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Reformulating Agriculture and Forestry Education in the Philippines: Issues and Concerns

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More than ever before the reformulation of agriculture and forestry education in the Philippines has become increasingly essential in the light of a rapidly diminishing industry sector, shifting uses of land and other natural resources and the changing climate and the environment in general. As its foundational context changes the educational system and programs on agriculture and forestry must also change to be able to produce trained human resources with the skills and orientation consistent with what is required to address the prevailing and emerging problems and opportunities associated with the changing biophysical and socioeconomic landscape. The slow pace of adaptation of agriculture and forestry education has caused the decline of interests among prospective students as the demand for graduates of the traditional programs declines in favor of the rising demand for graduates with new sets of skills. Further, the diminishing opportunities to get employment and start new agriculture and forestry enterprises also erode the attractiveness of professional and business career in agriculture and forestry.

Needless to say agriculture and forestry education remain vital considering the unabated population growth and increase in the demand for food, fiber, wood and other related goods. But to remain responsive and relevant, agriculture and forestry education must rise up to the challenge of transforming it into a system where the end products are graduates with the desired set of skills and knowledge that are necessary to make a positive difference in the industry sector and the overall improvement of the state of the biophysical and socioeconomic environment.

Toward this end the Philippines through the Commission on Higher Education (CHED) aims to redesign the highly performance based educational system for agriculture and forestry into a largely outcomes based system. This paper presents the key elements of the envisioned reformulated agriculture and forestry education program along with the concerns, problems, opportunities and constraining and facilitating factors for its full and prompt adoption.

Key words: forestry, agriculture, outcomes-based education

1. Introduction

Agriculture, forestry and natural resources (AFNR) are known to be the three pillars that sustain the country's economic growth and development. More than 90 million Filipinos depend upon these resources for food, shelter and economic well-being. Confronted with issues and problems such as unabated population growth, increasing poverty, high unemployment rate, declining forest resources, climate change and other emerging global issues, there has been a concerted effort among the various government agencies to work towards the sustainable management of the country's various ecosystems. One of these government agen-

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cies is the Philippines' Commission on Higher Education whose mandate is to formulate plans, policies and strategies that promote quality and higher education in the hope that these will redound to the development of AFNR professionals with the basic competencies (knowledge, attitudes, values, and skills) required for the sustainable management of the country's various ecosystems.

The CHED has consistently recognized the vital role that the agriculture, forestry and natural resources (AFNR) sector play in ensuring food security, sustainable agriculture, and management of the country's natural resources and has implemented programs and supported initiatives to improve the quality of AFNR education through the National Agriculture and Fisheries Education System (NAFES) as well as the identification and development of centers of excellence and development in agriculture and fisheries. In order to help the government revitalize and modernize the agriculture sector, the CHED is also pushing for the rationalization and streamlining of the AFNR education system thereby assisting the government in revitalizing and modernizing the agriculture sector to promote widespread economic growth and development (PIDS, 2011).

Killen (1996 as cited by Adedoyin and Shangodoyin, 2010) defines outcomes-based education (OBE) as a method that requires educators (teachers) and learners (students) to direct their attention and efforts on the desired end results of education. He further explains that OBE encourages educators to use desired results or outcomes as a guide to their entire instructional decision-making, specifically, planning. Accordingly, teaching should be organized so that planned results or outcomes are achieved. In OBE, the learners should have a clear understanding of: 1) what they need to know; 2) what they must be able to do; 3) what attitudes and values are desired at the end of the learning experience. When outcomes or desired end results are used to guide learning, learners are given an equal opportunity to achieve these outcomes (Adedoyin and Shangodoyin, 2010). In short, OBE focuses more on the students' abilities to put into practice what they know and have learned rather than on teachers' teaching and content. In this method, the abilities and qualities that graduates or students should possess after finishing their education program are predetermined and used to guide the educators and learners along the way.

As an initial attempt towards the full implementation of OBE, the CHED is slowly transforming the engineering education into an outcomes-based system in order to meet the demands of global equivalency of quality standards in engineering programs as well as to promote continuous quality improvement in HEIs offering engineering programs (CHED, 2012). It is also towards this end that the CHED aims to redesign the highly performance based educational system for agriculture and forestry into largely an outcomes based system.

2. Importance of Agriculture and Forestry

2.1 Contributions to the country's GDP/GVA

Agriculture and forestry remain a vital sector of local and national economy. The whole population depends on these sectors for food, shelter and livelihood. The sector employs nearly half of the total labor force and contributes over 20% of gross domestic product (GDP). Combining all economic activities related to agro-processing and supply of non-farm agricultural inputs, the agricultural sector, in broader terms, accounts for about two-thirds of the labor force and 40% of the GDP (Tolentino *et al*., 2001; Habito and Briones, 2005). It should be noted that the contribution of forests, in particular, to GNP is measured not only by the forest products they provide, but also by the intangible services they provide to humanity.

Table 1 shows the performance of agriculture from 2004−2010 contributing a yearly average of 18.4 per cent GDP with an average growth rate of 2.6% annually. In 2011−2012, the agriculture sector contributed 3.5 per cent of the country's GDP (NSCB, 2012).

On the other hand, the contribution of the forestry sector to GNP has been almost insignificant during the last decade as shown in Table 2 (Cruz, *et al*., 2011) owing to the significant decline in the country's forest cover brought about by natural phenomena, anthropogenic activities and a less than conducive policy environment. However, the latest report of the Forest Management Bureau (PFS, 2011) indicated that the forestry sector bounced back in 2011 from the 2010 level with a 40% increase contributing PHP 4,286 million (at constant prices of 2000) or 0.07 percent to the country's Gross Domestic Product (GDP) of PHP 5. 924 billion. At current prices, its equivalent value was equal to PHP 3,906 million or 0.04 percent of the GDP.

Table 1. Agriculture and fishery (with forestry) performance and contribution to economy, 2004-2010.

AFF Sector	2004	2005	2006	2007	2008	2009	2010	Ave
PERFORMANCE (in %)								
Growth	5.2	2.0	3.8	4.9	3.1	0.01	(0.5)	2.6
Gross Value Added (in Php M)	226,417	230,954	239,777	251,495	251,495	259,424	258,081	246,508
% share to GDP	19.6	19.1	18.8	18.4	18.3	18.1	16.8	18.4
Employment in agriculture (in '000 persons)	11,381	11,628	11,682	11,785	12,030	12,043	11,974	11,789
% share to total employment	36.0	36.0	35.8	35.1	35.3	34.3	33.2	35.1

Source: NSCB, 2011 as cited by NEDA, 2011.

Table 2. Gross domestic product and gross value added in forestry sector (million PhP)

Year	GDP	At Constant Prices	
		GVA in Forestry	% Share to GNP
2011	5,924,409	4,286	0.07
2010	5,701,539	2,676	0.05
2009	5,297,240	3,896	0.07
2008	5,237,101	3,977	0.08
2007	5,028,288	3,894	0.08
2006	4,716,231	5,159	0.11
2005	4,481,279	4,396	0.10
2004	4,276,941	4,275	0.10
2003	4,008,469	2,759	0.07
2002	3,818,667	2,151	0.06

Source: NSCB, 2011 as cited by NEDA, 2011.

2.2 Roles of agriculture and forestry in addressing food security

Forests are the sources of various types of food that supplement and complement what is obtained from agriculture, which include wood fuels for cooking, agroforestry products and an array of traditional medicines and other hygiene products. Apart from playing the role of source materials, the presence of a sustainably managed forest enables the provision of such source materials plus water, fertile soil and other ecosystem services. The list of benefits include direct (food, timber, herbal medicines, spices) and indirect (ecological services, economic opportunities, cultural preservation, social activities, aesthetics).

However, food supply is threatened by a growing demand to feed an increasing population in the face of scarcity in land and water resources. It has been reported that population growth will continue through 2050 accompanied by unparalleled rise of urbanization resulting in rapid growth in demand for food, both in quantity and quality. The capability of the agriculture sector to feed more than 90 million Filipinos is likewise threatened by climate change and climate variability. There are compelling evidences that suggest the potential and real threat of climate change to the environment, as well as to human systems, including agricultural production, biodiversity, health and other sectors and processes (IPCC, 2007 as cited by Espaldon, 2010). Several assessment studies suggest that climate change will significantly undermine crop production in the country, posing a serious threat to future food security of millions of Filipinos particularly the poor and the marginalized whose survival and well-being largely depend on agriculture.

2.2.1 Population trend in 2050

The Philippines is one of the most populous countries in the world. As of 2011, the total population of the country is 97 million Filipinos. The Philippine population will continue to grow, increasing from 76.5 million in 2000 to 141.7 million in 2040, according to the Medium Series of the 2000 census-based population projections. This means an addition of about 65 million Filipinos from 2000-2040, even if the average

Table 3. Top ten most populous countries, 2009 and 2050

2009		2050	
Country	Population (millions)	Country	Population (millions)
China	1,331	India	1,748
India	1,171	China	1,437
United States	307	United States	439
Indonesia	243	Indonesia	343
Brazil	191	Pakistan	335
Pakistan	181	Nigeria	285
Bangladesh	162	Bangladesh	222
Nigeria	153	Brazil	215
Russia	142	Congo Dem. Rep.	189
Japan	128	Philippines	150

Source: Haub and Kent, 2009.

annual growth rate declines drastically as projected from 2.34 percent during the 1990−2000 period to around 1.0 percent during the 2030−2040 period (Osias, *et al*., undated).

The latest publication (*Population Bulletin, a companion to PRB's 2009 World Population Data Sheet*) has projected that by 2050, the Philippines will belong to the top ten most populous countries (Table 3). An increase in population will most likely result rapid growth in demand for food, both in quantity and quality.

2.2.2 Water needs now and in the future

The country has vast water resources. Rainfall is estimated at around 2,400 mm annually. There is also an extensive groundwater resource in the country covering an estimated area of 5 M ha and stores about 251,158 MCM. The safe yield is estimated at 31,554 MCM per annum. The dependable yield of the total water resources of the country is a total of 975 MCM per day (MCM/day), coming from a surface runoff of 833 MCM/day and 142 MCM/day of groundwater safe yield (Cruz *et al*., 2011).

The agricultural sector is considered to be a high water user with a demand of 85 percent, while industry and domestic have a combined demand of only 15 percent (Table 4). Irrigated agriculture is considered as the major water user since nearly 62 percent of the total water use is used for it. As of 2003, only 1.43 M ha of the country's 3.3 M ha of total potential irrigable area irrigated based on estimates of the National Irrigation Authority (NIA). Of the irrigated lands, 0.7 M hectares are served by the NIA, 0.5 M ha by the Communal Irrigation Systems (CIS) and 0.2 M ha by private irrigation systems (PIS) from which more than 1.1 M farmers benefit. Water from the various irrigation systems are sourced from the country's watersheds.

The demand for water across all users is rising and that by 2025 all user groups in various regions of the country would experience water deficits (Table 4). Currently, many areas of the country are now experiencing water shortages due to increasing demands for water for various purposes (e.g., domestic and industrial water supply, fisheries, sewage disposal, irrigation, power generation and transportation). The availability of water for human consumption will be affected by rapid urbanization, increasing discharges of untreated wastes and various pollutants, worsening climate change and variability, inefficiencies in distributing and using water, changes in the land use patterns and continuous degradation of watersheds.

2.2.3 Livelihoods/employment generated by agriculture and forestry sector

Agriculture and forest significantly contribute to achieving sustainable livelihoods and alleviating poverty. With an estimated 30 million Filipinos living in the uplands, majority of households generate some of their income from selling forest products especially when farm production is not enough and other sources of income are not available. Earnings derived from selling forest products are reportedly used to buy certain inputs for other activities that contribute to

Table 4. Water Demand in the Philippines (in MCM/year)

Water Demand	1996	2025		% of total (1996)
		Low	High	
Municipalities	2,178	7,430	8,573	7.27
Industrial	2,233	3,310	4,997	7.46
Agriculture	25,533	51,920	72,973	85.27
Irrigation	18,527	38,769	53,546	61.87
Livestock	107	224	309	0.36
Fishery	6,899	14,437	19,939	23.04
Total Demand	29,944	62,660	86,543	100.00
Groundwater (GW) Recharge	20,200	20,200	20,200	
% GW Potential/ Total Demand	67.46	32.24	32.24	

Source: Adapted from PEM, 2003.

livelihoods, for example, to purchase seeds, hire labor for cultivation or as working capital for other economic activities. Forests also contribute to livelihoods by providing materials for construction, basket weaving, storage structures, agricultural implements, boats and hunting and fishing gear. The agriculture sector, on the other hand, is the dominant source of livelihood and employment of around 70% of the country's rural poor (Habito and Briones, 2005).

2.2.4 Land and agricultural resources

Being an agricultural and archipelagic country in Southeast Asia with a total land area of 298,170 square kilometers, the agriculture areas occupy around 9.7 million ha (BAS, 2011), which are further classified as permanent croplands (4.9 million ha); permanent meadows/pastures (4.225 million ha); forestland (0.074 million ha); and other lands (0.307 million ha) (Fig. 1).

The top four crops with the highest hectarage are coconut (3.33 million ha), followed by rice (2.47 million ha), corn (1.35 million ha), and sugarcane (0.36 million ha). According to Tolentino *et al.* (2001) the Philippines has an estimated 4.7 M ha of potentially irrigable agricultural lands. Of these, an estimated 0.65, 0.44 and 0.4 M ha are national, communal and minor (shallow tube wells and low-lift pumps) irrigation systems service areas, respectively. As of 2006, the actual irrigated agricultural areas amount to only 1.4 million ha of the more than 3 million ha of irrigable areas.

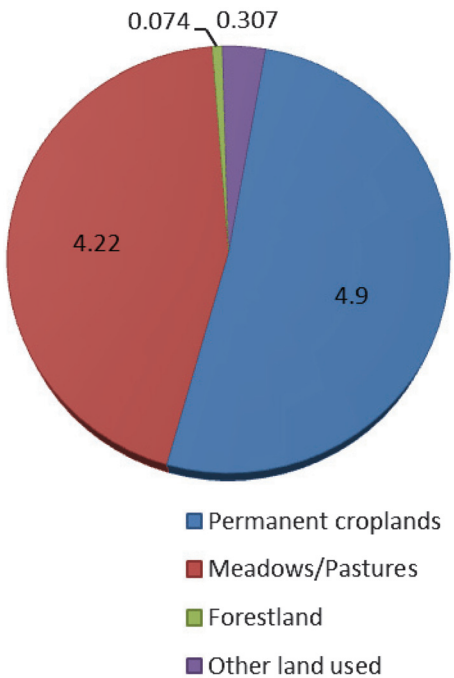

Fig. 1. Distribution of agricultural areas in the Philippines by land use (BAS, 2011)

On the other hand, those that are classified as forestland, which is mainly for forest use, is further categorized into established timberland (10.056 million hectares or 69%), established forest reserves (3.270

Table 5. Forest cover by categories (ha)

	Forest area in forest land	% of total land area	Forest area in A&D[1] lands	% of total land area	Total Forest Cover
Total	6,521,548	22.08	646,852	2.19	7,168,400
Closed Forest	2,495,833	8.45	65,039	0.22	2,560,872
Open Forest	3,578,526	12.12	452,062	1.53	4,030,588
Mangrove	165,425	0.56	81,937	0.28	247,362
Plantation	281,764	0.95	47,814	0.16	329,578

Source: Forest Resources Assessment Report, 2003 as cited by FAO, 2009.

million hectares or 22 %), national parks, game refuge and bird sanctuaries and wilderness areas (1.34 million hectares), military and naval reservations (0.126 million hectares), civil reservation (0.166 million hectares) and fishponds (0.091 million hectares) (PFS, 2011).

Table 5 shows the distribution of the forest cover located in forestlands and in alienable or disposable lands including their categories as closed forest, open forest, mangrove and plantation forests.

3. Reformulation of Agriculture and Forestry Curricular Programs

3.1 The traditional performance standards-based curricula

The academic programs in agriculture and forestry are among the oldest disciplines in the Philippines. These programs were first offered at the University of the Philippines Los Baños (then called the University of the Philippines College of Agriculture) as early as 1910. Through the years, a number of state colleges and universities in the countryside have also started implementing the academic programs in agriculture and forestry. As of 2011, there are 97 SCUs offering forestry and other related courses (PFS, 2011). On the other hand, at least 106 SCUs implementing agriculture programs such as BS Agriculture, Diploma in Agriculture, MS Agriculture and PhD in Agriculture.

Pursuant to CHED Memorandum Order (CMO) No. 44 Series 2006, all HEIs offering the Bachelor of Science in Forestry program should adhere to the policy standards which are based on the duties and competencies of a Forester and CHED's perception of new developments and concerns in forestry. These include the following: Executive Order 318 which promotes sustainable forest management; recognized role of forests and forestry in poverty alleviation and support of sustainable livelihood; forestry and land use implications including climate change; adoption of the criteria and indicators (C&I) for SFM; emerging trends and agreements in local and international forestry; and CHED's guidelines for the formulation of policies and standards of academic programs.

The standard BS Forestry curriculum contains 73 units of General Education courses comprising of Language, Humanities, Literature, Mathematics, Natural Sciences, Social Science, mandated Subjects (Life and Works of Rizal). The curriculum prescribes a total of 87 units of forestry technical courses consisting of basic forest biological courses, applied biological courses (dendrology, silviculture and forest wildlife), basic physical courses (forest geology and meteorology, forest survey, structure and identification of vascular plants, chemistry of forest production, forest statistics), applied physical courses (forest biometry and mensuration, processing and utilization of forest products and forest infrastructure), basic and applied social courses (principles and concepts of social forestry and forest economics, etc.), forest practicum/thesis, and electives (environment, forest resources management, agroforestry, forest products utilization, processing and marketing, forest resource policy and advocacy.

On the other hand, the BS Agriculture (BSA) Program was recently revised with the end in view of keeping abreast with the demands of global competitiveness. The old BSA curriculum was apparently highly specialized covering several areas of interest such as agronomy, horticulture, animal science and soil science among others. However, with the lack of experts in such areas in many Higher Education Institutions (HEIs), BSA graduates are not fully equipped with the required knowledge and skills. The revised

BSA is envisioned to "educate students in the scientific habit of thought, entrepreneurial skills and prepare them to become professionals with entry level competencies in technical agriculture". Furthermore, it puts more emphasis on the processes and techniques of identifying, diagnosing and analyzing problems and in designing, packaging and applying technologies needed in the development and conservation of the agriculture and food system resources (CHED, 2008). The revised standard BSA curriculum has 74 units of General Education similar to that of the BS Forestry curriculum. In addition, the curriculum prescribes a total of 49 units of fundamental agriculture courses in crop science, crop protection, animal science, soil science, genetics, and biotechnology, among others. An additional 39 units of core courses are prescribed depending on the field of specialization. These core courses include postharvest and seed technology, plant breeding, animal nutrition, agricultural policy and development, financial management for agri-based enterprise, etc.

While the fields of agriculture and forestry are considered as the pioneer academic programs in most of the state colleges and universities in the Philippines, these programs are currently facing a number of issues and challenges such as declining enrollment, limited employment opportunities for AFNR graduates, proliferation of agriculture, forest and natural resources programs, inability to attract the best and the brightest students and declining quality of AFNR graduates (Carandang *et al*., 2008; Nair, undated).

The state of the country's agriculture and forest resources vis-à-vis the current state of the agriculture and forestry education, calls for a more responsive and relevant agriculture and forestry education programs.

In a traditional performance standards-based curriculum students are trained to memorize rather than analyze and knowledge is viewed merely as an accumulation of information. Thus, the students have the tendency to just be contented with passing the subject or courses through memorization rather than studying to come up with new ideas or to improve the existing theories and apply theories learned.

3.2 Towards an Outcomes-Based Educational System

Zundel and Needham (2000) describes OBE as a system that focuses on students' abilities to apply or practice what they have learned rather than on teachers, teaching, and content. The purpose of OBE is to equip all students with the knowledge and competencies needed to meet the demands of global competitiveness and for their future success. Such a method begins with explicitly and publicly identifying the abilities and qualities that the HEI would want their students to possess. Teaching and assessment must be aligned with the resources available, the students and the expected outcomes as well. "Outcomes" refer to learning results that include knowledge, skills, values, and behavior. These "outcomes" are demonstrated at the end of significant learning experiences: *what learners can actually do with what they know and have learned.* In addition, outcomes are actions/performances that embody and reflect learner competence in using content, information, ideas and tools successfully. Success is then measured on how well students perform. For instance, a student may be able to memorize the parts of a Forester's Transit but may not be able to measure horizontal distance, read azimuth much less conduct a topographic survey using the

Table 6. Traditional based education vs. outcomes-based education.

Traditional	Outcomes-based
• Inputs are important	• Outcomes are important
• Passive learners	• Active learners
• Teacher oriented	• Learner-centered
• Lecture-based	• Various learning activities
• Assessment process-exam and grade driven	• Continuous assessment
• Student recalls knowledge	• Student demonstrates knowledge, skills and behavior

instrument. Table 6 compares a traditional based-education as against outcomes-based education:

Under an OBE curriculum, twelve (12) program areas are identified for the BSF program, namely: 1) forest ecosystems services and resource assessment and accounting; 2) sustainable management of natural forest; 3) industrial forest plantation development and agroforestry; 4) protected areas management and biodiversity conservation; 5) research development and extension; 6) forest products processing and utilization; 7) livelihood and enterprise development; 8) social forestry and governance; 9) forest and climate change; 10) leadership and management; 11) communication; and 12) ethics and standard practice.

These program areas correspond to program educational objectives that are actually broad statements that describe the career and professional accomplishments that the program is preparing the graduates to achieve within 3−5 years of graduation. Likewise, every fundamental program area, has program or student outcomes that specify what the students are expected to know and be able to do by the time they finish their studies. These pertain to the knowledge, understanding, skills and attitudes that students should acquire to enable them to reach their full potential and lead successful and fulfilling lives as individuals, as members of the community and at work (Killen, 2000).

For example, under the program area on sustainable management of natural forest, the objective is to "learn the basic knowledge and skills in forest resources particularly on forest restoration, forest protection, conservation and multiple uses of forest". After the completion of the program, the student or the learner is expected to be able to: 1) conduct comprehensive assessment and accounting of forest ecosystem services and resources and social processes using appropriate ICT and related tools and methods; 2) formulate, implement and evaluate forest management, watershed management, PAM, BC, and other related management plans using multi-stockholder and inter-disciplinary approaches; 3) ability to mobilize, organize and manage various stakeholder groups; 4) apply ICT and other traditional and modern tools, methods and approaches in problem solving, planning, management and other forest management activities; 5) assess the drivers of forest biodiversity, soil, water and other resources, degradation and identity, formulate and implement, appropriate conservation, protection and development interventions; 6) interpret, assess and formulate forest related policies and law; and 7) practice forestry profession adhering to ethical standards.

These program outcomes are the same set of human and technical competencies identified during a multi-sectoral workshop involving academicians, forestry practitioners in government and non-government organizations, and forestry employers conducted by the Philippine Technical Panel for Agricultural Education (TPAE) Committee on Forestry long before the OBE has been implemented by CHED. These are the desired human and technical competencies that forestry professional should possess for him to play an effective role in sustainable forest management (Rebugio and Camacho, 2003). According to Rebugio and Camacho (2003), these human competencies include: seeing, thinking, and doing systemically; communicating, managing and supervising people, managing conflicts, and interrelating or collaborating with others, effectively. Aside from the traditional forestry skills, the new technical competencies which the new forestry professional should develop include sourcing and processing information through information technology (IT) and other sources; geo-spatial visualization, interpretation and application; and integrated and balanced management of forest ecosystems. The new forestry professional should also be able to practice professional ethics and be conversant with national, regional, and global issues relevant to forestry. Bantayan (2007) likewise affirmed in his study that apart from the technical competence, the forester should be skilled in report writing and articulate in presenting his/her ideas that is one of the learning outcomes in the program area in communication. Carandang *et al*. (2008) noted that forestry sector is now looking for forestry graduates with competencies in the formulation and implementation of forest policies, laws and regulation; establishment and management of forest resources using appropriate technologies; design of appropriate resources conservation and preservation techniques; and, interpretation and application of geospatial methods in forest and other natural resources. These competencies are embodied in the program outcomes of the outcomes-based BSF curriculum. Table 7 summarizes the outcomes-based curricula for the BS Forestry program.

The proposed outcomes-based BS Agriculture curriculum is presented in Table 8. Similar to the BS Forestry program, several program areas have been

identified with corresponding program outcomes or the knowledge, values, skills and attitudes that a graduate of BS Agriculture must possess at the end of his/her learning experience.

3.3 Constraints and Needs

At the outset, the OBE system for both the BSA and BSF programs promises high level of learning for all students as it facilitates the achievement of the program outcomes, characterized by the ability of the learner to apply and demonstrate the knowledge and skills acquired during the learning experience. However, there is a need to enrich the existing curriculum by instituting courses that will address the fundamental program areas identified. This could involve the modification of the curriculum by changing the basic orientation and areas of concentration of the curriculum through the abolition of old irrelevant courses and institution of new courses. The implementation of an OBE will also require creativity and innovativeness on the part of the educator in order to achieve the program or learning outcomes that the learner must possess at the end of the program.

To match the improvement of human resources, the physical resources needed for the implementation of outcomes-based education system will also have to be upgraded. This would entail the acquisition of modern equipment, modernization of laboratory and research facilities that are conducive to the learning process. The success of OBE system likewise depends upon the availability and willingness of educators to be trained using the OBE method. A program for building up required human competencies and for promoting appropriate institutional mechanisms is therefore essential to ensure successful implementation of OBE. A system for monitoring compliance of HEIs to the OBE method must also be in place.

4. Concluding Remarks

The Philippine education paradigm for agriculture and forestry must be transformed from traditional performance standards-based curricula towards an outcomes-based educational (OBE) system. The reformulation of agriculture and forestry education is necessary to energize the industry sector, positively address the shifting uses of land and other natural resources, especially in the light of the impact of rising temperatures and extreme rainfall events. A secure industry sector is a vis greater employment opportunities is the best incentive to attract students and thus produce the required human capital for the industry.

An OBE system for agriculture should include the following program outcomes:

- Has the ability to promote resource conservation and sustainable use of natural resources.
- Knowledge of current trends and scientific advances
- Demonstrate leadership and social concerns
- Demonstrate capacity to engage in agribusiness engage in agribusiness and livelihood activities
- Demonstrate ability to diagnose and analyze problems and design solutions.
- Apply global experiences to solve local agricultural problems
- Recognition of opportunities for lifelong learning
- Demonstrate maturity and emotional intelligence
- Demonstrate ability to apply systems approach in problem solving

On the other hand, an OBE system for forestry should include the following program outcomes:

- Ability to conduct comprehensive assessment and accounting of forest ecosystem services and resources and social processes using appropriate ICT and related tools and methods
- Ability to formulate, implement and evaluate forest management, watershed management, protected area management, biodiversity conservation, and other related management plans using multi-stockholder and inter-disciplinary approaches
- Ability to formulate, package, implement, and evaluate forest management-related research, development and extension programs, projects and policies
- Ability to mobilize, organize and manage various stakeholder groups
- Ability to apply ICT and other traditional and modern tools, methods and approaches in problem solving, planning, management and other forest management activities
- Ability to assess Climate Change impacts, adaptation, risks and accessibilities and formulate suitable Climate Change adaptation and mitigation and DRR plans
- Ability to assess the drivers of forest biodiversity, soil, water and other resources, degradation and identity, formulate and implement, appropriate conservation, protection and development interventions

Table 7. Summary of outcomes-based BSF program.

Fundamental Program Areas	Program Educational Objectives (Depending on Appropriate typology of Institutions)	Program Outcome											
		1	2	3	4	5	6	7	8	9	10	11	12
Forest Ecosystem Services and Resources Assessment and Accounting	Equip graduates with knowledge and skills on forest ecosystem services and resources assessment and accounting	×	×					×					
Sustainable Management of Natural Forest	Learn the basic knowledge and skills in forest resources particularly on forest restoration, forest protection, conservation and multiple uses of forest	×	×		×	×		×		×			×
Industrial Forest Plantation Development and Agroforestry	Flourishing manage and developed industrial forest plantation using appropriate technologies					×			×				
Protected Areas Management and Biodiversity Conservation	Manage and maintain socio-cultural-ecological balance through protected area management and biodiversity conservation				×			×		×			
Research, Development and Extension	Formulate, implement and disseminate results of Research & Development			×		×			×			×	
Forest Products Processing and Utilization	Know efficient, economically viable and environment friendly forest products					×			×				
Livelihood and enterprise development	Know economically viable forest-based enterprises for community and industries								×				
	Learn how to formulate, promote, implement and evaluate PAM-BC programs, projects and policies			×					×		×		
Forest and Climate Change	Recognize and understand the impacts of climate change on forest and the roles of forest in climate change adaption and mitigation and disaster risk reduction						×	×					

Table 7. Summary of outcomes-based BSF program. (Continued)

Fundamental Program Areas	Program Educational Objectives (Depending on Appropriate typology of Institutions)	Program Outcome											
		1	2	3	4	5	6	7	8	9	10	11	12
Leadership and Management	Competent leaders for the administration, academe and research				×					×	×	×	×
Communication	Effective communication and interpersonal skills				×						×	×	×
Ethics and Standard Practice	Practice professional ethics												×

1. ability to conduct comprehensive assessment and accounting of forest ecosystem services and resources and social processes using appropriate ICT and related tools and methods
2. ability to formulate, implement and evaluate forest management, watershed management, PAM, BC, and other related management plans using multi-stockholder and inter-disciplinary approaches
3. ability to formulate, package, implement, and evaluate forest management-related research, development and extension programs, projects and policies
4. ability to mobilize, organize and manage various stakeholder groups
5. ability to apply ICT and other traditional and modern tools, methods and approaches in problem solving, planning, management and other forest management activities
6. ability to assess Climate Change impacts, adaptation, risks and accessibilities and formulate suitable Climate Change adaptation and mitigation and DRR plans
7. ability to assess the drivers of forest biodiversity, soil, water and other resources, degradation and identity, formulate and implement, appropriate conservation, protection and development interventions
8. ability to identify timber and non-timber forest products including services, undertake feasibility studies, prepare proposals and business plans integrating product development and marketing
9. ability to interpret, assess and formulate forest related policies and law
10. ability to organize, govern and lead forest-related groups, programs, research, HEI and other agencies
11. ability to express oneself orally and in writing; and apply appropriate communication strategies in forest management and biodiversity conservation, in formulating advocacy social mobilization programs, and knowledge management and sharing
12. ability to practice forestry profession adhering to ethical standards

Table 8. Summary of outcomes-based BS Agriculure program.

Fundamental Program Areas	Program Educational Objectives (Depending on Appropriate typology of Institutions)	Program Outcome
Environment	• practice and promote public safety in the use of agricultural technology • implement agricultural development compatible with resource conservation • manage resources effectively and efficiently	Has the ability to promote resource conservation and sustainable use of natural resources.
Biotechnology	• relate and apply concepts to promote public safety in the use of agricultural technologies • relate concepts and practice to solve major production problems	Knowledge of current trends and scientific advances
Leadership	• provide leadership and vision in identifying, creating and pursuing opportunities in agricultural development	Demonstrate leadership and social concerns
Entrepreneurship	• relate and apply knowledge to actual practice and business of agriculture	Demonstrate capacity to engage in agribusiness engage in agribusiness and livelihood activities
Problem analysis and solutions	• diagnose and analyze problems and design solutions.	Demonstrate ability to diagnose and analyze problems and design solutions.
Global exposure	• recognize and appreciate global issues and relate to local conditions • Technology search and exposure and gain experience on appropriate adoption	apply global experiences to solve local agricultural problems
Lifelong learning	• Engage in lifelong learning activities such as graduate studies or other advance scholarly endeavors	Recognition of opportunities for lifelong learning
Ethics and standard practice	• Practice ethical interpersonal relations with employers, • Subordinates, peers, clients and the general public	Demonstrate maturity and emotional intelligence
Systems thinking and Trans-disciplinary	• Ability to relate, integrate and apply relevant body of knowledge	Demonstrate ability to apply systems approach in problem solving

- Ability to identify timber and non-timber forest products including services, undertake feasibility studies, prepare proposals and business plans integrating product development and marketing
- Ability to interpret, assess and formulate forest related policies and law
- Ability to organize, govern and lead forest-related groups, programs, research, HEI and other agencies
- Ability to express oneself orally and in writing; and apply appropriate communication strategies in forest management and biodiversity conservation, in formulating advocacy social mobilization programs, and knowledge management and sharing
- Ability to practice forestry profession adhering to ethical standards

To be successful, an OBE system will require creativity and innovativeness in implementation and a long-term and deliberate effort of universities to train and upgrade its faculty. Needless to say, it will also entail installation of modern equipment, modernization of laboratory and research facilities.

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