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ARTIGO

Decision Making and Agriculture

A Recent Review of Organic Farming

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Abstract

This paper presents a review of recent literature covering decision-making and organic farming. Two databases, Science-Direct and SciELO, were used to look for studies within the 2005-2015 period. A total of eighteen documents that met our criteria were found and used for this paper. Particular attention has been given to the methodology employed in these studies, and following the classification by Bohak et. al. 2010, they have been classified as the ones that use general analysis and descriptive statistics in one hand and inferential statistics/mathematical methods in the other. The paper concludes with a few considerations that may be useful to promote organic farming studies involving decision-making.

Keywords: Agriculture. Decision making. Organic farming. Review SciELO. Review Science-Direct.

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TOMADA DE DECISÃO E AGRICULTURA: UMA REVISÃO RECENTE SOBRE AGRICULTURA ORGÂNICA

Resumo

O presente artigo apresenta uma revisão recente do tema tomada de decisão e agricultura orgânica. Foram utilizadas duas bases de dados, Science-Direct e SciELO, para a busca por artigos relacionados ao tema no período 2005-2015. Um total de 18 documentos foram localizados e analisados conforme a metodologia empregada: estudos que utilizam análise geral e estatística descritiva por um lado, e estudos que utilizam estatística inferencial/métodos matemáticos, por outro. O artigo finaliza com considerações importantes para promover estudos sobre agricultura orgânica envolvendo tomadas de decisão.

Palavras-chave: Agricultura. Tomadas de decisão. Agricultura orgânica. Revisão SciELO. Revisão Science-Direct.

Since the second half of the twentieth century, agriculture around the world could be characterized as heavily dependent on mineral/chemical inputs and motto mechanized. According to the Food and Agriculture Organization of the United Nations (FAO), this dependency, and increasing concern over the number of chemicals used in crop and animal production, contributed to a greater awareness and visibility of organic agriculture in the 60's (FOOD..., 2012). Environmental, economic and social benefits are often attributed to organic agriculture (Ibid., 2012). However, if the benefits associated with organic agriculture are so advantageous, then why is it that most food around the world continues to be produced conventionally? Is it less productive or more expensive to produce? Are the returns comparatively poor? If the benefits are not clearly apparent – or even if there are identifiable disadvantages associated with organic agriculture – then why is it that (some) farmers choose to adopt this obsolete technology?

Answers to some of these questions may be found in decision-making studies. Originally and extensively studied by Herbert Simon at firm level, decision making was applied to agriculture thanks to pioneering studies by Gasson (1973, 1988), Smith and Capstick (1976); Harper and Eastman (1980), and Cary and Holmes (1982), among others. In particular, the study by Gasson (1973) shed some light on values and goals of English farmers back in the seventies. When specifically addressing organic agriculture, Fearweather and Campbell (1996) traced some of the first decision-making studies back to the 1980s. Seemingly, specialized literature related to decision-making and agriculture start gaining importance only in the 1990s.

As the promotion of organic agriculture seems to be a worldwide trend (THAPA, RATTANASUTEERAKUL, 2011), decision-making studies have slowly gained attention from scholars and public institutions. Thereof, a series of publications have slowly emerged analyzing the rationale surrounding this particular type of agriculture. Since organic agriculture, and more precisely decision making and organic agriculture, is not a widely studied subject, this article presents a recent review (2005-2015) of decision-making

literature specifically applied to organic agriculture. Studies were drafted from two recognized scientific databases: ScienceDirect and SciELO. The objective of this paper was to review recent literature focusing on the methodology used when conducting research, differentiating between studies using general analysis/descriptive statistics, and inferential statistics/mathematical methods; following the proposal of Bohak, Borec and Turk (2010). After the description of the methodology, literature using general analysis/descriptive statistics is presented. This then leads to an overview of literature using inferential statistics/mathematical methods. Lastly, a discussion section is used to highlight important concepts and particularities about the studies, followed by a brief conclusion section.

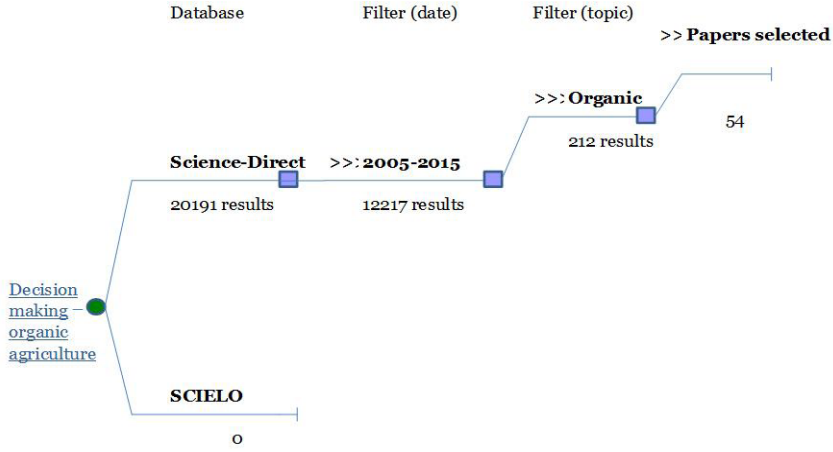
Methodology

In an effort to gain perspective from different geographical locations, two databases of scientific production were consulted to do the following literature review: Science-Direct (Elsevier), a western European database based in the Netherlands, and SciELO (Scientific Electronic Library Online),[3] a Latin American database headquartered in Brazil, which boasts a strong search engine unlike other Latin American portals. In each of these databases, the term "decision making organic agriculture" was used to search for articles and/or books related to the present topic, spanning from years 2005-2015.[4] Special issues that would require additional payment and article reviews were excluded. Additionally, studies accounting for topics such as fishery, water management and other related articles not directly addressing decision-making and organic agriculture were omitted.

[3] According to their respective websites, Science-Direct offers journal articles and book chapters from nearly 2,500 journals while SciELO publishes scientific content from 1.268 journals.

[4] Since the document was originally written in 2015, documents were looked for up until July 2015.

Figure 1 – Search term and results according to each database.



Source: Prepared by the authors (2015)

Figure 1 shows the searching process. For Science-Direct, the search was conducted on July 4th, 2015, and a total of 20,191 results were found using the mentioned term. After filtering for "2005-2015" period, 12,217 results returned. Finally, after the topic filter "organic" was applied, 212 papers were found. Every single one of those articles was screened to see if they directly addressed decision-making and organic agriculture. Out of the total, 54 papers had directly studied the topic, however only 18 did so in a producer or farmer point of view while the remaining 36 did it from a consumer perspective. Since the main interest of this paper is decision--making and organic agricultural farming, only the 18 articles that addressed decision making from the farmer's perspective were considered. Given that there is scarce literature about organic production and decision-making at the farmer level, it was considered more fitting to focus on this specific literature. Additionally, decision-making and organic agriculture with a consumer perspective has also been studied by other disciplines ranging from psychology and marketing, to economics and others. However, it is

also worth mentioning that articles related to decision-making and organic agriculture from a consumer's perspective almost doubled those who had a farmer's point of view.

The search in SciELO, was performed on July 6th, 2015. using the same term "decision making agriculture". This exploration, yielded 144 results. After filtering these results to be within the "2005-2015" period, 134 studies remained. Each one of them was analyzed to determine if organic production was addressed, with no positive results. Finally, the search-term "toma de decisión agricultura" was used, returning 17 results, however none was related to organic production.

Taking the total results into account, only 18 relevant articles from Science-Direct were found and used to conduct the following literature review. This was done by using the methodology used by Bohak, Borec e Turk (2010) to separate articles applying either general analysis and descriptive statistics or those applying inferential statistics, econometric and mathematical models.

Decision Making and Organic Farming: general analysis and descriptive statistics

Luttikholt (2007) was interested in principles of organic agriculture. In his article, he describes the process of formulation and implementation of the principles of organic agriculture through a worldwide participatory stakeholder analysis developed by the International Federation of Organic Agriculture Movements (Ifoam). The principles identified were: health, ecology, fairness and care. From an apparent Ifoam official perspective, the author claims that globalization and trade both influence organic agriculture and threaten to lead it to its conventionalization (BUCK; GETZ; GUTHMAN, 1997; GUTHMAN, 2004; BEST, 2008, among others). Since conventionalization seems to be a latent concern in organic production, clearly defining the principles associated with it becomes increasingly important. Some

studies have been researching organic production in accordance with these four principles previously mentioned, though not all of them explicitly cite the Ifoam effort.

Padel, Röcklinsberg and Schmid (2009) were also concerned with the implementation of organic principles in European regulation. Drawing upon principles defined by the Ifoam, the author's analysis was based on the European Regulation EEC –2092/91 research project (organic) revision. The paper's objective was to improve the understanding of core ethical values associated with organic farming and to analyze differences between the implementation of the regulations by national governments and private standards. Based on their analysis, the authors surmised that there is a general consensus as to what the concept and core values of organic agriculture are in Europe; however not all core values are covered by the minimum regulatory standards (legislation). They also reported a high number of differences within the European Union regarding regulation as well as governmental and private standards in relation to input use, which might suggest that there is still room for harmonization of values and rules in this area. Research on values, ethics and principles promises to be a productive and yet to be explored topic of decision-making and organic farming studies.

Oelofse et al. (2010) studied determining factors for farmer's access to certified organic agriculture and the effect of organic farming in productivity, nutrient budgets, income and labor (compared to conventional farmers). To do so, they focused on three case studies of organic and conventional farmers in 2 locations in China and one in Brazil. In their sample, they found that only some farmers were able to pursue organic agriculture as a livelihood strategy, and this was influenced by farmer's sufficient access to social and natural livelihood capitals. After the adoption of organic farming, they reported similar yields and nutrient budgets as their conventional pairs. When considering income, the gross output for almost all crops was similar in organic and conventional farming, with the production of oranges being the exception. Labor use was found to be higher in organic soybean

production, while being similar in other crops investigated. There was, however, a particular common factor perceived in all three cases: farmers had the opinion that the adoption of organic practices had increased their farm labor demand, although analysis shows this perception is most likely due to other aspects such as intensification and/or crop diversification, and not actually because of the shift to organic farming.

Sutherland (2011) assessed that the reason British farmers chose to convert to organic farming was to undertake low input agriculture. He studied the commonly named "effectively organic" or "semi-organic" farmers in England, and discovered that their reduction of inputs was a response to financial pressures. Thus, even when farmers reduced inputs, the authors did not find a formal conversion to organic farming, suggesting that this practice was only an option, among many, to achieve financial viability. They also found that the farmers lacked understanding of organic farming techniques, thus reaffirming that using low external chemical inputs was only a means to an end rather than a deliberate "organic" strategy. Findings also open the door once again for the possibility of conventionalization of organic farming, or as the author mentions, a process of greening conventional farming practice.

Zanoli, Gambelli and Vairo (2012) applied a scenario analysis approach – a qualitative method, to develop four scenarios regarding organic farming in Europe in order to help decision making process, particularly for policy makers. Authors held a scenario workshop with eight European experts and were able to develop the following four scenarios: stable expansion (very positive environment for organic farming), policy driven growth (sector's reaction under global economic crisis), agricultural industrialization (general worsening of economic conditions combined with a reduction in the competitiveness of organic farming with respect to conventional farming) and techno sustainability (involving a general improvement in global socio-

-economic conditions combined with a reduction of competitiveness of organic farming). Table 1 shows a summary of decision making and organic agriculture studies using general analysis / descriptive statistics.

Table 1 – Summary of studied literature on decision making and organic farming using descriptive statistics. Articles sorted by collection method, processing method, and objective

Study	**Data Collection methods and samples**	**Data processing methods**	**Objectives**
Luttikholt (2007).	Description of the formulation and implementation process. Discussion.	Principles emanated from Worldwide participatory Stakeholder analysis.	To describe principles of organic agriculture and how they were established.
Padel; Röcklinsberg; Schmid (2009).	Focus groups, database developed for the ECC209 /91 project.	Analysis Tables.	To analyze differences in the implementation of the regulation by national governments and private standards.
Oelofse et al. (2010)	Extensive semi-structured questionnaire in two locations in China (Jilin and Shandong) and Itapolis Brazil.	Sustainable Livelihoods Framework. Descriptive statistics.	To investigate determining factors for farmers' access to certified organic agriculture, to investigate the effects of the adoption of organic agriculture on productivity, nutrient budgets, income, and labor.
Sutherland (2011)	Survey conducted by authors using own means (yellow pages, association information) (n=48).	Qualitative field research Theory of Planned Behavior. Descriptive Statistics.	To assess the rationales for undertaking low input agriculture, placing decisions to (and not to) convert to organic farming within this context.
Zanoli; Gambeli; Vairo (2012)	8 European experts to develop the scenario analysis.	Scenario analysis, Network Analysis.	To develop a scenario analysis regarding the future development of the market of organic food products in Europe.

Source: Prepared by the authors (2015).

Decision Making and Organic Farming: inferential statistics/econometric and mathematical methods

Läpple and Van Rensburg (2011) explored the differences between early and late adoption of organic agriculture in Ireland, looking for variations in characteristics among different farmers. Using multinomial logit analysis, they investigated the differences between early, medium and late adopters and whether factors affecting uptake of organic practices changed with ongoing diffusion. They constructed the study based on some hypotheses ranging from structural, socioeconomic, personal characteristics and environmental considerations to information seeking. Authors reported that early, medium, late and non-adopters differed significantly in important characteristics such as information use, age, environmental attitude, and profit motives. Early adopters were found to have a negative relation with profit maximization and late adopters were constrained by risk considerations. However, environmental attitudes emerged as an important characteristic for the adoption of such practices for all farmers, though at different levels depending on adoption time. Since European policy makers have shown an increasing interest in organic agriculture since 1992 with the MacSharry reform, and considering that the Irish government seems open to fostering such practices, this study would have implications for Irish authorities, suggesting that highlighting economic potential, facilitating access to markets and improving information provision might help with increasing organic agriculture, depending on adoption time.

Läpple and Kelley (2013) had the objective to understand what lead to the decision of Irish farmers to adopt organic agriculture. With a fairly complex mix of methods that range between theory of planned behavior, various statistical tools such as principal component analysis and a few regression types; the authors determined that while economic incentives and technical barriers can affect a farmer's decision to adopt organic farming, its lack of social acceptance constrained the adoption of such agriculture in their sample of Irish drystock farmers. Specifically, results showed that

the adoption of organic farming is determined by social norms, or that the decision is dependent on the opinion of others, such as fellow farmers. It was also found a positive effect between organic subsidy payments when converting to organic farming. The authors were also coherent with other publications by avoiding homogeneous treatment of all farmers and instead explicitly accounting for farmer heterogeneity. This allowed the authors to discern farmer characteristics such as whether they were environmentally aware or non-aware, the former being more influenced by perceived economic incentives and less by farm management than the latter. The authors also point to some policy related implications of the study, given that the Irish government plans to increase its organic production from 1% to 5% by 2020. Findings would suggest that economic incentives would not suffice to increase the local organic sector. Rather, a shift in general attitudes towards organic farming would be needed, not only at farmer level, but also the community level. This would be consistent with other studies indicating economic incentives are not enough to understand conversion to organic agriculture (BURTON; RIGBY; YOUNG 2003; KERSELAERS et al., 2007; LÄPPLE; van RENSBURG, 2011; OELOFSE et al., 2010). For instance, Burton, Rigby and Young (2003) found in the UK that the adoption of organic agriculture may be conditioned by more than economic and social factors, since the previous accumulation of experience would also prove important. Kerselaers et al. (2007) found evidence pointing that organization of well--structured distribution and market channels would be key for increasing organic agriculture in Belgium.

The level of adoption and extent of Organic Vegetable Farming at a farm household level in Thailand (Mahasarakham) was studied by Thapa and Rattanasuteerakul (2011). These authors were also interested in examining factors related to the variations in the extent of organic vegetable farming (OVF) between various households. According to them, governmental initiatives made it possible to cultivate an area of only 13,900 ha in 2002, which would account for 0.07% of the country's arable land. Authors

found that more than half of the sample was growing organic vegetables, although the extent of cultivable area varied. Also, factors like leadership among women, motivation by government and NGOS, motivation by community members, attendance in training, satisfaction with the price of organic vegetables and the intensity of pest hazard affected organic vegetable farming in their sample. When explaining what determined the extent to which farmers would engage in organic vegetable farming, the authors reported three significantly influential factors. These include the amount of organic fertilizers produced by farmers themselves, perceptions surrounding the harmful effects of organic pesticides, and the degree of experience in growing vegetables. Given their results, authors determined that to increase the adoption of organic vegetable farming, certain policy actions should be orientated to increase capacity building and mobilization of women's group or to increase the production of compost or farm yard manure.

Wollni and Andersson (2014) were interested in analyzing factors, with emphasis on spatial patterns, influencing the decision to convert to organic agriculture in the degraded, low agricultural areas of La Paz, in Honduras. They applied a spatial autoregressive probit model. Main results showed evidence that those farmers who act in accordance with their neighbor's expectations and also have greater availability of information in their neighborhood network are more likely to adopt organic agriculture. The former may indicate that farmers do care about the acceptance of their peers regarding their agricultural technology, while the later suggests that the availability of information related to technologies, such as organic farming, plays an important role. Therefore, a spatial pattern was identified, suggesting that the "neighborhood effect" exists. Findings suggest that community activities would be more effective in fostering organic agriculture. These findings are relevant since they indicate that adopting organic agriculture in such agriculturally degraded soils for an economically vulnerable population may present an alternative solution to breaking the vicious cycle of low agricultural productivity, poverty and low investment capacities.

A case study in the United States by Veldstra, Alexander and Marshall (2014) focuses on studying organic agriculture and official certification by competent authority. It addresses these two matters separately, by analyzing the decision-making process of cultivating organic products and by also identifying the factors that influence farmers to certify that practice. Regarding production, the authors found a relation between gender (women), less experienced producers and small-scale size and organic output. They also found that the certification cost and associated processes hinder the certification of organic products. When examining the certification process, they found that gender does not influence the decision to certify; however, farmers with more experience in organic production, bigger farm size and more years of education had higher amounts of certified production. Surprisingly, the authors discovered evidence suggesting that a larger number of crops and more market channels do not influence the decision to certify. Additionally, producers who use organic practices and place the greatest economic importance on direct markets have a greater tendency not to obtain organic certifications, thereby reaffirming the trend that "local is the new organic".

Additionally, another article was found which addressed the question of why farmers chose to stop organic farming and also why they stopped certifying its practice. Flaten et al. (2010), for instance, studied the reasoning behind why Norwegian farmers chose to cease certifying organic production. In their case, the decision to stop did not necessarily mean that farmers would instead produce conventionally. Rather, the farmers would face a threefold decision: To still produce organically but stop certifying, to change to conventional farming, or to quit farming altogether. Through factor analysis, the identified five sets of reasons for why to stop certifying: economical, regulatory, knowledge-exchange, productive and market access related. The authors discovered the most prevalent reason for opting out to be excessive bureaucracy associated with certification and control. Other factors such as unpredictability of organic farming policy and low price

premiums were commonly identified as motives for ceasing certification. It may be of interest to note that nearly one in four organic farmers in the study reported that they planned to cease certification within the next 5-10 years, which might present a great challenge for Norwegian policy-makers if certified organic farming is to be fostered.

Gambelli and Bruschi (2010) developed a model to investigate factors that influence the exit of organic farms and to simulate the probability of maintaining an organic scheme for different farm types in the Marche Region of Italy. In their study, the authors found evidence suggesting that large and arable farms run by men in the region, which happens to be the core of organic agriculture in Marche, have a higher probability to stay in production for a relatively longer period of time. Similar results were found for olive production farms, while vegetable farms, having an almost 50% probability of being soon abandoned, had the greatest difficulty with maintaining productivity in the organic sector. The authors also credited their developed model with aiding them to identify age, province and farm size as the most influential variables when deciding whether to stay organic for a significant period. However, even when the model proved useful, farm types not explicitly included in the database could not be simulated, which may suggest that generalization in bigger regions, or comparison to other farm types, requires more comprehensive databases.

An analysis by Zorn, Lippert and Dabbert (2013) of German organic farmers and their risk of non-compliance with the European standards presents another western European region for consideration. The authors sought insight into characteristics associated with the farmer's non-compliance with European regulation. In other words, they wanted to understand why the farmers were falsely stating that their products are organic even though they consciously practiced conventional farming. From an economics of crime approach and through use of logistic regression, the authors found evidence indicating that limited farming experience, farm size and the existence of a conversion area significantly increased the probability of non-compliance.

It can be discerned that as a policy implication, the authors recognized that the applicability of a quantitative risk analysis, as the one developed in this study, requires technical and methodological skills that are usually unavailable to certifying bodies. This may pose a great challenge for such agencies.

Another note of interest concerns two articles published in the journal "Computers and Electronics in Agriculture," both of which modeled decision-making and organic agriculture. Rozman et al. (2013) presented a model for organic farming development in the eastern European country of Slovenia, based on system dynamics given that limited data and time series were available regarding organic farming. Using a complex model, the authors report that conversion to organic farming strongly relies on subsidies, which are the main motivation to convert to organic farming in Slovenia. However, activities that promote organic farming are also key, since sufficiently large subsidies to complete the conversion to organic farming cannot be provided. Development of organic-farming marketing, production, etc. would prove useful to improve demand for such products. This study is especially important for a country like Slovenia, which has poor conditions for agriculture, given that 68% of all arable areas classified as less favorable or as and other as karst areas.

Dragincic, Korac and Blagojevic (2015) also developed an approach related to organic agriculture, for Serbia, another eastern European country. They originally wanted to select the most suitable variety of grape among Ljana, Karmen, Augusta and Moldova based on criteria such as sugar content, yield, maturation, and disease resistance. Organic grapes have reportedly been an increasing trend in vitiviniculture, which may be a lucrative venture in Serbia, where the production of that fruit is highly viable due to its climate and soil condition. The approach made use of other multi-criteria methods such as Simple Additive Weighting (SAW), Analytical Hierarchical Process (AHP), and the consensus model. The first is a frequent method used for multi-criteria evaluation, while AHP enables decomposition of complex decision-making problems into a hierarchy. The

authors obtained results showing Ljana grapes to be the most suitable for organic vitiviniculture, followed by Moldova, Karmen and Augusta. Expertise with vectors and matrices were needed when formalizing the AHP consensus model.

A topic already studied with descriptive statistics was found to be analyzed through inferential methods: Dinis et al. (2015) were concerned with the organic agricultural values in Italy and Portugal. Starting from a general view of organic agriculture as a practice that combines quality production with sustainable practices along with positive impacts on resource conservation, biodiversity and animal welfare; the authors reported that the founding values of such agricultural practices were originally associated to small-scale production, minimization of external inputs use, diversification and short market circuits. However, they also identified the growth of organic farming with growing specialization, increase of scale, involvement of big corporations and even inclusion of global trade. This new tendency has also been reported in countries like Brazil where big corporations are finally entering the organic business, thereby leading to a conventionalization of organic production where the importance would lie in ecosystem management with organic agriculture (NIEDERLE; ALMEIDA, 2013). Given that European legislation, when it comes to certifying, is limited to identifying permitted and prohibited substances, it has no feasible way to evaluate values related to biodiversity, nutrient recycling and social values even though these values are usually mentioned. Therefore, the authors expressed an interest in the values of organic farming, by seeking to identify factors that influence the choice of organic farmers to opt for more suitable practices, which would even go beyond limits posed by certification. To do so, the authors constructed a "deep organic" classification for farming, which would be met if at least three out of the following four criteria were met: crop diversity, presence of livestock, on-farm reproduction of seeds, and selling in local markets. Using a probabilistic model and logistic regression, the authors found that out of the total sample, slightly more than

60% of farmers could be considered as deep organic. They also reported that farms managed by women and early entrants as well as family farms tended to be less conventionalized. They also found that farm size was not related to the adoption of deep organic practices. Their most striking finding was that deep organic farmers who have access to universities and other public centers as main sources of information are more likely to adopt deep organic practices.

Lastly, a unique approach was pursued by Wheeler (2008) when studying organic production and decision-making. The author focused on influences and attitudes of agricultural professionals in South Australia, given that these professionals are thought to have a key role in the diffusion of technology, and in this case, organic practices. Using an ordered probit model, Wheeler found evidence indicating that professional acceptance of agricultural innovations is not separate from their beliefs, values and environment. Specifically, professionals with a tertiary education, younger and aged over a certain threshold, those who had a higher knowledge of organic issues, and worked in resource management, as well as other various factors, were more likely to think that organic farming conveyed positive net benefits. It may be interesting to note that professionals who worked for the Commonwealth Scientific and Industrial Research Organization, (a federal scientific research institution), those who had longer working age in the area, and those who cited scientific information as their main source of information were more likely to think that organic farming conveyed no net benefits. This last finding is particularly interesting given that scientific studies tend to vary, and no definitive consensus exists, when comparing organic and conventional agriculture. Table 2 shows a summary of decision making and organic agriculture studies using Inferential Statistics / econometric and mathematical methods.

Table 2 – Summary of studies using Inferential Statistics / econometric and mathematical methods

Study	Data collection methods and samples	Data processing methods	Objectives
Kerselaers et al. (2007)	Belgian farm accountancy data network (n=685)	Normative approach to estimate economic conversion potential	To model economic conversion potential (ECP) of individual conventional farms
Wheeler (2008).	Telephone survey (n=185 professionals)	Ordered probit model	To identify what influences overall professional's attitudes towards organic farming.
Flaten et al. (2010)	Cross- sectional survey data from organic farmers (n=200) and random sample in 2006 (n=407)	Explanatory principal component analysis. Multiple linear regression. Factorial analysis.	To examine reasons why Norwegian farmers cease to produce certified organic food.
Gambelli and Bruschi (2010)	Istituto Mediterraneo di Certificazione IMC database from 1993- 2006 (n=966)	Probabilistic model: Bayesian Network	To investigate factors of organic farm exit.
Läpple and Van Rensburg (2011)	Nationwide survey based on organic certification bodies and National Farm Survey for conventional farming (n=546)	Multinomial logit model	To investigate differences between early, medium and late adopters of organic farming.
Thapa and Rattanas- uteerakul (2011)	Primary data collected trough household survey, group discussion and key informants survey (n=172)	Linear and logit regressions	To analyze the level of adoption and extent of Organic Vegetable Farming at farm household level in Mahasarakham.
Läpple and Kelley (2013)	Questionnaire with 193 Irish conventional drystock farmers	Theory of planned behavior. Cluster analysis. Non-linear and probit regression.	To understand the determinants of the decision of Irish farmers to adopt organic agriculture.
Zorn, Lippert and Dabbert, (2013)	German organic control body (n=4263). 1421 each year	Probabilistic model. Ordinal Logistic regression.	To analyze the risk of non-compliance with European regulations on organic farming in Germany.
Rozman et al. (2013)	Statistical Office of the Republic of Slovenia	System Dynamics	To present a system dynamics model for organic farming development.
Wollni and Andersson (2014)	Survey data (n=239)	Spatial autoregressive probit model	Analyze factors influencing decision to convert to organic agriculture.
Veldstra, Alexander and Marshall (2014)	Online survey with two postal mail invitation (n=1016).	Two limit tobit model.	To document producers using organic practices without certifying. To model organic certification and production as separate decisions.
Dinis et al. (2015)	Survey data from 352 Italian and Portuguese certified organic farmers. Questionnaire with personal interviews, phone interviews, and online interviews.	Probabilistic Model. Logistic Regression.	Identify the factors that influence the choice of organic farmers for sustainable practices.
Dragincic, Korac and Blagojevic (2015)	Four table grape varieties obtained from laboratory analysis.	Group multi-criteria decision making, SAW, AHP.	To select the most suitable variety of grape for organic viticulture.

Source: Prepared by the authors (2015).

Discussion

Surprisingly, no study was found in the Latin American database. A possible reason for this may be that the SciELO search engine is not powerful enough to find references for such a specialized type of study. Another plausible explanation is that the number of Latin American scholars studying decision making applied to organic agriculture is low. Nonetheless, a couple of Brazilian scholars have recently been focusing on this topic (WIVES, 2013; REICHERT, 2012; REICHERT, 2013, for instance). The most likely reason is that studies related to the topic are not indexed in SciELO. Regarding this matter, other databases such as the Latin American and the Caribbean, Spain and Portugal's Network on Scientific Journals (Redalyc) or Regional Cooperative Online Information System for Scholarly Journals from Latin America, the Caribbean, Spain, and Portugal (Latindex),[5] should be consulted to see what related studies they host.

When analyzing the studies found, it was curious to find that the number of available articles was so few, to begin with. As mentioned before, the majority of papers found addressing decision making and organic agriculture did so from the consumer's perspective and mainly to explain consumer behavior. This seems to be supported via another review by Rödiger and Hamm (2015) on consumer behavior regarding the price for organic food. Using a broader database core, authors reported 21 studies in 2013 alone regarding this topic. It seems there is an increasing interest in understanding what the consumer perception is when acquiring organic products. This interest might be partially motivated by a business concern to understand consumer's demand to increase profits, rather than simply engaging in a holistic, caring and more responsible way of producing food.

It is also important to point out that the results, approaches, and techniques used in the studies selected are quite diverse. Therein lays the point of studying decision making. Specifically, subjects change (as their

[5] These two databases were consulted in the preparation phase of this review. However, both of them have poor search engines, making it difficult to search for such a specific term.

perceptions do), collectives are different, and motivations and goals differ. Therefore, if aiming to do a minimum planning work when dealing with groups of people, decision-making studies are a valuable option, particularly from a rural development perspective. Similarly, although there is a wide range of methodologies applied, the two main methods, which stand out are descriptive statistics and inferential statistics (or econometric and mathematical methods). This would suggest that universities or research institutions working in applied statistics and mathematics could contribute towards increasing the production of such literature. In the long run, if scholars are interested in the topic, they will need to become better versed in statistics.

Even when study results were highly heterogeneous, it seems that there exists a trend related to main topics such as determinants of (shifting to) organic farming, reasons to exit (or stop certifying) organic farming, and values and ethics in organic farming. The latter is likely of greater importance given that the originally attributed environmental and health benefits of organic farming seem to be at risk due to the "conventionalization" of organic agriculture.

It was also remarkable that the vast majority of studies (around 83% of them) were conducted in industrialized regions. As seen in Table 3, only the studies of Oelofse et al. (2010), Thapa and Rattanasuteerakul (2011), and Wollni and Andersson (2014) took place in developing countries. The great majority of authors also conducted studies in their respective country/countries/region, and just two of them came from a developing country. On their review of consumer behavior and organic food, Rödiger and Hamm (2015) also found that the majority of authors came from industrialized regions (mainly Europe and the United States), which seems consisted with results found in this review. Given that the agrarian sector of the developing world is usually seen as less productive, third world countries would most likely benefit themselves if rural development initiatives were planned with the insights and inputs of decision making studies.

Table 3 – Studies reviewed sorted by country, author's link and economic support acknowledged

Study	Country where study was conducted	Origin (country of authors)	Economic Support
Dragincic, Korac and Blagojevic (2015).	Serbia	Serbia	Ministry of Education, Science and Technological Development of the Republic of Serbia.
Dinis et al. (2015).	Italy and Portugal	Italy and Portugal	European Community's Seventh Framework Program (FP7/ 2007–2013).
Flaten et al. (2010).	Norway	Norway	Research Council of Norway and the Agricultural Agreement Research Fund.
Gambelli and Bruschi (2010).	Italy	Italy	None reported.
Kerselaers et al. (2007).	Belgium	Belgium	Institute for the Promotion of Innovation by Science and Technology in Flanders (IWT-Flanders 20415).
Läpple and Van Rensburg (2011).	Ireland	Ireland	Teagasc Walsh Fellowship Scheme from Irish National Agriculture and Food Development Authority.
Luttikholt (2007).	Inter - national	German	None reported.
Oelofse et al. (2010)	China and Brazil	China, Brazil, and Germany	None reported.
Padel, Röcklinsber and Schmid (2009).	Europe	European	Public. EU for the Project EEC 2092/91 (organic)
Rozman et al. (2013).	Slovenia	Slovenia	Ministry of agriculture and environment of the Republic of Slovenia and Slovenian research agency.
Sutherland (2011).	United Kingdom	United Kingdom	None reported.
Thapa and Rattanasuteerakul (2011)	Thailand	Thailand	None reported.
Veldstra, Alexander and Marshall (2014)	USA	USA	Organic Research and Education Initiative grant number: 2010-51300-21305.
Wheeler (2008).	Australia	Australia	None reported.
Wollni and Andersson (2014).	Honduras	Germany	None reported.
Zanoli, Gambelli and Vairo, (2012)	Europe	Italy	Commission of the European Community under the Sixth Framework Programme.
Zorn, Lippert and Dabbert, (2013)	Germany	Germany	European Community under the 7th Framework Programme.

Source: Prepared by the authors (2015).

Lastly, it is important to note that a significant number of the studies received funding from an official source as shown in Table 3. This could represent an interesting opportunity for scholars pursuing research on the topic, and an option for official bodies to foster such studies. Thus, it seems like no coincidence that a high number of the articles reviewed had policy recommendations and implications, which served as a bridge to reconnect the academic and political arenas in an effort to improve socio-economic conditions for various rural regions. This could prove of great importance for developing countries, where rural policies are sometimes elaborated from a top-down perspective, jeopardizing rural development.

Conclusions

This paper presents a review of recent literature on decision-making and organic farming from the two databases Science-Direct and SciELO. A total of 18 articles from Science-Direct were described in this paper, all of them coming from Science-Direct. Further reviews should be done to comprising articles from other databases, including but not limited to those in Latin America and Western Europe. As shown in this article, research covering decision making and organic agriculture, particularly in Latin America, was identified (WIVES, 2013; REICHERT, 2012; REICHERT, 2013), however, they were not indexed in either of the mentioned databases.

Although articles covered several matters, concerns and approaches, a group of topics were identified: determinants of (shifting to) organic farming, reasons to exit (or stop certifying), and values /ethics surrounding this practice. This would suggest such topics are central to academic research.

It seems there's a greater interest in researching decision making applied to organic agriculture from a producer's point of view, which makes research from a consumer's perspective less abundant. If this type of studies were to be fostered, particularly in Latin America, some measures could be implemented: creating specific grants for the topic, generating partnerships

between governments and research centers, and including mathematicians/ statisticians in decision making research teams for instance. These measures could be particularly important in developing countries, which attract less interest from scholars and researchers but are usually more exposed to varying agricultural conditions

References

BEST, H. Organic agriculture and the conventionalization hypothesis: a case study from West Germany. *Agriculture and Human Values*, v. 25, p. 95-106, 2008.

BOHAK, Z.; BOREC, A.; TURK, J. An appraisal of family farm succession studies: a review. *Agricultura* (a). v. 7, p. 9-13, 2010. Available from: <http://www.agricultura--online.com/portal/issues/issue-11/114-an-appraisal-of-family-farm-succession--studies-a-review.>

BUCK, D.; GETZ, C.; GUTHMAN, J. From farm to table: The organic vegetable commodity chain of Northern California. *Sociologia Ruralis*, v. 37, n. 1, p. 3-20, 1997.

BURTON, M.; RIGBY, D.; YOUNG, T. Modelling the adoption of organic horticultural technology in the UK using Duration Analysis. *Australian Journal of Agricultural and Resource Economics*, 47: p. 29-54, 2003. <doi:10.1111/1467-8489.00202>.

CARY, J.; HOLMES, B. Relationships among farmers' goals and farm adjustment strategies: some empirics of a multidimensional approach. *Agricultural and Resource Economics*, v 26, 2, p. 114-130, 1982.

DINIS, I. et al. Organic agriculture values and practices in Portugal and Italy. *Agricultural Systems*, v. 136, p. 39-45, 2015. Available from: <http://dx.doi.org/10.1016/j. agsy.2015.01.007.>

DRAGINCIC, J.; KORAC, N.; BLAGOJEVIC B. Group multi-criteria decision making (GMCDM) approach for selecting the most suitable table grape variety intended for organic viticulture. *Computers and Electronics in Agriculture*. v.111, p. 94-202, 2015. Available from: <http://dx.doi.org/10.1016/j.compag.2014.12.023.>

FAIRWEATHER, J.; CAMPBELL H. The Decision Making of Organic and Conventional Agricultural Producers. *Research Report*, Agribusiness and Economics Research Unit., Caterbury, New Zealand: Lincoln University, n. 233, 1996. Available from: <https://researcharchive.lincoln.ac.nz/bitstream/handle/10182/521/aeru_rr_233. pdf?sequ ence=1>. Cited: july 5th 2015.

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS (FAO). Organic agriculture and the law. *FAO Legislative Study*, 107, 2012. Available from: <www.fao.org/docrep/016/i2718e/i2718e.pdf>. Cited: July 5th, 2015.

FLATEN, O. et al. Norwegian farmers ceasing certified organic production: Characteristics and reasons. *Journal of Environmental Management*, v. 91, v. 12, p. 2.717-2.726, 2010. Available from: <http://dx.doi.org/10.1016/j.jenvman.2010.07.026>.

GAMBELLI, D.; BRUSCHI V. A Bayesian network to predict the probability of organic farm's exit from the sector: A case study from Marche, Italy. Computers and Electronics in *Agriculture*, v. 71, v. 1, p. 22-31, 2010. Available from: <http://dx.doi.org/10.1016/j.compag.2009.11.004>.

GASSON, R. Farm diversification and rural development. *Journal of Agricultural Economics*, v. 39, 2, p. 175-182, 1988.

_____. Goals and values of farmers. *Journal of agricultural economics*, n. 24, v. 3, p. 521-542, 1973.

GUTHMAN, J. The trouble with Organic Lite in California: A rejoinder to the "conventionalization" debate. *Sociologia Ruralis*. n. 44, v. 3, p. 301-316, 2004.

HARPER, W.; EASTMAN, C. An evaluation of goal hierarchies for small farm operators. *American Journal of Agricultural Economics*, v. 62, p. 742-747, 1980.

KERSELAERS, E. et al. Modelling farm-level economic potential for conversion to organic farming. *Agricultural Systems*, v. 94, n. 3, p. 671-682, 2007. DOI: <http://dx.doi.org/10.1016/j.agsy.2007.02.007>.

LÄPPLE, D.; KELLEY H. Understanding the uptake of organic farming: Accounting for heterogeneities among Irish farmers. *Ecological Economics*, v. 88, p. 11-19, 2013. DOI: <http://dx.doi.org/10.1016/j.ecolecon.2012.12.025>.

LÄPPLE D.; VAN RENSBURG T. Adoption of organic farming: Are there differences between early and late adoption?. *Ecological Economics*, v. 70, n. 7, p. 1.406-1.414, 2011. DOI: <http://dx.doi.org/10.1016/j.ecolecon.2011.03.002>.

LUTTIKHOLT, L. W. M. Principles of organic agriculture as formulated by the International Federation of Organic Agriculture Movements. *NJAS – Wageningen Journal of Life Sciences*, v. 54, n. 4, p. 347-360, 2007. DOI: <http://dx.doi.org/10.1016/S1573-5214(07)80008-X>.

MINGCHAI, C.; YOSSUCK, P. Thai organic farming: policy context and content analysis. In *Proceedings of the 46th Kasetsart University Annual Conference*. Thailand, Bangkok: Kasetsart University. 2008. p. 1, 8.

NIEDERLE, P.; ALMEIDA, L. A nova arquitetura dos mercados para produtos orgânicos: o debate da convencionalização. In: NIEDERLE, P.; ALMEIDA L.; MACHADO F. (Org.). *Agroecologia:* práticas, mercados e políticas para uma nova agricultura. Curitiba: Kairos Edições, 2013.

OELOFSE, M. et al. Certified organic agriculture in China and Brazil: Market accessibility and outcomes following adoption. *Ecological Economics*, v. 69, n. 9, p. 1.785-1.793, 2010. DOI: <http://dx.doi.org/10.1016/j.ecolecon.2010.04.016>.

PADEL, S.; RÖCKLINSBERG, H.; SCHMID, O. The implementation of organic principles and values in the European Regulation for organic food. *Food Policy*, v. 34, n. 3, p. 245-251, 2009. DOI: <http://dx.doi.org/10.1016/j.foodpol.2009.03.008>.

REICHERT, L. *Avaliação de sistemas de produção de batata orgânica em propriedades familiares:* uma aplicação da metodologia multicritério de apoio à decisão (MCDA). 2012. Tese (Doutorado em Agronomia) – UFPEL, Pelotas, Brazil, 2012.

REICHERT, L. O processo administrativo e a tomada de decisão de agricultores familiares em transição agroecológica. *Revista de la Facultad de Agronomía*, La Plata, v. 112, n. 2, p. 105-113, 2013.

RÖDIGER, M.; HAMM U. How are organic food prices affecting consumer behaviour? A review. *Food Quality and Preference*, v. 43, p. 0-20, 2015.

ROZMAN, C. et al. The dynamic simulation of organic farming development scenarios – A case study in Slovenia. *Computers and Electronics in Agriculture*, v. 96, p. 163-172, 2013. DOI: <http://dx.doi.org/10.1016/j.compag.2013.05.005>.

SMITH, D.; CAPSTICK, D.F. Establishing priorities among multiple management goals. *Southern Journal of Agricultural Economics*, v. 8, n. 2, p. 37-43, 1976. doi: https://doi.org/10.1017/S0081305200013212

SUTHERLAND, L. "Effectively organic": Environmental gains on conventional farms through the market? *Land Use Policy*, v. 28, n. 4, p. 815-824, 2011. DOI: <http://dx.doi.org/10.1016/j.landusepol.2011.01.009>.

THAPA, G.; RATTANASUTEERAKUL, K. Adoption and extent of organic vegetable farming in Mahasarakham province, Thailand. *Applied Geography*, v. 31, n. 1, p. 201-209, 2011. DOI: <http://dx.doi.org/10.1016/j.apgeog.2010.04.004>.

VELDSTRA, M.; ALEXANDER, C.; MARSHALL M. To certify or not to certify? Separating the organic production and certification decisions. *Food Policy*, v. 49, n. 2, p. 429-436, 2014. DOI: <http://dx.doi.org/10.1016/j.foodpol.2014.05.010>.

WHEELER, S. What influences agricultural professionals' views towards organic agriculture? *Ecological Economics*, v. 65, n. 1, p. 145-154, 2008. DOI: <http://dx.doi.org/10.1016/j.ecolecon.2007.05.014>.

WIVES, D. G. *Fatores influentes na tomada de decisão e organização dos sistemas de produção de base ecológica da banana no litoral norte do Rio Grande do Sul*. 2013. Tese (Doutorado em Desenvolvimento Rural) – UFRGS, Porto Alegre, Brazil, 2013.

WOLLNI, M.; ANDERSSON, C. Spatial patterns of organic agriculture adoption: Evidence from Honduras. *Ecological Economics*, v. 97, p. 120-128, 2014. DOI: <http://dx.doi.org/10.1016/j.ecolecon.2013.11.010>.

ZANOLI, R.; GAMBELLI, D.; VAIRO D. Scenarios of the organic food market in Europe. *Food Policy*, v. 37, n. 1, p. 41-57, 2012. DOI: <http://dx.doi.org/10.1016/j.foodpol.2011.10.003>.

ZORN, A.; LIPPERT, C.; DABBERT, S. An analysis of the risks of non-compliance with the European organic standard: A categorical analysis of farm data from a German control body. *Food Control*, v. 30, n. 2, p. 692-699, 2013. DOI: <http://dx.doi.org/10.1016/j.foodcont.2012.08.020>.