Making Soil Science Education Relevant to Societal Needs

by Rattan Lal

A drastic increase in agricultural production during the second half of the 20th century, made possible by growing input-responsive varieties and making plant nutrients and water available during the critical stages of plant growth through soil-specific management, is a success story that makes us all proud of the soil science and agronomy professions. Average grain yield increased in the U.S. between 1900 and 2004 by a factor of 5.9 (1.6 to 10.1 Mg ha^{-1}) for corn, 3.2 (0.9 to 2.9 Mg ha^{-1}) for wheat, 2.6 (1.1 to 2.9 Mg ha^{-1}) for soybean, 4.6 (1.7 to 7.8 Mg ha^{-1}) for rice, and 4.0 (0.8 to 3.4 Mg ha^{-1}) for peanut. There was also a corresponding increase in fertilizer use. Between 1930 and 2004, fertilizer use (10^3 Mg) in the U.S. increased from 378 to 13,098 for N, 794 to 4,813 for P, and 354 to 5,498 for K. The number of people fed by one U.S. farmer increased exponentially as well, from 12 in 1930 to about 100 in 1990, and the number of farms decreased from 5.7 million in 1950 to 2.2 million in 2000, leading to an increase in farm size and attendant mechanization. While doomsayers expressed apprehension and predicted famines in Asia and elsewhere, soil scientists and agronomists ushered in the Green Revolution that saved hundreds of millions from starvation.

Alas, the increase in agricultural production was realized at a high cost. With agricultural intensification came soil degradation, with increased fertilizer and pesticide use came contamination and eutrophication of natural waters, with increased irrigation came waterlogging and salinization, with land use conversion and deforestation came emission of CO_2 into the atmosphere, with an increase in monocultures came extinction of species, and with expansion of agriculture to marginal lands in harsh climates came desertification. Yet, there is no cause for complacency in increasing food production because even greater challenges lie ahead as the world population is projected to increase from 6.5 billion in 2006 to 10 billion towards the end of the 21st century, with almost all of the future increase occurring in developing countries.

Challenges in the 21st Century

Society faces a number of different challenges at the onset of the 21st century. Important among these are:

1. achieving food security for the current and projected increase in population,
2. restoring degraded soils and minimizing risks of new land degradation and desertification,
3. reducing emission of greenhouse gases from agricultural activities and making soil a sink for atmospheric CO_2,
4. growing lignocellulosic feedstock for production of C-negative biofuels,
5. reducing risks of eutrophication and contamination of natural waters and hypoxia of coastal ecosystems,
6. using soil for disposal of urban and industrial wastes, and
7. improving human health through the elimination of hidden hunger by growing food on high quality soils, which contain adequate amounts of all macro- and micronutrients and are devoid of toxic elements (e.g., As and Se).

Soil scientists must be proactive to avoid becoming redundant or irrelevant by other disciplines (e.g., geography, geology, climatology, ecology, hydrology, and engineering).

While enhancing ecosystem services, judicious management of soil is also essential to national security. A future threat to national security may arise from the relationship of "human to nature" rather than "human to human." This threat is especially grave in the impoverished regions of the world, where soil resources are severely degraded, natural resources are scarce and in jeopardy, and desperate people have nothing much to look forward to. It is these desperate conditions that breed fundamentalism, terrorism, and fanaticism.

Revisiting Soil Science Curricula

Thus, there is a strong need for a paradigm shift in training young soil scientists to effectively address these societal needs. Soil science curricula, from high school through undergraduate and graduate education, needs to be revisited to address what students must know to be good world citizens. To gain a better understanding of soil science, students must also possess a strong background in physical, biological, and social sciences. The soil science curricula must train graduates to be prepared for life, responsive to societal needs, and useful to humanity, especially in the current era of a flattening earth and globalizing economy. They must focus on problem-solving skills, creativity and originality, synthesis and integration, and linking scientific advances to indigenous wisdom. While the computer is a good tool to master, it should not be allowed to master the human brain and hinder innovative thinking. To be innovative thinkers, students must depend more on their brains than their computers.

In an era of budgetary constraints, dwindling faculty positions, declining enrollment, and the ever-looming threat of extinction to soil science departments within the Land Grant University systems, soil science must be taught as a business. The goal should be to attract the "best and the brightest" and provide more value for the

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taxpayer's dollar without eroding the traditional values of the educational system. Therefore, responsibility of teaching soil science is more than just giving a set of lectures on soil taxonomy, water movement, or carbon sequestration. The real purpose is to train students to be innovative problem solvers rather than lab technicians, original thinkers rather than data massagers, and knowledge synthesizers rather than disciplinary hermits.

Engine for Economic Development

With regards to the issue of poverty in developing countries of Asia and Africa, knowledge of soil science must be used as an "engine for economic development." Even modest improvements in soil quality can have a drastic positive effect on productivity, farm income, and the environment. The benefit of genetic improvements and GM crops can be fully realized only through improvements in soil quality. Human welfare is indeed very intimately linked to soil quality.

Soil science has advanced more since the 1950s than in all prior history. This momentum must be kept up through modernizing the curricula and making soil science education relevant to societal needs. Soil scientists must be appropriately educated to address the emerging issues of increasing global temperatures, decreasing per-capita freshwater resources and arable land area, mounting industrial and urban wastes, ever-increasing energy demands, dwindling biodiversity, and degrading ecosystems, which threaten political stability and exacerbate terrorism. Making soil science education relevant to the needs of society is also the best strategy for increasing enrollment, creating new faculty positions, strengthening soil science programs, and reversing the downward spiral that is threatening the soil science profession. Now is the time to take appropriate action.

R. Lal, SSSA President; lal.1@osu.edu or 614-292-9069.

ASA President's Message

Where is ASA Going?

by Jerry Hatfield

In 2007, we will celebrate ASA's Centennial. The meetings in New Orleans, LA will provide us with a great opportunity to review our past accomplishments and the contributions from ASA members. This will be a special celebration in terms of showcasing what we have done over the past 100 years and the impact that we have made on science, education, and the public. Too often, we don't place our contributions into a perspective that encapsulates what we have done as agronomists. Over the next few months, you will begin to see these plans unfold, and I look forward to seeing you in New Orleans and hearing your own story about how agronomy has impacted your life.

Big, Audacious Goal

It is one thing to look back and bask in the limelight of our accomplishments. Our biggest challenge is to look forward and forge the program that will continue to build upon that foundation for the next 100 years. If you haven't done so already, I would urge you to look at the ASA Strategic Plan (www.agronomy.org/pdf/06_strategic_plan.pdf). The ASA Board developed a Big, Audacious Goal of "ASA [being] a global leader in integrated and sustainable agronomic sciences." This goal can be divided into pieces, and I want to share two components of that process with you. At the November 2007 meetings, we will launch our Leadership Development Program to begin to train future leaders. This training will require a nomination process because enrollment will be limited. It will impact your career, your Society service, and your personal life. This process will help us begin developing future ASA leaders. Our goal is to make this training a core component of our strategic planning and implementation and prepare us for future development of leaders and programs.

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Another item in our Strategic Plan is to "Move the Board toward becoming more strategic in its thinking and planning." The ASA Board will begin monthly online meetings to share information, evaluate our progress, and implement change. This is the beginning of strategic thinking and planning. Communication is one of the cornerstones of effective organizations, and this process will help us begin more regular and effective communication.

I am proud of what ASA has done in the past 100 years and am excited about being able to help lay the foundation for what we can accomplish in the next 100 years.

J. Hatfield, ASA President; jhatfield@agronomy.org or 515-231-7355.