A Study of Agro Ecosystem/Environmental Interaction

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ABSTRACT: ***This special issue of Agriculture, Ecosystems and Environment honors the significant contribution of Dr. J.W. Struck to \sagroecosystem and environmental research via his long-term position as Editor-in-Chief (1982–2000). An historical overview \sof agro ecosystem and environmental research is provided to illustrate the continued growth of scientific endeavor in this area, \sand to show its importance for a better understanding of ecological interactions within agro ecosystems and especially at the \sagroecosystem/environmental interface. The articles included in this special issue are chosen to demonstrate the range and \diversity of agro ecosystem and environmental research. They may be put in the following four areas: the environmental \impact of farming systems; the management of organic resources, the connection between the ecology of farming systems and The environment; and the ecological interactions that occur within or between agricultural systems. Intensification of food \production, population growth, technological change, changing land-use patterns, and global change will further impact the \structure and functional properties of agro ecosystems, and intensify the interaction between agriculture and the environment, \sand will present a major continuing need for research in the 21st century***

KEYWORDS: Agriculture; Agro ecosystems; Ecological interactions; Environment.

1. INTRODUCTION

Dr. J.W. Stroke's editorial leadership of Agriculture, Ecosystems, and Environment over the last 20 years is honored in this special issue. During that period, research on the agro ecosystem-environment interface has grown and varied. This broad variety is reflected in the articles included in this collection. The goal of this editorial is to track the evolution and expansion of published material on agro ecosystem and environmental research, to describe the variety of current research, and to highlight future concerns. Overview of agroecosystem and environmental studies throughout history Following the evolution of agroecosystem and environmental research publications may give you a good idea of how far the field has progressed. The shifting goals and scope of journals, as well as the different subjects of published articles, demonstrate both an extension of science and a gain in knowledge. Elsevier began publishing two journals covering agroecosystem and environmental studies in 1974. Agriculture and Environment, edited by Dr. F. de Soet (1974–1978) and Dr. T.L.V. Ulbricht (1978–1982), addressed the connections between agriculture and food and biosphere management. A second journal, Agro-Ecosystems, was funded by the International Association for Ecology and dealt with the science of agroecosystems in a broad sense. It was edited by Professor J.L. Harper (1974–1981) and Associate Editor P. Gruys, and then followed by Dr. J.W. Sturrock (1982–1983) [1].

Agriculture is reliant on the environment, and agriculture is reliant on the environment (De Soet, 1974). Agriculture may be defined by pattern or structure as well as procedures when it is conducted on a landscape. Land use and landscape design affect agriculture patterns, whereas agricultural techniques influence processes (e.g. energy flow, nutrient cycling, plant succession, and soil transformations). Agriculture's patterns and processes have an impact on both agricultural output and the agricultural ecosystem's stability. Agroecosystem stability is usually improved when the structure is highly differentiated, as shown by a varied land use pattern. A key goal for Agriculture and Environment was to achieve an appropriate balance between agricultural output and ecological stability. The goal was to provide a platform for study towards the development of more environmentally friendly farming methods. It was recognized that socioeconomic and cultural factors had a significant impact on the relationship between agriculture and the environment [2]. In developed countries, for example, there is a keen awareness of the ongoing need for environmental protection in intensive agricultural production, whereas in developing countries, rising human population and intensified land use have increased the desire to

replace or improve traditional farming methods. The ultimate result of these tensions has been often shown in adverse ecological and environmental phenomena, such as water, air, and soil pollution or quality issues in industrialized countries, and over-exploitation of forest soils and resources.

Agriculture and its surroundings have a spatial relationship. Using computer modeling methods characterize the impact of agricultural activities on the environment and biosphere carrying capacity; clarify the underlying circumstances that support a fair balance between agricultural output and environmental conservation. Concerns about the global food supply and biosphere management Document the balance between adequate food supply and appropriate environmental management, particularly in a variety of geographic, demographic, social, economic, political, and cultural contexts. Land and water usage, as well as landscape design By addressing issues such as mechanization, input application and efficiency, and food quality, relate the patterns or structures of land use in rural regions to different agricultural and animal husbandry operations. Agriculture's use of energy addresses the need for feasible alternatives to agricultural systems that are heavily reliant on fossil fuels, are highly automated, and rely on fertilizers. Overgrazing of grasslands in developing nations causes widespread soil erosion, the depletion of intrinsic soil fertility, and the development of Stalinization in irrigated regions. Agricultural and Environment intended to offer a platform for scientific study on the integration of agriculture, food production, and environmental management in light of the aforementioned issue s[3]. A list of some of the research topics that were discussed. Before the word "ecosystem" was commonly used in ecology, the introductory editorial of Agro-Ecosystems showed that agricultural research had long included the practical management of ecosystems (Harper, 1974). Much agricultural research is concerned with the interaction between organisms (e.g. flora and fauna) and their environment, while ecosystems study is concerned with the examination of interactions among components of a system. Agro ecosystems and forest systems, in contrast to natural ecosystems, are usually not self-sustaining and are susceptible to 'leaks,' or the movement of both mineral and organic resources [4]. A large portion of the research published in Agro Ecosystems sought to describe the changes that occur when a natural ecosystem is converted to an agroecosystem. Furthermore, the use of both mineral and organic resources, as well as the addition of water resources

2. DISCUSSION

2.1. APPLICATION:

The subject areas covered by Agriculture and Environment and Agro Ecosystems had a lot of overlap. The realization that agro ecosystems are inherently unstable had ramifications for the greater environment, air and water quality, food quality, and the quality of the countryside. Concerns about soil erosion and the impact on biological diversity also meant that agroecosystem research had to take into account the larger environment. However, ecological interactions within agro ecosystems, nutrient flows and leaks, and functional aspects of organisms and tropic levels continue to be a source of research interest. Agriculture and Environment and Agro-Ecosystems were merged in 1983 to form Agriculture, Ecosystems and Environment, with Drs. J.W. Sturrock and T.L.V. Ulbricht as editors, for the reasons stated above. The merging of the two journals was seen as a logical step that covered both research areas while also allowing for significant overlap. Overall, the merging of the two journals improved the research area's continuity as well as the flow and frequency of publication. The new journal, Agriculture, Ecosystems, and Environment, merged the two previous publications' goals and scopes, capturing the study areas listed in Tables 1 and 2. The new journal's subtitle read, an international journal for scientific research on the relationship between agriculture and food production for the biosphere." The following were the research topics: comparison of different agricultural production methods in terms of their environmental impact; • impact of agriculture on soil, water, and food quality; • use of energy and non-renewable resources; • effects of industrial pollutants on agriculture; • policy issues involved in agricultural change and development[5]. Current research on agro ecosystems and the environment Agriculture, Ecosystems, and the Environment: Recent Advances M.R. Carter/Agriculture, Ecosystems and Environment 83 (2001) 3–9 A large percentage of the articles submitted to Agriculture, Ecosystems and Environment dealt with the essential subject of soil ecology. To encourage this tendency, Applied Soil Ecology was published as a distinct part of the journal. The function of soil organisms and their interactions in connection to agricultural production, nitrogen cycling, and other elements of soil ecosystems has been the focus of this publication since 1994.

After more than 20 years of engagement in agro ecosystems and environmental research, Dr. T.L.V. Ulbricht retired as joint Editor-in-Chief in 1998 (see publisher's notice, Agriculture, Ecosystems and Environment, Vol. 68 (iii) 1998). Dr. M.R. Carter took his position the next year. Agriculture, Ecosystems and Environment's objectives and scope were revised in 1999 to explain and redefine the journal's mission for writers and readers (see editorial note, Agriculture, Ecosystems and Environment, Vol. 73 (v) 1999). 'An worldwide magazine for scientific study on the relationship between agricultural productivity, agro ecosystems, and the environment' was added to the subtitle. The modification was made to highlight that the journal's primary focus is on the intersection between agriculture and the environment. The revised goals and scope placed a greater emphasis on the interplay between agroecosystem practices and the resulting ecological and environmental outcomes, such as their impact on environmental and biological quality and health, agricultural sustainability, and agricultural variety. Papers that are inter- and multi-discipline in nature, that bridge or connect scientific fields, are increasingly given priority. In agricultural systems, ecology (e.g., animal, crop, bird, insect), ecological interactions, and variety are all important [5]. 21 Interactions between soil biota and nutrient cycling in agro ecosystems 18 Diseases, pests, integrated pest management, insecticides, and biological control in agricultural systems Land use, landscapes, soil conservation, and land degradation/rehabilitation are among the 14 topics covered. 13 Greenhouse gas emissions, ozone depletion, and climate change Agricultural by-products, waste management, and heavy metals are just a few of the topics covered in this article. 5 Farming system evaluation; organic farming 5 environmental (soil, water, air quality) and ecological indicators 5 \stoic-economics; energy-use in agro ecosystems 4 \sCrop/soil modeling 2 A total of 30 themes or subject categories were discovered and listed. These were merged to create 10 main themes as indicated in the table. incorporate scientific assessments, and are presented in as wide an international or comparative perspective. an idea of the kind of research subjects published in Vols. 62–76 (1997–1999) of the journal, omitting special issues. Further to this, shows the special issues of the journal during the same time period to highlight the broad variety of stoics dealing with the agroecosystem/environmental interface. the rising number of articles submitted to the journal (excluding special issues) during the past 11years(1989–1999), demonstrating the continued development of agroecosystem/environmental research [6].

Table 1
Range of research topics in the journal *Agriculture and Environment* (1974–1982)

Research topics	Comments
Spatial relation between agriculture and its environment	Characterize the effect of agricultural practices on the environment and the carrying capacity of the biosphere, using computer modeling techniques; elucidate the underlying conditions that promote a reasonable balance between agricultural production and protection of the environment
Concerns with global food supply and management of the biosphere	Document the balance between sufficient food supply and responsible environmental management, especially under various geographical, demographic, social, economic, political, and cultural situations
Land and water use and landscape planning	Relate the patterns or structures of land use in rural areas to various agriculture and animal farming processes, by addressing problems associated with mechanization, input application and efficiency, and food quality
Energy use in agriculture	Address the need for viable alternatives to the high fossil fuel dependent, highly mechanized, and fertilizer dependent farming systems

2.2. ADVANTAGE

The articles included for this special edition represent the breadth and variety of contemporary agroecosystem and environmental research. Hansen et al. present an overview of the environmental impact of organic farming systems with a focus on Denmark, while Palm et al. present a detailed organic resource database that will help move organic matter management for improving soil fertility in tropical regions from an empirical to a predictive basis. The following five articles in the special issue look at different aspects of agro ecosystems and their environmental and ecological consequences. Haas et al. compare the ability of various agricultural intensities in southern Germany to decrease environmental pollution. Agriculture, Ecosystems, and Environment 83 (2001) 3–9 7 M.R. Carter Special issues of Agriculture, Ecosystems, and Environment (1997–1999) covering the following topics Special issue research subject Description/comments Agriculture's biodiversity: the key to a long-term future The significance of elucidating the connection between agriculture and biodiversity for the development of sustainable

agricultural systems Agriculture's landscape values: methods for improving long-term productivity Agro-landscape criteria for preserving the quality of rural regions in Europe are being evaluated [7].

Integrated crop protection: a path to long-term viability? Using integrated methods, address state-of-the-art research in the theory and practice of weed, pest, and disease control. Long-term implications of changes in rural land use on soil pollutants Land use changes and their impacts on soil characteristics and processes, as well as pollutants, are predicted and described. Indicators of productivity and sustainability in Sub-Saharan African agriculture include nutrient balances. Examining soil fertility and nutrient depletion, as well as the necessity for integrated nutrient management to solve Africa's food crisis Fruit insect pest management using ecosystem methods Describe and assess integrated pest control strategies for reducing chemical pesticide usage in orchard ecosystems. Bioindicators of sustainable landscapes: invertebrate biodiversity Use of tiny organisms as bioindicators to monitor the state of the environment in rural areas and evaluate agricultural operations Sustainable landscape development criteria Using life cycle assessment, create an integrated set of criteria as a checklist for assessing landscape quality and rural development effects in Europe, such as biodiversity, landscape image, eutrophication potential, and global warming potential. Esse et al. look at nitrogen release from ruminant dung in acid sandy soils and the consequences for crop nutrient buildup and leaching in semi-arid west African sahel agro-pastoral systems. Viglizzo et al. investigate key ecological characteristics of the Argentine pampas under long-term low-input farming, focusing on energy flow, nutrient dynamics, and hygrometry. Figure 1 illustrates the continuous development of agroecosystem/environmental research over an 11-year period (1989–1999) by comparing article submissions to Agriculture, Ecosystems, and Environment. Processes drological [8].

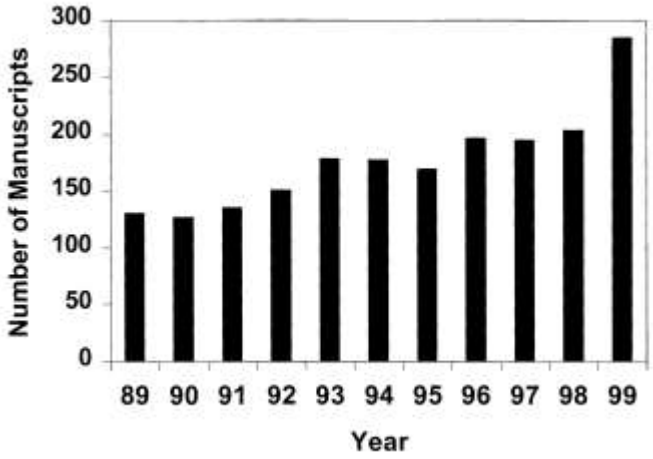

Figure 1. Comparison Of Manuscript Submissions To Agriculture, Ecosystems And Environment Over An 11-Year Period (1989–1999), Illustrating The Continued Growth Of Agroecosystem/Environmental Research.

Table 2
Range of research topics in the journal *Agro-Ecosystems* (1974–1982)

Research topics	Comments
Ecosystem comparisons	Comparison of the ecological impact of agriculture and forestry in newly developed areas, by extensification, to long-term agroecosystems; characterization of ecosystem dynamics and interactions
Ecological implications of disease, pest, weed control, and nutrient inputs	Document the influence of pesticides and addition of organic and inorganic fertilizers for crop and livestock production within agroecosystems, including changes in biological balance and characterization of indirect consequences and ecological interactions
Analysis of the effects of agriculture on biological diversity	Characterize the disruption of agroecosystems on all aspects of wild-life; advancing knowledge on the relationship between biological diversity and productivity, and between diversity and stability
Advancing both theoretical and practical contributions to the science of ecology	Agricultural and forest ecosystem studies provide a useful background for advances in ecology: predator–prey interactions; life-cycles of organisms; nutrient cycling; and development of statistical methodology

2.3. WORKING

Rompaey et al. investigate land use change (i.e. set-aside programs) caused by European government policy and the resulting soil erosion risk for agricultural systems in central Belgium. Finally, Alvarez et al. discuss the impact of different kinds of agro ecosystems and location on arthropod community composition and diversity in the United Kingdom, as well as the possible ecological consequences. The special issue includes six articles that look at ecological interactions within or across agricultural systems. Epstein et al. present integrated pest control methods for orchards in California that minimize pesticide use and possible pollution of surface water and sediment. Basky et al. investigate the impact of wheat aphids from South Africa and Hungary on both susceptible and resistant wheat cultivars in various agro ecosystems to determine genetic diversity within aphid populations and geographical limitations of plant resistance in a research on pest biotype differences. In a study on bumble bees in the United Kingdom, Osborne and Williams describe the impact of habitat fragmentation in an intense arable farming system on this beneficial insect's foraging behavior and the implications for gene flow in the ecosystem. Interactions within an agroecosystem are also interesting, as shown by an eastern Canadian biodiversity research showing the impacts of avian predation on certain pest insect populations. Under intensive agriculture, according to M.R. Carter/Agriculture, Ecosystems and Environment 83 (2001) 3–9. The complexity of the plant and animal population, as well as other ecological interactions, may be influenced by the spatial organization of the agricultural landscape, particularly the establishment of field boundaries and riparian strips or zones [9].

Varchola and Dunn show how woody hedges can serve as overwintering sites for predatory beetles, which have been linked to a reduction in the abundance of herbivore pests in maize (Zea mays L.) in Iowa, while Maisonneuve and Rioux show how riparian strips in Quebec not only protect the environment but can also significantly reduce the abundance of herbivore pests, depending on their complexity of vegetative structure.The remaining articles in the special issue show how research on environmental bio-indicators, greenhouse gases, and global change may be used. Cole and colleagues utilize collembolan ecology to track the environmental effect of sewage sludge usage on agricultural land in western Scotland. Agriculture has an effect on the environment, and the environment has an impact on agriculture, according to De Soet (1974). Dan et al. illustrate how nitrogen fertilization stimulates both methane (CH4) synthesis and oxidation in rice (Oryza sativa L.) production in Italy, whereas Kumagai et al. in Japan show how ultraviolet-B radiation has a substantial effect on the development and productivity of Japanese lowland rice.

Table 3
Summary of topics for research papers (excluding special issues) published in *Agriculture, Ecosystems and Environment* (1997–1999)[a]

Combined topics of published research papers	Proportion of total papers
Ecology (e.g. animal, crop, bird, insect), ecological interactions, and diversity in agricultural systems	21
Soil biota interactions and nutrient cycling in agroecosystems	18
Diseases, pests, IPM, pesticides, and biological control in farming systems	14
Land-use, landscapes, soil conservation, and land degradation/ rehabilitation	13
Greenhouse gases, ozone, climate change	10
Agricultural by-products, waste management, and heavy metals	5
Evaluation of farming systems; organic farming	5
Environmental (soil, water, air quality) and ecological indicators	5
Socio-economics; energy-use in agroecosystems	4
Crop/soil modeling	2

[a] A total of 30 topics or subject areas were identified and listed. These were combined to give 10 broad topics as shown in the table.

Table 4
Topics of special issues published in *Agriculture, Ecosystems and Environment* (1997–1999)

Research topic of special issue	Description/comments
Biodiversity in agriculture: for a sustainable future	Elucidation of the link between agriculture and biodiversity and its importance for the development of sustainable agricultural systems
Landscape values in agriculture: strategies for the improvement of sustainable production	Evaluation of agro-landscape standards for maintaining the quality of rural areas in Europe
Integrated crop protection: towards sustainability?	Address state-of-the-art studies in the theory and practice of weed, pest, and disease management by integrated approaches
Long-term perspectives for effects of rural land use changes on soil contaminants	Prediction and description of land use changes and effects on soil properties and processes, and contaminants
Nutrient balances as indicators of productivity and sustainability in sub-Saharan African agriculture	Examination of inherent soil fertility and nutrient depletion, and the need for integrated nutrient management to address the African food problem
Ecosystem approaches to managing insect pests of fruits	Description and evaluation of integrated pest management approaches to reduce use of chemical pesticides in orchard ecosystems
Invertebrate biodiversity as bioindicators of sustainable landscapes	Utilization of small organisms as bioindicators to assess environmental status of rural landscapes and evaluate farming systems
Criteria for sustainable landscape development	Development of an integrated set of criteria as a checklist for the assessment of landscape quality and rural development in Europe

3. CONCLUSION

As reflected in Tables 3 and 4, present day research concerns on the agroecosystem environmental interface are similar to those in the 1970s (Tables 1 and 2). However, the magnitude of this type of research has increased significantly due to the growing anthropogenic influence on the stability and function of agro ecosystems, and the environment. Some of the major aspects of future research concerns are as follows. • Increasing human activity, intensification of food production, and technological change will result in further impacts to agroecosystem attributes, structure, and functions (Ellert et al., 1997; Giampietro, 1997), and the environment (Gregory et al., 2001). • Challenges of global change will have major implications (e.g. climate change, land, water, and air quality, biological diversity) for managed ecosystems and the environment (Awmack et al., 2000). • Requirements for farming systems that are both ecologically and socio-economically sustainable will generate a move from concepts and attributes to the development of an integrated approach to land use (Hurni, 2000) and production systems (Holland et al., 1994; Spedding, 1995), and the need for the development of predictive tools and ecological and environmental indicators (Smith et al., 2000; Von Wirén-Lehr, 2001). Under the above scenarios, the impact of agricultural systems on the environment and the influence of a changing environment on agriculture will intensify, and will present a major continuing need for research in the 21st century [10].

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