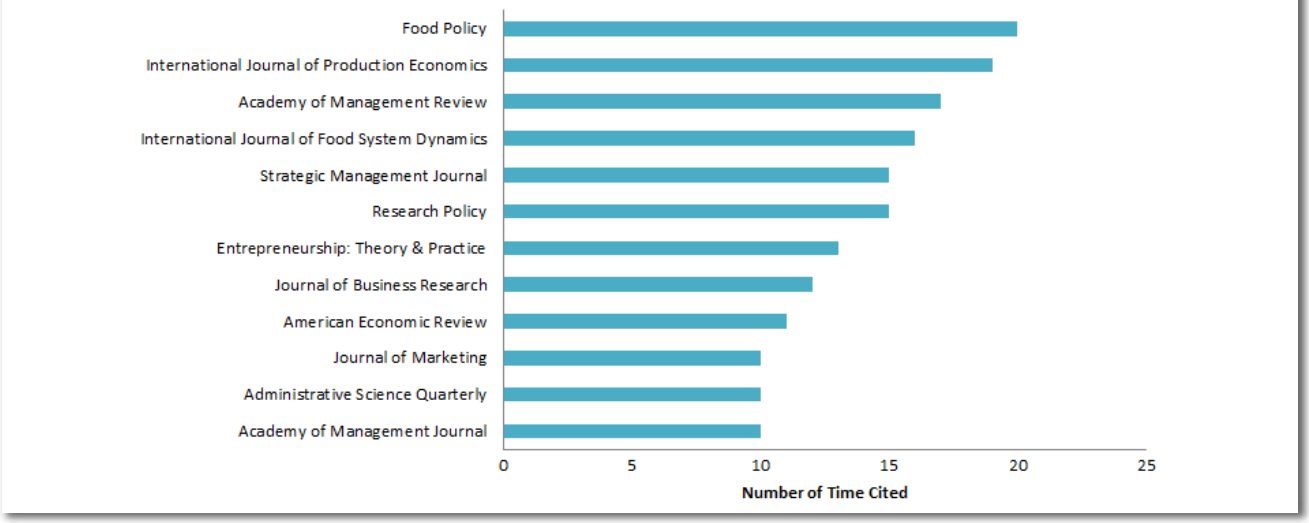

Figure 8 – Journal of Agriculture, Food Systems, and Community Development

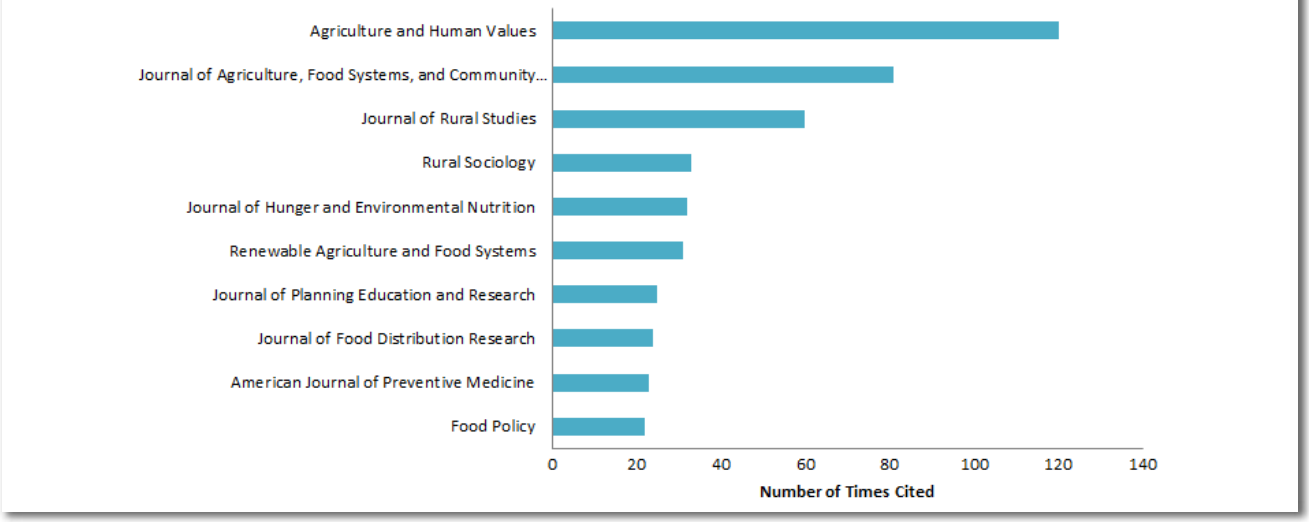

Figure 9 – Renewable Agriculture and Food Systems