Student
Takele M. Dinka

Advisor
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Description of the proposed research

Vertisols are expansive soils that are fertile and important to agricultural production in many parts of the world. Despite its great importance, these soils with characteristic of shrinking while drying and swelling while wetting create serious management problems (Dudal and Eswaran, 1988; Smiles and Raats, 2005). Formation of cracks due to soil shrinkage varies spatially and temporally with changes in moisture conditions and other soil factors. The frequency, size and rate of development of cracks influence the transport of water, nutrients and gases in the soil profile and plant growth processes in Vertisols (Bandyopadhyay et al., 2003). Cracking enhances the rapid transport of solute through cracks, leading to crop nutrient stress (Coles and Trudgill, 1985), groundwater contamination (Kazemi, 1995; Thomas and Phillips, 1979), and surface water contamination if transport is to a drainage system (Brown et al., 1995; Harris et al., 1994). Therefore, understanding the impact of a catena on soil shrink-swell potential is needed to accurately represent hydrology in shrink-swell landscapes.

Present approaches to hydrology of swelling soils are generally based on non-swelling soil theory; they rarely account for crack formation and its consequences. Use of these models result in significant errors in estimating local water flux, solute flux, water balance, and aquifer recharge (Smiels and Raats, 2005). Nonetheless, models that can account for crack formation and associated hydrology are rarely used because the phenomena of crack formation and closure are poorly understood. Understanding hydrology on shrink-swell landscapes is needed for improving hydrology models that predict non-point source pollution and flood management in urban areas. In fact, much of the Dallas/Ft. Worth and Houston urban/suburban development is on shrink-swell soils.

The overall objective of this research is to study a spatial and temporal variation of soil shrink-swell activity in a Vertisols catena. At the completion of the proposed project, we expect to have an ability to quantify the spatial and temporal dynamics of soil cracking which provide the information necessary for understanding watershed hydrology and improving hydrology models applied in watersheds with shrink-swell soils. An improved understanding of how soil cracking affects watershed hydrology will lead to improved simulation of water, solute and particulate movement in watersheds and to more sound estimates of the effect of topography on surface and groundwater quality and quantity. A mechanistic model of the spatial heterogeneity and temporal dynamics of soil cracking will be created using a set of soil properties across the Vertisol catena. Therefore, this research would benefit the Texas state, where 6.5 million ha land is covered by shrink-swell soils, which is more than what exists in the USA (Coulombe et al., 1996).

Academic qualifications of Takele M. Dinka

- Ph.D student and Graduate Research Assistant, Soil Science, Texas A&M University, Texas, since January 2008.
  - Courses taken and grade:

- M.Sc., International Land and Water Management, Wageningen University, the Netherlands, August 2007.
  - Some of the courses taken and grade:

- B.Sc., Soil and Water Conservation, Mekelle University, Ethiopia. July 2002.
  - Some of the courses taken and grade:

Proposed use of funds

The fund will be used to pay a tuition fee, to purchase books, to cover travel expenses during field work and will be used to attend seminars/conferences to present the findings of my research. My current research site is located at Riesel, TX, near to Waco.

Intended career path

Increased human population and inefficient land management systems have resulted in high pressure on the limited natural resource. These challenges demand an integrated approach to improve the efficient utilization of land resources and sustainable management of natural resources to meet the growing demand of human being. In the future, as my career, I would like to focus on natural resource management, mainly soil and water in a watershed approach. I preferred a watershed approach as it gives an opportunity to integrate several and complex physical, political and socio-economic factors that influence the sustainable of management land resources. I also would like to use remote sensing and GIS techniques to improve land use planning, and efficient management of soil and water. These techniques also help develop better database management system for natural resources. A development oriented research or a research oriented teaching work will be a priority in my future plan.