Chapter 12

Dissemination of Scientific Data for Sustainable, Organic Milk Production Systems

Sezen Ocak and Sinan Ogun

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/51739

1. Introduction

Most ecologically sustainable or organic agricultural projects concerning "Milk Production" have not been monitored comprehensively or been subjected to stringent evaluation methods to allow the outcomes to be regarded as scientifically acceptable. There is a strong need to not only promote such dairy projects but to collect, scrutinize and share the information in an appropriate scientific manner to encourage more widespread acceptance.

Researchers dealing with organic production have been more interested in solving practical problems than publishing papers, as such it makes it difficult to do comparative analysis with conventional productions systems and draw general conclusions regarding the nutritional value of dairy produce or health and well-being of livestock.

Despite the lack of reliable data on the benefits of organic produce from around the globe, the organic dairy sector is reported to be growing at between 15 to 23 percent a year in the countries assessed in this study, namely; Europe, USA, Australia and New Zealand. It is expected that by 2015, 25-30 percent of consumers of dairy products in the above nations will ensure that their regular purchases will be organic (Lohr, 1998).

In addition to the human health benefits, organic dairy farming aims to create more holistic, agro-ecological systems. Therefore the aim is not only to produce nutritious and chemical free produce but to ensure a sustainable management of natural resources where these products are produced. Animal health and welfare are also important elements of such a system (Lund & Rocklinsberg, 2001). This is a factor that is clearly recognized by the International Federation of Organic Agricultural Movements (IFOAM), the organization setting the basic standards for what can be labeled as organic.

The aim of this study is to review some of the relevant research carried out in this field and to assess suitable methods to disseminate such scientific data in a standardized, reliable and an easily accessible manner to farmers needing this information. The information should be reliable enough to inform the conventional farmer of the benefits and shortfalls if they are considering organic production, or at least provide resource material for them to pursue further research into the topic.

Marketing and consumption of organic produce also being an important factor in the decisions of a potential producer; the study also evaluated numerous factors that may be the cause of the global shift toward the increased consumption of organic produce.

Besides the generally accepted health benefits of organic products, the contemporary, educated and well informed consumer is also trying to make a statement about the environmental benefits of organic production. They are asking from the producer/supplier to further inform them about food miles, efficient energy use, water pollution, soil conservation, carbon credits, natural resource management and alike. The study discovered that further effort was required on how information about consumer preference could be relayed back to the farmer.

Besides general scientific literature on organic dairy farming carried out by few very committed organizations and some institutions the authors also looked at a number of farms in the USA and Australia as case study farms to see if they were open to sharing relevant information about their outcomes. These farms were selected based on the importance they gave to the principles of sustainable organic production, such as; diversified farming measures and the use of crop rotations, resilient production systems based on diverse cultural system, minimal use of external agrochemical inputs, minimal use of pharmaceuticals for animal health issue by encouraging preventative measures rather than curative ones, emphasis on the use of local resources, recycling organic wastes, reduced environmental impact, reduced use of mechanization, utilization of small areas for cultivation and encouraging the use and preservation of traditional skills.

The producers who apply these principles have a very limited database of information on which to rely on, in addition the information would not stand up to the rigors of intensive scientific scrutiny. The study has provided numerous resources in its acknowledgment and reference list, which supports the principles of a holistic and dynamic production systems, but would strongly encourage further research in the field.

2. Farming trends

In the present market place with heightened scrutiny on how food is produced, the conventional dairy farm unit is going through a major shift from mid-size farms to very small and very large ones - this is particularly the case in USA (Benbrook, 2009). In the very large size farms the cows do not have access to sufficient pasture to contribute significantly to their daily feed intakes, therefore grain-based rations and high-quality alfalfa (lucerne) hay form the backbone of the cows' diet. However in contrast to this trend the number and importance of small to moderate-scale organic dairy farms is increasing. The most successful operations grow all or most of their feed on or near the home farm. In addition, pasture and grazing contributes significantly to daily feed intakes in those parts of the year when the weather supports active forage plant growth. On conventional, feedlot-based industrial dairies, corn and other corn-based feeds typically account for around two-thirds of a cow's diet, whereas on grazing-based organic farms, pasture and forage-based feeds typically account for at least two-thirds of daily feed intake, and corn in all its forms less than one-quarter.

On large conventional dairies, artificial insemination is used on mostly purebred Holstein cows. Each milking dairy animal is expected to produces about 10 to 11,000 liters of milk during a 305-day lactation period (Benbrook, 2009). A range of drugs are routinely administered to these animals to help them fight infections, efficiently digest their energy-dense, low-fiber feed, and to help synchronize artificial insemination breeding attempts.

On most small and moderate scale organic dairies, production levels are lower, averaging closer to 8,000 liters per year. Breeds of cattle other than Holsteins, as well as crossbreed cattle are common and artificial insemination is a tool used on many farms, but has not replaced bulls and traditional breeding programs.

However the authors have struggled to find sufficient research results in the agricultural economic domain to support this concept of a more long-term productive and a cost efficient production system in that of organic dairies. The few case study farms that were looked at certainly had the figures but were reluctant to share the results assumedly with the fear of losing their premium market edge. Due to the lack of actual accounting figures, its difficult to ascertain whether a shift in the supply – demand curve of organic milk in the market place would affect the profitability of organic farming in the long run. Presently the price premium is based solely on the availability of organic milk. It would appear however that if more people consumed organic milk and as such the health benefits became more evident than this could result in increase in consumption of organic milk products, meaning higher demand maintaining the high value in the market place.

3. Organic vs. conventional vs. biodiversity

Organic farming demonstrates clear advantages for biodiversity over conventional farming. Depending on altitude, organic farms have between 46 and 72 percent more semi-natural habitats and host 30 percent more species and 50 percent more individuals than non-organic farms (Source: FiBL). The lower farming intensities and higher proportion of semi-natural areas enable site-typical plant and animal species to exist on organic farms and allow farmers to benefit from an intact and therefore sustainably functioning ecosystem.

Agricultural policies are increasingly promoting ecologically-oriented farming methods that preserve biodiversity and conserve natural resources (FAO, 2002). Intensive farming by introduction of exotic species, land clearing, vegetation fragmentation, habitat change and soil erosion has been one of the main causes of biodiversity decline. (Bengtsson et al., 2005; Hole et al., 2005). Specific contributing factors to this decline with conventional farming have been; indiscriminate use of pesticides and synthetic fertilizers, land consolidation, drainage as well as the use of heavy machinery.

Numerous comparative studies showing the impact of conventional and organic farming systems verify the positive effect organic farming has on flora and fauna on field and also farm level (Fuller et al., 2005, Hole et al., 2005). A comprehensive analysis of 66 scientific studies shows that organically farmed areas have on average 30 percent more species and 50 percent more individuals than non-organic areas (Bengtsson et al., 2005). The positive effect of organic farming is most significant in cleared landscapes, but is also seen in structurally rich regions (Gabriel et al., 2006; Gabriel et al., 2010).

In particular birds, predatory insects, spiders, soil dwelling organisms and field flora benefit most from organic management as can be seen in **Figure 1** below. Pests and indifferent organisms on the other hand occur in similar numbers in the various farming systems. The differences in species diversity are especially noticeable with arable and horticulture crops in valleys – the differences seen in grassland are less pronounced. Comparison studies in mountainous regions are scarcely existing.

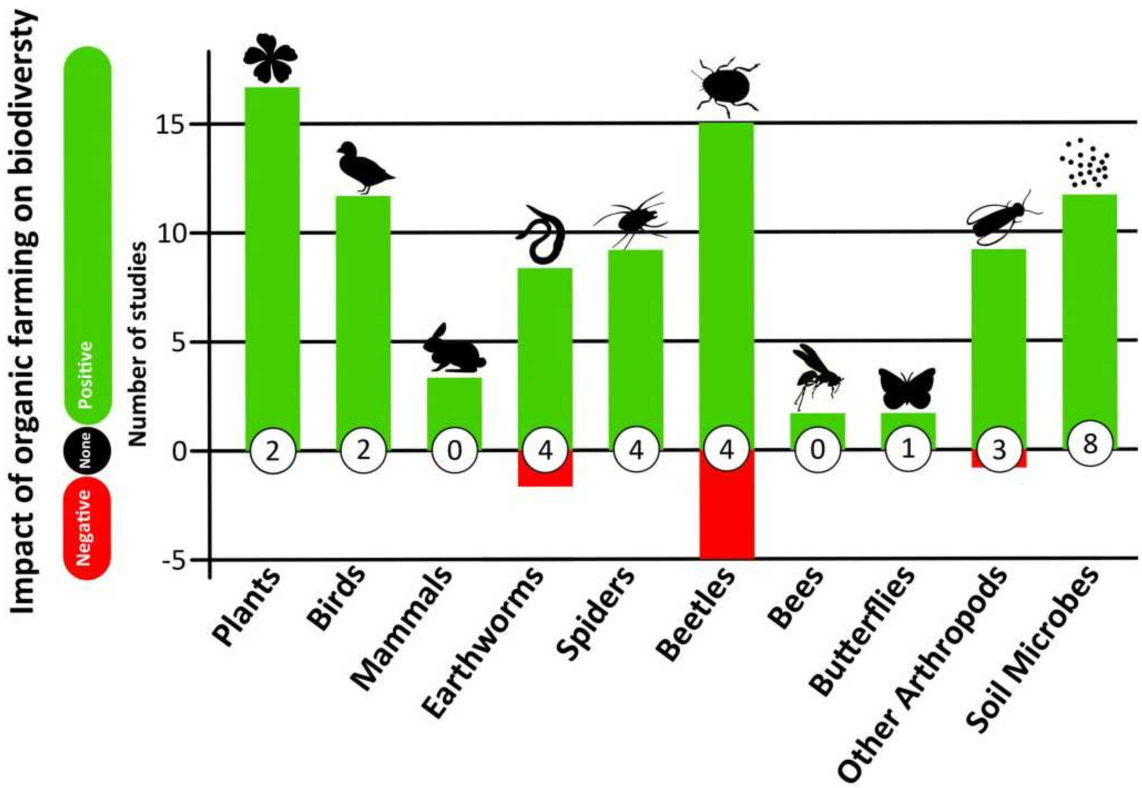

Figure 1. Impact of Organic Farming on Biodiversity - Number of studies that show organic farming having a positive (green bar), negative (red bar) or no effect (number in white circle) on biodiversity of various animal and plant groups in comparison to non-organic farm management. Summary of 95 scientific publications. **(Source: FiBL)**

To preserve rare and endangered species, adapted species protection programs are frequently necessary. The typical ecological compensation programs for farmland are not sufficient. Organic farming in combination with valuable semi-natural areas can therefore significantly contribute to improving species numbers (Pfiffner et al., 2003). Sky larks (Photo 1), a typical species that have been suppressed through intensification of farming, as well as the now rare lapwings, partridges, and whinchats, achieve higher population densities on organically managed farms (NABU, 2004; Neumann et al., 2007). Rare plant species on agricultural land (Gabriel et al., 2006; Gabriel et al., 2007) and ground beetles (Pfiffner et al., 2003) are also proven to be in higher diversity and density on organic farms.

Photo 1. Ground-nesting birds can only survive in less intensively used areas (Skylark).

Habitats with numerous species are shown to better adapt or are more resilient to environmental changes. For instance, species rich mountain meadows erode less and allow for more stable yields during dry periods.

Critical ecological processes are influenced by the higher biodiversity and larger population densities of various species seen on organic farms. Organic farming shows significant improvements for functions such as:

- Pollination (Gabriel et al., 2007; Holzschuh et al., 2007, 2008; Moradin et al., 2005)
- Reduction in soil erosion on arable land (Siegrist et al., 1998)
- Decomposition of dung in pastures (Hutton et al., 2003)
- Natural pest reduction in soil (Klingen et al., 2002) and crops (Crowder et al., 2010; Zehnder et al., 2007)

Flower-visiting insects such as honeybees, wild bees, and bumblebees benefit from the higher coverage and diversity of secondary flora in organic grain fields. Biodiversity is 3 times higher and the number of bees 7 times higher than in conventional areas (Holzschuh et al., 2007). With organic farming areas increasing, populations of wild bees, honeybees, and bumblebees are also markedly climbing in the surrounding farmland and semi-natural areas (Holzschuh et al., 2008). Organic agriculture thus improves the pollination of flowering plants in the surrounding environment (Gabriel et al., 2007).

The higher diversity of flora and fauna also encourages beneficial organisms that naturally reduce pests (Zehnder et al., 2007). Organic farming leads to a significantly more balanced number of beneficial insects that reduce pests and yield losses in potato crops (Crowder et al., 2010). Organic pastures allow richer fauna to exist in dung than conventional pastures as they are not contaminated by chemical veterinary drugs (Holzschuh et al., 2007). Dung fauna considerably adds to the degradation and recycling of dung and in turn makes for better-feed quality.

A more diverse flora and fauna in organic soil result in a revitalized, more active soil life (Mäder et al., 2002). Research from Norway shows a stronger reduction in soil pests in organic soils than in conventional soils due to richer fungal fauna (Klingen et al., 2002).

Various farm practices and landscaping measures are implemented in organic farming that have a proven positive influence on biodiversity as shown in Figure 1 above. The following measures typically carried out on organic farms that most notably promote biodiversity are:

- Non use of herbicides
- Non use of chemically-synthesized pesticides
- Less and purer organic fertilizers
- Fewer cattle per square meter
- More diversified crop rotation with higher clover grass percentage
- Conservation tillage
- Higher percentage of semi-natural areas
- Higher percentage of arable and ecological areas
- More diversified farm structure

These factors enhance not only biodiversity, but strengthen natural cycles and improve environmental performance that in turn increase the sustainability of organic farms (FAO, 2002; Pimentel et al., 2005). To optimally promote biodiversity, cross-farm and landscaping measures need to be instituted – ideally on extensively managed habitats within landscapes (e.g., bioregions) (Gabriel et al., 2010). It would seem from the amount of scientific literature albeit limited, that organic farming with its strong principles of natural resource management significantly protects biodiversity by maintaining species numbers as compared to conventional farming.

4. Consumer trends

Retailing of organic milk has changed since the early 1990s, when most organic food was sold in specialty shops. Since then, organic food products have become available in a wide range of venues, with trends in retailing organic milk following those of conventionally produced food, including a growing reliance on private-label products (Dimitri, et al., 2007).

Two other factors have affected retailing of organic milk and other organic products: *Stringent Certification Codes* (Marketing of organic products is facilitated through the use of global organic standards, which establish rules for the use of the label "organic" and the accompanying logo) and *Price Premiums* (Organic milk, like most organic products, receives a price premium over conventional products).

4.1. Price premium

Consumers have been willing to pay premium prices in the market for certified organic dairy products, with the understanding that the food has been raised in a sustainable, environmentally sound manner and that they are helping support and keep family farmers on the land. As stated earlier, consumers also assume that humane animal husbandry practices are employed by organic farmers, and they may believe that organic food is more nutritious. Those able to make the difficult three-year transition (*2) to organics have been rewarded by top commodity prices at the farm-gate something that stands in stark contrast to the intense price squeeze that has driven many of their conventional neighbours from the business. The success story of organic products in present day agriculture could be the catalyst for doing more reliable scientific research in this field. Unless off course there may be fear in the industry that more comprehensive scientific research may reveal that the product is not as distinctly more beneficial to warrant the current price premiums to that of the conventionally farmed milk. As a result this could then affect the marketability of the product. The present day mystique around organic produce can be attributed to the lack of conclusive scientific evidence proving its benefits to human health.

4.2. Marketing

The boost in organic milk sales is part of a wider growing interest in organic products, which resulted in an average annual growth rate of retail sales of organic food of nearly 18 percent between 1998 and 2005 (Dimitri et al., 2007). Rising consumer interest in organic milk has been accompanied by a newfound widespread availability of the product, and organic milk is now available in nearly all food retail venues, including conventional supermarkets.

In 2006 media reports in USA, the largest organic milk-consuming nation in the world indicated that supermarkets experienced significant shortages of organic milk during 2005 and 2006 (Oliver, 2006; Weinraub & Nicholls, 2005), suggesting that consumer demand is unmet at current market prices.

To date, most characterizations of consumers who purchase organic products result from industry studies and offer conflicting views. The studies have focused on consumers of organic foods in general, not just consumers of organic milk.

These market analyses use consumer surveys to gather information and have focused on trends in consumer purchases of organic foods (For instance in the USA - Whole Foods

Market, 2005) and demographic characteristics of organic consumers (Hartman Group, 2004, 2002, 2000). The Whole Foods 2005 survey indicates that 65 percent of consumers have tried organic foods, 27 percent bought more organic food in 2005 than in 2004, and 10 percent consume organic food several times a week.

Supply responses necessarily lag behind increases in consumer demand because it takes 3 years to convert farmland to meet organic standards so that they can provide organic feed. The cows have to be managed organically and fed organic feed for 1 year.

The authors have studied the most recent Hartman report 2006 which indicated that the majority of organic milk consumers are of ethnic origin with an annual income of less then $50,000.

In contrast to the Hartman 2006 and 2004 results, earlier studies characterize organic consumers as White, affluent, well-educated, and concerned about health and product quality (Lohr, 2001; Richter et al., 2000; ITC, 1999; Thompson, 1998). These studies also cluster the average age of organic consumers in two age groups: 18-29 years and 45-49 years (Thompson, 1998; Lohr & Semali, 2000). One element that has remained generally accepted through the years is that parents of young children or infants are more likely than those without children to purchase organic food.

Figures 2 to 5 show the distribution of organic households compared to conventional households by income (Figure 2), education (Figure 3), household size (Figure 4) and share of households (Figure 5). The percentages were calculated by dividing the number of organic (or conventional) households in each region by the total number of organic (or conventional) households in the sample. This information is useful in that it provides insight into the characteristics that differentiate the typical organic household from the typical conventional household, plus it allows for a comparison of these results with those published by industry groups.

Household income and education of the head of the household seem to be associated with the likelihood that a household will buy organic or conventional milk. The data indicates that the share of organic households across income categories rises as income increases, and the high-income group is the only category where the proportion of households purchasing organic milk exceeds the proportion purchasing conventional milk (Figure 2). Most (80 percent) organic milk consumers have at least attended some college, and those who have graduated from college or completed some post-graduate education make up 51 percent of organic milk consumers. The share of organic households with the highest two levels of education (graduated from college or completed some post-graduate studies) is greater than the share of conventional households with the same level of education (Figure 3). What accounts for the association between income and education and purchasing organic milk? Household income and education are correlated, so income could be the factor driving the association with purchasing organic milk. Alternatively, education could be the driving factor, in that greater education may enhance one's understanding of the relationship between organic production techniques and environmental impacts.

Reasonable explanations are lacking as to the association (or lack thereof) between some demographic factors and the distribution of organic milk households. For example, one might expect that larger households would buy much less organic milk than smaller households, particularly since smaller households have greater disposable income, household size appears to have little relationship with the propensity to purchase organic milk (Figure 4).

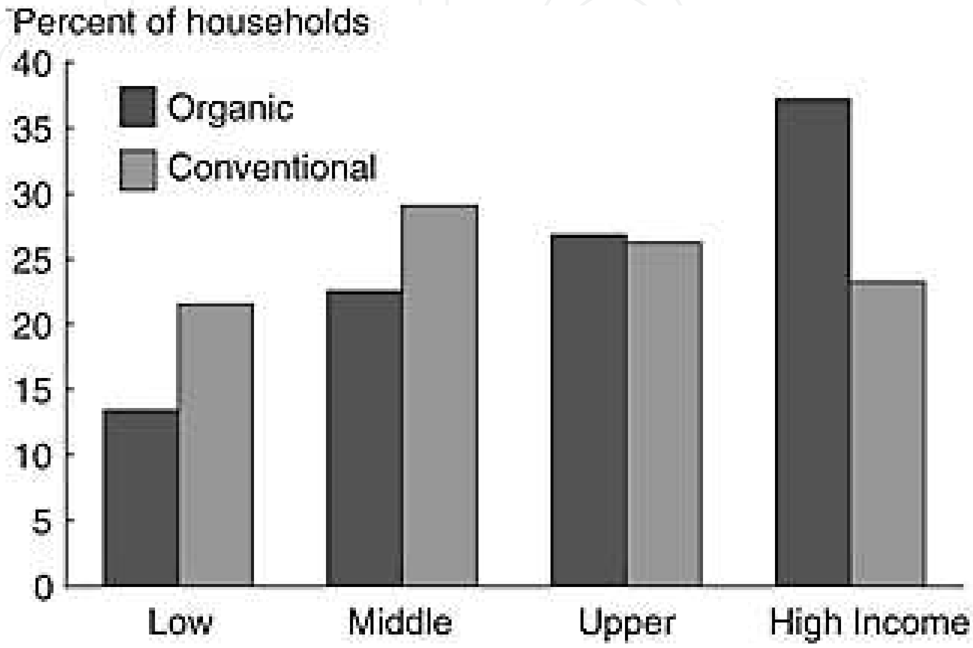

Figure 2. Distribution of organic and conventional milk households by income, **2004

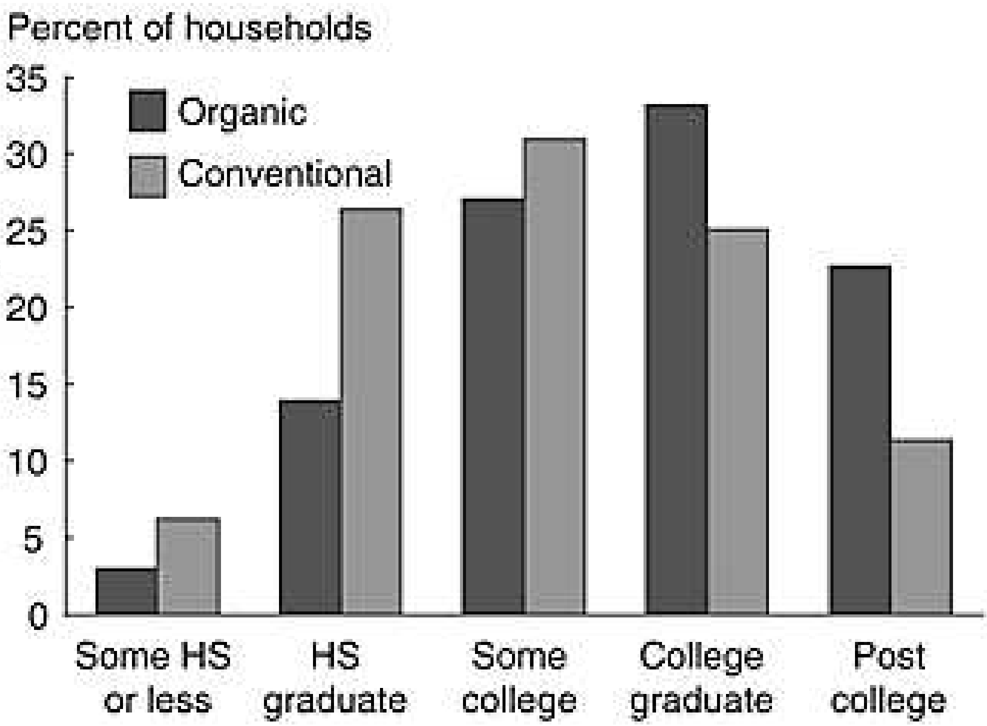

Figure 3. Distribution of organic and conventional milk households by education, 2004

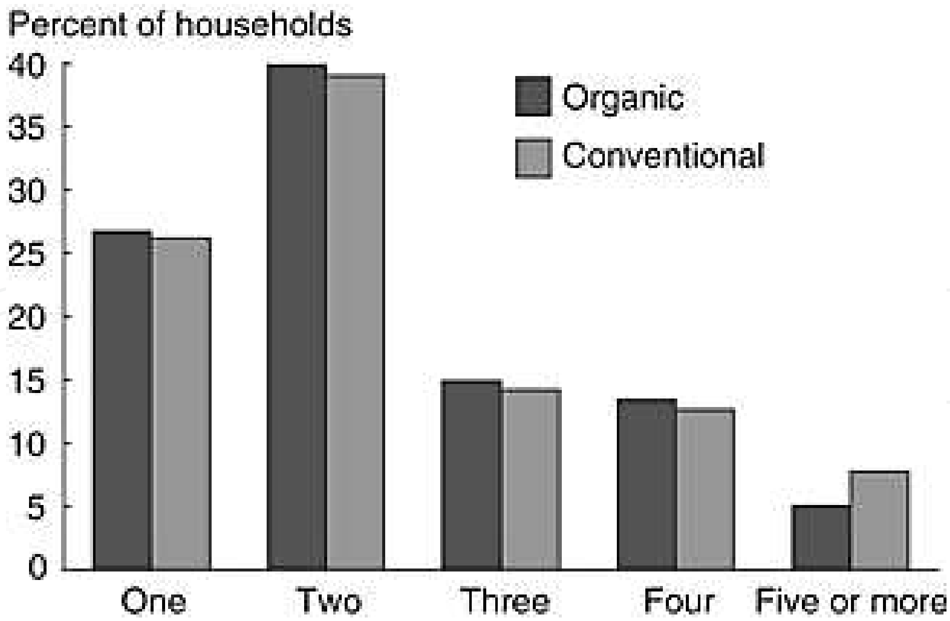

Figure 4. Distribution of organic and conventional milk households by household size, 2004

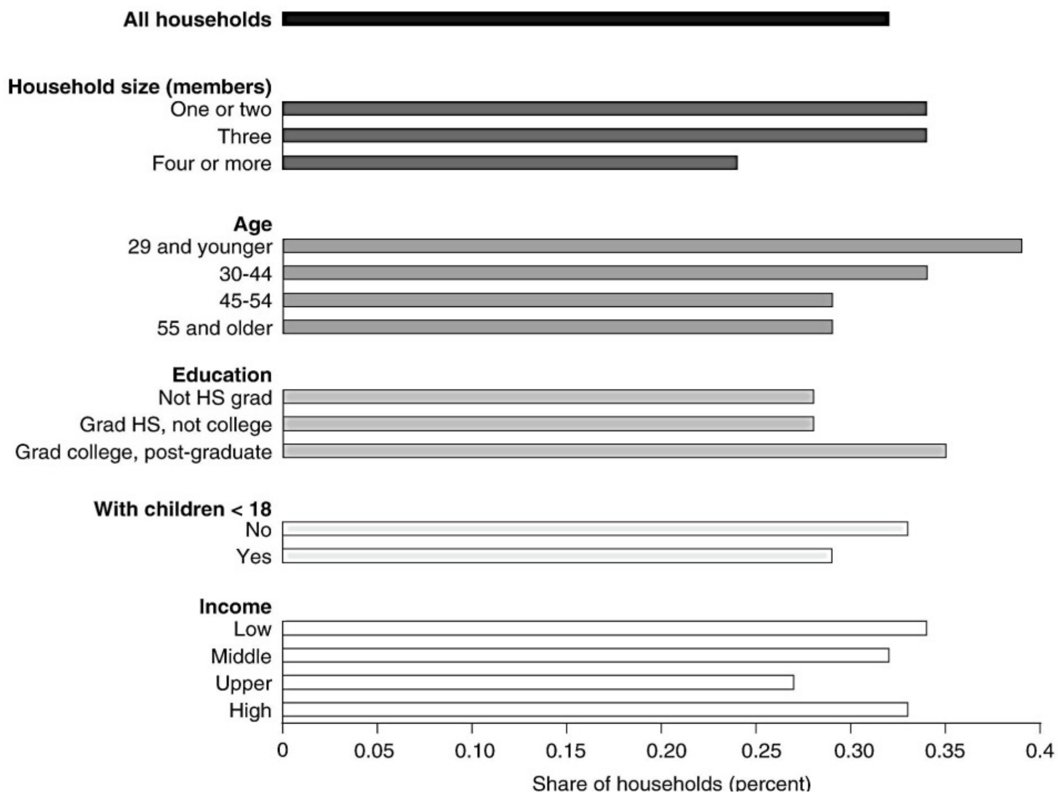

Figure 5. Share of Households (percent - %)

In sum, the demographic data indicate that organic households are most likely to be headed by someone age 54 or younger, have a college degree, and have annual household incomes of at least US$70,000. Conventional households are more likely to have annual household income less than US$70,000, have not graduated from college, and be headed by a household head age 55 or older. Household size has little bearing on whether a household purchases only conventional milk, and the presence of children under age 18 has no bearing on the likelihood of a household to purchase organic or conventional milk. The importance of factors such as high income and a college degree together suggest that organic households have higher discretionary income than conventional households and, thus, are able to afford and are willing to purchase higher priced organic milk.

5. Conclusion

Certain concepts became quite evident during data collection and literature assessment;

- The motivation for implementing organic agricultural systems may be diverse but persuading farmers to change and maintain organic systems required some financial incentive;
- Successful initiatives may have diverse origins, but significant impact required the harnessing of resources and commitment of numerous stakeholders, both private and public sector on a complementary mission;
- the verifying role of organic certification services is both a burden and also a means of delivering truly sustainable agriculture;
- projects based on organic agriculture are more subtle than chemical agriculture and therefore, situation specific, successful organic agriculture is 'knowledge intensive' requiring more design and management from the outset, as opposed to the 'just in time' approach of chemical agriculture.

It is the view of the authors that training, extension and demonstration are perhaps even more critical here than with conventional projects, benefits from organic agriculture may not be immediate. Small farmers will require considerable support or incentive over the initial years if the system is to gain momentum and be maintained, some agro-ecological situations, such as agro-forestry, will convert more easily to organic systems than others.

Farmers appear to resist conversion to organic agriculture when:

- they have been heavily exposed to the chemical message;
- they currently operate high input, high output systems;
- previous extension services have been effective;
- production is relatively mechanized;
- labour costs are high or labour is not available;
- the system is thrust upon them;

Farmers appear more receptive to conversion to organic agriculture when:

- they have not been exposed to the chemical message;
- their farming system is traditional or nil input;
- previous extension services have not been effective;
- production is relatively labour intensive;
- labour costs are low or labour is readily available;
- the concept is developed by them or with them;

In conclusion; organic projects involving milk production systems should be as rigorously identified, designed, implemented, monitored and evaluated as any other agricultural development project with strong stakeholder participation. The organic context does not make the project immune to the potential problems with project implementation from misidentification of issues, political influences and weak institutional support. Extra emphasis should be placed on human resource and institutional development, recognizing that organic dairy farming is knowledge intensive rather than input intensive. Dissemination of information is one of the main drawbacks for appreciating the benefits of organic milk production systems.

Author details

Sezen Ocak and Sinan Ogun
Zirve University / Middle East Sustainable Livestock,
Biotechnology and Agro-Ecology Research and Development Centre, Turkey

Acknowledgement

The authors would like to extend their appreciation to Northeast Organic Dairy Producers Alliance, Cornucopia Institute, Dairy Economic Research Service - USDA, Organic Farming Research Foundation, The Organic Centre, Research Institute of Organic Agriculture (FiBL) and would also like to ackowledge the following authors as their publication, although not directly quoted, were never the less used as a guide in assessing some of the concepts discussed in this study and Emin Basar Ozdemir for his graphic abilities.

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