

Promoting Sustainable Development via Agroforestry Education: Lessons and Experiences from the Philippines

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In this paper we argue that sustainable natural resource management is the key to sustainable development. Sustainable natural resource management can only be achieved if environmental stability, socioeconomic productivity, and social acceptability are all achieved. We also argue that agroforestry is a strategy that can help achieve sustainable development in the Philippines.

Agroforestry is a land use management system that combines the production of woody perennials and agricultural crops, which may also include livestock husbandry or aquaculture, with the aim of meeting both ecological and economic objectives. From what began as a simple farm practice, agroforestry has evolved into a field of science and academic discipline.

We highlight the historical developments and milestones in the progression of agroforestry as a development strategy and in agroforestry education programs in the Philippines. Agroforestry education and training developed in response to the need to rehabilitate and restore degraded upland environments. Programs in this field aim to train and produce people equipped with the knowledge, skills, and attitudes needed to promote the science and practice of agroforestry at all levels to promote sustainable natural resources management.

Because of the immense potential of agroforestry as a development strategy, a number of local development organizations have expressed the need for trained workers who are equipped with knowledge and skills in various aspects of agroforestry. However, fewer students are selecting agroforestry education programs.

Finally, in this paper we claim that there is a clear link between agroforestry education and sustainable development. Agroforestry addresses the socioeconomic production needs of farmers, while at the same time ensuring environmental stability. These are the prime concepts of sustainable development.

Key words: natural resources management, forest conservation, community participation, capacity building

Recognition of Agroforestry in Promoting Sustainable Development

The Philippines is an archipelago located in Southeast Asia with rich natural resources comprising large mountainous tracts of tropical forest, mineral deposits, and a long coastline providing access to marine resources. However, the Philippines experiences endemic urban and rural poverty and numerous problems related to environmental management. The combination of poverty and population pressure has led to various forms of abuse,

misuse, and mismanagement of the country's natural resources.

Until the 1970s, the Philippine Government employed a regulatory and punitive approach to countering forest destruction and residential encroachment on forested uplands (del Castillo, 1999). During the 1970s, the government's policy on forest occupancy and the traditional upland farming method known as *kaingin-making*, or slash-and-burn farming, shifted to a more development-focused and people-oriented approach (del Castillo, 1999). This approach embraced the concept of actively seeking

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the participation of forest occupants in protecting and conserving forest resources.

Forestry Administrative Order No. 62, known as the Kaingin Management and Land Settlement Regulations, was issued in 1971 and emphasized site-based management on the part of forest occupants in upland areas. This regulation led to the implementation of the Revised Forestry Code of the Philippines in 1975, which prescribed that agroforestry management be adopted in occupied forestlands. A number of development-oriented and people-oriented forestry programs were implemented by the Department of Environment and Natural Resources (DENR) over the years following enactment of the new code (Table 1).

Tolentino *et al.* (2010) assessed the demand for agroforestry competency in the Philippines. They surveyed some 90 institutions involved in delivering sustainable natural resources management programs and found that the most common type of project or activity was some form of agroforestry development. Other projects and activities that occurred with high frequency were reforestation and greening, watershed management, upland development, and community-based forest management. Many of the current reforestation projects funded by the Development Bank of the Philippines and being undertaken by local governments, academic institutions, and people's organizations also embrace agroforestry. Non-government organizations (NGOs) include agroforestry as a module when delivering capacity-building programs in the field of natural resources management. These facts show that agroforestry development and promotion are a major priority in the programs and activities of most of the public and non-government developmental organizations in the Philippines.

How agroforestry practice differs from agriculture and forestry

Agriculture is the production of crops in monoculture or crop-combinations; trees play no integral role other than perhaps as windbreaks and boundaries. Forestry is the production of trees, with no role for agricultural crops. Hence, people who are engaged in agriculture produce only products from crops, and people engaged in forestry produce only timber products that usually take a minimum of 7 years, and often many more, before any direct benefits are obtained.

The definition of agroforestry has evolved over time. Today, agroforestry is viewed as a dynamic, ecologically based, natural resource management system that integrates trees on farms as a means to diversify and sustain production within landscapes that can be predominantly forest or predominantly agricultural (Leakey *et al.*, 1996 as cited by Carandang *et al.*, 2006). Lasco and Visco (2003) defined agroforestry as a production system that has two or more species of plants (with or without animals), at least one of which is a woody perennial; two or more outputs; a cropping system that is always longer than a 1-year cycle; and is characterized by significant interactions between woody and non-woody components. Bene *et al.* (1977) argue that agroforestry, as a sustainable land use management system, can increase the overall yield of the land. It can produce direct benefits such as food, fodder, feed for fish and livestock, fuel, fiber, poles and timber, and other products such as gums, latex, oil, and herbal medicines. Likewise, it can provide indirect benefits or "service roles" such as soil and water conservation, improved soil fertility, microclimate amelioration, live fencing, and many more.

These multiple direct and indirect benefits have obviously expanded the role of agroforestry over a wide range of land use contexts. It integrates the features of both agriculture and forestry and may have arisen specifically to address the need for environmental stability and economic productivity in environmentally vulnerable settings. Thus, agroforestry as a land use may have emerged to respond to the needs of society that were not addressed by agriculture and forestry.

Agroforestry is also a production system that can contribute to the mitigation of and adaptation to climate change. Agroforestry systems can store five times more carbon from the atmosphere than traditional croplands (International Food Policy Research Institute, 2006).

Emergence and Evolution of Agroforestry Education Programs

The accumulation of a body of knowledge on agroforestry and the recognition of agroforestry as a strategy to overcome environmental degradation while sustaining livelihoods in upland communities prompted research and educational institutions in the Philippines to implement formal and non-

Table 1. Timeline of people-oriented forestry programs in the Philippines (DENR, 1996; www.denr.gov.ph)

People-oriented forestry program	Year of implementation	Brief description
Family Approach to Reforestation	1979	This program was designed to help raise the living conditions of upland farmers and those living near forestlands. It was a 3-year contract program offered to families to hasten the reforestation efforts of the government by allowing them to plant trees in cleared forestlands, intercrop trees with agricultural crops, and harvest their crops within the contract period.
Communal Tree Farm (CTF)	1979	The CTF prioritized the development of degraded forestlands into productive farmlands to provide economically viable landholdings to participating farmers who would rehabilitate open and denuded forestlands. Participating families were given a 25-year CTF certificate, renewable for another 25 years, and a package of incentives such as tax exemption on produce, no government share of the income from agroforestry plantations, and technical assistance for implementation of income-generating projects.
Integrated Social Forestry Program (ISFP)	1982	The ISFP was launched to maximize upland productivity, enhance ecological stability, and improve the socioeconomic conditions of forest occupants and communities. The ISFP was expected to democratize the use of public lands and promote a more equitable distribution of forest bounty through stewardship principles.
Upland Development Program	1982	The Upland Development Program was launched hand-in-hand with the ISFP to facilitate the participatory approach to promoting sustainable upland development.
National Forestation Program	1986	This program was designed to rehabilitate denuded forestlands and provide income opportunities to upland communities through the reforestation of open lands and rehabilitation of denuded watersheds for sustained production of wood and other products for wood-based industries;
Community Forestry Program (CFP)	1989	This program allowed people's organizations to extract, process, and sell forest products for 25 years; the program is renewable for another 25 years.
Community-Based Forest Management Program (CBFM)	1995	The CBFM integrated and unified all people-oriented forestry activities of the ISFP, CFP, Coastal Environment Program, and Ancestral Domains. This program entitled forest communities to use and develop the forestland and resources for 25 years with the active participation of the DENR and local government units.
Upland Agroforestry Program	2005	The new Upland Agroforestry Program (UAfP) allows qualified Filipino individuals, organizations, corporations, cooperatives, association, NGOs, etc. to apply forestlands of 50 hectares and above in order to establish and develop agroforestry farms and plantations.

formal education programs in agroforestry. As early as 1976, the Don Mariano Marcos Memorial State University (DMMMSU) in La Union, Philippines started offering a 4-year degree program leading to a Bachelor of Science in Agroforestry in partnership with the University of the Philippines Los Baños (UPLB) as part of a Institutional Assistance Program of the then Ministry of Education and Culture-Technical Panel for Agriculture Education. The Institutional Assistance Program enabled DMMMSU to implement the program with technical assistance and capacity-building programs provided by UPLB. The number of state colleges and universities (SCUs) offering agroforestry education programs has increased to 34 as of year 2009. The greatest proliferation was observed in the mid-1990s, when people-oriented forestry programs were being intensively promoted. Fig. 1 shows the geographical distribution of SCUs engaged in agroforestry education.

Not only have agroforestry schools proliferated but also the types of agroforestry education. Among the agroforestry curricula that are available in the Philippines are the: (a) Bachelor of Science in Agriculture with a major in Agroforestry (BSA-AF); (b) Bachelor of Science in Forestry with a major in Agroforestry (BSF-AF); (c) BS Agroforestry; (d) Bachelor in Agroforestry Entrepreneurship (gradually being phased out); (e) Bachelor in Agroforestry Technology; and (f) Certificate/Diploma in Agroforestry; and (f) Master of Science in Agroforestry.

The BSA-AF program is a 4-year program in agriculture with a specialization in agroforestry, whereas the BSF-AF is a four-year program in forestry with a specialization in agroforestry. The Bachelor in Agroforestry Entrepreneurship/Bachelor in Agroforestry Technology are skills-oriented agroforestry programs that are aimed at building entrepreneurial skills in students studying agroforestry farm establishment. The MS Agroforestry is a 2-year graduate program aimed at providing advanced knowledge and skills in agroforestry.

The proliferation of agroforestry schools and curricula raises questions about the consistency of quality. Thus, to standardize program implementation, the Commission on Higher Education (CHED) through the Taskforce on Agroforestry Education developed a set of minimum standards for the BS

Agroforestry (CHED Memorandum Order No. 9, 2006). This memorandum prescribes all SCUs offering agroforestry education programs to offer only the BS Agroforestry program effective from school year 2007–2008.

A number of non-formal training programs in agroforestry are being provided by UPLB. These training programs include: (a) Agroforestry Project Planning and Management, (b) Soil and Water Conservation and Management, (c) Agroforestry Seed Technology and Nursery Management, (d) Technology Verification through On-farm Trials, (e) Integrated Pest Management, and (f) Agroforestry Production and Post-Production Systems. The UPLB also provides research and development programs in agroforestry.

Carandang *et al.* (2006) noted that the offering of various agroforestry education programs in the Philippines is anchored in the belief that practitioners of agroforestry play an important role in the conservation and management of natural resources. Thus, the state colleges and universities that are strategically located close to upland areas subject to deforestation and degradation perceived the need to produce human resources capable of performing this function.

Agroforestry education is the process of producing human resources imbued with competencies in the science, art, and practice of producing and maximizing the positive ecological and economic interactions between the woody perennials and agricultural crops and animals produced on the same unit of land (Policy, Standards and Guidelines for BS Agroforestry, 2006). Furthermore, the PSG for BS Agroforestry states that agroforestry education is anchored in the belief that “an educated human resource can be an instrument for harmonizing and unifying the interaction and synergy between people and the soil upon which agroforestry crops are grown to raise the economic status of the people and sustain the environment”. The essence of this unity is dynamically embedded in the individual’s context, culture, environment, and changing contingencies. The agroforestry program was formulated in the belief that the environment is the context in which agroforestry occurs. Agroforestry education program embodies a commitment to care for the environment even as its resources are being mustered for socioeconomic productivity. Within

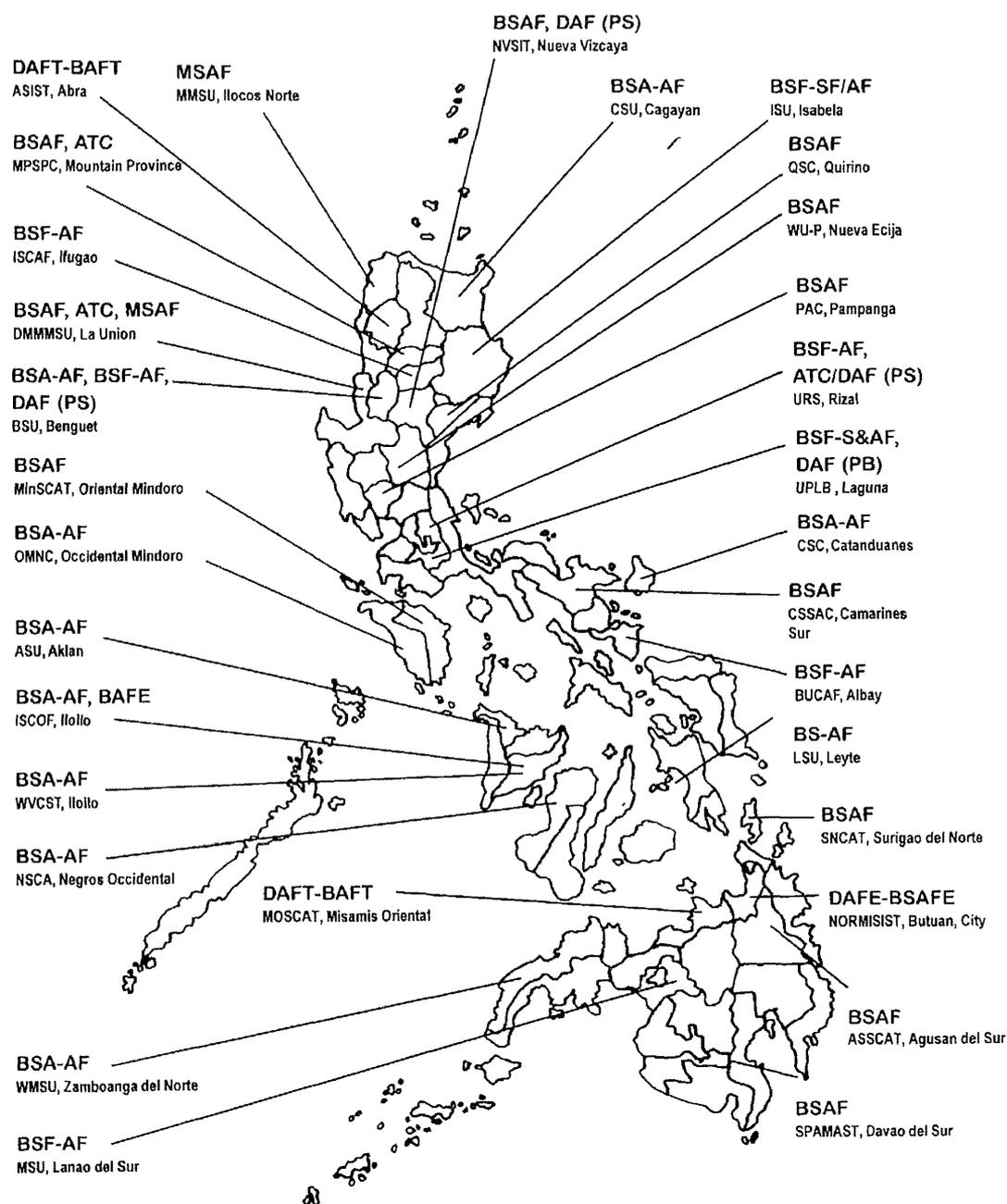


Fig. 1

this context of caring, the program also places value on the quality of human life. This is the philosophy behind CHED's formal recognition of the BS in Agroforestry in 2006.

The Framework of the BS Agroforestry Program in the Philippines

The curriculum is process-based and is anchored in the observation that the practice of agroforestry is predicated on critical thinking, analytical reason-

ing, and the ability to critique and construct knowledge as faculty and students engage in the mutual search for meaning and understanding in professional agroforestry.

The curricular framework of the BS Agroforestry program covers 18 units of core agroforestry courses, 28 units of major courses, and a thesis (Table 2). These courses are neither pure agriculture nor pure forestry, but the integration of both

Table 2. Contents of the Bachelor of Science in Agroforestry as prescribed by Memorandum Order No. 9, 2006, of the Philippine Commission on Higher Education

Core courses	Major courses
Introduction to Agroforestry	Community Organizing and Development in Agroforestry
Agroforestry Nursery and Plantation	Systems Appraisal and Design in Agroforestry
Agroforestry Taxonomy	Managing Agroforestry Projects
Agroforestry Physiology	Agroforestry Policies and Programs
Surveying and Mapping with GIS	Agroforestry Production Systems
Ecology for Agroforestry	Soil and Water Conservation
	Agroforestry Enterprise Management
	Agroforestry Research Methods
	Agroforestry Extension Models and Approaches
	Seminar in Agroforestry
	Thesis in Agroforestry

along with social science and economics.

This framework calls for an interdisciplinary and multidisciplinary orientation, pooling the expertise of the faculty members of various disciplines, particularly agriculture, forestry, agroforestry, environmental science, management, economics, and sociology, to develop a more relevant, responsive, and integrative agroforestry curriculum.

Recognizing the importance of agroforestry in delivering economic and ecological stability, a body of scientists, academics, and agroforestry advocates recognized the need to advance scientific knowledge in this field. Their coordinated efforts led to the creation of the Philippine Agroforestry Education and Research Network (PAFERN), a formal organization of state colleges, universities, and other institutions actively engaged in agroforestry education and research. PAFERN was formally established to institutionalize the strong links existing between and among institutions to strengthen the quality of agroforestry education in the country. The major milestones of agroforestry education development in the Philippines are found in Table 3.

The Role of Agroforestry Education and Training in Promoting Sustainable Development

Enhanced agroforestry adoption among upland farming communities in the Philippines

Most of the SCUs engaged in agroforestry educa-

tion are located within regions containing vast upland areas subject to forest or watershed degradation because of the pressures of human settlement. These SCUs began to offer agroforestry education programs based on the perceived need for rehabilitating these upland areas. Through their research and extension (non-formal education) programs, the adoption of agroforestry technologies and practices were enhanced in their respective areas. From 1997 to 2000, a collaborative project entitled Agroforestry Support Program for Empowering Communities Towards Self-Reliance (ASPECTS) was implemented in the three major island groups of the Philippines (Luzon, Visayas, and Mindanao). This program was implemented in collaboration with the three SCUs offering agroforestry education programs in each of these regions. A follow-up study¹ conducted by Palma (2007) to gauge the impact of the program indicated that the farmers in Mindanao who previously monocropped tomatoes have transformed their land into agroforestry farms producing a variety of annual and perennial crops. The agroforestry systems now being practiced include alley cropping, planting of natural vegetative strips, woodlots, and aquasilviculture. At the Luzon and Visayas project sites, pre-existing agroforestry farms that adopted alley cropping and multistorey systems have been enhanced as farmers have applied at home the skills they learned in training courses and cross-farm visits. Community demon-

¹ Impact evaluation of ASPECTS in Mindanao project site, Philippines.

Table 3. Milestones in agroforestry education development in the Philippines

Year	Milestones/Significant Developments	Impacts/Outcome
1975	Revision of the Forestry Code (Presidential Decree No. 705)	Promoted agroforestry development in the management of occupied public forestlands
1976	Offering of the Bachelor of Science in Agroforestry	Training and production of human resources equipped with the knowledge and skills in agroforestry
1981	Issuance of Ministry of Education, Culture and Sports (MECS) Order No. 4, 1981, prescribing the minimum standards for the BS Agriculture major in Agroforestry and the BS Forestry major in Agroforestry	Encouraged the state colleges and universities to offer agroforestry as an optional major in the traditional programs of agriculture and forestry
1991	Establishment of the University of the Philippines Los Baños Agroforestry Program	Opened training opportunities in agroforestry to technicians, extension workers, teachers, and researchers from academic institutions, NGOs, government agencies, community organizations, and private organizations. Subjects included agroforestry project planning and management, agroforestry production and post-production systems, soil and water conservation and management, technology verification through on-farm trials, seed technology, and nursery management.
1992	Multisectoral workshop on agroforestry curriculum development organized by the University of the Philippines Los Baños	Led to widely accepted specific definition of agroforestry in the Philippines and paved the way for the institution of curricula leading to the post-baccalaureate Diploma in Agroforestry
1995	Implementation of the Philippine Agroforestry Education Needs Assessment (PHILAFENA)	Revealed the institutional issues, needs, and challenges being faced by the state colleges and universities offering agroforestry education programs. These issues included few staff development opportunities; few teaching staff; lack of basic references; insufficient on-campus and off-campus laboratory areas; lack of research and extension programs; outdated minimum standards; lack of minimum standards for the BS Agroforestry program; limited employment opportunities for the BS Agroforestry graduates; and the need to expand linkages.
1998	First National Workshop on Agroforestry Education	Gave way for the establishment of an informal coalition of agroforestry schools called the Philippine Agroforestry Education and Research Network (PAFERN)
2002	Formalization of PAFERN	Formal recognition of PAFERN as a channel to convey the issues and concerns being faced by the agroforestry schools and to serve as the core organization responsible for addressing the issues and development needs of agroforestry education, particularly capacity-building of teaching staff, provision of basic references, assistance in improving on-campus learning laboratories, launching policy advocacy programs, and helping agroforestry schools gain access to information
2004	Lobbying for the Professionalization of Agroforestry Practice in the Philippines	Aimed at widening the employment opportunities for agroforestry graduates and lead towards recognizing agroforestry as a discipline distinct from agriculture and forestry
2006	Issuance of the Commission on Higher Education (CHED) Memorandum Order No. 6, stipulating the guidelines and minimum standards for the offering of the BS Agroforestry program	Standardized the offering of the BS Agroforestry program and serves as a mechanism to control the proliferation of agroforestry schools and programs

stration farms that integrate high-value fruit-tree crops and annual crops have been established, while the agroforestry farms belonging to farmer-trainers have also been improved through the adoption of better agroforestry technologies.

The UPLB-Institute of Agroforestry (UPLB-IAF) assessed a selection of its training alumni and found that most of their project sites had advanced beyond the demonstration and early adoption stage of the agroforestry technologies and were moving towards the establishment stage; some had already reached the production and maintenance stage (Institute of Agroforestry, 2001).

Improved knowledge and skills of agroforestry practitioners

The short-term training courses that were implemented by the then UPLB Agroforestry Program (now the Institute of Agroforestry) as early as 1991 enhanced the technical capabilities of the extension staff involved in agroforestry promotion. The UPLB-IAF conducted a study² in 2001 that indicated that the knowledge of trainees on integrated farming systems, crop diversification, and organic farming was enhanced. In addition, the trainees gained confidence in providing technical assistance to the farmers in the field and had their knowledge on environmental conservation techniques enriched. At the field level, the implementation of their re-entry plans enabled the trainee farmers to conduct farm planning, establish nurseries, develop their agroforestry farms, further diversify crops, strengthen the local people's organizations, and create awareness among other farmers about the use of organic fertilizers. The re-entry plans are the indicative plans that serve as the major outputs of the participants of the agroforestry training courses. These plans should be implemented by the training alumni upon return to their respective home institutions.

Development of a pool of advocates for agroforestry

From 1991 to 2001, the UPLB-IAF trained 1528 development workers from NGOs, government agencies, research institutions, people's organizations, and private organizations. A total of 176 researchers and agroforestry teaching staff were trained in specialized agroforestry courses from 2002 to 2008. The Institute conducted a training

impact assessment that indicated that the knowledge and skills of these trainees improved. Enhanced knowledge and skills in agroforestry on the part of these educators and researchers implies a better delivery of research and extension services to their target clientele, and better implementation of the institutional programs and mandates on agroforestry. Agroforestry graduates have likewise been formally developed. Del Castillo *et al.* (2001) reported that agroforestry graduates employed in non-government and government organizations usually perform the following tasks: (a) planning and establishment of agroforestry projects, (b) community organizing and development, (c) implementation of community-based forest management, (d) development of project proposals, (e) soil and water management, (f) monitoring and evaluation of agroforestry-related projects, (g) teaching agroforestry courses in formal degree programs, and (h) agroforestry advocacy.

A mechanism for local government units and other agencies to integrate agroforestry into development programs

The agroforestry training courses require participants to prepare an indicative plan to be implemented upon return to their respective home institutions. Consequently, training alumni either improves their agroforestry education, research and development activities or integrates agroforestry in the existing programs of their respective institutions into their development programs. In addition, collaborative projects between agroforestry schools and local development organizations have enhanced the latter's recognition of agroforestry and led them to incorporate it into their programs. With 90 institutions in the Philippines incorporating agroforestry into their programs and mandates, and even banks implementing sustainable natural resources management programs, agroforestry has become one of the main production technologies. From 2005 to 2009, a total of 5719 hectares and 4272 farmer beneficiaries became partners with the Development Bank of the Philippines in rehabilitating forests and mangrove forests via agroforestry (Pagkanlungan, 2009).

² Training impact and needs assessment was conducted by the UPLB-Institute of Agroforestry among its selected training alumni

Participation of various stakeholders in agroforestry advocacy

The regular national and regional congresses organized by PAFERN have enabled many local, national, and international organizations to discuss agroforestry advocacy issues. These congresses have also served as venues for information exchange and promotion and development of agroforestry. More importantly, they have provided opportunities for awareness building, linkage building, and the development of policy instruments in the form of resolutions that have helped institutionalize agroforestry as a development strategy in the Philippines.

Improved science of agroforestry

As a recognized educational discipline, agroforestry calls for continuous research to contribute to the body of knowledge. Carandang *et al.* (2006) noted that the scientific community in the Philippines has performed numerous research and development studies on agroforestry that have lent the respectability of a science. Academic and research institutions, private organizations, NGOs, and even peoples' organizations have all contributed to the advancement of agroforestry as a science in the country. PCARRD, 2003 as cited by Carandang *et al.*, (2006) reported that 64 studies examined the underlying biological and physical processes of agroforestry technologies and practices, 47 projects focused on the promotion of agroforestry systems, 21 projects dealt with agroforestry systems and socio-

cultural interactions, 14 projects dealt with the documentation of indigenous agroforestry systems, 8 projects concerned the economics of agroforestry, and 6 projects studied the sustainability using indigenous species for hedgerows. These numbers do not include undergraduate and graduate theses.

Prospects for the Contribution of Agroforestry Education to Sustainable Development

Among the eight Millenium Development Goals (<http://www.undp.org/mdg/basics.shtml>) to be achieved within the next decade are the eradication of poverty, the eradication of hunger, and environmental security. The science of agroforestry can contribute to the achievement of these goals. Hence, agroforestry curricular programs must be responsive to the needs of modern society.

Approximately 20 million Filipinos live in the uplands and about 10 million hectares of degraded uplands need to be made productive and ecologically stable (Mancebo, 2003). As these people represent almost 25% of the nation's population (NSO, 2003 as cited by Mancebo, 2003), a major part of the country is in need of improved socioeconomic welfare and the arrest of environmental degradation (Mancebo, 2003).

Tolentino *et al.* (2010) identified 64 institutions that expressed a need for agroforestry graduates. In the next 10 years, these institutions would likely

Table 4. Projected demand for agroforestry graduates in the next 10 years

Respondent-institutions	2010-2013			2014-2015			2016-2010			TOTAL
	Male	Female	Sub-total	Male	Female	Sub-total	Male	Female	Sub-total	
DENR ¹	61	54	115	93	77	170	113	109	222	507
LGU ²	42	33	75	53	40	93	56	53	109	277
DA ³	38	19	57	64	34	98	60	38	98	253
AI ⁴	17	13	30	27	24	51	44	29	73	154
NGO ⁵	21	8	29	20	10	30	22	12	34	93
Total	179	127	306	257	185	442	295	241	536	1284

Source: Tolentino *et al.* (2010).

¹ Department of Environment and Natural Resources.

² Local government units.

³ Department of Agriculture.

⁴ Academic institutions.

⁵ Non-government organizations.

Table 5. Types of agroforestry graduates preferred by the respondent-institutions

Type of Agroforestry Graduate	Frequency (<i>n</i> =64)**					Total
	DENR	DA	NGO	LGU	AI	
Graduate of a full-degree program in AF	9	—	3	9	4	25
Agriculture graduates with specialization in agroforestry	—	6	1	9	1	17
Forestry graduates with specialization in agroforestry	14	—	—	3	—	17
Professionals with advanced knowledge in agroforestry (MS/PhD)	2	1	1	2	8	14
Agroforestry graduates with entrepreneurial competencies who can manage agroforestry farms	1	—	—	3	1	5

Source: Tolentino *et al.* (2010); ** multiple responses.

employ about 1284 agroforestry graduates (Table 4). This suggests that around 128 agroforestry graduates per year are likely to be employed in national government agencies, local governments, academic institutions, and NGOs. While these numbers do not guarantee employment for all graduates from the 34 PAFERN institutions offering agroforestry programs and specializations, they are enough to encourage students to pursue agroforestry as a career, and the number is actually likely to be an underestimate because some institutions may not have responded to the survey (Tolentino *et al.*, 2010). The DENR was the organization with the greatest reported need for agroforestry graduates in the next 10 years.

The respondent institutions indicated biases in the types of agroforestry graduates they were looking for (Table 5). The DENR respondents preferred forestry graduates with a major in agroforestry and only a few graduates from full-degree programs in agroforestry. The Department of Agriculture preferred agriculture graduates with a major in agroforestry. These two national government agencies likely preferred those types of graduates because the positions of forester and agriculturalist already exist in the DENR and Department of Agriculture, respectively. Graduates in either discipline possessing a specialization in agroforestry would be considered to hold added value over the basic position of forester or agriculturalist.

The academic institutions that responded to the survey preferred graduates with an advanced degree from an agroforestry program. As specified in

the new Policy, Standards and Guidelines (PSG) for BS Agroforestry, one of the minimum requirements that an institution must meet to be certified to offer the BS Agroforestry program is that at least six faculty members must have advanced degrees in agroforestry.

Despite the projected demand for agroforestry graduates, enrollment trends across all levels of agroforestry curricular programs have generally been decreasing (Table 6). This finding validates earlier studies and observations (Carandang *et al.*, 2008; Landicho and Fernandez, 2010) that interest among students in agriculture and forestry sciences is declining. This trend also holds true in other Southeast Asian countries and other parts of the world (Rudebjer, *et al.*, 2004; Temu and Kiwia, 2008). The declining enrollment in agroforestry education programs is attributed to the perceived lack of employment opportunities for graduates (Landicho *et al.*). Students are now more inclined to take programs such as information technology and nursing. In addition, the lack of financial support in the form of scholarships discourages some students from studying agriculture and allied programs (Carandang *et al.*, 2008).

The challenge for agroforestry advocates is to continually review the educational programs and forces influencing student course selection and adopt strategies that will increase student recruitment to ensure a steady supply of the human resources ultimately needed for promoting sustainable development.

Table 6. Observed enrollment trend in agroforestry education programs in 27 state colleges and universities in the Philippines

Agroforestry education programs	Enrollment trend for the last five years		
	Increasing	Stable	Decreasing
Diploma	4	—	—
Bachelor/Baccalaureate	2	3	17
MS/Graduate program	—	—	1
Total	6	3	18

Source: Landicho and Fernandez (2010).

Conclusion

This paper concludes that agroforestry offers great potentials in promoting sustainable development in the Philippines. Agroforestry is a sustainable land use management system that primarily aims to address the twin goals of socioeconomic productivity and ecological stability. The direct benefits that it provides to individual farmers clearly address the economic dimension. The indirect benefits from providing environmental services (e. g., carbon sequestration, improving microclimate, providing soil erosion control) ensure the ecological balance of the whole community.

The science and practice of agroforestry is ultimately geared towards promoting sustainable development by improving the socioeconomic productivity of the practitioners without sacrificing the environment, particularly the forest and agricultural resources. Agroforestry is being promoted in large parts of the Philippines to help rehabilitate degraded environments, particularly upland areas, stabilize the soil and microclimatic conditions, and sequester carbon. These environmental services provided by agroforestry will in the long run provide a healthy environment.

The aims of agroforestry practice are consistent with the concept of sustainable development. As defined, sustainable development is maintaining a delicate balance between the human need to improve lifestyles and feeling of well-being, while preserving natural resources and ecosystems on which the present and the future generations depend (Srinivas, 2010). Agroforestry is, therefore, one of the key strategies to attaining at least two Millennium Development Goals, namely, eradication of

extreme hunger and poverty; and, ensure environmental sustainability.

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