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Summary

Dr. Tammo Steenhuis is internationally recognized for his outstanding contributions to hydrology, especially in the areas of preferential flow, nonpoint source pollution transport, and watershed modeling. However, it may be his contributions in developing countries to water resources engineering and education that will most sharply define his legacy to society. In recent decades, Professor Steenhuis has increasingly focused his research and education projects on many developing countries including Ethiopia, Ghana, Mali, Rwanda, Zimbabwe, Philippines, Honduras, Mexico, Indonesia, India, Thailand, and China. One recent and particularly notable achievement is his work in developing, coordinating, and actively teaching in training and research graduate programs at Bahir Dar University, Ethiopia. These programs are addressing the region's growing crisis in water quality and soil degradation by developing local research and resource management capability by guided *in situ* research and instruction of students drawn from the region, primarily Ethiopia and Sudan. In 2007, in cooperation with the President of Bahir Dar University, Dr. Steenhuis helped establish a Cornell graduate program of Integrated Watershed Management and Hydrology at Bahir Dar, which has trained over 30 students to immediately apply their training to pressing regional resource issues. Applications for the third class of students are currently under review.

Nomination Statement:

Accomplished Hydrologist

Dr. Tammo Steenhuis has left an indelible mark on hydrological science and water resources engineering in the form of exciting research pinned to contemporary water resources issues as well as in the form of a large number (>70) of graduate students who carry on his legacy. Professor Steenhuis has well over 200 publications in ISI-rated peer reviewed journals, addressing a wide range of water resource issues. His primary scientific achievements concern the study of pollutant movement through rural, agricultural watersheds. His highly-cited work on preferential flow in the vadose zone from the 1990's explained why standard percolation theories failed to predict the observed presence of pesticides and other contaminants in groundwater. Dr. Steenhuis and his graduate students also played central roles in identifying the linkages between variable source area (VSA) hydrology and nonpoint source pollution in the New York City water supply watersheds. He and his laboratory group, known as the "Soil and Water Lab," used this information to develop strategies for mitigating phosphorus loads to the New York City drinking water supply reservoirs. These fundamental concepts are now being more widely adopted in other watersheds including the Susquehanna River Basin and the Blue Nile of Ethiopia.

International Activities

Increasingly Dr. Steenhuis' research and educational activities have expanded beyond the boundaries of the United States. As with much of his work, his international endeavors have honed-in on regions facing critical water resources issues.

For several years he has been co-teaching (with Dr. Gail Holst-Warhaft and other) a course at Cornell University called "The Right to Water" that focuses on water issues in the Mediterranean region, with particular emphasis on the Nile River Basin and Greece. In addition to his students' on-the-ground research in this region, Tammo Steenhuis recently co-edited, along with Dr. Holst-Warhaft, *Losing Paradise: The Water Crisis in the Mediterranean*, which features case-studies from Lebanon, Italy, Spain, Egypt, Greece, Jordan, and Cyprus by some of the world's internationally renowned researchers. This book has drawn international attention. The senior advisor on water to the president of the United Nations General Assembly, Maude Barlow, referred to it as an "important book" and a "wake up call."

Much of Dr. Steenhuis' and his group's research has focused on developing nations including Ethiopia, Ghana, Mali, Rwanda, Zimbabwe, Philippines, Honduras, Mexico, Indonesia, India, Thailand, and China. This work addresses each region's specific water resources issues in the context each region's unique hydrology. For example, in the Philippines he focused on hillside springs (e.g. Malvacini et al. 2005. *Advances in Water Resources* 28(10):1083-1090); in Ghana one concern is evaluating many scattered, small water supply impoundments (e.g., Liebe et al. 2009. *IEEE Trans. Geoscience and Remote Sensing*, 47(5): 1536-1547); and in the north China plain, groundwater overdraft has been difficult to quantify (e.g. Kendy, et al. 2003. *Hydrological Processes* 17(10): 2011-2031) and he is currently involved with similar groundwater issues in India.

It is also worth emphasizing the trans-disciplinary nature of Tammo Steenhuis' research, especially in developing countries where data resources are often limited or non-existent or where the fundamental problems have more to do with societal issues than physical hydrology. Examples include his close collaborations with aforementioned Dr. Holst-Warhaft, a professor of European Studies; his work in Mali on building community participation in water resources management (e.g. Gleitsmann et al. 2007. In: (Kitissou, Ndulo, Nagel, Griego eds). *Hydropolitics in Africa. A contemporary Challenge* 133-156); and his use of quasi-qualitative, community-based information (soft data) to reconstruct flood risks and irrigation supplies in the Oaxaca region of Mexico (Mendoza. 2002. Doctoral dissertation, Cornell University, 114 p).

Graduate Program at Bahir Dar University, Ethiopia

One of Tammo Steenhuis' most notable international achievements is the establishment of a successful graduate program in Water Management and Hydrology at Bahir Dar University, the primary university in the Amhara region of Ethiopia. His involvement in this endeavor has been at all levels including securing funding, developing the program and courses, coordinating faculty and staff, actively teaching several courses, and mentoring graduate students in their research projects. The primary goal of this program is to train local professionals with the skills need to address the region's growing crises in water quality and soil degradation.

Dr. Steenhuis initiated his work in Ethiopia with a 2002-grant from the US Agency for International Development (USAID). He served as the advisor for the watershed management component of the Amhara Micro-Enterprise Agriculture Research Extension and Watershed Management Project (AMAREW) project. This project initiated a number of applied research projects on soil and water conservation practices and facilitated initial contacts with engineering faculty members of Bahir Dar University. Mutual interest in developing integrated research and teaching capacity at the university lead to the proposal for the Association Liaison Office (ALO) for Higher Education Institutional Partnerships (now called Higher Education for Development, abbreviated HED) concerning "Training and Research in Integrated Watershed Resources in the Lake Tana Basin." Faculty and students conducted research projects in the Lake Tana Basin and a summer research program engaged about 20 students. These students developed proposals and conducted research on various topics including groundwater and surface water hydrology in tributary watersheds in the Tana basin, hydropower development, plant diversity in wetlands around the lake, lake water quality, and more.

Through the success of these initial efforts, Dr. Steenhuis worked with the Bahir Dar University president and the administration at Cornell University to develop a Masters-degree program in integrated watershed management and hydrology. Rather than bring Ethiopian students to Cornell University, this program brings Cornell's faculty, staff, and course materials, to Bahir Dar, Ethiopia to complement and enhance the existing educational resources. Faculty members from Cornell and cooperating institutions travel to Ethiopia to conduct three-week intensive courses on topics including hydrology, soils, economics, research methods, watershed management, environmental modeling, and program management in collaboration with Bahir Dar faculty. The degrees earned are awarded by Cornell University, often distributed, in-person, by the presidents of Cornell and Bahir Dar.

In November 2007, a group of 20 students began the Cornell-Masters-degree program at Bahir Dar University. From a group of 20 students, 19 earned a Cornell degree after two years of study. Currently, the second batch of 13 Ethiopian students and one Sudanese student are concentrating on their research and will complete the program in about one year. A third class will begin in the fall 2011. Of the first class of students, six have been admitted to advanced graduate programs in Europe and the United States, seven are currently instructors at universities in Ethiopia, and two are working as professional environmental consultants. Student research has been published in refereed journal articles and book chapters and students have presented at ten different professional conferences.

Dr. Steenhuis currently serves as an adjunct professor in the School of Civil and Water Resources Engineering at Bahir Dar University. In addition to the Masters-degree program, he works with the university's faculty to develop proposals for continued cooperation. He also advises two Bahir Dar Masters recipients who are now pursuing doctoral degrees at Cornell with research focused in Ethiopia. The first of several classes of students will (or have) receive their degrees from Cornell University. However, the long-term goal is to turn the program over to Bahir Dar University as the university's water resources and hydrologic teaching and research infrastructure matures. It is anticipated this will occur gradually over the next two to five years.

Summation

In the light of Dr. Tammo Steenhuis' ceaseless efforts to improve our fundamental understanding of water resources issues, especially in developing countries or parts of the world facing critical water crises; we nominate him for the American Geophysical Union's International Award. Unique to Dr. Steenhuis' accomplishments are his continuous efforts to build educational and research capabilities within countries and regions where such resources are scarce and difficult to accrue. Thus, not only has he improved our understanding of hydrological processes central to water resources protection in many parts of the developing world, he has also been largely instrumental in enabling scientists and engineers in these areas to more effectively continue to improve our knowledge of these systems.