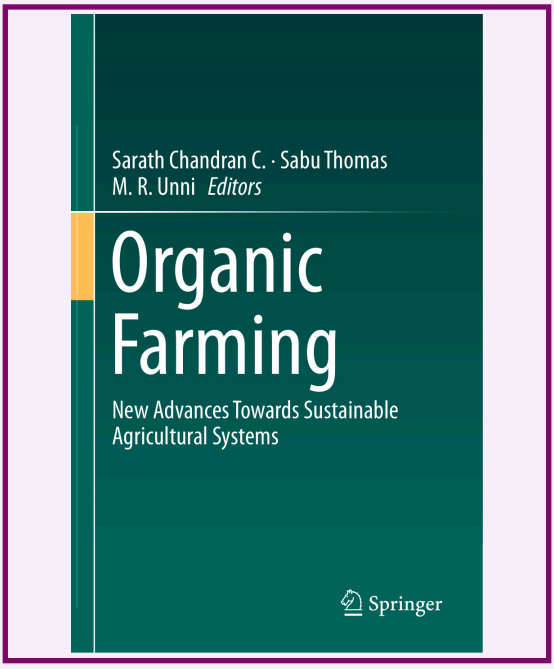
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Sarath Chandran C. · Sabu Thomas
M. R. Unni *Editors*

Organic Farming

New Advances Towards Sustainable Agricultural Systems

Springer

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Preface

Organic farming has received considerable attention recently, especially since 2000. Growing research and academic interest have led to considerable development in this field. With conventional agriculture also following a more sustainable direction, organic farming practices will be inspiring more people towards more ethical directions. With this concept in mind, the main aim of this book is to provide an overview of different perspectives like sustainability and food security, challenges in organic farming, and the role of organic farming in maintaining ecological justice. This book springs from the Inter University Centre for Organic Farming and Sustainable Agriculture, affiliated with Mahatma Gandhi University, Kerala, India.

This book provides an overview of the impact of organic farming practices on the quality of crop production, followed by a discussion on the role of organic farming in protecting water quality. This is followed by a chapter on current status and soil biology impacts of organic farming. The significance of biochar in organic farming and different organic strategies of pest and disease control are also discussed. Organic animal husbandry is then critically evaluated. Finally, the effect of pesticides and their degradation products are discussed in detail.

In short, the contribution of organic farming towards sustainable development, different pest and disease control strategies, organic animal husbandry, and side effects of various pesticides and their degradation products are answered in a unique and updated manner. The Inter University Centre for Organic Farming and Sustainable Agriculture wishes to thank all the authors of this book, and their efforts are gratefully acknowledged.

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Organic Farming in Protecting Water Quality



S. Sivaranjani and Amitava Rakshit

Introduction

Water is a basic necessity for human and ecosystem health, as well as the long-term ecological and socio-economic resilience of our food and farming systems. The agricultural sector bears a large share of responsibility for water consumption and contamination; thus, it must show leadership in conserving and protecting water resources. The use of chemical pesticides and fertilizers in food production leads to the continued deterioration of water quality and raises the costs for society. Efforts to reduce the contamination of ground and surface waters from agricultural sources remain a constant challenge. A large number of water treatment techniques are available, but not all are cost-effective or affordable for small farmers, which leads to the use of poor-quality water in agricultural fields. This chapter reviews how organic farming reduces the deterioration of water quality. Although some progress has been achieved, poor management practices continue to have a negative impact on water quality.

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What Are the Different Ways by Which Water Quality Deteriorates?

Five environmental problems are associated with the improper implementation of conventional and organic cropping practices:

- Nutrient leaching and runoff
- Soil erosion
- Pathogen transport into water bodies
- Pesticide leaching or runoff
- Heavy metal accumulation in soil

Organic Farming

Organic farming claims to have the potential to provide benefits in terms of environmental protection, conservation of non-renewable resources, improvements in food quality, reductions in the output of surplus products, and the reorientation of agriculture toward areas of market demand (Lampkin 1990). Governments have recognized these potential benefits and responded to them by encouraging farmers to adopt organic farming practices, either directly through financial incentives or indirectly through support for research, extension, and marketing initiatives. However, farmers' decisions on whether or not to make the switch from conventional to organic farming have not been studied extensively thus far.

Aims and Definitions of Organic Farming

There are many definitions of organic farming. Mannion (1995) referred to it as a holistic view of agriculture that aims to reflect the profound interrelationship between farm biota, agricultural production, and the overall environment. Scofield (1986) stressed that organic farming does not simply refer to the use of living materials, but emphasizes the concept of "wholeness," implying the "systematic connection or co-ordination of parts in one whole." As Scofield pointed out, the concerns that motivated the early adopters of organic farming included issues of soil health and structure, the exhaustible nature of artificial fertilizers, and human health. According to the Codex Alimentarius (Le Guillou and Scharpe 2001), organic farming involves holistic production management systems (for crops and livestock) that emphasize the use of management practices in preference to the use of on-farm inputs.

One of the most significant expositions of the aims and principles of organic farming is presented in the International Federation of Organic Agriculture

Movements (IFOAM) basic standards for production and processing (IFOAM 2002). According to the principle aims of IFOAM, organic farming involves a clear vision of a major change in society in order to make organic farming possible.

Organic Farming: Environmental Benefits

Water pollution is largely associated with the use and discharge of water in both animal and plant farming. For example, each time water is exchanged in a fish pond, wastewater is discharged to the surrounding surface waters. The wastewater carries a number of pollutants, as reflected in the selected indicators. These pollutants ultimately stem from the chemicals, fertilizers, and feed added to the ponds (Anh 2010). Therefore, in organic farming, water pollution is lower because there is greatly reduced eutrophication of the chemical inputs used in conventional farming systems, such as nitrogen and phosphorous. The soil structure on organic farms also is much better, which leads to less pollution from nitrates and is healthier for the crop plants because it is free of chemicals (Trewavas 2004).

Systems-based organic production practices conserve nutrients, protect water quality, and maintain biological diversity through a combination of the following:

- *Increasing soil organic matter* by returning organic materials to the soil and choosing practices that support a biologically active humus complex.
- *Composting* animal manure and other organic residues to form a more uniform and chemically stable fertilizer material.
- *Timing* the release of nutrients from organic-matter mineralization to coincide with the times when plants are actively growing and taking up nutrients.
- *Using crop rotations for nitrogen fixation* and to recycle nutrients from the soil profile, increase soil tilth through root growth, and provide a diversity of crop residues.
- *Using intercropping practices* to diversify crops in the field, enhance soil fertility, increase the efficiency of nutrient use, and decrease pest pressures.
- *Planting catch crops or cover crops* to recover nutrients that may otherwise leach into the subsoil.
- *Using conservation practices* that reduce the potential for water runoff and wind and water erosion.
- *Providing buffers or filter* areas between cropping areas and water bodies to protect against nutrient and sediment movement into lakes and streams.
- *Managing and monitoring irrigation practices* to enhance nutrient uptake, decrease leaching of nutrients, and minimize root and stem diseases.
- *Controlling pest populations* through cultural practices, enhanced pest-predator balances, and the use of biodegradable pesticides that have low toxicity to beneficial insects, fish, birds, and mammals.

The keys to both effective crop production and water quality protection are high levels of soil organic matter and an active community of soil organisms.

Nutrient Leaching and Runoff

The two agricultural nutrients of particular concern to water quality and human health are nitrate and phosphorus, as mentioned previously. Nitrate, the common form of nitrogen in soils, is subject to leaching. Unlike potassium, calcium, and magnesium, which are positively charged, nitrate is negatively charged. Positively charged nutrients are able to bind onto most soil particles, including organic matter, because these soil particles have negative charges. Negatively charged nitrate, however, is repelled by negatively charged soil particles. Thus, it is easily transported down through the soil profile and into the groundwater.

Phosphorus is the nutrient of most concern for runoff and erosion losses because this nutrient is limiting in freshwater systems. Therefore, a modest addition of phosphorus to lakes, rivers, or streams can cause nutrient imbalances that stimulate the growth of algae, which in turn limits the access fish have to nutrients and oxygen.

Leaching affects crop growth when nutrients are moved beyond the reach of plant roots. It is of concern to water quality when nutrients are transported into groundwater. Leaching of water and contaminants into groundwater is favored by soils that:

- Are saturated
- Have a high water table
- Have a sandy or gravelly texture
- Have cracks caused by soil drying or tunnels formed by animals or earthworms

Various researchers have reported significantly greater nitrate leaching from conventional practices as compared with organic systems.

How Organic Farming Controls Nutrient Leaching and Runoff

Organic cropping systems control nitrate leaching by stabilizing nitrogen in crop plants used in rotations (Stolze et al. 2000). Adding organic matter to the soil stimulates the growth and reproduction of soil organisms, which also retain soil nitrogen in a relatively stable form (Drinkwater et al. 1998). As decomposition processes continue and the populations of soil organisms increase, they stabilize mineral nutrients in their bodies and in the soil humus fraction. Effective practices to promote the stabilization of nitrogen in this manner include using a legume and forage grass rotation or using non-leguminous plants as cover crops (Granstedt and L-Baeckstrom 2000). Wander et al. (1994) reported that high levels of biological activity in cover-cropped fields corresponded with a greater ability of the soil to hold nitrogen against leaching.