

Curriculum Enhancement and Reform to Meet the Needs of Smallholder Farmers in Developing Countries: Survey of Literature

**Mywish Maredia, Michigan State University
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Introduction

An agriculture-focused development agenda requires building and strengthening three core institutions—education, research and extension. These are the three nodes of what is referred as the “Agriculture Knowledge and Information System” (AKIS) or simply the “knowledge triangle” (FAO 2000, Rivera et al. 2006). Smallholder farmers are at the heart of the knowledge triangle. The agricultural education system plays an important role in developing knowledge resources and preparing well-trained individuals who serve smallholder farmers through these three core institutions (i.e., researchers, educators, extension staff) as well as prepare the labor force that becomes part of the public sector (government), the private sector (entrepreneurs, farm producers, agri-business entities) and the NGOs. An education system that is innovative and responsive to the complex and rapidly changing work environment is critical to ensure the effectiveness of all the institutions that contribute to agricultural development agenda. To make the education system responsive requires developing and implementing curriculum and teaching programs that are relevant to the production needs and employment demands of the agricultural sector. This paper reviews recent literature on experiences gained in the development of innovative and demand-driven curriculum to make the agricultural education system serve the needs of smallholder farmers in developing countries. The focus is on curriculum enhancement and reform in the post-secondary agricultural education system.¹

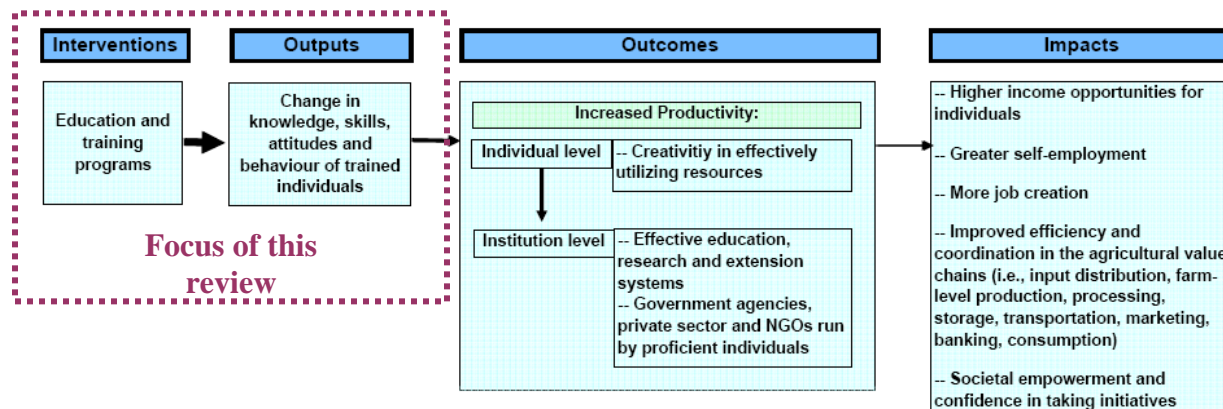
Conceptual Framework

Figure 1 illustrates a simplified and generalized interventions-to-impact pathway of educational programs adapted from Maredia (2007). At the heart of most development interventions, is an attempt to bring about change in people with an ultimate goal of realizing development impacts that result from collective changes aggregated across a large number of individuals (Taylor 1998). For educational interventions, the intended output is change in people's knowledge, understanding, skills, attitudes and behavior (Figure 1). The outcome of this change from education is expected to result in a person having an increased capacity (empowerment) to make decisions and to choose, implement and evaluate strategies/options in a complex and rapidly changing environment, while effectively utilizing the available resources. This increased capacity to make informed and knowledgeable decisions with available resources is essential for improving “productivity” at the individual level (i.e., labor productivity of persons trained by the education system) and at the institution level (i.e., institutions where trained individuals are employed) (Figure 1). A well-trained pool of individuals employed in core institutions (e.g., research, extension, education, government, private sector and NGOs) that directly or indirectly serve participants through out the agriculture-based value chains (from input providers, farm-level producers and processors to traders, retailers and consumers) can then collectively increase the productivity of the agriculture sector. The ultimate impacts (along with other appropriate interventions and outcomes) will be increased private as well as public benefits from education (Bloom et al. 2006b). This will be reflected in indicators such as

¹ The post-secondary agricultural education system, in this paper, is broadly defined to include all tertiary level agricultural education providers. It can be located in agricultural universities or in colleges or departments of agriculture in the wider university; diploma granting (sometimes third level sub degree) institutes or polytechnics. The scope includes traditional and distance learning degree programs, short term – diploma or certificate courses that prepare technicians for entry level extension work or entry level technician work with the public or private sector, in-service training programs for extension staff, farmer training of short duration, adult training and young farmer education and training (both formal and informal).

improved income opportunities for trained individuals, greater self-employment, self-confidence, more job creation, and an efficient and well-coordinated agricultural value chains serving input providers, farm producers, processors, traders, financial institutions and consumers (Figure 1).

Figure 1: A generalized impact pathway for post-secondary educational interventions



Arrows in the impact pathway indicate the direction of influence and its thickness indicates level/degree of influence on an effect

Source: Adapted from Maredia (2007)

As indicated by the tapering thickness of the arrows in Figure 1, the influence of education and training programs as a single intervention decreases as one moves away from outputs to outcomes to impacts.² This is because other types of interventions (e.g., infrastructure, policies, technologies, etc.) are also required to realize the ultimate impacts. However, suffice to say that education and training interventions at the post-secondary level are necessary conditions for realizing these developmental impacts as confirmed by recent empirical studies linking higher education with economic growth (TFHES 2000; World Bank 2002, Bloom et al. 2006a, 2006b; Tilak 2007). The agricultural education system, as a subset of higher education, thus plays a critical role in promoting broad-based economic growth and structural transformation by raising labor productivity in core institutions (research, extension, education) and across the government, private and NGO sectors focused on agricultural development.

The challenges associated with strengthening the first set of influence (depicted by the arrow between interventions and outputs in Figure 1) such that it ensures the realization of outcomes and long-term development impacts is the focus of this paper. The skills, knowledge, attitudes and behavior exhibited by an individual in a work environment depend on: a) the level and type of education that individual has received; and b) the “learning” that takes place during an individual’s formal and informal education. The process by which individuals actively “learn” from an educational program (whether in groups or individually) and the content of that “learning” is referred to as the “curriculum.” It encompasses the educational purposes to be attained and the educational experiences provided to achieve those purposes (see FAO 1998 for various definitions).³

² Note however, that innovations within the education system (esp. in curricula and delivery methods) can strengthen these linkages and increase the likelihood that educational interventions will result in desired outputs, outcomes and long-term impacts.

³ It is important to draw a distinction between the terms curriculum (which is the focus of this paper) and syllabus. The syllabus is the list of contents of a course—**how** the curriculum is to be taught. The curriculum, on the other hand, is much broader than the syllabus. It deals with the issues of **what** or **why** the subject matter is to be included and with the identification of both the common and differentiated roles of the teachers and the students in the learning process.

For the “formal” post-secondary educational system to be effective in fulfilling its role in supplying well-trained and productive work force for the agricultural economy, the curriculum must have as many of the following desired characteristics as possible:⁴

1. Adaptive to local environment: Curricula must be geared towards addressing local trends and factors that influence agricultural development agenda.
2. Demand driven: Curricula and teaching programs must be relevant to the clientele needs and employment demands of the agricultural sector.
3. Innovative and interactive: It must make use of innovative and interactive tools, methods and approaches to deliver the content of education that maximizes the “learning” of intended skills, knowledge and practices.
4. Dynamic: The curriculum must not be a fixed and authoritative structure which contains the organized content for learning. It should change and evolve as the clientele needs and employment demands change.
5. Quality: The curriculum must meet accreditation standards of quality in order to produce trained human resources with qualifications that are accepted by prospective employers.
6. Cutting-edge: The curricula must keep pace with and incorporate new advances in science and technology to prepare students for taking up or creating new employment opportunities.
7. Versatile (meet needs of diverse groups): The curricula and training programs in agriculture must not only meet the learning requirements of fresh trainees/graduates seeking employment for the first time but also of unemployed and under-employed people, dismissed public-sector workers, and agricultural professionals seeking career changes and advancement. It should also benefit and meet the needs of both the gender. It must be flexible to allow students to create unique interdisciplinary majors to meet individualized curriculum program needs.
8. Focused on imparting skills and abilities that are transferable to a wide range of occupations: The curricula must focus less on specific technical knowledge that will quickly become obsolete and more on processes and abilities of students to critically think and solve problems that are relevant to societal needs.

The current general state of agricultural curriculum in developing countries with respect to these desired characteristics, and experiences gained in implementing different approaches to develop, enhance and reform agricultural curriculum to incorporate these desired characteristics are the two main focuses of the literature review presented in this paper. The purpose is to identify constraints, challenges and successful examples of these approaches so as to derive recommendations for ways forward.

3. Agricultural Curriculum in Higher Education System in Developing Countries: An Overview of the Current Situation

In many developing countries, especially in Sub-Saharan Africa, Asia and Latin America,⁵ the higher agricultural education system is experiencing serious problems of low quality, irrelevancy, lack of funding, poor infrastructure, low faculty morale, and high graduate unemployment (Maguire and Atchoarena 2003) (see Annex 1 for a summary). In this broader context, the need for curriculum enhancement and reform is often presented as one of the solutions to these problems and to making the agricultural education system more responsive to the needs of rural and agricultural development.

⁴ These are based on author’s experience and judgments formed from the common themes and generic patterns emerging from the literature review.

⁵ By comparison with the general literature on constraints, challenges and opportunities in the higher education system, the literature around innovations and reforms solely focused on the agricultural curriculum is relatively limited. Therefore, the overview and discussions presented in this paper are frequently drawn from the broader literature on the higher education system in the developing country context.

In addition to reviewing the literature, the author engaged in personal communications with administrators/faculty members of many higher education institutions in Africa and Asia to learn more about the process and frequency of curriculum changes and other pertinent information about the outputs of their graduate programs in agriculture.⁶ In all of these “sampled” institutions curriculum review and change is a routine process that occurs at a frequency of four to five years. The process usually entails following steps: The curriculum review usually starts from the academic unit; a small internal committee is normally formed to look at the syllabus and course contents and submit a report to the Unit/Faculty/College. Once the initial report is submitted, inputs are sought from relevant stakeholders (for agriculture, it includes the Ministries of food, Agriculture, Land, Forestry, etc., NARS partners, NGOs, professional organizations, etc.). Stakeholder participation may be at a formal meeting to which they are invited or by correspondence in which case copies of the draft program are sent to them. All the comments/suggestions are then incorporated in the final draft document to be prepared by the College Board for the attention of the University's Academic Board (or Senate) where the final approval is given for implementation of revised or new programs.

Although this sample was not scientifically selected to represent the whole population of higher agricultural education institutions in developing countries, studies reviewed do confirm this process and frequency to be a general practice in most agricultural higher education academic institutions in developing countries (e.g., Sundstol 2004). Taylor (1998) characterizes this process as hierarchical, top-bottom, and content-oriented approach to curriculum development. At best, some stakeholders are consulted in this process, but this as Taylor (1998) claims, may simply be a gesture of inclusion. The curriculum development process is controlled by the experts (faculty members, administrators and policy-makers) who make the judgments and decisions about what should be learned by the learners. Taylor (1998) notes that “...this hierarchical approach is likely to result in the content being the basis of curriculum development. Policy-makers and subject matter specialists, for example, choose topics and subjects that they feel are necessary and desirable in order to achieve predetermined outcomes. A training needs analysis may be carried out but, in the end, the decision on the curriculum content and the objectives rests with the group of experts.”

Thus, the issue is not that there are no attempts made to review and change the agricultural curriculum over time, but whether the process followed and changes made really meet the needs of stakeholders and the broader goal of rural development. This is an issue; because despite the review processes in place, many agricultural education curricula have shortcomings. A list of common shortcomings mentioned in the literature can be grouped under the following categories:

1. Disconnect from realities in rural areas: Several studies point that the curricula implemented in agricultural higher education system are irrelevant, inappropriate and unresponsive to socio-economic and technological changes in the rural sector (Wallace, Mulhall and Taylor 1996 cited by Taylor 1998). Part of the reason for this disconnect is that the urban origin of agricultural students is now so dominant in agricultural higher education system, that students have little knowledge and experience of rural areas (FAO 1997). The curricula are not geared towards orienting these urban-based students to issues, constraints and experiences in rural areas.
2. Disconnect from realities in labor market: Several studies underscore the agricultural curricula's shortcoming with regard to labor-market preparation. Rivera (2006) contends that agricultural higher education institutions do not have a good understanding of the labor market for agriculturally oriented professions. The system has not kept pace with the labor market realities,

⁶ Author's personal communications in June-August 2007 with Dr. J. Lungu (Dean, College of Agriculture, University of Zambia), Dr. I. Kosley, (Dean's Office, Faculty of Agriculture, Egerton University), Dr. N. Mdoe (Dean, Faculty of Agriculture, Sokoine University of Agriculture), Dr. M. Bekunda (Dean, Faculty of Agriculture, Makerere University), Dr. S. Osei (Provost, College of Agriculture and Natural Resources, Kwame Nkrumah University of Science and Technology), Dr. G. Kanyama-Phiri (Principal, Bunda College of Agriculture), M. Malunga (Lecturer, Zambia Forestry College), L. Pelembe (Professor, University of Eduardo Mondlane).

have not tracked the changing human resource needs in the agricultural sector, to align the profile of human resource outputs with the agricultural development strategy, and to ensure that students are not prepared for jobs that do not exist.⁷

3. Inappropriate teaching approaches and methods, and lack of effective delivery mechanism and modes. Curriculum and teaching methods tend to be traditional lecture methods, too theoretical with little practical training to meet needs of agricultural labor market (Johanson and Saint 2007; Rivera 2006). Agricultural education system has not tapped in to digital technologies (distance education, e-learning, and course management systems), which offer considerable potential for in-service staff development, knowledge upgrading, or just-in-time learning. In general, distance-education initiatives are not yet mainstreamed and do not contribute significantly to increasing access to higher education in developing countries.
4. Rigidity: This refers to the inability of the curriculum for real-time modifications and to change/evolve to suit the needs and profiles of student community. For example, the curriculum does not allow for students to: be admitted during any semester of the academic year; move from one degree course to another related program with credit transfers and move from one university to another also with credit transfers. This latter flexibility allows students to shop around, and makes universities struggle to excel to retain students. This also refers to the inability of the curriculum to adapt to the needs of students from various backgrounds and stages of professional careers (fresh high school graduates to extension workers, working professionals and farmers).

In summary, this list of shortcomings (which is not at all exhaustive) suggests that the agricultural curricula in higher education systems lack many of the desired features listed on page 3 of this paper. Reasons for this less than desirable state of post-secondary agricultural education system in many developing regions, especially in Sub-Saharan Africa (SSA) and South Asia are numerous, involving both exogenous and endogenous factors. However, one of the common reasons presented in the literature include the fact that education was the most neglected component of the AKIS triangle investments by national governments and international donors (especially the World Bank) (Rivera 2007).

4. Challenges for Innovative Changes in Agricultural Curriculum: Driving Forces, Responses and Guiding Principles

Parallel to descriptions found in the literature on the dismal state of agricultural curricula, there are also discussions about the contemporary and broader global issues surrounding agricultural higher education, in relation to which the challenges for innovative change must be made. These “global drivers of curriculum change” identified from literature review include: 1) The changing profiles of students pursuing agricultural higher education; 2) Rapid scientific progress and technical change in an information-driven global economy, and challenges posed by global issues; 3) The changing labor market; 4) Emergence of information and communication technologies (ICTs); 5) Increased awareness of environmental issues; and 6) Increased awareness of gender issues.

Table 1 describes the implications of these global “drivers of change” and innovative curriculum responses/guiding principles for curriculum development suggested in the literature to address these challenges. For example, the increasing urban-based profile of agricultural students all over the world requires designing special education programs to introduce them to rural life and village people. This is driving some institutions to look for ways to ensure that these students gain a practical understanding of the realities of rural and farm life.

⁷ This disconnect between agricultural education system and the changing human resource needs is illustrated by the example of Indian agricultural universities that produce less than 100 graduates in food processing when the country has projected a need for about 200,000 professionals by the end of 2010 (Katyal 2006).

Table 1: Driving forces of change, challenges for curriculum development and innovative responses discussed in the literature to meet the challenges

Driving forces of change	What it means?	Challenges for curriculum development	Innovative responses suggested in the literature to meet the challenges
<p>Changing profiles of students pursuing formal agricultural higher education</p>	<ul style="list-style-type: none"> • More and more students are urban-based • More and more are working students, stay-at-home students, traveling students, part-time students, day students, night students and weekend students • Agriculture is not attracting best quality students • Agriculture and rural development may not be their long-term career goals 	<ul style="list-style-type: none"> • Need to design education programs to introduce students to rural life. • Need to retain and/or increase student interest in agriculture/rural development • Need to meet the diverse needs of different types of students 	<ul style="list-style-type: none"> • Integration of students in rural life through practical training. • Include field seminars organized with the participation of farmers and farmers' organizations throughout the courses. • New course/program structures to meet diverse student community needs (intensive courses, week-end courses, flexibility in course requirements, time to complete a program, etc.)
<p>Rapid scientific progress and technical change in information-driven global economy; and challenges posed by global issues (e.g., climate change, biofuel, HIV/AIDS)</p>	<ul style="list-style-type: none"> • Need to find new solutions to emerging challenges/issues • Short “shelf life” of knowledge, skills, and occupations • Premium placed on a person’s ability to access “information” and agility to acquire new “knowledge” 	<ul style="list-style-type: none"> • Need to continually update curricula (need new subjects and types of courses to understand today's agriculture). • Students need skills and attitudes that will allow them to continue to learn effectively and to develop their own competencies during the rest of their working lives. • Adapting global knowledge to local conditions • Farmers need continual update in knowledge and skills to remain competitive in local/global markets 	<ul style="list-style-type: none"> • Shift away from a curriculum focused on production agriculture to productivity by integrating new subjects and courses. • Curriculum focused on preparing highly trained specialists at higher degree levels and broadly educated generalists at intermediate levels • Curriculum based less on memorization of facts and more on building critical thinking skills and analytical skills • Curriculum flexibility and course structures that allow life-long learning • Curriculum that strengthens effective delivery of non-formal education to farmers (through extension workers, teachers)
<p>The changing labor market</p>	<ul style="list-style-type: none"> • Declining importance of government as the primary employer of graduates • Emergence of private sector through out the value chain • Self-employment increasingly sought as an option after graduation 	<ul style="list-style-type: none"> • Need a major shift in the content of agricultural education from a production to a market orientation. • Better relate curricula to employment opportunities in different sectors. 	<ul style="list-style-type: none"> • Curriculum more focused on productivity issues and principles of market competitiveness • Integrate new subjects and courses that will be in demand by private sector—viz., food processing and post-harvest technologies, biotechnology, agri-business management and farming systems development • Curriculum that imparts students with good communication skills • Integration of special student-developed projects in the curricula that impart business skills, promote entrepreneurship

Driving forces of change	What it means?	Challenges for curriculum development	Innovative responses suggested in the literature to meet the challenges
Emergence of information and communication technologies (ICTs)	<ul style="list-style-type: none"> • Scientific knowledge is changing rapidly as modern communication technologies facilitate the sharing of information among educationists and researchers • New opportunities to access knowledge and information globally 	<ul style="list-style-type: none"> • Making use of ICTs in a cost-effective manner (sustainability) • Adapting ICTs to local conditions • Teaching students skills to use ICTs 	<ul style="list-style-type: none"> • Integration of distance education in agricultural curricula • Curriculum based on new teaching methods and approaches that utilize ICTs
Increased awareness of environmental issues	<ul style="list-style-type: none"> • Sustainability of agricultural and natural resources has become an important developmental goal • Increased environmental stewardship role of higher educational institutions 	<ul style="list-style-type: none"> • Curricula need to incorporate sustainable development issues • Curricula need to foster open-mindedness to innovations and foster participation among different stakeholders 	<ul style="list-style-type: none"> • Curriculum focused on Interdisciplinary teaching and research • A holistic/systems approach to economic, social, cultural, ecological and public policy concerns to technological change • Problem-focused curricula • Learning activities that are based on first-hand experience of the physical and social environment • Participatory approaches/methods to teaching and R&D • Curriculum that empowers local NR users to make their own analysis and decisions • Incorporate new skills such as environmental economics and impact assessment.
Increased awareness of gender issues	<ul style="list-style-type: none"> • Increasing recognition of the vital roles played by women in all areas of the agricultural sector • Need for women to have access to the knowledge and skills related to agricultural production, processing and marketing 	<ul style="list-style-type: none"> • Developing gender-sensitive teaching and training programs • Curriculum that attracts women to pursue higher agriculture education 	<ul style="list-style-type: none"> • Curricula that provides education and information about rural women's problems, potentials and aspirations. • Course structure and content that promotes equal gender benefits • Curriculum that strengthens effective delivery of non-formal education to women in rural areas (through extension workers, teachers)

The FAO report (1997) cites two examples of successful implementation of these practices: 1) The Faculty of Agronomy of the University of Buenos Aires in Argentina which has organized a series of field seminars throughout its courses since 1981. All seminars are organized with the participation of farmers and farmers' organizations. 2) The Institut Agronomique et Vétérinaire Hassan II, Morocco which conducts a system of practical field training periods as a fundamental part of its teaching program. The practical work is carried out with rural people who take an active part in the students' work. The changing profiles of students pursuing higher education also means that educational institutions will have to organize themselves to accommodate the learning and training needs of a more diverse clientele such as working students, stay-at-home students, traveling students, part-time students, day students, night students, weekend students, and so on. The EARTH College in Costa Rica provides yet another example of how a college has successfully implemented these practices and made it an integral part of the curricula for undergraduate degree education (Zaglul 2007).

New advances in science and ICTs are yet another driving force for continual update and change in curricula. They influence the subject matter and types of courses students need to understand today's agriculture. Several studies identify food processing and post-harvest technologies, biotechnology, agri-business management and resource management for sustainability as some of the subject areas which need to be incorporated into curricula (Johanson and Saint 2007, p. 49). Rapid advances in S&T also necessitates that students develop the skills and attitudes that will allow them to continue to learn effectively and to develop their own competencies during the rest of their working lives. The Task Force on Higher Education and Society convened by the World Bank and UNESCO note that in the knowledge economy, highly trained specialists and broadly educated generalists will be at a premium, and both will need to be educated more flexibly so that they continue to learn as their environment develops (TFHES 2000). The second dimension of this short "shelf life" of knowledge, skills, and occupations is the growing importance of continuing education and of regular updating of individual capacities and qualifications (Wagner 1999). It also implies diminished emphasis on remembering countless facts and basic data and the growing importance of methodological knowledge and analytical skills—the skills needed for learning to think and to analyze information autonomously. The curricula thus need to be increasingly based on the capacity to find and access knowledge and to apply it in problem solving. Learning to learn, learning to transform information into new knowledge, and learning to translate new knowledge into applications become more important than memorizing specific information.

The World Bank argues that rapidly changing market conditions require a major shift in the content of agricultural education from a production to a market orientation (Maguire and Atchoarena 2003), from discipline- and department-focused to inter-disciplinary.⁸ However, note that in countries where a majority of farmers are still dependent on farming for food security, production agriculture should remain an important focus of agricultural curricula (especially in public institutions). Strengthening "market orientation" in agricultural curricula should not come at the cost of weakening production agriculture.⁹ Given the current need to "substitute growth through increased input use" with "growth driven by a more knowledge-intensive agriculture" (World Bank 2004:13-14), it becomes important that the agricultural curricula impart knowledge and skills that are demand-driven, including demand from small-holder farmers, and better related to employment opportunities. This requires a continuous analysis of smallholder needs, market needs and employers' requirements in order to plan and develop appropriate curricula. Consultations with farmer groups and prospective employers are essential for curriculum reform and to obtain estimates of the types of positions that are likely to be available for graduates.

⁸ The early emphasis of many agricultural universities in the developing world was on modernizing farming practices through an emphasis on applied innovations in biology and chemistry and minimal attention was given to social sciences. As early as 1990, Hansen (1990) argued that this emphasis on the sciences (at the expense of disciplines such as social sciences) and a department-based format has kept the agricultural university from enhancing its role in society and has seriously weakened its ability to establish a strong political base from which to derive sustenance and support.

⁹ See more discussion in Section 5 on developing and enhancing curriculum and education programs targeted towards smallholder farmers.

Given the close link between agriculture and environment, agricultural education institutions need to incorporate sustainable development issues in their curricula. A holistic approach should be applied when incorporating the concept of environmental and sustainable development since it relates not only to technological concerns, but also to economic, social, cultural, ecological, and public policy matters. It will necessitate a change in attitudes, practices, policies, goals and resource allocations. In particular, an open-mindedness and willingness to innovate should be fostered with attention paid to participatory approaches to making decisions. Environmental issues will clearly require an interdisciplinary research and teaching approach, and learning activities that are problem-focused (Mertz et al. 2000).

Lastly, several studies point to the need for the curricula to better meet the need for women to have access to the knowledge and skills related to agricultural production, processing and marketing. In most cases, male and female audiences will need different treatment and approaches within a given formal or non-formal educational program. Crops grown,¹⁰ time constraints, and farm and family responsibilities are not the same for men and women, and educational programs must take into consideration these "differences" in order to have equal benefit from educational offerings. Kwapong (2005) provides examples of harnessing the potentials of some innovative technologies for rural adult women education to bridge the rural-urban and especially the gender divide.

These driving forces (listed in Table 1) have increased demand for higher education institutions to function as market-like organizations in the context of fiscal constraints as well as orient the curriculum to issues of direct relevance to food security and poverty in rural spaces. With this paradigm shift comes emphasis on quality rather than quantity, broader development of the rural economy rather than production agriculture, and experiential learning focused on inductive reasoning skills rather than factual and specialized knowledge solely based on text books. Revised and reformed agricultural curricula also need to better reflect the importance of social and environmental issues for sustainable agricultural development and a better understanding and incorporation of the underlying psychological processes that influence learning. However, one must note and be cognizant of the fact that these global driving forces may not be 'active' at the same rate/intensity across all developing regions. Some of these "drivers" of change, such as rapid scientific progress and ICTs may be more advanced in Asia and Latin America than say, for example, in sub-Saharan Africa. Thus, the innovative responses suggested in Table 1 based on the literature review needs to be adapted to specific country situation depending on the presence or absence of a particular "driving force."

The global "driving forces" described in Table 1 point to the need for curriculum development and change to be a continuous and dynamic process in higher agricultural education institutions. If institutions don't keep pace with these driving forces, they risk being out-dated and ineffective in realizing outputs, outcomes and impacts anticipated from such interventions (see Figure 1). The literature contains several examples of various agricultural higher education institutions embracing the need for curriculum change and reform and moving in the direction of updated, broadened curricula. Table 2 tries to capture some of these examples organized around the guiding principles of good practice in curriculum development emerging from the literature review.¹¹ The examples include references, and where available the URL of websites where more information can be accessed by interested readers.¹²

¹⁰ Although, a simple distinction between men's and women's crops cannot be made across countries, there are many crops that are disproportionately grown by men or women (Doss 2002). For example, the harvesting and processing of *shea* is primarily an activity of rural women in many West African counties.

¹¹ Note that this is not an exhaustive list.

¹² An excellent source of additional examples of good practices in agricultural education reforms (which includes curriculum change and reform as a component) is the website of the SEMCIT initiative (<http://www.changetropics.org/>). Annex C of one of their workshop document available online lists several region-specific studies documenting strategies and inventory of good practice and innovations in Asia, Africa and Latin America (http://www.hcmuaf.edu.vn/cpb/phtqt/workshop_document.htm#The%20Change%20Agenda).

Table 2: Examples of Elements of Agricultural Curriculum Development/Enhancement Based on Guiding Principles Derived from Literature Review

Guiding Principles for Agricultural Curriculum Development/Enhancement		Examples/references of good practice
Innovative	Flexible course/program structures to meet diverse student needs	<ul style="list-style-type: none"> Continuing Agricultural Education Center at Makerere University, Uganda, offers short-term training, outreach programs, and workshops/seminars to extension workers, agribusiness and receptive farmers (Obua 2006, p. 12). The Sasakawa Africa Fund for Extension Education (SAFE) set up to strengthen the capacity of universities and colleges to develop farmer-focused formal continuing education programs for mid-career agricultural and rural development workers (Naibakelao 2000).
	Use of distance and open access education	<ul style="list-style-type: none"> The Methodist University in Meru, Kenya has put together a six-month distance education program for agricultural professionals and farmers and includes occasional hands-on workshops (cited in Johanson and Saint 2007, p. 51). Imperial College London Distance Learning Program has some 1,000 students from more than 100 countries. It offers postgraduate study programs, certificate programs and short courses in applied economics and business, development and sustainability, and environment and biodiversity. Students benefit from up-to-date interactive material and online learning support, and their degrees are awarded by the University of London. http://www.cefims.ac.uk/cedep/ The Central Agricultural Broadcasting and Television School (CABTS) in China operates in a cost-effective manner, reaching large numbers of students across vast geographic areas in rural China. The School is dedicated to serving rural areas, agriculture and farmers. CABTS provides education and training services to diverse audiences, including youth, grassroots leaders, agricultural technicians, women, ethnic minority group members, and farmers, whose education levels range from those who cannot read or write to those working toward university degrees. http://www.agrifoodasia.com/English/partners/crde.htm See Siaciwena (2000) for excellent examples and case studies of how this approach is used for non-formal education of farmers.
Experiential/learner-centered	Practical/field-based training	<ul style="list-style-type: none"> Agricultural Technical and Vocational Education (ATVET) program in Ethiopia (Vandenbosch 2006) See more examples in Johanson and Saint (2007), p. 50-51.
	First-hand experience of the physical and social environment	<ul style="list-style-type: none"> Makerere University Agricultural Research Institute, Kabanyolo (MUARIK) is an agricultural research and training facility within the Faculty of Agriculture. MUARIK is mandated to undertake innovative applied research and is involved in agricultural technology development and transfer. It is also a home to the third year B.Sc. Agriculture students to enable them undertake research and get familiar with the farm environment (Obua 2006, p. 12). Raghavan and Nemes (2005) list 14 principles and 12 conditions that have to be applied for successfully adopting a learner-centered education system.

Guiding Principles for Agricultural Curriculum Development/Enhancement		Examples/references of good practice
Evolutionary/ market-driven	Integration of new subjects and courses	<ul style="list-style-type: none"> Johanson and Saint (2007) give some examples of the integration and introduction of new subjects and courses in traditional agricultural universities in Africa. For e.g., new degree programs in agribusiness at the University of Cape Coast, Ghana and Bunda College, Malawi; and post-harvest technology studies, agricultural business studies and entrepreneurship at the University of Ghana. The establishment of new faculties and the College of Rural Development (CORD) at the China Agricultural University is one of the reforms of higher agricultural education institutions in China that took place in 1990s described in Yonggong and Jingzun (2004).
Skill-building	Management and business skills (i.e., entrepreneurship mentality)	<ul style="list-style-type: none"> Baraka Agricultural College, Kenya focuses on entrepreneurship and self-employment. Students undertake commercial operations on individual 10 square meter plots with a loan from the college. They keep proper records of production and expenses, employ the appropriate husbandry practices, purchase inputs and sell produce. The students then repay the loan and keep the nest income. The learner-based approach is also reflected in four-month field attachments for each student: www.sustainableag.org See also EARTH College, Costa Rica. http://www.earth.ac.cr/ing/info_general.php.
	Promotion of lifelong learning skills (critical thinking skills, communication skills and analytical skills)	<ul style="list-style-type: none"> Massey University, New Zealand implemented major reform of the undergraduate degree program in horticulture which resulted in greater emphasis being placed on developing attributed of lifelong learning in students. This included action learning strategies, writing-to-learn exercises, group discussion, oral presentations, experiential learning in labs) (MacKay et al. 1999)
Cost-effective/sustainability	Utilization of ICTs	<ul style="list-style-type: none"> See Gasperini and Mclean (2001) for example of how FAO is using ICTs in various distance education projects, including training for farmers and farm families, and linking agricultural research and extension institutions. They contend that the use of ICTs has been most appropriate at higher-education level and most cost-effective in the training of teachers and extension agents (training of trainers).
	Adaptive to local conditions and problem focused	<ul style="list-style-type: none"> Kwadaso Agricultural College, Ghana, in collaboration with the University of Cape Coast and with help from SAFE, has developed a 2-year diploma program for extension workers who have a certificate. A key feature of the revised extension curricula is supervised enterprise projects in which students spend 6 to 8 months in the field working with farmers to introduce a new technology adapted to local conditions. The projects allow students to meld their newly acquired knowledge with their experience while sharpening skills in interacting with farmers. Faculty advisors visit each student's project to monitor progress and to offer counsel. A report on the project's outcome is part of the student's B.Sc.

Guiding Principles for Agricultural Curriculum Development/Enhancement	Examples/references of good practice	
		requirements. (http://www.saa-tokyo.org/english/safe/)
Multi-disciplinary	Interdisciplinary	<ul style="list-style-type: none"> • Interdisciplinary food security studies at the University of KwaZulu-Natal, South Africa includes trans-disciplinary course modules on food production, storage and access, nutrition, sustainable livelihoods, food security information systems, simulation modeling and research methodologies (http://acfs.ukzn.ac.za/HomePage800.aspx) • Lessor et al. (1997) provide example of an interdisciplinary field course in Costa Rica focused on sustainable development that integrated sociology and political economy with agricultural ecology. The curriculum was empirically based, involved working collaboratively, and utilized multidisciplinary investigation.
	Holistic/systems approach	<ul style="list-style-type: none"> • EARTH College, Costa Rica exemplifies this principle in their curriculum built on the following four pillars that promotes: social and environmental responsibility, technical and scientific knowledge, entrepreneurial mentality and ethics and positive values (Zaglul 2007).
	Broader technical and science foundation, vis-à-vis specific knowledge of real-world issues.	<ul style="list-style-type: none"> • Zertuche (2005) describes the experience of the School of Agriculture at ITESM, Monterrey, Mexico in implementing a major reform of its education strategy, which consisted of (among other things): providing students not only with technical training, but with an integral education that takes into account the importance of attitudes, ethical values and capabilities (i.e., humanities).
Participatory	Use and promotion of participatory approaches/methods	<ul style="list-style-type: none"> • See Hermsen (2000), Taylor (1998) and Rogers and Taylor (1998) for examples of participatory approaches to curriculum development. • See Wentling et al. (2001) for examples of participatory environmental education and training at several universities in Asia
Gender sensitive	Promotion of equal gender benefits	<ul style="list-style-type: none"> • See Fong and Bhushan (1996, p. 48-52) for examples of incorporating gender issues in agricultural education and training
	Attractive to women faculty and students	<ul style="list-style-type: none"> • Karl (1997) provides experience and examples from five countries: Jordan, The Philippines, Jamaica, Nigeria and Cote D'Ivoire
Environmental stewardship	Promotion of balance between agricultural production and environmental preservation	<ul style="list-style-type: none"> • EARTH College provides a good example of how this principle is integrated in their mission and vision statements and reflected in their curriculum. http://www.earth.ac.cr/ing/info_general.php. • See Wentling et al. (2001) (cited above) for examples from Asia of integration of environmental education in agricultural training.

5. Curriculum Development with a Focus on Smallholder Farmers

Ideally, the ultimate beneficiary of an agricultural curriculum which is developed based on the guiding principles and examples illustrated in Table 2, in a developing country context, should be the smallholder farmer. However, in reality this may not be the case. First, given the limited involvement of smallholders in commercial agriculture, the “market-driven” and “technology-driven” curriculum reforms may by-pass them or only peripherally impact them. Second, it is very rare that a smallholder farmer will go through formal education beyond secondary school and thus will not directly benefit from the reformed post-secondary education system. Although the average number of school years of adults (age 15+) has increased dramatically in the last 40 years, it is still 3.4 and 4.6 years (as of 2000) in Sub-Saharan Africa and South Asia, respectively (Barro and Lee 2001 cited in Pardey et al. 2007). Thus, more likely than not, a farmer will be linked with the AKIS-knowledge triangle through interactions with people who are trained in the formal higher education system rather than as a direct beneficiary of post-secondary education.

Figure 2 illustrates the level of formal education individuals working in different types of institutions serving the agriculture sector are likely to have and their “distance” from direct interactions with smallholder farm families in a developing country setting. There is almost a positive relationship between the level of education and the direct interactions with small-holder farmers. This poses two challenges for post-secondary agricultural education system: 1) How to develop a curriculum focused on preparing individuals with different levels of tertiary education that can play an effective role as links between the formal education system (which is the source of their knowledge, skills and information) and the non-formal education system (which will be the most likely channel of transferring the knowledge, skills and information to farmers)? and 2) How can institutions of higher education play a developmental role through outreach activities and establish direct linkages with farming communities? Addressing both these challenges (enhancing the traditional teaching role as well as taking up a developmental role) requires change and reform in the education system beyond curriculum enhancement (something which is beyond the scope of this paper). However, there are three strategic approaches to addressing these challenges that should be given considerations in the discussion about smallholder-focused agricultural curriculum enhancement/reform.

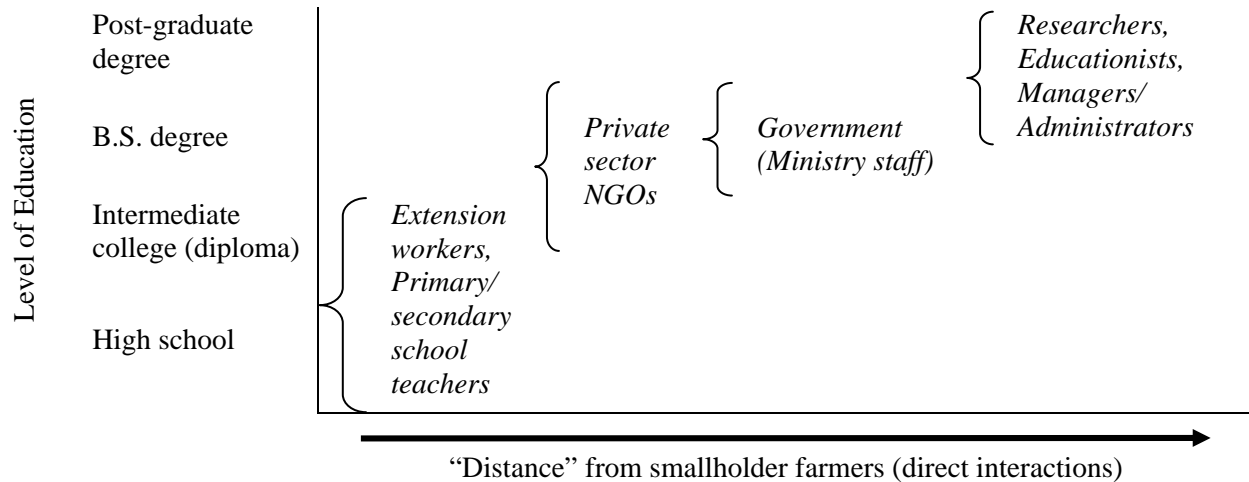
First, as indicated in Figure 2, the field-level extension workers, who mostly have high school or intermediate level of college education, maintain the most direct interactions with smallholder farmers. Thus, **non-formal education (through extension and input service providers—public, private or NGOs) becomes an important vehicle for linking the knowledge and information system with farm families.** Strengthening the curriculum of programs that train this group of people in the agriculture sector should therefore be an important goal of any curriculum enhancement/reform targeted towards smallholders. The Sasakawa Africa Fund for Extension (SAFE) program is a good example of this approach (Table 2).

Second, the teachers in the primary and secondary schools maintain close interactions with farm households in rural areas. But they are most likely to have at most high school or some level of college education. **Providing appropriate formal education to this group of development actors will ensure effective training of future farmers and residents of rural areas** (and of urban areas as rural populations eventually migrate to those areas as a result of structural transformation).¹³ A smallholder-focused curriculum in the

¹³ Although, not a focus of this paper, the development of appropriate curricula at the primary and secondary levels of education is equally important in ensuring that farmers are imparted with appropriate skills and knowledge. A curriculum focused on teaching general basic skills, such as literacy, basic math, and basic science knowledge may be better than providing detailed information about the most recent technological advances in agriculture. This will provide students with a foundation that they can use to learn on their own the latest technologies as they become available. A curriculum focused on basic skills can also reduce the cost of providing extension services when the students become farm operators or workers. Pardey et al. (2007, p.103) contend that general farmer education serves as a substitute for extension

higher education institutions should focus on training and upgrading the skills of staff that teach in the primary, secondary and vocational education programs targeted towards farm populations. A good example of this approach is the “Adopt-a-school” program at Central Luzon State University in the Philippines. This program encourages the faculty and students of the university to adopt a school and to develop collaborative projects as a way to build the teaching capacity of school, and to directly motivate and inspire the students from rural community (Asia Regional Advisory Team 2003).

Figure 2: Level of formal agricultural education of different agricultural development actors and their direct interactions with smallholder farmers in developing countries (especially in least developed countries)



A third approach would be to redefine the education system such that it gives smallholder farmers direct access to education components currently limited to higher education offerings. This means expanding the system to include education programs targeted to rural population (rather than solely creating an “elite” class of educated professionals). Group learning and participatory approaches such as farmer field schools and short-term training programs on specific themes/topics needs to be promoted to bring research and teaching conducted in higher education institutions “closer” to smallholder farmers. Several references listed in Table 2 provide good examples of some innovative curriculum reforms and the use of distance learning tools and open access programs that try to promote this approach (e.g., Obua 2006, Johanson and Saint 2007).

The ultimate desired characteristic of a good curriculum is to ensure that the post-secondary education system plays an effective role both as a teaching institution (that trains researchers, educationists, extension workers, policy makers, and workforce for the public, private and NGO sectors) and in its expanded role as a development institution for enhancing rural and agricultural development through direct farmer training, assisting in the development of curricula for primary, secondary and vocational schools that serve farm communities, and building greater institutional interconnectedness between multiple education actors in the agriculture sector (Maguire and Atchoarena 2003, Rivera 2006, 2007). Faculty and student outreach are important both to the teaching role and the developmental role of agricultural faculties and universities. The integration of research, education and extension that puts students and faculty in close touch with farmers

services, “since more-educated farmers can acquire information directly from a variety of sources, including sources that extension agents rely on.”

should be promoted. The SAFE program and other mid-career distance and mixed learning systems allow problem-based learning which encourages the communication of research done at the universities to be applied in communal areas. However a more direct and closer link between farmers, students and community projects may contribute to this. Involving students and recent graduates in development and entrepreneurial projects in rural communities is a very effective form of outreach that needs to be encouraged (Muir-Leresche 2003).

6. Ways Forward: Summary and Conclusions Emerging from Literature Review

Education is one of the most influential and powerful tools a society has for contributing to advancing knowledge and transforming lives. In developing regions like Africa, Asia and Latin America, where agriculture forms the base of the economy, for dramatic change to occur, change capable of transforming lives, a transformation in agricultural higher education is required—such that the higher agricultural educational systems are able to educate young leaders with the skills, knowledge and mindset that will enable them to transform the agricultural sector--making it more sustainable, more able to provide employment and capital to regional economies, and more responsive to the needs of rural populations. The colleges and universities need to produce graduates, diploma holders and short-course participants committed to serve rural communities and capable of developing and implementing new ideas - of generating employment rather than seeking employment.

Modernizing curricula and pedagogy at the post-secondary level, along with the necessary teaching inputs/methods is the most frequently cited ingredients of realizing this transformation. The focus of this paper was to survey the literature on experiences gained in agricultural curriculum development and reform at the post-secondary education level in developing countries with the aim of deriving lessons learned and recommending a way forward for those interested in supporting these efforts.

The review presented in this paper suggests that the challenges specific to agricultural curricula include the need to:

- Develop student-centered learning systems that encourage ethical, decisive, innovative, adaptable and reliable graduates.
- Train faculty in a new pedagogy which emphasizes active student involvement in an experiential, life-long learning process that encourages students to be independent and able to challenge the status quo.
- Train people to be creative and to develop low-cost, high-value technologies which are also environmentally friendly, using a country's abundant resources. To blend indigenous, traditional, imported and modern knowledge.
- Expose students to the global environment even with poor communications and limited resources
- Promote experiential-learning, where students learn subject matter, then apply that learning directly to a real-world problem.
- Use modern technology but with a focus on instruction and how the tools can be applied to gather and share information.
- Promote networking among all stakeholders, including educational institutions, governments, NGOs, civil society, private sector and the rural sector, is important to create synergies and develop an integrated, cross-disciplinary approach to curriculum development.
- Provide regular in-house seminars for teaching staff on innovative teaching-learning methods that promote effective student-centered learning.
- Provide basic instructional facilities (i.e., library, reference books, journals, computer and computer software).
- At the post graduate studies, establish strong research program as a part of knowledge based society tradition.

Higher education institutions in Asia and SSA have been faced with increasing enrolment and declining resources. This makes the challenge of transformation greater. Agricultural faculties have not been attracting the best students and their graduates are struggling to obtain employment. This highlights the need for agricultural graduates to be linked more closely with rural communities, to have more practical exposure and more marketable skills. They need to develop greater confidence and the ability to generate ideas and employment that would serve to increase incomes and enhance environmental integrity in rural areas.

Leaders, entrepreneurs and motivated practitioners are needed to steer farmers toward increased production and market orientation. To date, this has been promoted mainly by the bilateral and non-governmental organizations and private education institutions. The agricultural colleges and the faculties of agriculture in the universities have yet to produce the kind of practical entrepreneurs and commercial leaders needed at the rural level. Courses in “how to become an outgrower,” “how to organize a cooperative,” “developing value-added products,” and “creating a market information system” are likely candidates for re-designed curricula for agricultural education and training programs. Similarly, agricultural colleges and universities need to redesign their “outreach” programs such that it gives smallholder farmers direct access to “learning” opportunities in a higher education system. The curriculum reforms should enhance both the teaching as well as the development role of an agricultural higher education institution.

So how can this change be promoted to ensure agricultural education systems are teaching all the right things and outreaching the smallholder farmers? There are beacons of hope out there, as evident by the list of examples cited in Table 2 that shows that incremental change towards transformation is possible. As suggested by Maguire and Atchoarena (2003) and supported by this review change will never take place if education institutions fail to take the initiative. Leadership is critical in bringing about change. There must be a critical mass (but not necessarily a majority) of internal support for change to occur. There is much that can be done by international aid agencies to encourage and reward the efforts of those institutions committed to positive change. Expanding networking and support for those involved in the change process and providing training, facilities and ideas to promote this change are key roles supporters of these efforts can play.

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Annex 1: The Need for Change and Reform in the Broader Agricultural Higher Education System in Developing Countries: Summary of Main Messages from the Literature Review

Although the focus of this paper is only on the enhancement and reform of one aspect of post-secondary agricultural education system (namely, curriculum), it is useful to put curriculum enhancement and reform within the broader context of the development and change desired in the overall agricultural higher education system for it to serve its strategic role in the knowledge triangle. This encompasses issues related to: Policy and funding (which is the basis of national strategy and financial commitments); System governance (which defines structural arrangements, accountability and stakeholder representation); Human resource development and staff incentive/reward system (i.e., teaching and staff training to maintain curriculum relevance, staff retention and hiring); Curriculum development (providing knowledge of direct and contemporary relevance); Institutional linkages (i.e., collaboration with other educational institutions and strategic alignment of the knowledge-triangle institutions (AKIS) and with the agricultural innovation system (AIS)); and Physical infrastructure, equipment and communications technology (i.e., buildings, laboratories, instructional farms, libraries, internet access, and computer availability) (Rivera 2006).

The ways in which the higher agricultural education institutions address the above issue areas determine the extent to which the education system as a whole is able to keep up with the demands of today's global economy. The literature contains many studies and review reports that discuss the status and broader challenges facing the higher education system in developing countries in general, and the agricultural education system in particular (Rivera 2006, 2007; Van Crowder et al. 1998; Aker 1999; Tumapon 2004). Maguire and Atchoarena (2003) provide a good summary of the main problems with higher agricultural education based on the common themes emerging from recent literature. These are reflected in the following problem statements (Maguire and Atchoarena 2003, p. 316):

- National support for agricultural education has weakened;
- Investment in agricultural education by governments, donor agencies and organizations has dropped dramatically from the highs of the 1960s and 1970s;
- Funding is inadequate to maintain physical facilities and support minimum standards;
- The combination of lower investment and support has contributed to a qualitative decline in many agricultural education and training systems;
- Teaching and research standards have dropped; Insufficient practical and job-related skills are taught;
- Political interference prevents rationalization of undergraduate and trainee intake, leading to overcrowding, decreasing per capita funding support, and low staff morale;
- Isolation has encouraged inbreeding in staff appointments;
- Agricultural education has tended to become isolated from mainstream academia;
- Curricula do not keep pace with changes in the sector and employer expectations;
- Unemployment of graduates, especially at tertiary level, is high;
- There is a change in the profile of students' backgrounds from mostly rural to increasingly urban;
- Programs no longer attract the highest achievers from secondary streams;
- Information technology is underutilized.

The results of these list of constraints/problems are: an overburdened and insufficiently trained faculty, an aging teaching population due to decline in funds for staff recruitment, declining quality of post-secondary education, lowering standards, lengthening the time students must spend in getting their degree, a declining emphasis on faculty research and corresponding capacity to oversee thesis research and overextension of degree programs (Lynam and Blackie, 1994; Rivera 2006). Scientific leadership, which forms the backbone of higher education institutions, is in short supply.

This litany of problems in the post-secondary education system has attracted national and international attention in the last decade or so to reviving and reforming the tertiary education system in developing

countries (which was previously neglected in favor of support for primary education) (TFHES 2000). The literature contains discussions of several initiatives in the past 10-15 years commissioned by the FAO, the World Bank, UNESCO, and other regional and international organizations to address these problems (World Bank 2002; FAO 1997; Atchoarena and Gasperini 2003; Association of African Universities 2004). The importance of education reforms is also gaining the attention of some national governments, as evident by the bilateral U.S.-India Agricultural Knowledge Initiative (AKI) (<http://dare.nic.in/usa.htm>). The key messages emerging from these reviews, reports and initiatives that are useful to contextualize the discussion presented in this paper are as follow:

- Higher education institutions need to take an increasingly pro-active role rather than passively reacting to circumstances (FAO 1997).
- Educational institutions should provide regular in-house seminars for teaching staff on innovative teaching-learning methods that promote effective student-centered learning with emphasis on practical/hands-on/experiential learning.
- Provide entrepreneurial experience through involvement in student projects to develop an agribusiness idea/model (e.g., EARTH university in Costa Rica).
- Provide basic instructional facilities (i.e., library, reference books, journals, computer and computer software).
- At the post graduate studies, establish strong research program as a part of knowledge-based society tradition.
- Agricultural universities can make significant contributions to development agenda when they join together research, teaching and extension function.