Sustainable Agriculture Reviews

Volume 33

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Sustainable agriculture is a rapidly growing field aiming at producing food and energy in a sustainable way for humans and their children. Sustainable agriculture is a discipline that addresses current issues such as climate change, increasing food and fuel prices, poor-nation starvation, rich-nation obesity, water pollution, soil erosion, fertility loss, pest control, and biodiversity depletion.

Novel, environmentally-friendly solutions are proposed based on integrated knowledge from sciences as diverse as agronomy, soil science, molecular biology, chemistry, toxicology, ecology, economy, and social sciences. Indeed, sustainable agriculture decipher mechanisms of processes that occur from the molecular level to the farming system to the global level at time scales ranging from seconds to centuries. For that, scientists use the system approach that involves studying components and interactions of a whole system to address scientific, economic and social issues. In that respect, sustainable agriculture is not a classical, narrow science. Instead of solving problems using the classical painkiller approach that treats only negative impacts, sustainable agriculture treats problem sources.

Because most actual society issues are now intertwined, global, and fast-developing, sustainable agriculture will bring solutions to build a safer world. This book series gathers review articles that analyze current agricultural issues and knowledge, then propose alternative solutions. It will therefore help all scientists, decision-makers, professors, farmers and politicians who wish to build a safe agriculture, energy and food system for future generations.

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Sustainable Agriculture Reviews 33

Climate Impact on Agriculture

Springer

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Preface

Climate change is unavoidable but adaptation is possible. Climate change and agriculture are interrelated processes, both of which take place on a global scale[1]. Climate change affects agriculture through changes in average temperatures, rainfall and climate extremes; changes in pests and diseases; changes in atmospheric carbon dioxide; changes in the nutritional quality of some foods; and changes in sea level. Future climate change will likely negatively affect crop production in low latitude countries, while effects in northern latitudes may be positive or negative. Climate change will probably increase food insecurity for some vulnerable groups, such as the poor. Agriculture contributes to climate change both by anthropogenic emissions of greenhouse gases and by the conversion of non-agricultural land such as forests into agricultural land.

[1] https://en.wikipedia.org/wiki/Climate_change_and_agriculture

Soil erosion in wheat field, Pas de Calais, France, winter 1990. Copyright P. CHERY, INRA 1990

In order to adapt agriculture, there is actually an urgent need for management methods that will decrease negative impacts and allow food production on formerly sterile lands. This book reviews advanced knowledge and methods relevant to climate and agriculture. In the first chapter, Kulek reviews the agricultural nitrogen cycle, with focus on gas emissions of ammonia (NH_3), nitrous oxide (N_2O), commonly known as the laughing gas, and nitric oxide (NO) from animal husbandry and fertilisation. She found that camels emit much less ammonia and nitrous oxide than cattle, that the older the animal the higher the ammonia emission, and that fertilisation with calcium ammonium salts emits much less gases that urea fertilisation. In Chap. 2, Sarauskis evaluate the positive and negative effects of tillage; they found that sustainable tillage without ploughing reduces costs by 25–41%. Tsegaye reviews coffee production and climate change in Ethiopia, where the mean annual temperature has increased by 1.3°C between 1960 and 2006, and states that 'Africa can be easily converted into deserts', in Chap. 3.

Coastal agrosystems are particularly vulnerable to climate change and accelerated sea level rise. In Chap. 4, Banerjee et al. found that in some areas up to 40% of biodiversity has been lost; they propose adaptation practices such as agroforestry and salinity management. Singh et al. explain that wetland rice fields emit 15–20% of

anthropogenic methane (CH_4) emissions; they list the various factors and practices controlling emissions in Chap. 5. In the same vein, Srivastava et al. review in Chap. 6 the factors that control carbon sequestration in soils, a practice which is foreseen to decrease CO_2 emissions; they found that dry tropical soils are far away from carbon saturation and thus have high potential for carbon sequestration.

In Chap. 7, Arora and Vanza present bacteria and fungi that can be used to decrease salt stress in plants; they found that wheat and corn yields can be increased by 10–12% under salinity stress. Bhaduri et al. review the types of degraded soils and the bioindicators of soil degradation, such as plant biomarkers and biosensors, in Chap. 8. Usman et al. discuss groundwater evolution in Pakistan, and consequence for irrigated agriculture, in Chap. 9. In the future, there will be more food production in closed systems due to climate changes and increasing urbanisation. Here, Hadavi and Ghazijahani review the types of closed systems used in agriculture, with inspiring experiments of food production in outer space, in Chap. 10. In the last Chap. 11, Zahedi presents biofuels such as bioethanol, biodiesel, crop residues and algae.

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About the Editor

Eric Lichtfouse, PhD, born in 1960, is an environmental chemist working at the University of Aix-Marseille, France. He has invented carbon-13 dating, a method allowing to measure the relative age and turnover of molecular organic compounds occurring in different temporal pools of any complex media. He is teaching scientific writing and communication and has published the book *Scientific Writing for Impact Factor Journals*, which includes a new tool – the Micro-Article – to identify the novelty of research results. He is founder and chief editor of scientific journals and series in environmental chemistry and agriculture. He got the Analytical Chemistry Prize by the French Chemical Society, the Grand Prize of the Universities of Nancy and Metz, and a Journal Citation Award by the Essential Indicators.