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Education at Bogor Agricultural University: Toward Sustainable Agricultural Development in Indonesia

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Various definitions and methods of sustainable agricultural development have been proposed and implemented. In general, sustainable agricultural development is focused on agricultural activities that are environmentally friendly and financially meet the needs of community welfare, and its applied technologies are socially accepted by farmers. This paper describes the direction and current status of education, research, and extension programs focused on sustainable agriculture at Bogor Agricultural University, Indonesia. Our findings are based on content analysis of the last 10 years of secondary data collected and tabulated from the offices of academic affairs, research, and extension services, as well as faculties and departments.

Core Scientific Model (*pola ilmiah pokok*) of Bogor Agricultural University is a guiding principle in the implementation of the Three Duties or Three Functions (*Tridharma*) of Higher Education in Indonesia, which consist of education, research, and community service. Because the university's Core Scientific Model is a sustainable agricultural system, the academic curricula should take into account sustainability in courses on agricultural development.

Some undergraduate and graduate courses, such as the course on "Systems of Sustainable Agriculture", explicitly describe sustainable agriculture, whereas other courses, such as "Ecology of Tropical Forests", are more closely related to ecology and consider achieving an environmental balance as an important factor in utilizing natural resources. Most courses at the university consider the terms *environment* and *sustainable.* Some new graduate-level courses more comprehensively examine sustainable agricultural development, while considering the ethical, moral, and political implications of utilizing natural resources for agricultural development.

Research conducted and written by Bogor Agricultural University students as final assignments (undergraduate students) or theses and dissertations (graduate students) are easily accessible in the main library. Among the 23,000 undergraduate projects, few comprehensively describe sustainable agriculture, but instead generally discuss only one aspect of sustainability (e.g., environmental friendliness, economic feasibility, social acceptability). Among the 8375 thesis titles, only five dealt with sustainable agriculture research, 64 discussed two elements of sustainability (environment and economic or economic and social aspect), and the rest did not explicitly discuss sustainability. From among the 1287 dissertation titles, only 28 dissertations analyzed sustainable agriculture comprehensively and quantitatively investigated the three elements of sustainability. Ecological and environmental topics were given detailed examinations in 124 dissertations, whereas 1135 dissertations focused on other topics, especially technology, modeling, and characterizing points of view.

The lecturers or educational staff of Bogor Agricultural University have not necessarily carried out research on sustainable agriculture. Such studies are conducted only when proposals are approved and funded by competitive funding agencies. Nevertheless, 1506 final reports have been successfully written. Fisheries and marine science (13%) and animal husbandry (12%) studies accounted for the highest number of research projects conducted, whereas environmental pollution mitigation and natural resource conservation studies accounted for about 7%. The remaining studies were specific to agriculture: crop culture (10%), biotechnology (9%), technology development (9%), and other topics (1%–4%).

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A total of 594 agricultural project and extension programs have been implemented by the educational staff of Bogor Agricultural University. These projects were fully funded by governmental agencies and government-run and private companies. Eight projects concerned sustainable agriculture, 70 measured environmental baselines and implemented mitigation, and the remaining 516 were on other topics.

Thus far, the educational staff of Bogor Agricultural University have conducted only limited research and extension programs on sustainable agriculture. Funding for such work is available in the form of competitive grants, such as the Integrated Prime Research or Incentive Research Programs and other schemes that are offered every year. The university system needs to design an umbrella program to encourage and set standards for research The university system needs to design an umbrella program to encourage and set standards for researc, and the educational staff must consistently follow this program in conducting research.

Key words: curricula, ecology, environment, sustainable agriculture, research, extension program

Introduction

Sustainable development was first codified in the *World Conservation Strategy,* a report prepared in the late 1970s by the International Union for the Conservation of Nature nternational Union for the Conservation of Nature and financed by the United Nations Environmental Programme and the World Wildlife Federation. The theme was developed further in *Our Common Future* (a report of the World Commission on Environment and Development) and followed up in *Agenda 21* at the Rio Conference in 1992 (Adam, 2001). Sustainable development also was discussed at the Earth Summit held in South Africa in 2004. Although these reports and summits have tended to emphasize sustainable forest management, sustainable development must include sustainable agriculture as well. Sustainable development is defined as a process of change in which the exploitation of resources, the direction of investments, and the orientation of technological and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations (WCED, 1987).

The conceptual definition of sustainable agriculture has evolved over the years. In the early 1980s the concepts of regenerative agriculture and sustainable agriculture were first articulated; later stable agriculture was referred to in a global sense, involving all facets of agriculture and its interaction with society (Harwood, 1990). The following definitional framework can be modified with appropriate details by country and by desired time frame: sustainable agriculture is one that can evolve indefinitely toward greater human utility, greater efficiency of resource use, and a balance with the environment that is favorable both to humans and to most other species.

Under the US Food, Agriculture, Conservation, and Trade Act of 1990 (Public Law 101-624, Title XVI, Subtitle A, Section 1603; United States Government Printing Office, Washington, DC, 1990), sustainable agriculture is defined as an integrated system of plant and animal production practices having a site-specific application that will, over the long term: (a) satisfy human food and fiber needs; (b) enhance environmental quality and the natural resource base upon which the agricultural economy depends; (c) make the most efficient use of nonrenewable resources and on-farm resources and integrate, where appropriate, natural biological cycles and control; (d) sustain the economic viability of farm operation; and (e) enhance the quality of life for farmers and society as a whole. Therefore, sustainable agricultural development is focused on agricultural activities that are environmentally friendly and financially meet the needs of community welfare, and its applied agro-technologies are accepted by farmers. In addition to those noted above, there are many operational definitions of sustainable agriculture (Gold, 2007).

According to a study of Fuglie and Piggot (2006), the efficiency of agricultural production decreased between 1961-1967 and 1993-2000, with the output/input ratio of agricultural production reduced from 1.25/0.48 to 1.12/1.19. Upon the extensive discussions of sustainable development in the 1990s, Nasoetion (1996) proposed that a course of study in sustainable agriculture be delivered to

the students of Bogor Agricultural University (i.e., Institut Pertanian Bogor, IPB). Bogor Agricultural University (i.e., Institut Pertanian Bogor, IPB. In addition, the Tsukuba Asian Seminar on Agricultural Education under the Asia-Pacific Programme of Educational Innovative Development (APEID) has been successfully conducting annual seminars on various themes of sustainable development of sustainable developmen each term since 1979.

The Agricultural and Forestry Research Center at the University of Tsukuba, as an Associated Center of the APEID, sponsored the Eighth International Symposium on Agricultural Education for Sustainable Development (AgESD) in 2008. The aims of AgESD are to promote, reform, and improve agricultural higher education, while especially considering environmental problems from an international viewpoint. The goal of the 2008 symposium was to discuss the present situation and roles of universities and institutions in education for sustainable development, particularly focusing on agriculture. In this paper, we describe the current status and future direction of education, research, and extension programs focused on sustainable agriculture at IPB.

Approach of the Study

Secondary data for the last 10 years were collected and extracted from the relevant offices of IPB, such as academic affairs, research and community services, as well as faculties and departments. Data were tabulated, and previous and current curricula of undergraduate and graduate courses; topics of student, lecturer research; and agricultural project and extension program were comprehensively interpreted and analyzed.

Academic Curricula for Sustainable Agricultural Development at Bogor Agricultural University

The strategic plan of IPB includes the term "Core Scientific Model" (*pola ilmiah pokok*) to meet the vision, mission, motto, and objectives of the university. It is a guiding principle in the implementation of the Three Duties or Three Functions (*Tridharma*) of Higher Education in Indonesia, which consist of education, research, and community service. To achieve the Core Scientific Model, the academic curricula and course content should cover sustainability in agriculture systems.

Before 2005, the academic curriculum of IPB was a full-credit system. Starting in 2005, however, IPB implemented a major-minor system in which students must take major courses in order to exhibit competence in their major field of study, as well as minor courses to demonstrate competence in a complementary field. This academic curricula system has been applied to both undergraduate and graduate coursework. The academic curricula of the university's 36 departments in nine faculties are due to be revised every 5 years. Undergraduate students must take at least 144 credits, including a final assignment (6 credits), to earn a bachelor's degree, whereas master's and doctoral students must complete 39 and 40 credits, including a thesis (6 credits) and dissertation (12 credits), respectively. Tables 1 and 2 list the undergraduate and graduate courses on sustainable agriculture that are offered at IPB. The total number of sustainable agriculture courses offered by all departments and faculties are 49 and 54 for undergraduate and graduate students, respectively.

Examination of the undergraduate and graduate academic catalogues reveals that the academic curricula of IPB are fully consistent with the Core Scientific Model. Some undergraduate and graduate courses explicitly describe sustainable agriculture (such as "Soil and Water Conservation," "Agricultural Ecology," "Resource Economics," "Sustainable Development and Growth," "System of Sustainable Agriculture," and "System of Integrated Pest Management"; Table 3). Other courses are more closely related to ecology and fully consider achieving an environmental balance as an important factor in utilizing natural resources (such as "Principles of Ecology," "Human Ecology," "Plant Ecology," "Tropical Marine Ecology," "Ecology and Management of Animal Resources," and "Ecology of Tropical Forests"), whereas most others take into account terms such as *environment* and *sustainable*.

Some new graduate-level courses consider sustainable agricultural development more comprehensively than previous ones, while considering the ethical and moral implications of utilizing natural resources for agricultural development; such courses include "Ethics of Forestry," "Ethics and

Table 1. Undergraduate Courses in Sustainable Agriculture Offered at IPB

Subjects/ Course	Previous Curricula (before 2005)			Existing Curricula			Remarks
	Department	Status	Faculty	Department	Status	Faculty	
Natural Resource Economic	Agric. Econ.	Major	Agriculture				No longer offered
Human ecology	Agric. Econ.	Major	Agriculture				No longer offered
Soil & Water Conservation	Soil Science	Major	Agriculture	Soil Science	Major	Agriculture	Still offered
Soil & Water Pollution	Soil Science	Elective	Agriculture				No longer offered
Land Degradation & Rehabilitation	Soil Science	Elective	Agriculture				No longer offered
Soil Ecology	Soil Science	Elective	Agriculture				No longer offered
Sustainable Dev't of Land Resource	Soil Science	Elective	Agriculture				No longer offered
Plant Ecology	Agronomy	Major	Agriculture				No longer offered
Environmental Chemistry	Agronomy	Elective	Agriculture				No longer offered
Agriculture Ecology				Agronomy	Major	Agriculture	Still offered
History & Landscape Protection	Landscape Architecture	Major	Agriculture	Landscape Architecture	Major	Agriculture	Still offered
Basic Ecology	Plant Protection	Major	Agriculture				No longer offered
Introduction to Agroecology				Plant Protection	Major	Agriculture	Still offered
Integrated Pest Mgt & Plant Diseases	Plant Protection	Major	Agriculture	Plant Protection	Major	Agriculture	Still offered
Life Control & Habitat Mgt	Plant Protection	Major	Agriculture	Plant Protection	Major	Agriculture	Still offered
Family Ecology	Community Nutrition & Family Planning	Major	Agriculture				
Public Health Science	Veterinary Medicine	Major	Veterinary Medicine				No longer offered
Environmental Health	Veterinary Medicine	Elective	Veterinary Medicine				No longer offered
Mgt of Animal Health & Env't							
Aquatic Ecology	All Depts.	Major	Fishery	All Depts.	Major	Fishery	Still offered
Tropical Marine Ecology	Mgt of Aquaculture	Major	Fishery				Still offered

Source: Institut Pertanian Bogor (2001, 2007b).

Table 1. **(Continuation)** Undergraduate Courses in Sustainable Agriculture Offered at IPB

Subjects/ Course	Previous Curricula (before 2005)			Existing Curricula			Remarks
	Department	Status	Faculty	Department	Status	Faculty	
Conservation of Aquatic Resource	Mgt of Aquaculture	Major	Fishery	Mgt of Aquaculture	Major	Fishery	Still offered
Aquatic Pollution	Mgt of Aquaculture	Elective	Fishery				No longer offered
Aquatic Pollution & Waste Treatment				Mgt of Aquaculture	Major	Fishery	New course
Quantitative Aquatic Ecology	Mgt of Aquaculture	Elective	Fishery				No longer offered
Tropical Marine Technology	Marine Science & Technology	Elective	Fishery	Marine Science & Technology	Major	Fishery	Still offered
Tropical Marine Ecology	Marine Science & Technology	Major	Fishery	Marine Science & Technology	Major	Fishery	Still offered
Utilization Technology of By Product & Waste in the Aquatic Industry				Fishery Mgt & Technology	Major	Fishery	New course
Environmental Physiology	Animal Production	Major	Animal Husbandry				No longer offered
Animal Ecology	Animal Production	Elective	Animal Husbandry				No longer offered
Mgt of Animal Husbandry Waste	Technology of Animal Product	Elective	Animal Husbandry	Technology of Animal Product	Major	Animal Husbandry	Still offered
Mgt of Animal Husbandry Environment				Technology of Animal Product	Major	Animal Husbandry	New course
Ecol. & Mgt of Animal Resource	Nutrition Science & Feed Technology	Elective	Animal Husbandry				No longer offered
Forest Ecology	All Depts.	Major	Forestry	All Depts.	Major	Forestry	Still offered
Conservation of Biology Resource	All Depts.	Major	Forestry	All Depts.	Major	Forestry	New course
Mgt of Forest Ecology & Watershed				Forest Management	Major	Forestry	New course
Ecology of Wildlife				Conservation of Forest Resource & Ecotourism	Major	Forestry	New course
Mgt of Env't Services & Impact Mitigation				Conservation of Forest Resource & Ecotourism	Major	Forestry	New course

Source: Institut Pertanian Bogor (2001, 2007b).

Table 1. **(Continuation)** Undergraduate Courses in Sustainable Agriculture Offered at IPB

Subjects/ Course	Previous Curricula (before 2005)			Existing Curricula			Remarks
	Department	Status	Faculty	Department	Status	Faculty	
Ecology of Tropical Plant Species				Conservation of Forest Resource & Ecotourism	Major	Forestry	New course
Basic Environment Mgt	Industry Technology	Major	Agricultural Technology				No longer offered
Industrial Environment Management				Industry Technology	Major	Agricultural Technology	New offered
Basic Ecology	Biology	Major	Mathematics & Natural Science	Biology	Major	Mathematics & Natural Science	Still offered
Environment Science	Biology	Elective	Mathematics & Natural Science	Biology	Major	Mathematics & Natural Science	Still offered
Environmental Biochemistry	Biology	Major	Mathematics & Natural Science	Biochemistry	Major	Mathematics & Natural Science	Still offered
Environmental Economics				Economics & Natural Resource Economic	Major	Economic & Management	New course
Sustainable Development & Growth				Natural Resource Economic	Major	Economic & Management	New course
Econ. Valuation of Resources & Environment Degradation				Natural Resource Economic	Major	Economic & Management	New course
Human Ecology				All Dept	Major	Human Ecology	New course
Ecology of Food & Nutrition				Nutrition	Major	Human Ecology	New course
Participative Planning & Evaluation				Communication & Community Dev't	Major	Human Ecology	New course

Source: Institut Pertanian Bogor (2001, 2007b).

Morals of the Environment," and "Environment and Theory of Human Ecology." Other courses investigate the politics that affect sustainability and environmental issues; they include "Theory of Political Ecology and Ecological Action" and "Political Ecology of Natural Resources."

Sustainable Agriculture Research by Students and Faculty

Research conducted and written by IPB students as final assignments (undergraduate students) or theses and dissertations (graduate students) are easily accessible in the main library. Among the

Table 2. Graduate Courses in Sustainable Agriculture Offered at IPB

Subjects	Previous Curricula			Existing Curricula			
	Department	Status	Faculty	Department	Status	Faculty	
Advanced Soil & Water Conservation	Soil Science	Major	Agriculture	Soil Science	Major	Agriculture	MSc/PhD
Land Resource Evaluation	Soil Science	Major	Agriculture	Soil Science	Major	Agriculture	MSc
Watershed Management	Soil Science	Major	Agriculture	Soil Science	Major	Agriculture	MSc
Advanced Plant Ecology	Agronomy	Major	Agriculture				PhD
Sustainable Landscape Mgt.	Landscape Architecture	Major	Agriculture				MSc
Landscape Ecology	Agronomy	Elective	Agriculture				MSc
Natural Resource Economics	Agric. Economics	Elective	Agriculture				MSc
Human Ecology	Agric. Economics	Elective	Agriculture				MSc
Advanced Natural Resource & Environment Economics	Agric. Economics	Elective	Agriculture				PhD
Ecology of Food & Nutrition	Community Nutrition & Family Resource	Elective	Agriculture				MSc
Veterinary Public Health Science	Veterinary Public Health	Major	Veterinary Medicine	Veterinary Public Health	Major	Veterinary Medicine	MSc
Environmental Health	Veterinary Public Health	Major	Veterinary Medicine				MSc
Dynamics of Animal Husbandry Environment	All Depts.	Elective	Animal Husbandry				MSc
Aquatic Ecosystem	Aquaculture	Major	Fishery				MSc
Technology of Environment-ally Fishing	Marine Science	Major	Fishery & Marine Science				MSc
Mgt of Integrated Coastal & Marine Development	Marine Science	Major	Fishery & Marine Science				MSc
Advanced Forest Ecology	Forest Science	Major	Forestry				MSc
Habitat Conservation & Rehabilitation	Conservation of Forest Resources	Major	Forestry				MSc

Table 2. (Continuation) Graduate Courses in Sustainable Agriculture Offered at IPB

Subjects	Previous Curricula			Existing Curricula			
	Department	Status	Faculty	Department	Status	Faculty	
Technique of Soil & Water Conservation	Agriculture Engineering	Elective	Agricultural Technology				MSc
Environmental Physics	Agrometeo-rology	Major	Mathematics & Natural Science				MSc
Conservation of Forest Resources	All Dept	Major	Forestry				MSc/PhD
Environment Physiology & Animal Adaptation	Biology	Elective	Mathematics & Natural Science				MSc
Ecology of Tropical Resources	Biology	Elective	Mathematics & Natural Science				MSc
Environmental Economics & Its Control System	Rural Regional Planning	Major	Multidisci-pline				MSc
Approach of System & Mgt of Environment	Mgt of Natural Resources & Env't	Major	Multidisci-pline				MSc
Mgt of Sustainable Agriculture Practices	Mgt of Natural Resources & Env't	Elective	Multidisci-pline				MSc/PhD
Ecology & Development	Mgt of Natural Resources & Env't	Major	Multidisci-pline				PhD
Precision Farming				Soil Science	Major	Agriculture	MSc
Problematic Soils				Soil Science	Major	Agriculture	MSc
Systems of Sustainable Agriculture				Soil Science	Major	Agriculture	MSc
System of Regional Planning				Soil Science	Major	Agriculture	MSc
Eco-physiology of Tropical Plants	Agronomy	Elective	Agriculture	Agronomy	Major	Agriculture	MSc
Waste Management for Agriculture				Agronomy	Elective	Agriculture	MSc
Systems of Integrated Pest Mgt	Plant Protection	Elective	Agriculture	Plant Protection	Major	Agriculture	MSc

Source: Institut Pertanian Bogor (1995); Institut Pertanian Bogor (2007b)

Table 2. (Continuation) Graduate Courses in Sustainable Agriculture Offered at IPB

Subjects	Previous Curricula			Existing Curricula			
	Department	Status	Faculty	Department	Status	Faculty	
Sustainable Mgt of Landscape				Architecture Landscape	Major	Agriculture	MSc
Interdisciplinary Approach to Veterinary Public Health				Veterinary Public Health	Major	Veterinary Medicine	MSc
Conservation of Aquatic Resources				Mgt of Aquatic Resources	Major	Fishery & Marine Science	MSc
Integrated Mgt of Coastal & Sea Resource				Mgt of Aquatic Resources	Major	Fishery & Marine Science	Mc
Sustainable Development of Coastal & Sea Resources				Mgt of Aquatic Resources	Major	Fishery & Marine Science	MSc
Advanced Sustainable Development of Coastal & Sea Resources				Mgt of Aquatic Resources	Major	Fishery & Marine Science	PhD
Mgt of Fishery Resources				Mgt of Aquatic Resources	Major	Fishery & Marine Science	MSc
Advanced Mgt of Fishery Resources				Mgt of Aquatic Resources	Major	Fishery & Marine Science	PhD
Policy on Forest Resource Mgt				Forest Management	Major	Forestry	MSc
Ethics of Forestry & Environment				Forest Management	Major	Forestry	PhD
Policy on Forestry Development				Forest Management	Major	Forestry	PhD
Ethics of Forestry				Forest Management	Major	Forestry	PhD
Conservation of Tropical Biodiversity				Conservation of Forest Resources & Ecotourism	Major	Forestry	MSc
Conservation of Diversity Genetic Biodiversity				Conservation of Forest Resources & Ecotourism	Major	Forestry	PhD
Planning & Mgt of Conservation Areas				Conservation of Forest Resources & Ecotourism	Major	Forestry	MSc
Ecology of Tropical Forests				Silviculture	Major	Forestry	MSc

Source: Institut Pertanian Bogor (1995); Institut Pertanian Bogor (2007b)

Table 2. (Continuation) Graduate Courses in Sustainable Agriculture Offered at IPB

Subjects	Previous Curricula			Existing Curricula			
	Department	Status	Faculty	Department	Status	Faculty	
Landscape Ecology of Tropical Forests				Silviculture	Major	Forestry	PhD
Advanced Techniques of Soil & Water Conservation				Agricultural Engineering	Major	Agricultural Technology	MSc
Plant Ecology				Biology	Major	Mathematics & Natural Science	MSc
Plant Diversity, Evolution & Ecology				Biology	Major	Mathematics & Natural Science	PhD
Environmental Physics				Physics	Major	Mathematics & Natural Science	MSc
Economics of Natural Resources & Environment				Economics	Elective	Economics & Management	MSc
Advanced Economics of Natural Resources & Env't				Economics	Elective	Economics & Management	PhD
Natural Resource Economics				Resource Econ. & Environment	Major	Economics & Management	MSc
Theory of Human Ecology				Communica-tion & Com-munity Dev't	Major	Human Ecology	MSc
Ecology Politics of Natural Resource				Communica-tion & Com-munity Dev't	Elective	Human Ecology	PhD
Theory of Politics, Ecology and Ecology Action				Communica-tion & Com-munity Dev't	Elective	Human Ecology	PhD
Environment and Theory of Human Ecology				Communica-tion & Com-munity Dev't	Major	Human Ecology	MSc
Theory of Politics, Ecology and Ecology Action				Communica-tion & Com-munity Dev't	Major	Human Ecology	MSc
Ethics and Morals of Environment				Mgt of Natural Resources & Env't	Major	Multidisci-pline	MSc

Table 3. Description of Several Sustainable Agriculture Courses (Current Academic Catalogue of IPB)

Courses	Description
Undergraduate Courses	
Soil and water conservation	application of watershed and soil erosion prediction model as well as selected agro-technology for planning of sustainable agricultural development
Agriculture ecology	description of agricultural ecosystem components, interaction between plants and its environment, and culture manipulation for sustainable maximum production
Management of landscape	ecological problem solving and evaluation, and planning of landscape management to achieve sustainable environment
Basics of fish stock study	models of fish stock prediction in sustainable management of fishery resources
Sociology and community forest	community adaptation in forests, and public and other stakeholder participation schemes towards sustainable forest management
Resource economics	principles of resource economics, philosophy of natural resource extraction for sustainable development
Sustainable development and growth	patterns of natural resource utilization and its implications for environment and public welfare generation towards sustainable economics and environmental development
Ecology of food and nutrition	interaction between people and environment to meet food and nutrition need
Graduate Courses	
Precision farming	crops, fertilization, irrigation, and other crop cultural needs are precisely and appropriately managed along with soil condition, crop requirements, and other environmental factors in order to achieve economically expected production and crop quality
Sustainable agriculture system	theory and practices as well as implementation of agriculture for sustainable development
Policy on watershed management	policy instruments for sustainable watershed management
System of integrated pest control	integrated control strategy with regard to ecology, socio-economics
Sustainable landscape management	utilization of landscape resources and environmental problems in sustainable landscape management
Study of fish stocks	techniques and models for sustainable fishery management
Management of coastal and marine biological resources	,management pattern of sustainable, coastal, and marine resources
Assessment of forest ecosystems	ecosystem-based sustainable forest management to achieve ecological sustainability, economic profitability, and social acceptability

Source: Institut Pertanian Bogor (2007a)

23,000 undergraduate projects, few comprehensibly describe sustainable agriculture, but instead generally discuss only one aspect of sustainability (e.g., environmental friendliness, economic feasibility, social acceptability). Among the 8375 thesis titles, only five dealt with sustainable agriculture research, 64 discussed two elements of sustainability (environmental and economic aspects, or economic and social aspects), and the rest did not explicitly discuss sustainability. Of the 1287 dissertation titles, only 28 dissertations analyzed sustainable

vestigated the three elements of sustainability. Ecological and environmental topics were given detailed examinations in 124 dissertations, whereas 1135 dissertations focused on other topics, especially technology, modeling, and characterizing points of view (Table 4). Doctoral dissertations should be written comprehensively yet contain a novel approach or perspective; therefore, the topic of sustainable agriculture is more likely to be found in a dissertation than a thesis or final assignment.

The lecturers and educational staff of IPB have

Table 4. General Topics of Undergraduate and Graduate Student Research Projects at IPB (last 10 years)

Research Content	Final Assignment (BS)	Thesis (MSc)	Dissertation (PhD)
Sustainable Agriculture	—	5 (0.04%)	28 (2.18%)
Ecology and Environment	—	64 (0.76%)	124 (9.63%)
Others (Technology, Modeling etc.)	23,000 (100.00%)	8306 (99.18%)	1135 (88.19%)
Total	23,000 (100.00%)	8375 (100.00%)	1287 (100.00%)

agriculture. Such studies were conducted only when proposals were approved and funded by competitive funding agencies. Nevertheless, 1506 final reports had been successfully written. Fisheries and marine science (13%) and animal husbandry (12%) studies account for the highest number of research projects conducted, whereas environmental pollution mitigation and natural resource conservation studies accounted for about 7%. The remaining studies were specific to agriculture: crop culture (10%), biotechnology (9%), technological development (9%), and other topics (1%-4%) (Table 5). Analysis of the distribution of these topics reveals that faculty research at IPB is not yet integrated, but rather reflects the specialization of each staff member. In general, however, all the studies are interrelated in aiming to solve problems, formulate the needed actions, and produce innovative technologies to cope with agricultural problems.

Nearly all faculty research projects are short-term studies, as the limited budget does not yet allow for multiple-year research. The educational staff must be creative in securing continued funding for long-term (multiple-year) research. Funding for such work is available in the form of competitive grants, such as the Integrated Prime Research or Incentive Research Programs and other schemes that are offered every year. The university system needs to design an umbrella program to encourage and set standards for research, and the educational staff must consistently follow this program in conducting research. It appears as though the topics of the research projects have been determined by the sponsors, yielding a more narrow range of sustainable agricultural topics than is seen in the theses and dissertations. Rather than the funding agencies, however, Sjafrida (2007) noted that the main strength of institutions of higher education lies in the development of concepts and technology to answer the many problems of sustainable agricultural development.

Extension Programs and Networking of Sustainable Agriculture at Bogor Agricultural University

The major tasks of the Research and Community Services Office of IPB consist of: (1) conducting quality assurance of the implementation of research and community services carried out by the research centers of IPB, thus realizing academically excellent research based on the university framework; and (2) determining the direction/policy of research and community services that support the vision, mission, and objectives of IPB.

A total of 594 agricultural projects and extension programs have been implemented by the educational staff of IPB. These projects are fully funded by federal offices such as the Ministry of Agriculture, local government agencies such as the District of Bogor, government-run companies such as Indonesia Power Co., private companies such as Freeport Indonesia Co., and international agencies such as the Food Agriculture Organization. Among all the contracted projects, eight dealt with sustainable agriculture, 70 covered environment baseline measurements and mitigation, and 516 were on other topics (LPPM, 2008).

Very few extension programs dealt with sustainable agriculture. Most were driven by the urgent needs of the sponsors or funding agencies, rather than providing research toward basic problem-solving, and some of it is just economic driven point of view. The community Service Office of IPB has recorded only a small number of sustainable agriculture projects implemented in the field, although some individual educational staff members conduct extension services of sustainable agricultural practices by themselves with limited budget resources. Our data analysis suggested that there are not many

Table 5. Research Themes of Projects by IPB Educational Staff (last 10 years)

Theme	Title Content	Number	Percentage
Culture technique	Soil fertility, nursery, cropping pattern	150	9.96
Plant protection	Inventory kind and plant pest and diseases control	57	3.78
Plant breeding	Selection of variety through breeding and tolerance to water stress, nutrient toxicity, and pests and diseases	35	2.32
Post harvest	Post-harvest technology to maintain quality of agricultural products, and development of techniques for grading of agriculture product yield	25	1.66
Fisheries and marine	Freshwater aquaculture, marine culture, identification characteristics, and development of technology increasing fisheries products	199	13.21
Animal husbandry	Livestock, development of feed quality and breeding	182	12.08
Forestry and forest products	Identification of kinds and varieties of forest products and development of wood products for downstream industries, construction and wood selection for development of other industry	48	3.19
Biochemistry	Characterization of plant bioactive substances and technological development to support probiotic products	20	1.33
Biology	Development of in vitro technique, selection of bacteria and other microorganisms to support agricultural development	30	1.99
Biopesticides	Identification and development of botanic pesticide formula	3	0.20
Bioprocesses	Protein engineering, characterization of active substance and testing of biodegradable bioplastic	7	0.46
Biotechnology	Bioremediation, DNA transformation, and hormonal engineering to increase agricultural product	132	8.76
Food processing	Processing of agricultural product to increase value added	68	4.52
Agribusiness	Trading and competitiveness of agricultural product, marketing and feasibility analysis	28	1.86
Socioeconomic and policy	Consumption and income of farmers, communication strategy of farmers, analysis of economic growth, investment characteristics and analysis of government policy	44	2.92
Mapping and regional planning	Mapping of land resources quality, regionalization of commodity manually and with GIS, and regional planning for agriculture	21	1.39
Phytopharmaca	Identification, extraction, and isolation of bioactive substance and its utilization for natural herbal medicine	51	3.39
Food and nutrition	Identification of nutrition in food product and inventory of community nutrition	16	1.06
Veterinary medicine	Investigation of clinical cases of peds, inventory of wild animal diseases, surgery	19	1.26
Public health and environment	Identification of food variability, food quality, virulence factors, detection and quantification of heavy metals, microbiology tests, diagnostic method development, model of environmental biophysics	51	3.39
Community empowerment	Analysis of gender and elevation of women's role in agricultural development, human quality index, revitalization of development agent in agricultural region	57	3.78
Organic waste and environmental pollution	Utilization of agricultural waste and small industries, study of air pollution level, development of garbage composting technique	30	1.99
Conservation of natural resources and environment	Soil and water conservation, conservation of wild species and habitat, agroforestry, greenhouse gas emission, biodiversity and water balance	77	5.11
Technological development	Analysis of material, analysis method, model simulation, instrument development to increase agriculture productivity	133	8.83
Others	Biodiesel, management information system, humaniora, action research	23	1.53
Total		1506	100.00

official ongoing international exchange programs for sustainable agriculture. Information on these programs is scattered and is not centrally recorded, although either Office of Research and Community Services or Office of International Collaboration of IPB keeps not all of the information. Those few international exchange programs are coordinated by individuals or a team of faculty members and are simply legitimized by the Central Office of IPB. A student exchange program has been set up under a Memorandum of Understanding between the University of Tsukuba and IPB, and research has been funded by Japan Society for Promotion of Science. The research is entitled "Comparative Study of the Trend of Decentralization and Privatization in Forest Resources Management of Developing Countries since 2005," and it will end in 2008.

Research and extension programs on sustainable agriculture need further development by the educational staff of IPB, because at this stage such programs are still limited. Chozin (2007) proposed that the strategy for sustainable agricultural development should consist of human resource development, research development based on local resources and environmentally friendly outcomes, farmer and community empowerment, and empowerment of institutions supporting agriculture, with a role for higher education. The IPB urgently needs to design an umbrella program to coordinate and oversee research and extension projects, and educational staff must consistently work within such a program when conducting their research.

Concluding Remarks

The academic curricula of undergraduate and graduate programs at IPB are in line with the Core Scientific Model, which is a sustainable agriculture system.

Doctoral research is more comprehensive than masters' theses and final undergraduate research projects. Sustainable agriculture research is comprehensively and quantitatively investigated in some dissertations, whereas theses and final assignments generally discuss only one or two components of sustainable agricultural development.

At IPB, agricultural project of educational staff, as well as extension programs or community services, rarely examine sustainable agricultural development comprehensively, because such projects are usually designed to fulfill the sponsor's or funding agencies' agendas. We recommend that the Office of Research and Community Services set up an umbrella program to facilitate such projects and to gather comprehensive reports on sustainable agricultural development projects.

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