

# Plenary Session Papers

# Preparing for the Future: Revisiting Agriculture and Environment Education in Asia

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**Dr. Charles J. Maguire**

*Former Sr. Institutional Development*

*Specialist*

*World Bank*

*Washington DC, USA*

*It is not the strongest of the species that survive or the most intelligent.  
It is the one that is most adaptable to change.  
(Charles Darwin)*

## **Executive Summary**

Agricultural and environmental education is increasingly impacted by dramatic world-wide developments. Against a backdrop of steadily increasing population, unsustainable management of natural resources, the undeniable phenomenon of global climate change, and persistent rural poverty the world expects a steady stream of reasonably priced food to reach its markets on a daily basis. The growth of urban populations continues apace and food consumption habits, reflecting higher levels of income, create demand for variety, quality, quantity and safety of farm products. The impact of the World Trade Organization rules and regulations is felt by small producers in the global marketplace and subsidies to farmers in the developed world often exclude others from potential markets and income. The public expectation of the role of the graduates of the agricultural and environment education system has changed. No longer does expertise in crop and animal production meet these expectations. The stakeholders of higher agricultural and environment education entities need graduates with non-traditional knowledge, skills, management and leadership abilities and they expect the education system to respond. This paper encourages university staff members to explore and support the change process in agriculture and environment education. It reviews four examples of change in Asia, Europe, Central America, and the USA and finds similarities in the impetus for initiating change and in the responses to the change challenge in each geographic area. While acknowledging the complexity of bringing about change, the paper identifies external phenomena that will continue to put pressure on education entities to bring about reforms and offers suggestions for catalyzing the change process.

## **The future is in our hands**

At a time when the line between agriculture and environment is almost invisible and the border between agriculture and rural development blurred; where sustainable agriculture and the management of natural resources are of critical importance and where the interdependence of rural areas and growing urban centers grows ever stronger, can we, as agricultural and environmental educators make a difference if we continue to produce graduates who are narrowly trained and work in isolated technical channels? Our responsibilities, explicit or implicit, are great. We service and support a vital aspect of life in Asia : we build the human capacity that feeds the region's growing population that was 3.75 billion in 2006 (Population Reference Bureau). We prepare those who produce, process, and continuously deliver foodstuff in the variety, quantity and quality that is expected in this modern era. We are front line troops in the new battle to find ways to mitigate and to solve environmental problems and we are the visible link between science and the food and natural resources consuming civil society. And, while our base is the vast and populous rural areas, our consumer clients with greater food purchasing power reside in ever-growing and politically influential urban settlements.

Is it any wonder, then, that leaders and thinkers in our midst encourage us to look around and identify the changes that need to be made in our universities and other centers of learning, in the degrees and diplomas we offer and in the skill mixes that we ourselves possess to enhance the standing of our professions? The changes we support and the changes we make, individually or in our universities, institutes or colleges should reflect the needs of all our stakeholders, our students' vision of the future, the accuracy and effectiveness of our communications with policy-makers, and our obligation to society at large.

And we are not the only group of agricultural and environmental educators on the planet who are faced with this challenge. We can learn from sharing the concerns of those in other parts of the world who face similar challenges and who have common problems in search of solutions.

### **Identifying changes that have to be made: The list is long and the challenges complex**

While individual authors (Tajima 2000, Mancebo 2000, Maguire 1999, 2004, Hazelman 2002) have highlighted the need for change in higher agricultural education (HAE) generally, an Asian event in 2002 brought together 65 participants from a variety of sectors and countries, largely from Southeast Asia, for a week-long session at Maejo University , Chiang Mai , Thailand to discuss the issue of change. Forty-one of the participants were from Bangladesh, Cambodia, China, India, Indonesia, Japan, Laos, Malaysia, the Philippines, Sri Lanka, Thailand, and Viet Nam . This was a

workshop in the Sustainability, Education and Management of Change in the Tropics (SEMCIT) seminar series that involved Asian and African leaders and stakeholders in HAE. ([www.changetropics.org](http://www.changetropics.org))

The primary objective of the event was to analyze some of the challenges confronting Asian agriculture and to examine the potential of innovative educational models in contributing to sustainable development. Specifically, the goals were to:

- Identify, discuss and disseminate innovative educational practices that might enhance sustainable development in Asia ;
- Explore avenues for mutual learning and networking among people who are actually involved in deploying solutions; and
- Identify and define new paradigms in education relevant to these issues.

### **What was the outcome of the event?**

Participants at the conference clearly identified the need for change if progress towards sustainable development was to be achieved. A keynote speaker at the conference provided a broad view of change and constraints in Asian universities dealing with agriculture, natural resources management and the environment.

*There has been some change in some places. The most notable changes have been the shift in emphasis from a curriculum focused on commodity-oriented production technologies to one of integrated production systems that includes courses in conservation and the environment, with a focus on community-based natural resource management. Villareal 2000(P.8)*

Villareal concluded that the responsive agricultural university in Southeast Asia must develop a curriculum with the following characteristics: (it should be) science-based with a socio-economic foundation; relevant to society; holistic and broad-based; sensitive to the environment and sustainability; flexible; reflect a good mix of the natural and social sciences; be market driven; incorporate information technology and entrepreneurship; and produce graduates that possess a commitment to lifelong learning, problem solving and critical thinking skills, and who are good communicators.

A Bangkok FAO/UNESCO seminar in 2002 echoed the need for a broader approach to knowledge and skill development.

*For many years, the approach followed by policy-makers and education specialists has been to focus on practical and occupational agricultural skill training provided mainly at the secondary and tertiary levels. Yet, in an environment increasingly shaped by non-farming activities, and*

in a policy context dominated by the poverty reduction agenda, education for rural development requires a holistic approach going beyond the narrow boundaries of the traditional agricultural education and training concept. (Introduction page 11).

## **Change Issues**

Maejo seminar participants deliberated the issues of change and sustainable agricultural development and found agreement and consensus on the urgent need for change in agricultural higher education in Asia, so that graduates could better contribute to sustainable development and poverty alleviation in the Asian tropics. It was felt that the transformation of current practices in agricultural higher education would be accomplished by proactively applying knowledge and practical problem solving in a student-centered environment, with the goal of producing high quality graduates that have strong leadership abilities, good communication and entrepreneurial skills, and strong ethical and moral values. The session also recognized the need for enhanced regional networks and opportunities for partnering.

The participants identified five key target areas for the transformation of higher agricultural education in Asia:

- Curricular reform;
- More effective networking, resource sharing and partnerships;
- Documentation and dissemination of innovations and good practices in agricultural higher education in the region;
- Transformation of existing university systems, including governance, admissions practices, university finance and management systems, and faculty development; and
- Creation of a new regional institution (to serve as an incubator for change processes). (SEMCIT 2002)

## **Obstacles to Change are Complex**

Universities are large and complex entities with their own rules and traditions often deliberate for considerable time before embracing change. Villareal (2000) noted some of the constraints faced by Asian Universities in reorienting their curricula toward sustainable agriculture development. These included cumbersome policies and procedures affecting the development and approval of new curricula; lack of common understanding of the concepts and practices of sustainable agriculture; cultural and social considerations; lack of sustainable agriculture advocacy at the national level; lack of staff capacity in teaching sustainable agriculture; and finally, faculty skepticism and resistance to changing old curricula in ways that would affect traditional teaching methodologies and syllabi. The reform of higher agricultural education institutions in China (Liu

and Zhang 2004) was a decade-long process that is still ongoing. The reform attempted to change a higher agricultural education institution system put in place in the 1950s and modeled on the former Soviet Union's education system. The problems and constraints in the system that led to the reform initiative included: a) institutional constraints that reflected a lack of incentives and decision-making autonomy; b) lack of qualified teaching and research staff because of low pay and poor recruitment policy; c) shortage of funds; d) outdated teaching methods; e) an inefficient curriculum and teaching management system; and f) outdated teaching and research facilities.

### **Change is never static and new pressures continue to mount**

*Since agriculture in many countries proceeds from crisis to crisis, there is not only concern about animal welfare, food safety, and sustainable production; there is also indignation, protest, and conflict. (Mulder and Ernstman 2006)*

It has only been seven years since the Maejo SEMCIT conference but in that period new challenges and concerns have gained prominence that directly impact on the public's expectation of graduates from higher agricultural and environment education. Food safety is a major issue as urban populations are alerted to potentially harmful human and animal food-related health dangers. There are worries about the transmission of potentially fatal diseases from animal production enterprises to humans. Global warming has become a key international topic and its potential consequences give rise to anxiety and to calls for mitigating interventions on an individual, national and a global scale (**Box 1**).

#### **Box 1: An Inconvenient Truth**

*The relationship between human civilization and the Earth has been utterly transformed by a combination of factors, including the population explosion, the technological revolution, and a willingness to ignore the future consequences of our present actions. The underlying reality is that we are colliding with the planet's ecological system, and its most vulnerable components are crumbling as a result. Gore 2006*

Over-fishing around the world has brought fish stocks to a crisis point with potentially serious consequences for food supply, nutrition, tourism and employment. The mysterious disappearance of honey bees threatens fruit, nuts and field crops (**Box 2**).

**Box 2:** *Dying Bees – investigating colony collapse disorder*

*Across America beekeepers are finding hives abandoned. What appear to be normal, healthy adults suddenly disappear within two days, leaving their queen, their food stores and the young. Colony collapse disorder, as the phenomenon has become known as, was first reported in America in mid-November 2006. It spread rapidly, with beekeepers reporting heavy losses of between 30% and 90% of bees. Some 24 American states have now reported cases of colony collapse disorder. It has also been seen in Greece, Italy, Poland, Portugal and Spain. Honey production is worth just \$200 million a year, but bees pollinate \$15 billion-worth of fruit, vegetables and nuts, especially the \$2 billion almond business. Scientists suspect immune systems failure but are not sure. (Economist April 28, 2007)*

The Millennium Development Goals that call for poverty reduction remind the public that, in many countries, the worst poverty is in the rural areas; spectacular natural disasters such as flooding, landslides, droughts, pollution, and destruction of eco-systems have highlighted the need for conserving and sustaining natural resources in an environmentally friendly manner. Globalization and the impact of foreign demand and supply for raw materials create new trading dynamics that impact on farming and farmers.

### **A Common Thread**

Although the list of challenges and concerns appears to be eclectic there is a common human resource thread. Those who are expected to help alleviate rural poverty, assure the region's food supply, and who have to deal with and alleviate the public's concerns about food and food safety and the environment are, directly or indirectly, the graduates of agricultural and environmental education.

### **Change challenges from around the world**

Despite the apparent slowness of educational organizations to bring about and incorporate change it is important to note that changes do take place often at sub-organizational levels and often without fanfare (examples 1-4, below). This is in contrast to the "big bang" approach where change happens almost overnight. In the larger society change can be dramatic and take place over a relatively short span of time. The ubiquitous cell phone is a modern and classic example. How often are we amazed at the number of people all over the world who appear to be constantly on the phone to the point where this means of communication seems to have become a vital necessity? In developing countries where land-line phone infrastructure was absent or of poor quality, millions have skipped the

infrastructure phase and moved immediately to cell phone adoption reflecting a widespread, speedy and successful change phenomenon. Examples from four geographic regions that reflect organizational concern about the future and the skill-mix required by graduates who will work in agriculture, environment and rural development are described below together with the responses chosen in each case.

## **East Asia Pacific**

### **1. Bogor Agricultural University, Indonesia**

Bogor was one of the universities represented in the SEMCIT Seminar Series described on page x. The university was conscious of the need for change in its curriculum and in the way it prepared its graduates for the future. Some of its concerns were:

- How can issues of globalization be incorporated in the curriculum and in teaching practices?
- How can the university program be aligned with national and regional interests?
- How can strong tradition in research be established or strengthened?
- How can an entrepreneurial mentality be built in the students?
- How can a graduate who exhibited inclusiveness and multi-cultural attitudes based on high moral values and ethical behavior be produced?
- How can an international network that stresses information, experience sharing and cooperation be created and nurtured?

The concerns were based on a series of problems associated with HAE that included:

- Higher agricultural education reflected a mix of systems stemming from colonial influences
- Inappropriate systems focusing on specialization instead of generalization and diversification
- Lack of practical skills
- Lack of entrepreneurship
- Faculty resistance to change
- Insufficient resources – financial and human
- Top down bureaucratic systems



## **Europe**

### **2. European Concerns about the graduates of the future**

Concerns about the content and focus of degrees for students of the future were a topic at the European Conference on Higher Agricultural Education and Research held in Prague in 2006. Among the concerns expressed were:

Graduates who would work in agriculture and its many facets would need new skills and capabilities. Changes in public expectations of graduates from the HAE institutions are forcing changes in qualifications. New competencies are needed, such as multi-disciplinary problem solving, addressing multiple stakeholder interests, participatory approaches in innovation, and interactive methods in conflict resolution, responsive actions regarding community needs, and social responsibility in entrepreneurship. (Mulder and Ernstman 2006) (P. 37). Warren et al (2006) stressed the ethical aspects of sustainable development such as social justice and economic welfare, climate change and pollution and their impact on rural education. Mulder (2006) suggested that new competencies are needed for graduates to meet the challenges of the diverse demands of the public and the strengths and weaknesses of many practices. He noted that educational institutes which were traditionally aimed at providing agricultural education had responded widely to new qualification needs.

## **Central America**

### **3. Central American concerns about meeting future sector needs**

The founders of EARTH, a private university in Costa Rica, were concerned that the graduates being produced from agricultural universities were not equipped to deal with the current and emerging problems of agriculture and rural development in Central and South America. They created a program whose explicit purpose is to “prepare tomorrow’s leaders today” by providing an environment in which the intellectual, physical, emotional and spiritual dimensions of the student are all developed. The ideal “exit profile” of graduates is that they possess:

- Positive values and ethical principles.
- Leadership abilities
- Commitment to improving community welfare
- Respect and tolerance of ideas of others and ability to work in teams
- Management and entrepreneurial capacity
- Ability to communicate effectively (in writing and verbally)

- Capacity to develop and implement practices that promote sustainable agriculture and natural resource use
- Capacity to develop, synthesize and present solutions to problems
- Open minds with the capacity and interest to be life-long learners

#### **4. USA: Concern about the importance of change in higher education**

Higher agricultural education is offered largely by the public Land Grant College (LGC) system in the USA. These universities are situated in different states throughout the country and are funded by state governments and by endowments offered by individuals and the private sector. There are 106 Land Grant Colleges and Universities (Wikipedia). In 1996 the Kellogg foundation provided resources for the creation of a commission to create awareness among public universities of the need for higher education reform. The commission, known as The Kellogg Commission on the Future of State and Land-Grant Universities began work in January 1996 and completed its work in March 2000.

The Commission summed up its concern about change in June 1996:

*Unprecedented problems confront our campuses. We face seismic shifts in public attitudes. We are challenged by new demographics and exploding technologies. We are beset by demands to act "accountably" toward students, parents, communities, and taxpayers. An increasingly skeptical press questions our priorities. ....We must take charge of change. (Kellogg Commission, June 1996)*

Six reports were produced by the Commission and focused on:

- Discussion and action on campus to reinvigorate the student experience
- Improving student access
- Energizing and enhance partnerships with the public
- Addressing the role of public universities in a learning society
- Attending to the culture of the campus
- Encouraging partnership of the public university with the society it serves

The reports were produced in consultation with university faculty, administrators, and a group of lay advisors. The reports were designed to provide universities insights to the need for change and make the case for specific types of change that should take place. Change was not mandated, given the decentralized nature of education in the USA so each university was free to decide on its own change actions.

Magrath (1999) suggested that reform of U.S. higher education was essential to avoid mediocrity, to adapt to new communications technology, and to recognize the impact of globalization.

### **Change Priorities and Concerns Compared**

The four geographic locations – Asia, Europe, Central America and the USA – reflect a concern with the status quo and chose a focus that would lead to change. These change priorities and concerns are summarized in **Table 1**. Asia's priorities are detailed while the other three are described in more general terms.

**Table 1. Comparing HAE Change Priorities and Concerns in Four Geographic Locations**

	Asia	Europe	Central America	USA
Change needed:	Curriculum reform Networking Partnerships Dissemination of lessons Transformation of existing systems	New competencies needed for a new era	New type of graduate required to serve as a leader of tomorrow	Demographics, Public's attitude toward universities Technology Accountability

Wirakartakusumah (2007), Mulder and Eernstman (2006), Kellogg Commission on the Future of Land-Grant Universities (1996)

### **Sample responses to the change challenge**

#### **Asia**

#### **What Bogor accomplished in terms of a change agenda 1998-2004**

(See Annex 1 for detailed description of accomplishments)

In response to the challenge to change, Bogor University took a series of actions:

1. Improved curriculum and teaching practices by introducing a Student Centered Learning Approach
2. Implemented good agricultural practices in the academic programs by undertaking community development and entering into cooperation with regional/local government
3. Strengthened international programs, networks and linkages by creating university to university cooperation, and multi-lateral and bi-lateral agreements and activities

(Wirakartakusumah, 2007)

## **Europe**

### **Educational Pedagogical and Instructional approaches in the Netherlands in response to needed change in HAE**

- Project-centered education which addresses social learning in self-directed student teams to a large extent
- Problem-oriented education which addresses integrated problem analysis, information finding and processing, team learning and problem solving
- Multi-disciplinary design and problem solving in which communication between students from various disciplines is encouraged
- Computer-based collaborative learning (a model of asynchronous network-based communication about learning content, knowledge construction and development of collective representations, widely used world-wide but new at Wageningen University). It is typically used for content areas in which diverse perspectives exist and students can have different opinions
- Video-based case study and problem solving techniques – a way of working with new and sometimes emotional situations (HIV, conflicts). Can be used for handling emotions, negotiation and conflict resolution
- Competence development based on competence assessment, personal development plans, coaching, feedback and reflection (See Annex 2 for details of competencies needed by future graduates)
- Entrepreneurial learning using models of small business education or simulations; inspiring learning environments or entrepreneurs can serve as examples for course activities in HAE
- Integration/interaction of natural, technological and social sciences (Beta-gamma interaction) in education.

(Mulder and Ernstman 2006)

## **Central America**

### **EARTH University's response to the change challenge**

Producing the "graduate of the future" who is a job creator and not a job seeker is achieved by providing a self-directed and experiential learning process; even when the transfer of knowledge is involved, the learner's active participation is encouraged. Practical experience in hands-on farm work, community service, entrepreneurial projects and both smallholder and corporate attachments are an integral part of the degree which produces a confident, self-starting person who can fit in many productive scenarios in agriculture and rural development.

The initiators and financiers of EARTH University made the deliberate decision to concentrate on developing a few exceptional graduates to return to their communities. These agents of change would provide the stimulus for encouraging innovative and sustainable development by promoting increased incomes and conservation through the effective use of agricultural and natural resources.

## **The United States**

### **The response to the call for change from the US Land-grant Universities and Colleges**

Five years after the Kellogg Commission on Taking Charge of Change: Reviewing the Promise of State and Land-grant Universities circulated its findings, the National Association of State Universities and Land-Grant Colleges and the W.K. Kellogg Foundation conducted a review of how far transformative changes had happened on the campuses. Thirty-five responses were received and analyzed. The respondents indicated that the work of the Commission had been influential on bringing about change in the following areas:

- Engagement of universities and colleges with society
- Internationalization of the campus with particular attention to overseas (learning) opportunities for students
- Holistic learning including residential and in-service learning
- Undergraduate research opportunities
- Distance and lifelong learning

Some campuses had revised their curricula with specific attention to the general core and to highlighting in-service experiences. Several had reviewed and revised guidelines for promotion and tenure in keeping with academic changes and greater engagement with society. (Byrne 2006)

### **Responses to the challenge of change**

When responses to these change priorities are compared (**Table 2**) there are many similarities. All locations would stress student-centered learning or holistic learning; three of the four would reach out to the community or engage with society; all would include entrepreneurial skills in the curriculum; two of the four would involve students in international issues and international study experience; and two would use information communications technology (ICT) to expand the reach of their programs to students and to foster life-long learning. Other areas of emphasis include practical farm experience and attachments for students.

**Table 2. Responses to HAE Change Priorities and Concerns in Four Geographic Locations**

Asia	Europe	Central America	USA
Student-centered Learning	Student Centered learning	Student-centered learning	Holistic Learning
Reaching out to community	Use of ICT	Reaching out to community	Engagement with society
Entrepreneurial skills	Entrepreneurial skills	Entrepreneurial skills	Undergraduate research
Good agriculture practices	Competence development	Practical farm experience	International focus
International cooperation	Integration of natural, social and technical sciences	Attachments	Distance and life-long learning
Building Staff Capacity			

Wirakartakusumah (2007), Mulder and Eernstman (2006), EARTH University ([www.earth.ac.cr](http://www.earth.ac.cr)), Byrne (2006)

**What is to be learned from the change initiatives now underway?**

It is evident that the “old” agricultural degree and the education model that produced it is out of date and is in the process of being replaced.

A number of change initiatives ranging from cosmetic to substantial are underway in different parts of the world. It is striking that the identified and desired changes are very similar in each selected geographic region described in this paper. Advocates of change in agricultural and environmental education observe that change is more frequently incremental than sudden and across the board - a “big bang” approach. It is difficult to undertake wholesale change because of the traditions of universities and institutes but, nevertheless, it behooves every university or university system to take a long and deep look at the role of their organization and to identify the weaknesses in how they prepare the graduates of tomorrow. It goes without saying that awareness of the need to change and the commitment to bring about the recognized changes must come from within educational organizations and not from outside.

While Villareal's definition (page x) of an ideal curriculum still holds, circumstances have inserted new and complex demands. These demands are cause for pondering on whether or not universities have to be more radical and proactive in dealing with the competences that graduates will need. Programs have to be more student-centered, more practical work has to be included, and students have to be matched to learning situations with stakeholders so that they understand the reality of the needs of agriculture, environment and rural development. And communications, entrepreneurial, and analytical skills will be a necessary part of the university program. In adopting this pragmatic approach to updating the way in which future graduates are prepared, there is a risk of criticism from those who might feel that the classic design of the degree is becoming more

“vocational” than academic. It is natural for those who protect the standards of degree programs to feel un-nerved but a two-fold case must be made that the modern change of emphasis has its basis in need and that academic rigor can still be applied and high standards achieved in a new-style program.

## **How can change be championed?**

### **Communicate**

Educators in agriculture and environment are generally an isolated group of professionals. The Asia Pacific Association of Educators in Agriculture and the Environment (APEAEN) reflects this situation. Despite the international conferences and the APEAEN website, very little communication between universities takes place on a regular basis. Education for agriculture and environment is not in immediate danger of being replaced or becoming redundant but the pressures from leaders in a changing sector, the special needs of the rural space, and societal expectations related to food and recreational opportunities make it imperative that educator professionals understand the needs of stakeholders and take appropriate action. Communication is critical if educators and administrators are to influence the future of the profession.

Agriculture and environment educators need not wait for international conferences to communicate. Information Communication Technology (ICT) makes it increasingly easy to link organizations and people separated by distance and time. Communities of Practice (CoP) where people with common interests can join discussions, ask questions, provide advice and share experiences, are ideal structures for educators in agriculture and environment. The best aspect of the CoP is that it is voluntary and members can join and leave when they wish. A professional does not have to wait to find a CoP for anyone can create a CoP site and send out a request for advice or dialogue. It does not take long to have responses.

The CoP can catalyze the change process by sharing successes and failures in attempting to bring about change. Further, it makes the change agent aware that he or she is not the “voice in the wilderness” pioneering change but that there are others who are attempting similar things. The fact that there are others who can share the change process and offer encouragement is an important element in bringing about organizational change.

Communication can also be enhanced by use of the Blog (Web log). Blogging is a term that has become part of our lexicon in a very short time and refers to the process of keeping a log or a diary related to a subject or an event or a profession. Journalists now send blogs from war zones, collectors, gardeners, and sports fans blog interested friends and others describing how they manage their hobby or business activities, tourists

who visit exotic places often create a blog that records where they visited, what they saw, where they stayed and how they found the experience. The relevant aspect of a blog to the educator is that while one person originates the text it can be sent to any number of people electronically and, any one of the recipients can respond and leave comments in an interactive manner. A typical blog combines text, Images, and links to other blogs, web pages, and other media related to the topic. (Wikipedia, the free encyclopedia 2007)

Another modern communication tool is the wiki which is a website that allows visitors to add, remove and edit content. The ease of interaction and operation makes a wiki an effective tool for mass collaborative authoring (Wikipedia 2007). The best known wiki by far is the free encyclopedia – Wikipedia which is developed by thousands of independent contributors. From an educational point of view a new curriculum can be created by people collaborating in a wiki. Members contribute to the process and, through comments, corrections and suggestions, iterations are completed until all members are satisfied with the outcome. Similarly, a wiki could be used to create a presentation, an article or a paper for a conference.

The Video Conference (VC) is another communication tool that can be used to link education organizations and professionals. The VC enables real time (synchronous) dialogue between entities separated by distance. By accommodating verbal and visual communication the VC is a powerful tool. Many Asian education entities are equipped with VC technology and the World Bank's Global Development Learning Network (GDLN) has a number of sites throughout the region supported by the Tokyo Development Learning Center (TDLC).

With the availability of so much ICT why is communication not taking place? Simplistic as it may sound, the fact is that someone has to initiate the communication process. Many educators in agriculture and the environment are waiting for someone else to take the communication initiative. Perhaps the APEAEN website is the place to begin the communication process. Any member can post a message, make a request for advice or share an experience and that can lead to the creation of a CoP and open dialogue between education entities and individual educators.

### **The Next Big Thing**

In the business community investors are frequently looking for the "next big thing" – the innovation that will capture large markets and make a lot of money. Educators in agriculture and environment need to be alert for the "next big thing" too. However, in this case, the "next big thing" will be a stakeholder problem, concern or issue that will require professional



support through appropriately educated and trained graduates from the system. Are there some candidates for the “next big thing” list? Yes there are and seven in particular can be mentioned:

First are the 1.5 billion who are the poorest in the region – the people at the base of the economic pyramid (BOP). A majority of the poorest are rural dwellers who spend over half of their household income on food (IFC, WRI 2007).

*Most in the BOP lack good access to markets to sell their labor, handicrafts, or crops and have no choice but to sell to local employers or to middlemen who exploit them. As subsistence and small-scale farmers and fishermen, they are uniquely vulnerable to destruction of the natural resources they depend on but are powerless to protect. In effect, informality and subsistence are poverty traps. (IFC, WRI 2007 P.4.)*

What does this mean for agriculture and environment education organizations? There is a vast population of people to be fed at the lower end of the pyramid. Asia has the largest measured regional BOP food market, \$1.1 trillion, reflecting a large, 1.5 billion, BOP population. They constitute a market and many of them are subsistence farmers. Are today's graduates of agriculture and environment skilled enough to work with this population? What technology and services will graduates be required to advise on and to offer? Micro-finance, extension, agribusiness, distribution, marketing, nutrition training, production techniques, land management, inputs and tools, post harvest information and technology? What policies are needed to bring about improvement in the economic and social lives of this large group of, mostly, rural poor?

It also means that graduates who serve those at the base of the economic pyramid must have exposure to the poor rural household and the capacity to work effectively in areas that are greatly constrained in terms of opportunities, resources, and services. Amongst the contents of a curriculum that would prepare students to work with BOP clients would be: development of competences, community attachments, ability to work in social and anthropological teams to understand the needs of BOP clients, ability to organize groups at the BOP to more effectively receive information, improve productivity and sell products. Are universities in the region ready for such an emphasis?

The second “big thing” concerns the needs of those rural people who are the core producers of food for the region's population and the urban dwellers who increasingly are becoming more sophisticated consumers. The value of the Asian food market in nine countries (1.49 billion people) is estimated at \$1.1 trillion. For this group of producers and consumer stakeholders, a versatile graduate who knows how to achieve greater productivity, add value to basic commodities and be the bridge between

science, agriculture and the environment and the urban consumer who's concern may range from food safety (**Box 3**), genetically modified organisms to organic crops and animals and to quality control. The graduate of the future will require a complex skill mix that includes the ability to communicate effectively. It is the responsibility of the education organization to identify these skills and incorporate them into the program of studies.

**Box 3:** *Food Safety: The Perceptions and Expectations of the European Public*

*A succession of food related crises have hit the agriculture and food industry worldwide in the past 20 years. These have included the BSE crisis; repeated salmonella and e-coli outbreaks; the use of genetic modification in food production and processing; foot and mouth disease, and, most recently, avian flu. These crises have resulted in seismic shifts in the way industry is viewed from both a political and societal perspective. There are significant implications associated with all this for curriculum design and development and the selection of appropriate teaching and learning strategies for higher education courses within Agriculture and Food. (Brennan and Ritson 2006)*

The third "big thing" is the development of the role of educators in agriculture and environment as resource persons for the public and private sector. The complexity of the challenges to agriculture, environment and rural development together with the needs and concerns of growing urban populations create the need for informed and creative input from credible specialists. Public sector policy makers need advice and guidance especially in areas where food-related public safety is in question and where the sustainability of natural capital is critical for increasing national wealth. (Where is the Wealth of Nations, 2006) University and other faculty can only gain credibility if they are familiar with the problems of agriculture, environment and rural development from a hands-on perspective. They must also enter into continuous dialogue with all stakeholders of the education organization in order to fully understand their needs and concerns.

The fourth "big thing" is developing support for life-long learning programs for a wide range of client groups including those from other sectors and from civil society. The university has to open up to the outside world and become both teacher and learner by interacting with those who are eager to expand their knowledge base and share their work and life experiences. The development of life-long learning programs opens the university to civil society and creates strong bonds. The program also provides an opportunity for the education entity to develop a distance learning capability to bring the university to those who, because of distance or time pressure or cost cannot physically attend activities on the campus.

The fifth “next big thing” is hardly a newcomer to the list of agriculture, environment and rural development concerns. It is the phenomenon of water usage and water shortage. Concerns were expressed at the beginning of the Millennium that future wars might be fought over access to water. Since then, and linked to global warming, water situations in many developed and developing countries continue to deteriorate. A recent worrying example of water shortage tied to prolonged drought, growing urban populations and competing demand from agriculture is that of Australia. (**Box 4**)

**Box 4:** *After 7 years of drought and many more years of over-exploitation and pollution the Murray-Darling River is in trouble. There is not enough water volume to carve a channel to the sea and it the river-mouth is silting up.*

*If mature vines and fruit trees die in the coming months, through lack of water, the economic fallout will be more serious and lasting (the drought knocked one percentage point off Australia's growth rate last year). Most alarming of all, the Murray-Darling's troubles are likely to worsen. As Australia's population continues to grow so does demand for water in the cities and for the crops that grow in the river basin. Meanwhile, global warming appears to be heating the basin up and drying it out. Although few scientists are confident that they can ascribe any individual event – including today's drought – to global warming, most agree that droughts like the present one will become more common. Many of the world's rivers, including the Colorado in America, China's Yellow river and the Tagus, which flows through Spain and Portugal, are suffering a similar plight. As the world warms up, hundreds of millions of people will face the same ecological crisis as the residents of the Murray-Darling basin. As water levels dwindle, rows (disputes) about how supplies should be used are turning farmers against city-dwellers and pitching*

e n v i r o n m e n t a l i s t s a g a i n s t p o l i t i c i a n s . (The Economist April 28 2007)

Graduates who work with farming communities, peri-urban and urban populations and commercial agricultural enterprises will, in many countries, be faced with water-related technical challenges. Water conservation, improved water management, water conserving technology and varieties of crops that thrive in water-constrained environments will be topics that future graduates will have to deal with. Graduates from agriculture and environment will also be called upon to advise and intervene in settling water rights and water use disputes and should be well-grounded in the legal aspects of these contentious and emotional issues.

The sixth “big thing” is linked to the phenomenon of water shortage and that is climate change. The world is now familiar with changing weather patterns that have ranged from floods in areas where drought was common;

drought where rainfall was a standard weather feature; rising sea temperatures that impact on coral reefs and on fish migration; and an increase in violent and destructive storms in many parts of the world. The implications of the impact of climate change for graduates of agriculture and environment programs are many and relate to new strains of crops that can withstand drought or floods; technology to dry and prevent spoilage of harvested crops in areas where harvests were always completed in dry conditions; infrastructure to protect land from high water tables and water levels; anti-erosion technology; and crop and animal farming systems that can provide an income in less predictable and more risky climatic times.

The seventh “big thing” with implications for agriculture and environment education is energy. Apart from the high cost of oil and of refined oil products that drive up the cost of farming and value added practices, there is, in 2007, a considerable interest in growing biomass to convert to “biofuel”. Countries such as Brazil and the USA are leading the production of biofuel from sugarcane and corn respectively. There is concern that crops that would normally find their way into the food chain are now being diverted to make fuel that reduces dependency on hydrocarbons. Countries are planning to convert large areas of land deemed useless for food crops (wasteland) to biofuel production sources. Graduates of agriculture and environment will need to have the knowledge and skills to give advice and technical direction on the production of biomass for fuels and analyze the impact of large quantities of biomass on land use, soil conservation and waste disposal.

To prepare for these and other “next big things” education entities must create the mechanisms to continuously talk to their clients and stakeholders to ascertain their needs and their expectations of future graduates. Faculty must be prepared to accept that there are no options left but to embrace and influence the change agenda. And education entities will need to make administrative processes more responsive to change initiatives.

### **Acronyms**

APEAEN	Asia Pacific Association of Educators in Agriculture and the Environment
AUSAID	Australian Agency for International Development
BOP	Base of the pyramid
BSE	Bovine Spongiform Encephalitis (Mad Cow Disease)
CIDA	Canadian International Development Assistance
DAAD	German Academic Exchange Service
EARTH	Escuela de Agricultura de la Region Tropical Humeda (Agricultural University of the Humid Tropics, Costa Rica)
GCHERA	Global Consortium of Higher Education and Research for Agriculture
ICT	Information Communications Technology
GMO	Genetically Modified Organisms

HAE	Higher Agricultural Education
JICA	Japan International Cooperation Agency
SARS	Severe Acute Respiratory Syndrome
SEAMEO	South-East Asian Ministers of Education Organization
SEARCA	SEAMEO Regional Center for Graduate Study and Research in Agriculture
SEMCIT	Sustainability, Education, and Management of Change in the Humid Tropics
USAID	United States Agency for International Development

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## **Annex 1: New Competencies for European Graduates of the Future**

European agricultural educators identified the need for future graduates to possess new competencies in order to deal with the complexities of modern European agriculture.

A survey was conducted to find out what strategies European universities were employing for developing the new competencies needed. Some of the expectations of the public as far as the ability of graduates and the competencies required are summarized below:

- 1. Dealing with the complexity of contemporary society** –because of globalization everything and everyone seems to be interconnected and because of this, issues have become increasingly ambiguous.

### **Competency required by graduates to deal with this issue**

Knowing the different sides of an issue and being able to deal with conflicting points of view

- 2. Decreasing the gap between science and society**  
The public generally sees negative aspects of experiments and so loses trust in science

### **Competency required**

Ability to communicate scientific information to society  
Student should have sufficient understanding of a problem to be able to translate it in layman's terms  
Therefore students need to have a holistic view of issues and problems and not just the (scientific) details.

- 3. Preparing students for increased competition**  
The labor market is increasingly competitive. Therefore universities need to provide students with good "narrow" technical knowledge but also broad qualifications to enable the student to be agile in the changed job market. Employers look for more than technical knowledge and skills these days.

### **Competencies required**

Good communications skills – ability to "sell" oneself  
Student needs to go through a process of personal development to be better rounded on leaving the university.

- 4. Responding to Internationalization**  
Because of the World Trade Organization and European Union people working in the agriculture sector have to be international in their outlook.

### **Competencies required**

Language ability  
Development of External contacts  
Cross-cultural skills  
Able to discuss NRM in the global context

- 5. Shift from generalization to specialization**  
The market for food commodities has changed. Small producers cannot compete with more industrialized and subsidized western farmers and the traditional production system is no longer profitable.

Either farmers drop out or become specialized for niche markets. Knowledge of production is important but this must be combined with knowledge of markets and market trends.

**Competencies required**

Innovation and creativity

Ability to combine (production and innovation)

Theoretical and practical agriculture knowledge and experience

**6. Human Resources Development (extension-consultancy)**

Change is battering the agriculture sector. Not only is there a fight for survival but there is a constant stream of regulations from the WTO, and EU. All this demands a range of knowledge and skills that few farmers can have. There is a demand for educated and skilled consultants who can support the development of human resources in rural areas by introducing them to innovative and efficient production methods, and explaining EU standards, expectations and market trends.

**Competencies needed**

Practical agriculture knowledge and skills

Ability to communicate at the farmer's level

Ability to communicate to groups (using appropriate methods)

**7. Responding to the wishes of the capricious consumer**

Today's consumer is demanding and agriculture has to anticipate and or meet the demands

**Competencies required**

Analytical capacity

Ability to make connections between things

Being flexible

Creative problem solving

**8. Bridging the gap between the consumer and the agriculture sector**

The urban –rural gap exists. Bad publicity when food-related crises occur. Providing the link that bridges the gap in understanding between producer and consumer.

**Competencies required**

Ability to communicate agriculture in a positive way to the public

Ability to transfer information to the public in layman's language

Ability to talk effectively to farmers and consumers

Ability to choose best method of communication for either group or for mixed audiences.

**9. Dealing with the consumer paradox**

Consumers claim to support sustainable and healthy production methods but, at the same time, demand the cheapest food products. Farmers find it difficult to deal with these mixed behaviors.

**Competencies required**

Students need to understand both sides of the issues (environmental impact of farming methods, economics, and marketing) and inform the debate.



### **Sustainable production/quality orientation**

There is a strong demand for food that is produced in a sustainable manner. Consumers can be critical and demand traceability of products. Farmers have to be less concerned about production outcome (volume and appearance) and more about quality and the production process

### **Competencies required**

Knowledge of organic production  
Understanding of consumer's point of view  
Understanding the meaning of quality  
Aware of environmental and social issues

## **10. Genetically Modified Organisms (GMO)**

Europeans very much against GMOs. There is a demand for clear labeling. Universities thrive on biotechnology. Courses and research on all aspects of GMOs is growing.

### **Competencies required**

Basic knowledge about the issues but neutral opinion in order to weigh risks and opportunities  
Critical thinking  
(Mulder and Ernstman 2006)

## **Annex 2: The Response to the need for Change at Bogor Agricultural University, Indonesia (1998 – 2004)**

In response to the challenge to change, Bogor University took a series of actions:

1. Improved Curriculum and teaching practices by introducing a Student Centered Learning Approach
2. Implemented good agricultural practices in the academic programs by undertaking community development and entering into cooperation with regional/local government
3. Strengthened international programs, networks and linkages by creating university to university cooperation, and multi-lateral and bi-lateral agreements and activities

Specific activities undertaken for each of the change actions at Bogor

### **The Student Centered Learning Approach**

- Provided students with internship assistance and an entrepreneurship program
- Arranged for international on-the-job training
- Facilitated direct student involvement in the national food security program
- Introduced a common multi-cultural program for first year students
- Established a student Management of Change Club

### **Implementing Good Agricultural Practices**

- Food Security: ensuring rice self-sufficiency by providing mass guidance for rice production
- Combating malnutrition by participating in a national households/families nutrition program

- Food Safety: combating food-borne diseases through a national street foods program
- Encouraging small and medium agro-industries to provide farmers with value added by creating national incubator programs

### **Activities to benefit the community**

Encouraging fishermen to move from solely fishing to restocking (shrimp)  
Introducing improved livestock production

Supporting Reforestation and Community Participation

Improvement of agro-industry practices that included:

- Training and education at vocational schools
- Small-scale industry development
- Food industry teaching and services
- Post harvest technology and processing
- Mechanization and processing machinery development
- Running a food station in PNG
- Developing entrepreneurial skills with students, community and the private sector
- Dairy and Poultry production and slaughter-house design and management

### **International Cooperation**

The university promoted three types of cooperation:

- Direct university to university cooperation through bilateral agreements with countries (AUSAID, USAID, CIDA, DAAD, British Council, JICA)
- Regional Cooperation with SEAMCO (SERCA, TROPMED), South-south activities
- Multilateral agencies, NGOs and Philanthropists

Specific International Activities

Networking with higher education institutions

- Training of Trainers
- Student exchange program
- Faculty-staff exchange program
- Joint degree programs

### **Other Change Activities**

Professional volunteerism – often undertaken by retired faculty

Establishing an open access library

Joint research and publications on tropical agriculture

Capacity building for faculty and staff

Technical assistance for faculty and staff

International training and internship

Joint degree programs

(Wirakartakusumah, 2007)

## **Forms or Models of Higher Education in Facing the Effects of Climate Change**

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**Dr. Martin Mulder**

Head of the Department of Education and  
Competence Studies

Wageningen University

Social Sciences Group – bode 68

Email: martin.mulder@wur.nl

Internet: [www.ecs.wur.nl](http://www.ecs.wur.nl)

Internet: [www.mmulder.nl](http://www.mmulder.nl)

In October I was having dinner in a hotel in Kampala, Uganda, where I was for a project on curriculum development for floriculture. I asked the waiter about the weather of the next day. He said: 'It will be about the same, very wet'. I said: 'Has it been raining much?' And he said: 'Yes, much more than usual, we had floods. That is very strange for this time of the year. It is raining much more and heavier. We even had hail. Normally we would start seeding for the next crops. But that is impossible.' I said: 'What will be the consequences?' And he went: 'We expect to have hunger and food prices will rise.' And I asked: 'Is there anything education can do?' Then he started to laugh, and said: 'Aahh, nothing, maybe the government will give money to the people to go to the shops.' I said: 'What about teaching students to build dykes (of course a typical Dutch remark), and to build protected areas against flooding.' He stared at me in disbelief and replied: 'No, that is very difficult!'

The Netherlands has a catastrophic flood in 1953 in the south-east of the country. Thousands of people drowned. Not long ago New Orleans was hit by Kathrina. Many more people were drowned. The Netherlands built its multi-billion Euro Delta Plan to protect areas below sea level against the devastating effects of extremely high tide and very strong storms. Now the Dutch are being hired to design a protection system against the flooding of the region of New Orleans. What is the point of this story? Not to tell you how great the Dutch are in designing and constructing large water protection infrastructures, but to use the stunning reaction of the waiter who said: 'It is difficult', meaning that he thought it would be too difficult. 'But it is difficult', should be like music in the ears of education, and spark energy to develop that competence in society which is needed to combat the big problems society is facing. In that sense, climate change should be a big challenge for education to address, since it is one of the bigger challenges of society.

## **INTRODUCTION**

Climate change is a big issue at the moment. Much research is pointing at the direction that this change is significant. However, there are signs that the public is responding to this issue in a positive way. The most appealing sign of this is the positive reception of the Al Gore documentary 'An Inconvenient Truth', and the public awareness it created about the urgency about the problems it creates. Many scientists have pointed at the fact that climate change is happening steadily, and that it will have a tremendous if not disastrous effect on human life.

There is a debate about the question to what degree climate change is caused by human intervention, or that it is a natural process. However, it is widely accepted that pollution caused by man is the most important factor.

Education has an important role to play in informing young generations about climate change and the changes it will bring about. It also has to generate leaders, managers, designers, technicians, politicians and administrators who will be able to cope with the threats and can contribute to solutions to prevent the worst-case scenario come true.

However, knowledge is not enough to solve the current environmental issues. Values, will to change and the perseverance to achieve sustainable solutions are equally important. Education also has a responsibility in this respect. It should be more than a deliverer of academic knowledge. It is imperative that it supports holistic competence development of students. Interactive modes of knowledge construction are crucial here.

At institutional level, education also has a role to play in realizing a sustainable world. It has to set the right example in terms of environmentally friendly policies and strategies, such as producing its own green energy. But it should also create new programs for jobs that will be created to fight the effects of climate change, and offer research, development and consultancy services to regions that will face structural socio-economic change, such as closing trades and employment losses. In this contribution, the various forms or models of higher education in facing the effects of climate change will be addressed. The title of the contribution sounds a bit reactive. However, education should be pro-active in this respect. Education plays an innovative role apart from preparing young generations for an existing world. It should cherish creativity, independence, self-management and entrepreneurship. It should be aimed at arranging learning situations that are aimed at solving problems, creating new sustainable solutions for the relevant problems, and challenging practices that are regarded as unfavorable.

## **Technological solutions are not the sole solutions**

Lots of efforts are being put in finding various technological solutions to the climate change. Pacala & Socolow have presented fifteen stabilization strategies in four categories: 1. efficiency, savings and reduction, 2. catching and storing of carbon dioxide, 3. having fuel with only a limited amount of carbon dioxide, and 4. green energy and bio-storage. The strategies are to improve fuel consumption (in terms of performance and efficiency) of cars. This is a technical solution which will take higher production costs, which will inevitably lead to a higher cost price, and thus consumer price. This strategy will therefore only work if there will be some facilitation.

The second strategy is reducing the number of miles cars drive. This will necessitate behavior change when it comes to private use; and more intelligent logistics and alternatives for business use. So public and private factors come into play to make these strategies work well. The same holds for the third strategy, which is to improve the energy use of lighting, heating, cooking and kitchen amenities. This will also be more expensive in the beginning, and the question is whether the consumer will pay for that. They also need to see the returns on investment, because, if they don't, they will not purchase more expensive machinery just for sustainability reasons, which is very visible in the organic food market. Although the public opinion is to cherish organic production, and there is massive dissent with the industrial agricultural production methods (such as in animal production systems), the vast majority of the consumers are not willing to pay the price which goes with these products. The percentage of the organic market of the whole food market is still in single digits. The problem is that consumers are not emotionally attached to the animals which were processed and of which the products are sold in supermarkets. Of course one can say they just don't want to know, but even if they know, purchasing behavior is not essentially influenced by this, at least for a large part of the consumer population.

The same goes for the fourth strategy, which is to improve the efficiency of coal or gas-heated power plants. Only with for instance subsidized price reduction consumers who are willing to switch to green energy. This at least is the lesson of consumers in the Netherlands, who have been able to opt for green power. As long as this is cheaper, it sells.

Other predominantly technical strategies are to provide coal or gas-heating energy plants with sub-terrain storage for carbon dioxide, to use the catching of coal-heated hydrogen plants for fuel production for cars, or for coal-heated synthetic fuel production plants. Of course these are the strategies which are propagated since a long time of replacing coal-heated power plants by gas-heated power plants, or by nuclear energy plants. The latter strategy has gained a lot of criticism in many countries around

the world, of course because of the active waste and disasters (like in Chernobyl).

There are also the strategies to gain more energy from wind mills and solar energy production systems. Wind energy can also be used for producing hydrogen for fueling battery cell cars. Then the production of ethanol is talked about a lot, and various chains have been developed to produce, distribute and sell this, requiring the cooperation of oil companies to set up a distribution network. In some countries this is working well, in others, there is hardly any ethanol for cars available at all. There is also the big discussion about the side effects of this strategy, which is that it takes about 16% of the total arable land world wide to grow crops to meet the needs of the fuel market. There will be even stronger competition about the land and its crops. Instead of feeding the poor, the crops are being exported for energy consumption abroad. Then there is the strategy of bringing an end to deforestation. However, the contrary is still happening, also because of the large wood consumption need in China, which is developing very fast, and which currently increases the wood prices considerably.

Lastly, there is the strategy of using soil in a sustainable way. However, much research has shown that this is hampered by social-economic factors such as ownership, culture, margins, and different stakeholders having different interests. As said, these are predominantly technical solutions to the challenge of climate change, and if they are followed up properly, they will indeed reduce carbon dioxide emission considerably. Socolow and Pacala even calculated the value of implementing the strategies they have suggested, and related this to future scenarios of price development. These range between +2°C to +5°C during the years until 2057. They estimated that most of the measures need to be implemented simultaneously to reduce the present growth which on the long run heads to 800 to 450 particles per million (ppm), which would lead to a temperature rise of +2°C. The present growth rate would end in a temperature rise of about +5°C in the time frame mentioned (the coming fifty years).

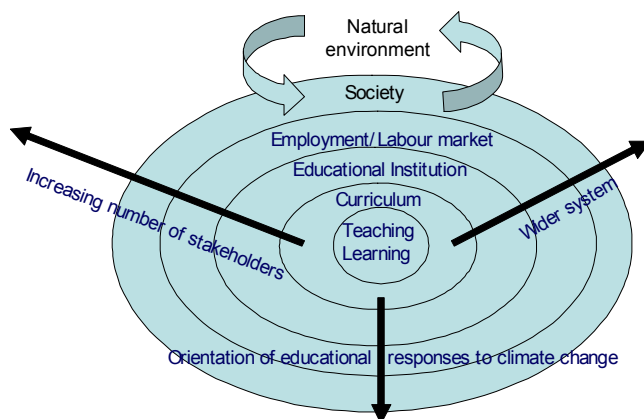
Behind many of the proposed measures are enormous commercial interests and various strategies are more expensive than the lesser environmentally friendly ones. Some believe that the life style or way of doing business (like transportation) need to be adjusted. The political, but also economic will need to be in place, to realize the measures mentioned, otherwise there will be no behavior change. Although this sounds a bit pessimistic (or realistic?) there are various good examples. The origin of food products (especially on dairy, meet and processed meat, but also vegetable and fruits), resulted in a change in one of the big supermarkets in the Netherlands. As soon as it appeared that a certain species of fish had traveled like 10,000 km before it was ready to sell in the supermarket, the directors of the company decided that this fish would be deleted from the product list, and it was removed from the freezers. So transparency of

product origin can make a difference in sensitizing big actors in the food chain to change their practices towards sustainable business.

### Levels of effects of climate change and education

Climate change has effects for education at different levels. Figure 1 (which was used in a different context and in a different way to study the sectoral approach in vocational education, Mulder, 2006) shows various system levels at which these consequences and educational policy measures can be positioned. In that project *types of green competence development projects* were studies for which the following categories for intended results were used: 1. instructional materials (including teaching guidelines) focused on use in institutions for vocational education; 2. curriculum materials (including new programs) also focused at implementation in educational institutions; 3. needs assessment in the sector (including the development of occupational profiles); 4. implementation of innovations in the sector (including training of workers and unemployed, the use of accreditation systems, and distribution of project results through social partner organizations); 5. employment improvement (including development of occupational sectors and sectoral certification systems).

**Figure 1. Systems levels of climate change issues in education**



The perspective from which these categories are developed is the institute for vocational education (the training provider). Theoretically, the categories are based on work of Romiszowski (1981, 1986) on instructional systems and wider systems. A comparable way of thinking from systems theory in the field of higher education and sustainability is employed by Sterling (2004, 52) when he speaks about nesting systems and the ecosphere, society and economy, and education as nested systems. Figure 1 depicts the systems levels of the different types of results. The wider the system, the more important the socio-economic environment, the more the inclusion of sector organizations in the project partnership is needed. The idea behind this set of categories was that the context of instruction is the curriculum, the context of the curriculum is the educational institution, and the context

of the institution is the region with its socio-economic infrastructure, and next the whole society. For curriculum and instructional development, needs assessment in the sector is needed (when it comes to sector specific competence development), and if the intention is to disseminate and implement the results of the development projects in the sector, sector involvement would facilitate this.

The categories are also based on work of Tanner & Tanner on curriculum development (Tanner & Tanner, 1995), Walker (1990), Mulder (1992) and more recent work of Mulder, Wesselink & Bruijstens (2005), which showed that different stakeholders have different opinions about the curriculum and that they should be included in curriculum deliberation processes.

From the changes in the natural environment, which are understood as wide as possible here, there are various interactions with society, also taken very broadly. The changes of the natural environment (such as changing habitats of insects) are influenced by activities in society (such as excessive carbon emission), and the activities in society are influenced by factors in the natural environment (such as changing hazardous health areas and medical treatments of previously foreign diseases). Changes in the natural environment and society are related to changes in the labor market and employment in the sense that whole sectors are subject to regional production conditions. Certain fertile areas may start to suffer from decreasing precipitation and thus draught, which may change them into poorer areas. Jobs in certain areas, such as in crop production may disappear, and workers have to find a new livelihood. Re-schooling, adult education, and corporate training may help to alleviate this process and to overcome the many negative effects of labor market restructuring. Part of the population in regions in which this takes place may migrate to economically more favorable regions or even countries. The uptake of these migrants in new contexts can be facilitated by courses which can be taught by educational institutes (but also by community centers and NGOs). In the Netherlands, immigrants need to take integration courses, and institutes for vocational education and a couple of private training organizations are supposed to teach these courses. However, enrolment currently lags far behind the agreements with the government (to the level of 1:10). Nevertheless, integration education may help to prevent social exclusion (such as what happened in China with the rural population which was forced to migrate to urban areas, and now back). Of course, participation on the labor market is essential here, because UNEVOC estimated that millions of jobs need to be created, which needs public support given the labor market imperfections.

Educational institutions are facing the effects of climate change, but their responses are different, depending on the way they perceive the urgency of the matter. Some of them are real innovators, and proactively implement policy that specifically addresses the issues related to climate



change. They can adopt strategies which are aimed at preventing pollution and adding to their sustainable delivery of services. On the other hand, they can also choose to set up new programs specifically aimed at jobs and roles in fields like environmental technology or multi-stakeholder process facilitation. If universities and colleges have included sustainability in their charters or mission statements, they can support the integration of this field in the courses they are teaching, or by introducing new courses or specializations (such as majors or minors) or even new programs (such as complete BSc and MSc programs). Within education which is aimed as sustainability targets, an important question is how to facilitate the acquisition of sustainability competence.

### **Effects of climate change on education and educational responses**

The various effects of climate change on education and educational responses will be presented in this section. The effects in educational responses will be categorized by the levels of effects as indicated in Figure 1, and as specified in Table 1. The list of effects and educational responses are examples, and by no means meant as exhaustive reality in different countries in the Asia-Pacific, in Europe and the Americas.

**Table 1. Levels of effects of climate change related to education, effects of climate change related to education, and educational responses to the effects**

<b>Levels of effects</b>	<b>Effects</b>	<b>Educational responses</b>
1. Society	1. Public policy making	<ul style="list-style-type: none"> <li>• Awareness, informed decision making</li> </ul>
	2. Enforcement	<ul style="list-style-type: none"> <li>• Informing</li> </ul>
	3. Raising public awareness	<ul style="list-style-type: none"> <li>• Informing, sensitizing</li> </ul>
	4. Raising worker awareness	<ul style="list-style-type: none"> <li>• Corporate training, education, development</li> </ul>
	5. Sector education policy	<ul style="list-style-type: none"> <li>• Sector programs and projects</li> </ul>
2. Employment/labor market	6. Migration	<ul style="list-style-type: none"> <li>• Acculturation, inclusion, participation</li> </ul>
	7. Labor market restructuring	<ul style="list-style-type: none"> <li>• Re-training of workers</li> </ul>
	8. Climate change as field of work	<ul style="list-style-type: none"> <li>• Education programs</li> </ul>
3. Educational institution	9. Widening external relations	<ul style="list-style-type: none"> <li>• Knowledge co-construction</li> </ul>
	10. Setting an example	<ul style="list-style-type: none"> <li>• EE policy making</li> <li>• Implementing EE practices</li> </ul>
	11. Beta-gamma interaction	<ul style="list-style-type: none"> <li>• Inclusion of integrated beta-gamma education</li> </ul>
4. Curriculum level	12. Sustainability competence needs	<ul style="list-style-type: none"> <li>• Identification of future competence needs</li> </ul>
	13. Sustainability competence development approaches	<ul style="list-style-type: none"> <li>• Competence-based curriculum</li> <li>• Competence assessment</li> <li>• PDP and portfolio</li> </ul>
5. Teaching/learning	14. Behavioral change needs	<ul style="list-style-type: none"> <li>• Integral learning</li> </ul>
	15. Needs for inspiring learning arrangements	<ul style="list-style-type: none"> <li>• Inspiring students</li> </ul>

## **Societal level**

At the societal level, public policy making, environmental law enforcement, raising public awareness, raising worker awareness and the sector education policy are distinguished.

### *1. Public policy making*

At societal level, the first effect is that public policy making, or public administration is paying systematic attention to this dossier. The public expects that, and policy experts are sufficiently informed about the necessity of this, and much is already going on. There are various platforms at different levels which deal with the issue of sustainability, such as separated waste management at municipal level, integrated waste management at regional level, setting policy targets at national level, and getting international agreements and treaties and starting and implementing programs (like the Kyoto protocol, and the UN Decade of Sustainable Development). There are also various projects on international cooperation, and private initiatives, such as the Clinton Global Initiative, voluntary actions all aimed at gaining collective commitment. These developments go together with resistance and even conflict, because much is at stake. Different parties in the process have different interests. For this, education has started specific teaching programs for multiple-stakeholder facilitation processes. These programs prepare professionals for stimulating and facilitating interaction processes between different public and private organizations, institutions, groups or individuals, who have vested interests in certain practices. Informing parties, gaining mutual understanding and respect, reaching the most reasonable trade-off, and conflict resolution are key achievements of these facilitators.

### *2. Enforcement*

The second effect at the societal level is enforcement, basically as one result of public policy making. Here I would like to acknowledge the work of Van Woerkum of the Communications Department of Wageningen University and others in the field of public policy making. They have contended that this policy making should follow principles of interactivity. Interactive policy making created a much larger platform, including commitment and compliance, than traditional top down strategies of public administration.

In serious fields like aviation, the nuclear industry, criminality, financial services, health care, but also in food safety, many countries have agreed upon national and international regulations and enforcement strategies, because incompetent behavior in these areas are detrimental for the population.

For instance, in the food industry, the inspectorate and obligatory participation in quality surveys, and international control by for instance

the IFPRI can be mentioned. In the field of environmental technology environmental policy and mandatory administration are examples of this.

The typical educational response here is that in various respective educational programs, new regulations and law enforcement systems are taken up in courses on food law, environmental law, etc. In this way new entrants on the labor market are informed about this. But when large changes occur, existing professionals also need to be informed, which can be done by large campaigns, which for instance happened with the introduction of the new VAT law in Australia some years ago.

### *3. Raising public awareness*

The third effect of climate change at societal level is the raising public awareness of the problematics that are related to that. All around the globe people are talking about the changes in the weather. In Africa, close to the equator, I was sitting on a terrace when it was feeling fresh and I had to put on my blazer. Young colleagues were wearing sweaters while freezing. They spoke about the weather as being wintery, which was quite unusual. It was much too cold too long for that time of the year. I think the documentary of Al Gore, an Inconvenient Truth, which I mentioned before, has to be mentioned here again, since it has been very influential on the attitude of the population in general. There is progress in this respect, which leads to behavior change, but the schizophrenia of the citizen and consumer can be reiterated again, and it also has to be said that some life styles, such as skiing in Dubai, do not really add to sustainability. Recycling and reduction strategies have to come first, since they add to the achievement of sustainability targets.

For education, there is a specific role to play in this respect. Educational institutions can start cooperation with public and private agencies for sustainable development. Cooperation can be with NGOs, municipal departments, centers for environmental education, as well as regional and national projects and organizations. The educational infrastructure can also be used to interact with the local population in courses and workshops in which climate change is addressed, to sensitize them for this field if they are unaware of what is happening. Using the often elaborate network of schools, colleges and universities as well as teacher training centers is now the core of certain strategies to communicate information which is essential for society.

### *4. Raising awareness of workers*

Apart from raising awareness of the public, workers should also be addressed. The typical effect of climate change at corporate level is that they set up a program for corporate social responsibility (CSR). They can do that at different levels, ranging from mere minimum compliance with the regulations to an internally felt commitment to a better world. Some

companies support wildlife protection programs, or other nature conservation projects. A cautionary remark can be made here, because organizations can employ these strategies for marketing reasons, so the details of these initiatives have to be studied first to judge whether they are really adding to the environment. Many of them are.

When companies have set CSR targets of companies, a corporate CSR strategy is developed frequently. After that, corporate regulations, cultures and practices (e.g. in the construction or catering sectors) need to be reviewed and adjusted where necessary.

Employees can be confronted with the consequences of the corporate sustainability policy by means of training, development, coaching or consultancy activities. To take real effect, these activities have to be embedded in structured strategies and practices of human resource management. Geiser (2006) gives examples of this kind of training and development, for instance in the field of reducing use of toxics by professionals.

##### *5. Sectoral education policy*

The last effect of climate change at the societal level is sectoral policy development. Whole sectors are making plans on how to deal with aspects of climate change. The agricultural sector builds scenarios, at the national, but also at the international levels. In a study of Luttik et al (2006) (from Mulder, in press), it is stated that '... agriculture may disappear in Western-European countries like the Netherlands. Four development pathways are distinguished as futures of land-based agriculture: eroding agriculture, changing agriculture, innovative agriculture and from land-based to sea-based agriculture. Based on these scenarios, nine draft ideas are developed based on which land-based agriculture can develop itself: 1. sea-based agriculture (agriculture in the sea, which is sea-based industrial production of various wet-land based healthy nutrients: fish, shell-fish, alga, crops), 2. bioport (turning the economy from fossil to biomass energy production, contributing to sustainable energy consumption), 3. demand-driven micro-chains (instead of supply-driven bulk-chains), 4. local autonomy (instead of central provisions), 5. boundary crossing food (eating as a way of bringing people of different cultures together), 6. nature at your fingertips (making nature more attractive by partially virtualising it), 7. dying with dignity (about a new experience in the terminal phase; think of hospices in beautiful natural environments with high quality care), 8. value driven financial arrangements (demand-driven planning of the landscape in stead of subsidy systems), covenant society (away from the government-regulated market economy to a self-managing network society). Also at the level of the European Union, scenarios for the future development of agriculture and rural development have been created, basically disappearance, stabilization and growth. It will be clear that if a certain scenario will come

true, this will have much consequence for the inclusion of certain education programs in the course syllabus.

Within the agricultural sector in the Netherlands, there are many sectoral initiatives, such as the reduction of carbon dioxide emission from greenhouse, and turning greenhouses into sources of energy instead of massive users of energy. Association governors are being educated in the new issues, as well as management of sectoral organizations and experts in sectoral organizations, because many of them have to lead and facilitate sustainable sectoral development, like greenhouse production. Also, from an economy of scale perspective, educational institutions in the agricultural sector make agreements on the places at which certain special programs are being taught. Maybe a special program on climate change or sustainable development can be taught at all places of the universities. Regional agreements are being made about who teaches which programs. Needless to say, this sometimes is a difficult process. To influence public awareness, the sector can also implement specific projects like 'adopt a chicken', or pig farm observation windows at farms.

### **Employment/labor market level**

At the employment and labor market level, three effects are being presented here, migration, labor market restructuring, and climate change as a field of work.

#### *6. Migration*

Migration is seen as an effect of climate change because significant changes may cause populations to move. This may take place in regions that are hit by extreme temperature rise, drought, or on the contrary abnormal precipitation and flooding. Changing living conditions for migrant necessitates cultural integration, acceptance, and basic education in the language and culture of the new society. There is a necessity of learning to work in the new context.

#### *7. Labor market restructuring*

For the people who stay behind in regions which are hit by extreme climate conditions, a restructuring of the labor market or employment, including self-employment has to take place. The type of economic activity will change. Complete sectors may disappear, and a new line of business needs to be generated. This calls for important coping strategies of workers searching for new employability. But job creation also comes in place, which is not easy without public support. For these labor market reconstruction areas, the EU has the so-called restructuring funds, which were heavily used in regions where many are unemployed and immigrants, such as the previous coal mine sector, metal sector, textile sector and also agricultural sector. Agriculture is now converting into multifunctional use like country-

side living, tourism, care and nature conservation (see Hortet in press). Education can pick up many of the re-training needs and make customized training programs for persons who want skills in new areas and that are profitable in the region.

#### *8. Climate change: a field of work*

Climate change itself is a growth market in terms of the organizations working on it, or companies that produce new technology for reducing the negative effects of it. So climate change is a growing field of work. More education is needed for that, which means that there will be higher pressure on the pertaining programs. Examples of labor market segments which will show a growth of employment opportunities are the climate control industry, the CO<sub>2</sub> emission reduction technology sector, the environmental technology measurement device sector, the clean air industry, the clean water industry, and of course the food quality sector.

There is also job growth in non-technical sectors, like the financial sector, because of climate change. The CO<sub>2</sub> emission sector has introduced trade of emission rights, which is being done at the carbon dioxide emission exchange. This created a completely new trade sector, with new jobs attached, and a specialized education program for that.

Education typically responds on four levels when it comes to introducing a new field of study: 1. new elements in existing subjects; 2. the introduction of new subjects in existing programs; 3. the introduction of new differentiations and specializations in existing programs; and 4. the introduction of new programs.

#### **Educational institution level**

At the level of the educational institution three effects are being discerned: the interaction with external relations in the field of climate change, the setting of a good example, and the introduction of new programs as mentioned above.

#### *9. External relations*

Schools and colleges which want to take serious action when it comes to climate change often engage in external relations to build up networks in which knowledge about innovative practices can be exchanged. In the Netherlands again, a program on knowledge circulation is being implemented to stimulate educational institutions in making contacts with research organizations and enterprises. This institutional cooperation takes place by having student groups do research projects for companies. These student groups are being guided by researchers in doing their projects for specific organizations, like farms or food production factories. This process is also referred to as cooperative knowledge

construction, as all parties involved learn from these educational research projects.

To elaborate a bit on this, two projects were implemented in the Netherlands, one on knowledge co-creation and one on knowledge arrangements. Both will be summarized here.

As to the project on knowledge circulation (Potters, Van der Hoeven & Gielen, 2006; Lans, Kupper, Wals, De Beuze & Geerling-Eiff, 2006) it is emphasized that effective arrangements between research institutes, industry, and educational institutions should be created, to inform education about the developments so that they can be integrated in their programs and to implement new interactive and participative initiatives in which students can develop competencies and expertise.

In the project called 'Learning with future' (Potters et al, op cit), three pilots of innovative arrangements between education and research were tested in cooperation with the Clusius College Hoorn, CAH Dronten and INholland Delft.

First of all, causes and consequences of suboptimal cooperation between research and education were analyzed and a model for future oriented learning was developed. The key causes of limited cooperation between education and research institutes were related to lacking overlap between the networks, little vision on cooperation and low priority, and restricted concepts for cooperation. All these resulted in limited vitality and sustainability in agriculture. Practical networks were not used as learning environment, new knowledge did not flow into educational innovation, chances for preparing students for professional practice were under-used, capacity for research of education was not used, which led to less innovation power.

After these observations, two meetings were organized in which perspectives were shared and opportunities for cooperation were identified. The concept of learning with future revolves around the idea that structural cooperation only starts and continues as long as the various stakeholders have mutual benefits of it. Because of this, participative methods were used to develop cooperation, and the project team played a facilitating role.

Based on the meetings three draft proposals were developed and the proposal which had the strongest support was elaborated and tested by three pilot core teams. The project gave room for exchanging experiences and went beyond traditional boundaries between entrepreneurs, research and education. The partners in the projects thus learned about new opportunities for cooperation and developed ideas for institutional integration.

The core of the pilot projects consisted of student teams who were working on questions for entrepreneurs. During the projects students were hoped to develop the following future oriented competencies: 1. strategic entrepreneurship in networks; 2. translating research findings into practice; 3. working in teams and project management; 4. communication: deliberation, making agreements, informing, interviewing, human relations, report writing and presenting.

The student teams worked independently, but they were supported by researchers, teachers and consultants. Teachers were coaching the learning processes and created a safe learning environment. Researchers and consultants gave advice regarding the content of the projects and the research process. The entrepreneurs served as project commissioners, but also acted as practical experts and information sources about the company.

As said, three pilot projects were implemented, one on biological agriculture, another on open integrated cultivation, and the third on greenhouse horticulture. Reactions of all stakeholders about this interactive entrepreneurship-research-education model were very positive. Participants said: 'This is REAL education', 'This is much better than doing an internship in a company. One makes the link between theory and practice. In other internships one in fact just works along in practice. Now one wants to also see what an entrepreneur has on paper inside', and 'One learns things one normally does not learn in the program, for instance how one can get as much out of an interview as possible'.

Lessons learned were about the cooperation and knowledge circulation between the actors, and structural embedding of the model.

Regarding the cooperation and knowledge circulation it was found out that the choice of the theme for projects influences the perceived value of the project for the partners. It is important to choose a specific question of entrepreneurs, to relate to project theme, to current research which fits in the running research program, and to link it to existing educational programs and themes of educational innovation. Furthermore, the right persons who have the right competencies should be linked together. Also, the learning project should be well defined, and a start-up meeting is essential. Clear communication, quality management and the flow of knowledge are also important. As for the institutional embedding vision development, agreements, flexibility in added value, a joint year calendar, organizational support from all actors, keeping watch of overregulation, financing, training and coaching of teachers, researchers and entrepreneurs, linkages with innovation processes, and appointing a coordinator within the participating organizations are important.

The second project mentioned (Lans et al, op cit) was about knowledge arrangements as powerful learning oriented combinations of



groups of actors. Ten of these knowledge arrangements were monitored: about cow, poultry knowledge, declaration-obligatory animal diseases, duration cultivation, crop protection, new style tree nursery, learning with future (described above), pre-university campus, knowledge circle food safety and the rural house of a specific region in the Netherlands. Pre-university campus is a service of the university for students of pre-university education such as the support of students who have to make assignments in field that are covered by the university. A knowledge circle on the other hand is a group of experts around the relatively new position of leader in higher professional education, who has the task of innovating educational programs, creating new programs, and to do practice-oriented research.

All knowledge arrangements were analyzed, and again lessons were learned that are important for setting up and maintaining good and innovative practices. Competencies were identified which are essential for these arrangements, and guidelines were given for 'directors' based on: 1. the four factors identified in this study that are important for success: vision, support, competence and culture, and 2. the three levels of the actors: individuals, organizations and the networks. Directors can assess the situation of a knowledge arrangement on these factors and levels and decide on a deliberate strategy to orchestrate (and develop and manage) the arrangements.

#### *10. Giving a good example*

An effect of climate change is also that educational institutions want to give a good example in sustainable behavior. They do not stick with a code of conduct, but actually realize things like carbon neutral enterprise. Wageningen University does that for instance by maintaining its own green energy supply; it has wind mills which generate sufficient energy for the whole university and research center. Needless to say that setting a good example is much more powerful than preaching the blessings of sustainable behavior without any care for the internal processes.

#### *11. Beta-gamma interaction*

As said before, sustainability is a concept at the interface of beta (technical, hard) and social sciences (Röling, 2004). It is not enough to just focus on technological issues when sustainability challenges are at stake. The human factor is as important, since humans have created many problems that cause sustainability challenges, and solutions very often imply negotiated changes in human action. Therefore, at various universities this interaction between the beta and gamma sciences is advocated, both in research and education. In an evaluation study of beta-gamma interaction in education in the department of environmental sciences at Wageningen University (Mulder, Van Loon & Broekman, 2004) it appeared that this interaction is by no means easy. Different educational cultures (if not

paradigms) come together, and if students are being supervised by teachers from both sectors, the chances are high that the teachers have different assessment standards in mind when it comes to the quality of the student work in their fields. Teachers in the beta sciences have higher standards regarding the beta component of the student work, whereas teachers in the social sciences use higher standards regarding the social component of the student work.

Further findings of the study (op cit) were the following:

- Didactics - Problem-based learning and case-based learning are good didactical approaches to realize beta-gamma interaction (BGI).
- Needed BGI knowledge – Important is to determine with which core problems in the subject domain graduates will have to deal and which beta- and social science knowledge is needed for solving those problems. BGI-education needs to be programmed based on these problems.
- Necessity of BGI – Students should get clear examples as to in which way they will be confronted with inter-, multi- or trans-disciplinary work after they have graduated, and that it is the task of the university to give attention to the integration between core subjects next to further (super) specializations. To make BGI understandable the way in which different disciplines are connected should be clearly indicated: there should be alignment. This can be achieved by presenting a conceptual framework to make the read thread visible.
- Mutual interest - BGI has to scaffold the stimulation of mutual interest and understanding in one another's content area and the differences in design and problem solving approaches. BGI education should be linked to the zone of proximal development of beta and gamma students.
- Language and way of thinking - Beta and gamma students have to learn to know their mutual language and way of thinking. They also have to be curious to the background of that thinking not only because of getting a better understanding of that, but also to be able to cooperate where necessary.
- Mixed teacher teams – Employing mixed teams with beta and gamma teachers works especially good when good ex ante agreements are made between the teachers involved and there is a clear framework of actions.
- Knowledge of teachers – Both beta and gamma teachers who are being chosen to implement BGI education have to have insight in their mutual domains.
- Continuous learning lines – Multi- or trans-disciplinary problem solving cannot be learned in one subject. That calls for continuous learning lines spread across the program. It is important to program BGI oriented competence development in such learning lines.

- Exams – It is also important to give attention to assessment of BGI competence. Teachers have to be very well aware of different assessment frameworks and accompanying standards. Different disciplines have their own grading practices. Beta teachers may have lower marks in mind when assessing work of BGI groups regarding the social sciences component and vice versa.

Research is going on to study the concept development during the learning process in a beta-gamma program of food safety (Spelt et al, 2007).

### **Curriculum level**

The next level of effects of climate change in education relates to sustainability competence needs and sustainability competence development needs.

#### *12. New competence needs*

Another effect of climate change is that it creates new competence needs to which educational institutions have to respond. However, to be able to do so, they need to have a clear picture of the impact of climate change in practice, and assess the new competence needs, and decide if they want to address them, and if yes, how. There are various methods to analyze future competence needs. Ongoing analysis remains necessary for regular updates of the information on which educational programs have been built.

#### *13. Competence development approaches*

As said before, educational institutions also can introduce completely new educational programs, such as new Bachelor and Master programs for broad fields (Tanner and Tanner, 1995) to combat the effects of climate change. Various universities have programs for environmental technology for years already, but various new special programs have been introduced.

Since environmental issues include a knowledge, skills and attitude component, we are conceptualizing education which addresses this as competence oriented. By this we mean that students not only have to develop a large amount of knowledge, they also have to have the skills to apply this knowledge, and to do this with a constructive attitude towards realizing sustainable development.

We will come back to the whole notion of competence development in the next section of this contribution, since we see it as a crucial innovation in higher education, which at the moment gains worldwide attention.

In an orientation on educational responses to diverse expectations of the public, Mulder & Ernstman (2006) have distinguished various educational innovations, or rather educational practices that in HAE institutes (in various European countries) consulted were observed as being important for the challenges. Respective competence development issues were identified. These educational practices are listed below.

- Organizing language courses at university or making language courses very accessible
- Organizing subjects on intercultural education
- Organizing student-exchanges between different countries
- Inviting foreign students to a university
- Strategic networks with leading international universities
- Interdisciplinary education
- Trial stations, in which students learn the practice of agriculture
- Merging universities with more practical educational institutes
- Organizing lectures together or designing joint Master programs
- Merging more practical and theoretical knowledge
- External students (organizations) provide more practical education for students
- Thematic courses; Academic Master Cluster
- Project oriented education to make students judge by themselves and think of solutions
- Providing of students with diverse stock of knowledge and opinions that students then merge in order to come to new conclusions. This gives them knowledge on both the details of an issue and an overview. For example, different scientists organize a lecture on plant, one of them will focus on cell-level, the next focuses on the plant as a production system, the third looks at the plants in relation to animals, etc.
- Problem-based learning
- Courses on communication skills
- Organizing opportunities in which students practice presentations
- Multi-stakeholder projects: students are taken away from the scientific world and drawn in practice, as stakeholders come up with practical questions and issues that automatically are more holistic
- Joint lectures: a subject is taught by a consortium of different experts/lecturers; they all focus on a different component of the issue; joint lectures
- Education-industry collaboration
- Venture Cup and Yearly industry convention

See for other curriculum responses to the issue of sustainability the work of Lowry and Flohr (2006).

### **Teaching/learning level**

Finally there are effects of climate change on the processes that take place at the level of teaching and learning. This effect is not direct,

but subject to the activities of teachers in educational practice, and ways in which students appreciate, interpret and utilize the learning arrangements that are being created for them. There are two effects we distinguish here: behavior change and the implication of that in teaching and learning, and the design of inspiring learning arrangements.

#### *14. Behavior change needs*

Climate change can only be counter-acted by human action. Values, preferences and customs need to change, to support behavior change. This directly relates to the previous educational response of competence development, which, as said, not only refers to knowledge, but also to the ability and will to apply this knowledge. Behavior change is also related to transformative learning, which means learning to look at things differently (Sterling, 2004). Viederman (2006) however contends that learning and behavior change can not easily be fostered by universities, but higher education needs to focus on that, and there are various possibilities to do so.

#### *15. Needs for inspiring learning arrangements*

Climate change leads to the need of seductive learning arrangements in which students not only are challenged, but also inspired to do something about the problem situation. There are various ways of implementing inspiring learning arrangement to promote sustainability competence. There are the interactive, participative ways of social learning (Röling, 2004), strategies to learn from and with each other, inquiry learning and experiential learning (Lowry & Flohr, 2006).

In a project on inspiring learning arrangements for entrepreneurs, prototypes of learning arrangement were developed which are now tested and adapted in higher agricultural education. In this project an attempt is made to design various learning arrangements for entrepreneurs which are inspiring for them to engage in (Gielen, Biemans & Mulder, 2006). It is well-known that entrepreneurs are not very interested in participating in formal education and training courses. Their learning preferences are different (Lans, Wesselink, Biemans & Mulder, 2004), and in an innovative context they tend to rely on reflection, observation and imitation (Mulder, Lans, Verstegen, Biemans & Meijer, 2006). Supporting entrepreneurs in their learning effort is a challenging effort, and the idea was that if learning support would be inspiring entrepreneurs would more benefit from it. Therefore, various pilot studies were conducted in which inspiring learning arrangements were found, which were labeled with metaphors. The metaphors are listed below, and the pertaining competencies are indicated behind the metaphors. Various specific didactic varieties are listed below the metaphors.

- Master class - Insight and experiential knowledge

- o Workshops, cases, court game
- Clinic - Skill
  - o Demonstrations, audits, benchmarks
- Workshop - New perspective
  - o Brainstorms, mind mapping, creative sessions, scenario-development
- Laboratory - Viability of solutions
  - o Model development, practice simulation, research, concept development
- Academy - Multidisciplinary knowledge
  - o Classes, lectures, seminars, symposia
- General rehearsal - Collective routine
  - o Training, conducting, development of cooperation and routines, presentation
- Entrepreneurs café - New networks
  - o Lectures, discussion, team quiz, socio drama
- Boxing ring - Improved performance
  - o Debate, panel discussion, game, training and coaching, competition
- Kitchen table - Deepening network
  - o Dialogue, group conversation, coaching conversation, reflection conversation, consultancy session
- Utopia - Innovation
  - o Discussion, negotiation, presentation to the public
- Study club - Mirroring company results
  - o Story-telling, company visit, company audit, systems analysis, presentation
- Expedition - Self-knowledge and new values
  - o Excursion, blind date, study tour, survival, journey report

These inspiring learning arrangements are being advised to institutes of HAE. The general idea is that taking authentic learning of entrepreneurs as an example, students of HAE will also be motivated to engage in these activities, in which they then acquire the competencies that are being conceived of as very important.

### **Other educational approaches**

After having given this overview of various effect of climate change on education and educational responses to it, it may also be informative to list some other educational approaches which have not been mentioned yet, but which may be interesting to apply in climate change-oriented programs, courses or lessons. The educational, pedagogical and instructional approaches mentioned below are frequently used in the Netherlands:

- Project education, which is employed for instance to a large extent by the college of Larenstein in Velp (now part of Wageningen University),

which addresses social learning in self-directed student teams to a large degree;

- Problem-oriented education (a model which started in the Netherlands within the School of Medicine of the University of Maastricht, and which was adopted in a modified way by Wageningen University), which addresses integrated problem analysis, information finding and processing, team learning, and problem solving;
- Multi-disciplinary design and problem solving (a model developed at various technological universities, but also implemented in a specific way in the Academic Master Cluster of Wageningen University), in which communication of students from various disciplines is developed;
- Computer-based collaborative learning (a model of a-synchronous network-based communication about learning content, knowledge construction and development of collective representations, widely used world-wide, but still in its infancy in Wageningen University (see Mahdizadeh, 2007), which is typically used for content areas in which diverse perspectives are existing, and students can have differences of opinion;
- Video-based case study and problem solving techniques (a way of working with new and sometimes emotional situations with which students may not have much experience, such as HIV-Aids or conflicts); this addresses for instance handling emotions, negotiation, and conflict resolution;
- Competence development, based on competence assessment, personal development plans, coaching, feedback and reflection (widely used not only in education but also in companies in Europe);
- Entrepreneurial learning, in models of small business education or simulations (such as being practiced in an agricultural college in Goes); inspiring learning environments of entrepreneurs can serve as examples for course activities in higher agricultural education (as studied in the greenhouse sector by Lans et al).

Further studies regarding innovative educational approaches for competence development in the Netherlands are the program on knowledge circulation, beta-gamma interaction in education, competence-based higher education, learning with future, learning of entrepreneurs, and inspiring learning arrangements. These studies will be described briefly.

### **Towards competence-based education**

The concepts of competence, competence development and competence-based education had been previously and repeatedly mentioned in this paper. To elaborate on this, the overarching innovation at this moment is competence-based education.

With competence we mean the integrated set of knowledge, skills and attitudes which are conditional for effective performance. Examples of this are the advice on river management, which requires knowledge about currents, tides, forces, social-economic situation in the river area, skills regarding measurement methods, handling equipment, data registration, and attitudes like objectivity, accuracy and creativity, or on facilitating multi-stakeholder processes, which requires knowledge about the field, group dynamics, interests of stakeholders, skills like the ability to start a dialogue, to stimulate exchange of opinions and arguments, finding common ground, enhancing transparency of disagreements and attitudes like appreciating to work with heterogeneous groups.

The implementation of competence-based education in this innovation is further in colleges for professional education at the undergraduate level than in universities at the graduate level, since the colleges are more oriented towards professional practices, whereas the universities are more focused on academic skills and research. Various principles of and experiences with competence-based education are proposed, based on studies of Wesselink, Biemans & Mulder (2007). A matrix was developed with these principles and levels of implementation. This matrix is primarily meant for competence-based agricultural vocational education, including higher professional education. The principles are the following which are further elaborated in an appendix of this paper:

1. The competencies, that are the basis for the study program, are defined.
2. Vocational core problems are the organizing unit for (re)designing the curriculum (learning and assessment).
3. Competence-development of students is assessed frequently (before, during and after the learning process).
4. Learning activities take place in several authentic situations.
5. In learning and assessment processes, knowledge, skills and attitudes are integrated.
6. Self-responsibility and (self)-reflection of students are stimulated.
7. Teachers both in school and practice fulfill their role as coach and expert in balance.
8. A basis is realized for a lifelong learning attitude for students.

First research into the application of competence-based agricultural-vocational education showed different (Biemans et al, 2004; Mulder, Weigel & Collins, 2007) critical remarks, such as the link with authentic learning which is difficult to realize, the costs and complexity of assessment, the opaque nature of the concept itself, the over-reliance on standardizations, the change of teaching and learning style, and the necessity of implementing competence management for teaching staff. All these can overcome if the right conditions are provided and strategies are implemented to avoid the pitfalls.



Various faculties and universities are now in the process of working with the concept of competence in their programs, also based on the Bologna process, the European Qualification Framework, the Dublin-descriptors, and accreditation requirements regarding the societal relevance of educational programs. Wageningen University takes this very seriously, and has implemented a program of identifying competencies in all programs, and now places this in a wider perspective of the preparation of students for the labor market and society, in which the expectations of the public also play their part.

### **Conclusion and wider perspectives**

There are various effects of climate change on education, and there are various responses to this, at various levels. Education for this field is characterized by its normative and mission-driven character, which relates to values and standards. To raise awareness for the problem area, understanding, acceptance and appreciation are needed. This will go along with disagreement, irritation, frustration, and conflict, since competing preferences are at stake. Ways of handling these conflicts are ignoring, dialogue, and conflict resolution. There is much case-based information about educational approaches which address this. A common understanding is that interactive and participative multiple stakeholder processes are needed for facilitating the agreement on the best trade-offs in given situations with conflicts of interest. We see competence development in higher education as essential for higher education in the field of sustainable development. The space in this contribution is too short to elaborate this further. The essentials of this approach and its origins are described in Mulder (2007).

This paper describes the responses of education to climate change although the methodology to assess the level of sustainability of higher education institutions is not included here. Work of this kind has been done by Roorda (2004), who presented the Auditing Instrument for Sustainability in Higher Education. This instrument is based on principle of quality management and comprises five stages of development of sustainability in higher education: activity orientation, process orientation, systems orientation, chain orientation and society orientation. A criteria list goes along with this instrument, which consists of five categories: vision and policy (on sustainability in higher education), expertise in this field, the alignment of educational goals and methodology to the field of sustainability, the content of education, and the assessment of educational achievement. The instrument can be used in audits of institutes of higher education, resulting in a profile of the extent to which the institutions meets the agreed criteria.

We neither went into the many case studies or national reviews that are presented in the field of education for sustainable development, like the one by Scott & Gough (2004), who have given an overview of the

developments in this field in the United Kingdom, the one by Calder & Clugston (2004) about the sustainability initiative by the University of South Carolina, or the one by Koester, Eflin & Vann (2006) on Ball State University.

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## **Appendix: Principles of competence-based professional education**

Source: Mulder, M. (2007). *New Competence-Based Initial and Continuing Vocational Education Policy Making in the Global Economy. Problems and Perspectives*. Contribution to the International Forum on Vocational-Technical Education, organized by UNESCO-APNIEVE and Tianjin Municipal Education Commission, Tianjin, China, 11-13 September 2007.

### *Principle 1 Competence profile*

The competencies, that are the basis for the study program, are defined.

Variables to check the implementation of this principle are:

- Putting together a job competence profile
- Using a job competence profile
- Interaction between education and vocational practice

The complete implementation of the principle means that a job competence profile is put together with participation of actors in the sector and occupation, and that this profile is frequently aligned with regional and local actors in practice including and reviewed against the major trends. This job competence profile has been used during the (re)design of the curriculum.

### *Principle 2 Vocational core problems*

Vocational core problems are the organizing unit for (re)designing the curriculum (learning and assessment).

The main variable to assess the level of implementation of this principles is the extent to which the vocational core problems determine the curriculum.

The maximum implementation of this principle is that core vocational problems have been specified and that these are leading for the (re)design of the whole curriculum of a training program.

### *Principle 3 Competence assessment*

Competence-development of students is assessed before, during and after the learning process.

Variables to check the level of implementation of this principle are:

- Accreditation of prior competence development
- The inclusion of formal competence assessment
- Formulating feedback based on competence assessment
- Ensuring flexibility in format and timing of assessment

The maximum implementation of this principle is that assessment takes place before, during and after the learning process. Assessment is used for both summative and formative assessment. Students determine moment and format of assessment themselves, in consultation with the teaching staff and assessors.

#### *Principle 4 Authentic learning*

Learning activities take place in different authentic situations.

Variables to check the level of implementation of this principle are:

- Authenticity
- Diversity
- Relation between learning in school and learning in practice.

The maximum implementation of this principle is that learning activities take place in a diversity of authentic settings to a large extent, and that they are clearly related with the learning activities in practice, at internship places or based on learning and working contracts.

#### *Principle 5 Integration of knowledge, skills at attitudes*

In learning and assessment processes, knowledge, skills and attitudes are integrated.

The main variables to check the level of implementation of this principle is the level of integration of knowledge, skills and attitudes in essential study tasks throughout the curriculum.

The maximum level of implementation of this principle is that integration of knowledge, skills and attitudes is the starting point for both the learning and assessment process, and specified in that sense.

#### *Principle 6 Self-responsibility*

Self-responsibility and (self)-reflection of students are stimulated.

Variables to check the level of implementation of this principle are:

- To what extent is self responsibility stimulated?
- To what extent is self reflection supported?
- To what extent is reflection on functioning in the vocational setting organized?
- To what extent are the learning needs of students taken as the starting point for their learning process?

The maximum level of implementation of this principle is that students are responsible for their own learning process based on their own learning needs.

*Principle 7 Balancing the expert and coaching role*

Teachers and trainers both in school and practice fulfill their role as expert and coach in balance.

Variables to check the level of implementation of this principle are:

- The way in which the learning process is supported
- The extent to which the knowledge acquisition process is supported

The maximum level of implementation of this principle is that teachers stimulate students to formulate learning needs and to manage their own learning processes based on careful self reflection.

*Principle 8 Lifelong learning*

Students have acquired a positive attitude towards lifelong learning.

Variables to check the level of implementation of this principle are:

- To what extent the educational programs contributes to personal and (labor) identity development
- To what extent the program addresses the development of learning competence
- To what extent is attention given to the future career of the student

The maximum level of implementation of this principle is that during learning trajectories the development of learning skills and (labor) identity are integrated, and that reflection on the future career of the students has taken place.

# **Green Productivity Initiatives in the Philippines**

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**Catherine Q. Castañeda, Ph.D.**

**Aline R. Genato**

*Commission on Higher Education*

*Office of the President*

*Philippines*

## **I. Country Background**

The Philippines is a newly industrializing democratic Republic in Southeast Asia. It is an archipelago with 7,107 islands and islets spanning 1,854 kilometer from north to south. It is a window to the New World, stretching from China to the North and the Indonesian archipelago to the South. It is situated in the eastern rim of the Asiatic Mediterranean between the warm and shallow waters of the Pacific and Indian Oceans between Australia and Asian mainland.

The Philippines has a total area of about 300,000 sq km and about 298,170 of the total area is land with the remaining 1,830 being the total water area. The country is made up of three island groups: Luzon (North), Visayas (Central) and Mindanao (South), which is further divided into 17 regions, 79 provinces, 114 cities, 1,496 municipalities, and 41,945 barangays. Manila is the capital. The country has a population of about 88,875,300 (2007-estimate) with an estimated population growth of 2.36% annually.

There are over 111 regional dialects and 87 main languages in the country. The national language is Filipino while English is the official language used for business, school, legal and government transactions.

The climatic condition of the country is generally tropical and varied due to its topography. June to November is the season of the southwest monsoon, which brings sultry wet weather. December to May is the season of the northeast monsoon. Considered to be part of the Tropics, the temperature ranges from 80 °F/26.6 °C to 90 °F/ 32 °C with the interior valleys tending to be a little warmer and the mountain peaks a little cooler than the mean. The relative humidity averages about 77%.

## **II. Overview on Productivity and Environment Programmes/Initiatives**

### **Productivity Policy**

As stated in the Medium Term Philippine Development Plan for 2005-2010, the Philippine Government aims to improve national productivity by further harnessing Science and Technology in order to make the industry and services more technologically competitive. This will be done by continuous implementation of programs that will attract students to pursue careers in mathematics, science and engineering with industrial applications. The needs and priorities of industry and services will be considered in carrying out government-sponsored and university-based research and development. In addition, scientific research in areas strategic to national development such as information and communication technology (ICT), biotechnology, material science and manufacturing technologies will be further pursued. Intellectual property rights will be protected in a manner that will both stimulate technological innovation and encourage technology diffusion throughout the economy. Improved science and technology services that will allow firms to better select and acquire needed technologies will be provided. Public education and employment systems and equivalency and accreditation for technical-vocational education and training will be expanded and improved

The Philippine National Productivity Office is under the Development Academy of the Philippines and forms part of its Productivity and Development Center. At present, there are two Green Productivity Projects being implemented: the Dissemination Assistance Project for the Livestock and Poultry Industry (April 2001 – September 2002) and the Demonstration Program for small and medium enterprises (SME) – Demonstration Factory (Jo-na's International Philippines, Inc.), November 2001- November 2002

### **Environmental Policy**

Sustainable development practices shall be through intensive promotion of environmental management systems, employment of clean production technologies and production of more environment-friendly materials in consultation with the private sector and civil society. Close monitoring of domestic and global environmental phenomena and involvement in forging international-level solutions under the various environmental protocols and bilateral, regional and multilateral trade agreements where the country is a signatory will also be done.

It is a continuing policy of the state, (*Philippine Environmental Policy of 1977*) to create, develop, maintain and improve conditions under which man and nature can thrive in productive and enjoyable harmony with each other and to fulfill the social, economic and other requirements of present and future generations of Filipinos. It is a state policy to insure the attainment



of an environmental quality which is conducive to a life of dignity and well-being. In pursuance of this policy, it shall be the responsibility of the Government to protect and advance the right of the people to a balanced and healthful ecology. The Government shall also encourage the widest optimization of the environment without degrading it, or endangering human life, health and safety or creating conditions adverse to agriculture, commerce and industry while attaining a rational and orderly balance between population and resource use including improvement of renewable and non-renewable resources.

The *Philippine Environment Code of 1977*, the national blueprint for environmental protection contains general principles dealing with the major environmental and natural resource concerns of the country. It was formulated to establish specific environmental management policies and prescribe environmental quality standards. Included in its policies is a) the integration of subjects on environmental education in the school curricula at all levels by the then Department of Education and Culture and b) engage in the conduct of special community education emphasizing the relationship of man and nature as well as environmental sanitation and practices.

Due to the urgency to formulate an intensive, integrated program on environmental protection which will bring about a concerted effort towards the protection of the entire spectrum of the environment, an environmental impact assessments and statements was imposed through Presidential Decree No. 1586 of 1978 establishing the *Environmental Impact Statement (EIS) System*. The EIS requires all government agencies, government-owned or controlled corporations and private companies to prepare an Environmental Impact Assessment (EIA) for any project or activity, which significantly affects the quality of the environment. The assessment is both a process of predicting the likely environmental consequences of implementing projects or undertakings, and designing appropriate preventive mitigation and enhancement measures. The EIA is a requirement in obtaining an Environmental Compliance Certificate (ECC) issued by the Department of Environment and Natural Resources (DENR). DENR administers environmental management, conservation and development in the country.

Various other laws have been enacted to address specific environmental concerns like the Philippine Clean Air Act of 1999, Ecological Solid Waste Management Act of 2000, Wildlife Resource Conservation and Protection Act of 2001, Animal Welfare Act of 1998, Agriculture and Fisheries Modernization Act of 1997, Revised Water and Forestry Code of the Philippines and the Toxic Substances, National Caves and Cave Resources management and protection Act of 2001, National Integrated Protected Areas System Act of 1992 and Hazardous and Nuclear Wastes Control Act of 1990.

Non-Government Organizations (NGOs) are extremely vibrant, particularly in relation to environmental protection, community-based resource management and defense of environmental rights. These NGOs conduct various activities and projects on the environment such as training, research, curriculum development, instructional materials and promotion and undertaking of community-based resource management strategies in specific sites. Some of the most significant and respected environmental NGOs are the Legal Rights and Natural Resources Inc. Environmental Legal Assistance Center, Foundation for the Philippine Environment, Institute for Environment and Sciences, Haribon Foundation, Green Mindanao Association, Miriam Public Education and Awareness Campaign for the Environment and the Northern Sierra Madre Wilderness Foundation. Some of these NGOs are members of the Philippine Environmental NGO Network, a coalition of environmental NGOs involved in matters relating to legal rights, indigenous peoples, natural resource protection and exploitation of local communities by corporations. Aside from these NGOs, universities, colleges and even elementary and secondary schools organize activities such as information campaigns, trainings, seminars and projects to help in the dissemination and implementation of different environmental policies of the government.

### **III. Education System**

#### **Basic Education**

The education system of the country can be categorized into formal and non-formal. Formal education involves a sequential progression of academic schooling at three levels, namely: elementary, secondary and tertiary. Non-formal education, on the other hand, is the specific learning on a vocational or technical area selected by out of school youth or adult illiterates.

The Department of Education (DepEd) is mandated to manage the elementary and secondary levels and the non-formal education. DepEd also oversees matters like subjects taught, time allocation and school's thrust. Environmental concepts are integrated in almost all subjects both in the elementary and secondary levels.

The first stage of formal education is the six year elementary education program which provides the basic knowledge, foundation skills, attitudes and values essential to the child's personal development. It is basically free and compulsory, and consists of grades 1-6 for the age group of 6-11. There are also pre-school classes and 7<sup>th</sup> grade classes that are optional for Filipino children. The elementary level is concluded with the National Elementary Achievement Test (NEAT). It measures a student's competency gained in various subject areas. NEAT is a pre-requisite for graduation and an admission requirement to the Secondary Level. There

are 12,913,845 enrollees and a completion rate of 56.76% for the elementary level as of School Year 2005-2006 from both public and private schools.

The next level is the secondary level, which provides general education for students aged 12 to 15. It is a four-year comprehensive study, which prepares the learners for higher education and for the world of work. The two types of secondary schools according to curricular offerings are: the General Secondary School, which offers a 4-year general academic secondary curriculum, and the Vocational School, which offers the same curriculum as the general high school with additional vocational courses. There are 6,267,015 enrollees and a completion rate of 54.14% for the secondary level as of School Year 2005-2006 from both public and private schools.

The Non-formal Education aims to improve the socio-economic status of the out-of-school youth and the poor by enhancing their basic educational capability through functional literacy and continuing education programs. It envisions to empower the Filipino with desirable values and skills that will enable him to improve the quality of his life, family, community and country.

### **Middle Level Education**

A post-secondary technical and vocational education is one option for students after the secondary level. This provides the country's skills orientation training and development for a particular occupation or group of middle level occupation. It covers both formal and non-formal systems. The formal system refers to post-secondary education that involves structured and sequential learning leading to a one or two year certificate for middle level occupation. Technical Education and Skills Development Authority (TESDA) is the national agency which plans, sets standards, coordinates, monitors and allocates resources for technical education and skills development in the country.

### **Higher Education**

Higher education provides the highest level of education and training for professional qualification and degrees. The Commission on Higher Education (CHED) is the national government agency that oversees higher education and is mandated to undertake the tasks of promoting quality higher education. The present system is patterned after the American system of education. Quality and excellence is measured by faculty qualifications, the performance of graduates in licensure examinations and the accreditation status of educational programs. See Table 1.

Embedded in the Medium-term Higher Education Development and Investment Plan (2001-2004) is the policy framework for higher education

goals to be achieved. Through this, the CHED has set its mission to: a) educate and train Filipinos for enhanced labor productivity and responsible citizenship, b) inculcate nationalism and patriotism among students, c) accelerate the development of high-level professionals and d) promote centers of research and development. Four goals of the CHED include a) quality and excellence b) relevance and responsiveness c) access and equity d) efficiency and effectiveness.

**Table 1. Higher Education Indicators: Actual Accomplishments**

Indicator	SY 2002-2003	SY 2003-2004	SY 2004-2005
Enrollment (all disciplines)	2,426,976	2,420,856	2,402,315
Graduates	401,787	386,920	431,689
Average passing rate in National Board Examination (%) ( all disciplines)	41.71	39.83	42.78
Expanded Tertiary Education Equivalency and Accreditation Graduates	720	404	501

There are 1,647 Higher Education Institutions and are further classified into: a) State Universities and Colleges (111) with 238 Satellite Campuses, b) Community Colleges (56), c) CHED Supervised Institutions (1), d) Special HEIs (5), e) Private universities and colleges which is further categorized into sectarian (341) and non-sectarian schools (1,124), and (f) other Government Schools (9) . The variety of tertiary offerings in the country includes associate, diploma courses, baccalaureate courses, graduate degree courses, at the master's and doctoral levels. All these are classified under the following major educational clusters: a) Agriculture Education b) Humanities, Social Science and Communications c) Information Technology d) Medical and Health-Related Courses e) Engineering and Architecture f) Science and Mathematics g) Teacher Education h) Business Education and Accountancy i) Maritime Education j) Legal Education.

The baccalaureate degrees account for the bulk of tertiary enrollment. A minimum of four years is necessary to complete these degree programs except for the some selected major disciplines. Graduate education, on the other hand, is the system's showcase of quality and discipline and is considered at the forefront of the recent advances in both art and practice of any profession.

Matters on environment may be offered either as a separate subject or integrated in appropriate subjects applicable to the degree programs. As of SY 1997-1998, there are forty-five (45) higher education institutions offering "Environmental Courses" both at the undergraduate and graduate levels, majority of which are located in the National Capital Region (NCR). Refer to Table 2 for list of programs offered.

**Table 2. List of Environmental Programs offered**

<b>Baccalaureate Degree:</b>	<b>Graduate Programs:</b>
<ul style="list-style-type: none"> <li>• Diploma in Environmental Science</li> <li>• BS Environmental Development</li> <li>• BS Environmental Hygiene</li> <li>• BS Environmental Science</li> <li>• BS Environmental Management</li> <li>• BS Major in Environmental Science</li> <li>• BS Ecological Tourism</li> <li>• BS Environmental Studies</li> <li>• BS Environmental Planning</li> <li>• BS Environmental and Sanitary Engineering</li> <li>• BS Environmental Engineering</li> <li>• BS Ecology and Environmental Engineering</li> </ul>	<ul style="list-style-type: none"> <li>• MS Environmental Planning</li> <li>• MS Environmental Education</li> <li>• MS Environmental Management</li> <li>• MS Environmental Engineering</li> <li>• MS Environmental Policy</li> <li>• MS Environmental Science</li> <li>• MS Environmental Studies</li> <li>• MS Environmental Planning</li> <li>• Ph.D. Environmental Science</li> </ul>

(CHED-OPPRI, MIS: SY 1997-1998)

#### **IV. Initiatives on Green Productivity for Educators**

##### **Constraints**

Environmental concepts and subjects are integral in the curriculum of environmental degree programs. However, for the other degree programs, Higher Education Institutions (HEIs) are given the option to offer environmental concepts either as a separate subject in the General Education Curriculum or integrated in appropriate subjects. The integration of a separate course on environment has not been advocated due to the possible call of other groups to include similar issues or concerns such as gender equality, peace, poverty resolution etc.. Other foreseen problems that may arise are: a) difficulty in hiring qualified teachers to handle the subjects, and b) difficulty in the acquisition of inexpensive textbooks and other instructional materials.

##### **Solutions**

Possible solutions to address the obstacles and thus promote the implementation of the concepts of Green Productivity (GP) can be recommended. Passing a law for the compliance of all concerned can be the major step to initiate the implementation and public awareness of the said program. Conducting trainings for teachers and developing workbooks or manuals for the teachers who will handle the subject can solve the problem on hiring qualified faculty and lack of standard textbooks, reference and other instructional materials.

The strategy adopted on the information campaign on HIV/AIDS can also be used. In this case, a workbook or teaching guide was developed specifically for the teaching of HIV/AIDS in Higher Education Institutions (HEIs).

If resources will allow, putting up a GP/ environmental center or department in a college or an educational institution will be of great help in the introduction of GP concepts. In this set-up, resources (human, financial and library) will be concentrated in one area.

## **V. Conclusion**

There are numerous possibilities of potential GP areas that can be addressed as a result of urbanization, pollution and garbage problems, insufficient environmental awareness and technological advancement. The CHED can substantially facilitate the integration of GP concepts in curricular offerings of schools in higher education. As part of the CHED mandate, Policies, Standards and Guidelines (PSGs) are formulated to standardize course offerings of HEIs, including recommendation of curricula for all educational programs, setting minimum standards for faculty qualification, administration, admission requirements and facilities like buildings, libraries and laboratories. Evaluations of these standards are made in order to monitor the compliance of HEIs to the said PSGs. However, these must be coupled with efforts geared towards intensified searching and sourcing of funds, since HEIs may not be that financially capable and prepared for the compulsory integration or separate offering of GP and environmental concepts in the different programs.

In addition, the CHED can also contribute to strengthen the network with the private sector and the industry to promote GP concepts and aid in information dissemination through its already established linkages.