Thematic and citation structure dynamics of Organic Food & Farming research

Guillaume Ollivier, Stephane Bellon, Servane Penvern

Thematic and citation structure dynamics of Organic Food & Farming research

Ollivier, G.[1], Bellon, S.[1] & Penvern, S.[1]

Key words: OF&F, scientometrics; document co-citation analysis; specialty detection

Abstract

This paper analyses the Organic Food & Farming (OF&F) scientific domain dynamic throught a "progressive document co-citation analysis" based on peer-reviewed papers from Web of Science. The dataset of OF&F domain displayed an exponential growth and a thematic diversification pattern. Both dominant and marginal clusters in association with their main cited articles were identified. This study enables to pinpoint major themes addressed or emerging. It can feed further research work and projects, namely with the definition of information system and research policy.

Introduction: need for research and research needs in OF&F

The organic sector is increasingly considered by stakeholders as a tangible alternative to address current challenges faced by agriculture. This leads to a continuous expansion of both the knowledge base and the demand of synthesis in OF&F. Several authors suggested topics for research, whether as general themes (Watson *et al.*, 2008; Rahmann *et al.*, 2009) or specific fields (Kristiansen *et al.*, 2006). Others addressed the specificity of organic research approaches (Lockeretz, 2000; Watson *et al.*, 2008; Drinkwater, 2009). However, such reviews do not analyse evolutions in topics within the OF&F literature. This assessment is important as transnational projects and journals dedicated to OF&F develop. We propose, using scientometrics, to identify dynamic of specialties and associated research topics in OF&F domain.

Material and methods

The *progressive document co-citation analysis* (PDCA), developped inside the CiteSpace Software (Chen *et al.*, 2010), allows to find the intellectual basis of specialties developed within the OF&F domain by mapping its internal citation structure. A co-citation link occurs when two documents are cited in the same citing documents. PDCA identifies high-density patterns (clusters) inside the co-citation network. Theses clusters gather the documents often cited together (intellectual basis) upon which authors build their specialties. The analysis is progressive since the dataset is divided into n-years slices, thus useful to interprete the clusters evolutions. As citation clusters are hierarchically organised, we iteratively tested various threshold parameters to produce different co-citation networks in order to detect a common robust structure emerging from the different resulting clustering. To better synthetise information, we gathered structurally and topically coherent clusters thanks to the CiteSpace *automatic cluster labeling* which detects specific cluster terms from citing documents (Chen *et al.*, 2010).

The *Web of Science* was used because it includes the cited references for each publication. The challenge was to build a query representing all the aspects of OF&F research (production modes, products, social dimensions) without inducing noises. Indeed, some terms related to OF&F are also used in other domains. After a first query, we extracted terms using “organic” to test their specificity in the OF&F domain.

[1] UR 0767 Ecodéveloppement, INRA E-Mail : gollivier@avignon.inra.fr

We finally built a complex query, composed of 120 specific terms representing the domain and resulting in a dataset of 4401 journal articles from 1975 to 2009.

Results

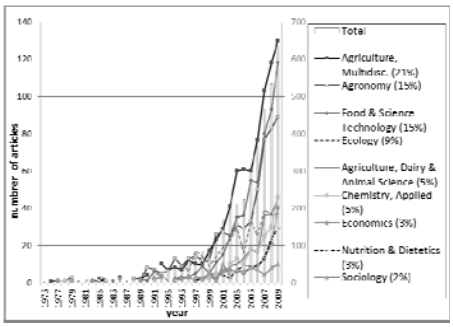

Figure 1: Evolution of significative subject areas[2]

The dataset displayed a clear exponential growth associated with a thematic diversification pattern (Figure 1). The OF&F domain was firstly developed inside Agricultural sciences. Every subject area (SA) increased in the 90's except for Sociology whose growth remained relatively low. Lately, three SA have dominated the domain. Agriculture (Multidisciplinary) and Agronomy prevailed jointly until 2001 and afterwards; they exhibit a rather similar growth.

The third SA, Food Science & Technology, remained marginal until 1999 before being the second most important one after 2002. While Ecology was also a major SA, it did not face such a development and increased constantly after the late 90's. In the meantime, secondary SA emerged with significant growth during the past years: Dairy and Animal Sciences, Economics, Applied Chemistry and Nutrition & Dietetics.

Table 1: main features of specialties detected

Specialty	year	1st Author	title	Journal	# cited
Farming performances	1973	Pimentel	Food production and the energy crisis	Science	11
	1978	Berardi	Organic and conventional wheat production: examination of energy and economics	Agroecosystems	13
	1981	Lockeretz	Organic farming in the Corn Belt	Science	36
Soil	1987	Vance	An extraction method for measuring soil microbial biomass C	Soil Biology & Biochemistry	88
	1993	Reganold	Soil quality and financial performance of biodynamic and conventional farms in New Zealand	Science	48
	1995	Drinkwater	Fundamental differences between conventional and organic tomato agroecosystems in California	Ecological Applications	73
	2002	Mader	Soil fertility and biodiversity in organic farming	Science	187
Biodiversity	1999	Krebs	The second silent spring?	Nature	30
	2005	Hole	Does organic farming benefit biodiversity?	Biological Conservation	91
	2005	Bengtsson	The effects of organic agriculture on biodiversity and abundance: a meta-analysis	Journal of Applied Ecology	78
Food qualities	1997	Woese	A comparison of organically and conventionally grown foods—results of a review of the relevant literature	Journal of the Science of Food and Agriculture	118
	2001	Brandt	Organic agriculture: does it enhance or reduce the nutritional value of plant foods?	*Idem*	51
	2002	Bourn	A comparison of the nutritional value, sensory qualities, and food safety of organically and conventionally produced foods	Critical Reviews in Food Science and Nutrition	98
Consumer & consumption determinants	1998	Schifferstein	Health-related determinants of organic food consumption in the Netherlands	Food quality and Preference	39
	2001	Magnusson	Choice of organic foods is related to perceived consequences for human health and to environmentally friendly behaviour	Appetite	32
	2004	Lockie	Choosing organics: a path analysis of factors underlying the selection of organic food among Australian consumers	*Idem*	16
Sociology of OF&F dynamics	1997	Buck	From farm to table: the organic vegetable commodity chain of Northern California	Sociologia Ruralis	51
	2001	Hall	Organic farmers in Ontario: An examination of the conventionalization argument	*Idem*	25
	2001	Padel	Conversion to organic farming: a typical example of the diffusion of an innovation?	*Idem*	45
	2001	Michelsen	Recent development and political acceptance of organic farming in Europe	*Idem*	27
	2004	Guthman	The trouble with 'organic lite' in California: a rejoinder to the conventionalisation'debate	*Idem*	35

[2]Each journal in Web of Science is associated with 1 or more SA. For more details see: http://science.thomsonreuters.com/mjl/scope/scope_sci/

The first major co-citation cluster identified concerns performances in the 80's turn, with studies tackling the energetic and environmental crisis of agriculture. This introduced the **multiple farming performances assessment** in the domain. The domain "diversification" occured since the turn of the 90's in correlation with its global growth A specialty related to **Soil** historically dominated while new specialties emerged. They are related to **Biodiversity**, **Food content**, **Consumers**, and **Social aspects of OF&F development**.

The main speciality (Soil), composed of many citation sub-clusters (almost 30% of detected clusters and included references) also contained the most cited references of the domain, with various focus of **Soil**. The most structured approach, first developed, concerned **soil biological activity.** It essentially referred to the Journal *Soil Biology & Biochemistry,* which introduced methodologies to measure soil biological features. Related smaller and peripheric clusters focussed on specific biological compartments. A second and more recent approach focussed on **nutrient cycling,** particularly on the role of nutrient processes in soil fertility. Some clusters combined the previous two approaches with a holistic view of soil. This approach is supported by comparative studies in agronomy or soil ecology, centered on the effects of organic/conventional systems or practices (fertilisation, tillage) on different soil features.

The **Biodiversity** specialty is the most distinctive of the domain due to the weakness of its interconnexion to other clusters. Emerging at the 90's turn, it concerns studies and reviews on farming systems or practices comparisons to assess the **effects of intensification on diverse elements of biodiversity** (landscape, bird, invertebrates, weed communities). Surprisingly, no citation cluster appears with Biodiversity as a source of services for farming.

Another well-structured specialty concerns **organic food content** in comparison with conventional food. Two linked clusters, without clear delineation, emerged in the beginning of the 2000's. The specialty focussed on chemical characterisation and to a lesser extent on nutritional and sensory quality concerns. Few studies appear in citing articles on the effects of organic food on human health, but not as a specialty *per se*, ie without a structured intellectual basis. The specialty is weakly linked to clusters focussing on farming system while some papers refer to the effect of specific production practices on food quality.

The connexion between production and products issues is made throught references related to **consumer** and **sociological approaches of OF&F dynamics.** The first specialty is based on two main clusters. The first one, occuring as a dense cluster around the 90's turn concerns **factors determining consumer purchase decisions**. Corresponding studies reveal the importance of Nutrition and Health determinants that are now emerging issues in the "food content" specialty. The second cluster largely extends this approach with a slight evolution in the type of references used. Whereas the first one is mainly anchored in Food Science & Technology, the second one includes more Economics and Sociology corresponding to the integration of commodity chains, linking production and consumption with individual-focused studies.

This partly explains the connexions between the last specialty and the one concerning **social sciences approaches of OF&F development dynamics**. Indeed, the clusters of this specialty, emerging at the turn of the 90's, share a common intellectual basis specific to their discipline whereas they mix different aspects of OF&F from producers to consumers. The main cluster concerns issues about OF&F sector development from the farmer level, with adoption/conversion/abandonment determinants, to the institutional level, with policy issues and certification devices, also addressing

collective actions and geographical diffusion. These aspects, emerging in the beginning of 2000's, are gathered under the conventionalisation thesis in OF&F development. A second cluster is focused on OF&F as an element of power/politics transformation in **food system/chain/network** through the localism issue.

In addition, some marginal clusters, ie with less structured intellectual basis, occured in the DCA tested. Some expected topics concerning production practices were marginal or absent. Clusters concerning dairy production may arise in some networks but are still in a marginal position. When present, this topic concerned animal health in organic production. We also expected to find specialties about crop protection and weed control but these topics are not based upon a highly cited reference pool.

Discussion and conclusion

The OF&F domain is very dynamic as shown with the continuous emergence of specialties. This outlines the gradual recognition and incorporation of OF&F into the larger agricultural scientific and policy communities where it is progressively viewed both as one credible variant of "alternative" agriculture and as a new research field. The analysis highlights the recurrence of comparative approaches of performances and effects. Researchers rarely design new production systems or techniques and they often tend to value OF&F in confrontation with a conventional model, still considered as the reference. This questions the autonomy of OF&F research.

This growth suggests early stages of development. As well as OF&F sector, research development could suffer forms of conventionalisation. Even if the multidisciplinarity and holistic approaches are fundamental in the emergence and the identity of the domain, recent specialisations induce some issues about the maintenance of OF&F as a separate domain. Yet organic research proved to be rarely different from those used in conventional agriculture (Lockeretz, 2000; Watson *et al.*, 2008).

We highlighted the institutionalisation but also some lacks in topics we expected. There is a methodological issue about detecting this kind of emerging or lightly structured topics, because statistical tools tend to detect patterns with high frequency. We could deepen our study by using lower thresholds or other paramaters in DCA to detect more clusters and crossing with other types of analysis to detect marginal topics (Chen *et al.*, 2010).

References

Chen, C., Ibekwe-SanJuan, F., Hou, J., 2010. The Structure and Dynamics of Co-Citation Clusters: A Multiple-Perspective Co-Citation Analysis. Journal of the American Society for Information Science 61, 1386–1409.

Drinkwater, L.E., 2009. Ecological Knowledge:Foundation for Sustainable Organic Agriculture. In: Francis, C. (Ed.), Organic Farming: The Ecological System. American Society of Agronomy, Crop Science Society of America, Soil Science Society of America, pp. 19-47.

Kristiansen, P., Taji, A., Reganold, J.P., 2006. Organic Agriculture: A global perspective. CSIRO publishing.

Lockeretz, W., 2000. Organic farming research, today and tomorrow. IFOAM 2000: the world grows organic. Proceedings 13th International IFOAM Scientific Conference, Basel, Switzerland, 28 to 31 August, 2000. vdf Hochschulverlag AG an der ETH Zurich, pp. 718-720.

Rahmann, G., Oppermann, R., Paulsen, H.M., Weißmann, F., 2009. Good, but not good enough? Research and development needs in Organic Farming. Agriculture and Forestry Research 59, 29-10.

Watson, C.A., Walker, R.L., Stockdale, E.A., 2008. Research in organic production systems – past, present and future. Journal of Agricultural Science, 1-19.