

Securing a future for soil science – *A white paper*

March 25, 2011

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Motivation

The soil-science community needs to continue to redefine its disciplinary context and expand its core activities. These measures are critical, not only to meet contemporary societal challenges and the needs and interests of students, but also to respond effectively and engage actively in central issues addressed by the scientific community (environment, climate change, food security, etc.). We think that perceived constraints on “soil science” as a discipline (i.e., that we are narrowly focused scientifically) limit the prospects of fully applying our knowledge and understanding of soil processes to address emerging societal challenges. Because the structure and image of the Soil Science Society of America (SSSA) have appeared inflexible, we believe this has limited broad integration of soil science into emerging transdisciplinary science topics. We are hopeful that the current strategy and proposed SSSA activities (e.g., enhanced outreach, reorganization task force, etc.) will broaden the association and improve dialog with the wider scientific community. Nonetheless, the perception of soil science as a dynamic and rewarding professional career for established and younger scientists is in decline, the reputation of the discipline among peers in neighboring fields and by some funding agencies is alarmingly low. Image problems may contribute to the persistent decline in soil science student and faculty numbers (Baveye et al., 2006; Hopmans, 2007; Havlin et al., 2010). The rapidly shifting emphases of many early-career soil scientists toward environmental issues confound the problem. It is therefore imperative that the SSSA take action to quickly reverse the persistent decline in key metrics—from attendance at annual meetings, to student populations and faculty in soil departments, to overall professional viability. Ironically this decrease in status is occurring when soil as a biogeochemical-hydrological element of the biosphere is gaining prominence in the context of many societal challenges: climate and land-use change, environmental protection, ecosystem services, food security and energy production, all while soil is undergoing profound change from human activities (Richter, 2007). Hence, in addition to building a stronger society internally, the SSSA must expand its efforts to build professional relationships with sister organizations in related environmental sciences. This white paper originated from members of the Soil Physics Division. More than 30 individuals (see Appendix I) across SSSA responded to an earlier draft; their suggestions are incorporated in this final version. We seek to chart a path forward—from the ground up—and to complement the agenda of other task forces/committees.

Redefining our disciplinary context and core activities

The evolving and broader context of soil science is derived from an array of functions and critical services provided by soils that include and transcend food production:

- *Soil is the planet’s life-support system*, functioning as Earth’s life support—a thin layer of life covering much of the terrestrial surface;
- *Soil is the most biologically active element of the biosphere*, hosting the largest pool of biodiversity of all biospheres;

- *Soil is a functioning complex natural body with unique characteristics and emergent behaviors* that cannot be deduced from a collection of its constituents or individual processes; soil integrates Earth processes in which it is intrinsically linked;
- *Soil is a giant recycling system*, providing food, feed, fiber, and, increasingly, energy production through biofuels;
- *Soil supports global biogeochemical cycles (C, N, P)*, representing the Earth's largest terrestrial stock of organic carbon;
- *Soil provides important ecosystem services (e.g., provisions of fresh and clean water)* essential for human needs, including drinking water and food, carbon storage, and flood regulation;
- *Soil preserves the sedimentary record upon which human history is imprinted.*

In this context, the soil-science community asks, “What should we do to change SSSA and soil science as a discipline?” Here is a list of certain *boundary* conditions and underlying principles (some of which appear in the new strategic plan for SSSA):

- We must raise the scientific expectations and standing of soil science by communicating the importance of soil to the public, decision makers (ecosystem services), and colleagues in other disciplines. We must engage in projects with other disciplines and publish in the highest impact journals.
- We recognize the continual role of soil science in core agronomic activities; however, we must also create curricula and a research agenda that focus on environmental challenges and expand the core activities of soil science and the disciplinary foci of SSSAJ, thus defining a new role for modern soil science.
- Soil science is interdisciplinary by nature; hence, we must expose students—and ourselves—to practices that prepare us to work in dynamic multimember teams, in which the project or question—not the discipline—drives the research. This approach, consistent with Bouma (2010), would lead SSSA to reorganize along thematic, not disciplinary, lines.
- We must emphasize that **soil science** is concerned with the study of soil as a natural, historic, and cultural body, one that is undergoing rapid change by humanity. As stated by Marbut (1921) (cited by Baveye, 2006): *“Probably more harm has been done to the science by the almost universal attempt to look upon the soil merely as a producer of crops rather than as a natural body worthy in and for itself of all the study that can be devoted to it, than most men realize. The science has undoubtedly been retarded in its development by this attitude.”*

An action plan

We see elements of an action plan falling into several broad categories (annual meetings, society structure, education, and leadership and communication).

Annual Meetings

1. We should restructure annual meetings to better address transdisciplinary science. Although the current format encourages co-sponsorship, meetings are organized by Division and then themes. We need to use “big science questions” as focal points, and translate the questions to action (e.g., RFP’s by funding agencies, special issues/topics in journals, etc.), bringing these into the forefront of our research.
2. We need to encourage and seek “outside-the-box” ideas that can be tested and widened at annual meetings and that will engage younger scientists and empower them to take active roles in our societies. This element fosters more “bottom-up” science within larger issues and themes that may feel more “top-down” or constrained.

Society Structure

3. Division boundaries should be reduced and reformed, as is being implemented elsewhere within the tri-societies. Many agree that SSSA could reduce S-division boundaries (originally created for coherence) and move toward a thematic organization and annual conference organization. This change could begin with annual meetings and eventually include society

structure. (Transdiscipline is harder to achieve under a divisional versus thematic framework—a more promising course of action is therefore thematic). Divisions need to work with the task force, generate discussion among its members, and provide feedback through representatives of the task force.

4. Members should be given more opportunities to contribute their suggestions toward reorganization. Current top-down approaches are difficult to understand. Modern communication tools are available (online formats and communication avenues) within SSSA and should be used earlier, thus encouraging members to become more involved in SSSA activities (e.g., generating ideas, webinars, training, etc.).

Education

5. Workshops should be expanded to include organizational leadership, with the goal of training future leaders and developing programs that will involve new generations of soil scientists. Workshops can/should make better use of technology (webinars, video links, etc.) avoiding the need for long-distance travel or for waiting until national meetings.
6. SSSA must play a more prominent role in national-level soil-science education that will define the rigor and future of soil science as an environmental, scientific discipline in its own right, yet ensure that soil processes are represented as essential elements in contemporary grand scientific issues. We strongly support SSSA's efforts to reach out to practitioners and certification boards nationally, so that soil science education is aligned with professional needs (via curricula and program accreditation, development of society approved courses and teaching materials, management of websites for different segments of the public, etc.) Practitioners may also benefit from the supported of a prominent and knowledge-based professional organization.

Leadership and Communication

7. We need to reach out to sister scientific organizations more effectively (AGU, ESA, GSA, SWCS), co-organize soil-related sessions and consider forming focus groups or other meaningful affiliations, while maintaining ties to CSSA and ASA. One effort being pursued is the formation of a sister focus area at the American Geophysical Union (similar to EGU's Soil Science Systems). These efforts should parallel the building of a stronger home base and encouragement of stakeholders and young scientists to join SSSA and become engaged in our community.
8. Members need broader opportunities to discuss these concerns. We suggest an annual town-hall meeting in which SSSA leadership interacts with its members and discusses organizational concerns. Such meetings should be planned jointly by all S-divisions.
9. SSSA should continue to promote scientific outreach for its members (e.g., panels, testimonies, etc.) by seeking contributions from scientists external to SSSA (i.e., encouraging a more prominent role for the National Academies and their staff).

Proposed actions (short term; 1–2 years): Items are organized loosely around the same subcategories as in the SSSA action plan.

1. Formulate a largely thematic annual meeting.
2. Seek SSSA support to plan and organize joint meetings with other organizations (EGU, AGU, ESA, SWCS, etc.).
3. Encourage annual town-hall meetings to solicit and promote a healthy exchange of ideas.
4. Seek AGU partnership by forming a soil focus area and strengthen links with EGU soils systems.
5. Identify timelines for implementing the many good ideas of the SSSA action plan. Find ways to engage society membership in debating and formulating a realistic plan, and keep members informed.

6. Engage other S-divisions (also relevant divisions from A and C) in the process.
7. Develop a strong position paper to university presidents and heads of research-based agencies, articulating why soil science education and research should be a priority and why maintaining a strong disciplinary core is essential strategically for curricula in earth science fields.
8. Develop mechanisms to promote society-approved textbooks, and create a repository for teaching tools (design and launch a soil-source educational website for a spectrum of users).
9. Actively pursue formal membership in national and international bodies—IPCC, UN Food Security, UNESCO, Millennium Ecosystem Assessment.
10. Expand use of communication tools (YouTube, webinars, etc.).

The overall goal of these actions needs to result in a more nimble and robust organization that is responsible for leading soil science and soil scientists into prominent roles in earth sciences and engineering, for promoting soil science as the underpinning of many earth science fields and practices, and for being the leading organization for outreach and recruitment of young, energetic, and creative scientists into our field.

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Appendix I

Compiled Comments from White Paper, dated 7 February 2011 (33 comments received)†

Comment Number	Compiled (and partially paraphrased) Comments	Responses
1	Legal certification is needed especially for practitioners (e.g., Nat. Soc. Consulting Soil Scientists and others). SSSA should better coordinate with State and national professional soil science associations, especially those that certify and license practitioners. In some instances, a position as a soil scientist requires significant coursework in core classes and is—per the Office of Personnel Management—a requirement for employment as a soil scientist.	6
2	SSSA needs to be more active in national-level soil science education. One comment is a suggestion that broad soil science “programs” be created similar to Water Resources Research Centers in each state. Another comment is to steer departments toward a broader, environmental soil science focus. Others suggest maintaining core principles in soil science to avoid losing focus?	5
3	Support partnerships with sister organizations (AGU, AWWA, ESA, etc.). We need to answer a strategic question: should Soil Science beckon to new stakeholders to come join us, or should we as Soil Scientists disperse ourselves out into these parallel science communities.	4
4	Modern communication modes should be used more often SSSA, especially as they relate to outreach and opportunities to provide feedback on this plan and other activities at SSSA (webinars, Facebook, etc.)	4
5	Reference new material on the subject and include the other efforts within SSSA and elsewhere. White paper does not adequately describe the work being done by SSSA.	4
6	Production agriculture needs to be maintained for future societies. Soils play a key role in this endeavor.	3
7	Items in action plan are too abstract. We need specific examples and then the will to implement the ideas.	2
8	SSSA and practitioners should more broadly to articulate career paths for students.	2
9	Is the structure of SSSAJ really narrowing the ability of soil scientists to think broadly? The thematic road to organization has not helped simplicity and can be ill-defined. SSSA should be careful about going this route, and manage change in a way that people can handle.	2
10	Soil science should be expanded away from being discipline oriented, and lean toward a broader understanding of how soils affect the land itself. Focus on outcomes of the disciplines, rather than the discipline itself.	2
11	We need to go beyond Ag versus Environment question. It’s an old argument and not helpful.	1
12	List of authors was too narrow and should have been expanded to include scientists from other Divisions.	1
13	Journals need to be aligned with “Big Science” questions and avoid the trap of requiring rigid experimental designs.	1
14	Perception that soil science is becoming a support science, but this can change with leadership into other areas of science.	1
15	Soil scientists are not collecting/reporting on data that describes potential opportunities for how the land can facilitate technological advances in food and energy production.	1
16	From a funding perspective, SSSA could advocate sponsors (e.g., NSF) to create a new discipline of Environmental Soil Science.	1

† - several respondents offered multiple comments