A New Nitrogen Index to Assess Sustainability of Cropping Systems of Andean Regions of South America

Jorge A. Delgado1, Jeff Alwang2, Carlos Monar3, LuisEscudero4, Ana Karina Saavedra5, Victor Barrera6 and Ruben Botello7

1USDA-ARS, Soil Plant Nutrient Research Unit, Fort Collins, CO 80526; 2Virginia Tech, Blacksburg, VA 24061; 3Universidad Estatal de Bolívar, Guaránda, Ecuador; 4INIAE, Guaránda, Ecuador; 5PROINPA, Cochabamba, Bolivia; 6INIAE, Quito, Ecuador

Abstract

Population growth, impacts from a changing climate, and other challenges highlight the need to conserve soil and water quality so that maximization of crop yields to feed the expanding world population can be achieved and sustained in future generations. The Andean regions of South America are predominantly rocky landscapes that have high slopes susceptible to erosion, especially after harvests, crops that lose few amounts of crop residue as stubbles, and/or removing the storages from green systems following cultivation of these landscapes. Tools that can be used by technical personnel who work with local farmers on these agricultural systems are needed to enhance communication with farmers and local communities in Andean regions and increase conservation. A new Nitrogen Index available in the English and Spanish languages, in inmate and English units, and with a Sustainability Index, was developed and evaluated for these regions by comparing results from its use with that of an earlier,Nitrogen Index, and for assessing effectsof management practices on farming systems in their region. Preliminary results from evaluation of the new Nitrogen Index and a Sustainability Index for these farming systems highlight that landscape combinations of South America were still present. These preliminary results suggest potential exists to use the tool to help assess effects of management practices on the sustainability of the systems and on nitrogen-use efficiencies in Andean regions of South America.

New 2012 Tool: Smartphone App

The Environmental Problem of Reactive Nitrogen Losses to the Environment: Nitrogen is one of the most important nutrients in agriculture; it is used worldwide as a fertilizer and it plays an important role in the Gross Revolution. The input of nitrogen to agricultural systems increases production and the stability of world farming operations. However, the use of nitrogen in agricultural systems can also pose a threat to water and air quality because it can limit nutrients to water and air (e.g., eutrophication). The smartphone app also allows users to monitor nitrogen use efficiencies and related losses of reactive nitrogen to the environment. These new tools and concepts are effective in helping users assess risk of nitrogen losses across landscape and cropping systems to conserve the environment and increase on-farm nitrogen use efficiencies for farmers (e.g., commodity savings through reduced use of nitrogen fertilizer).

New Tools to Assess Nitrogen Management and the Risk of Reactive losses: The 2012 Nitrogen Index (v.4.0), which is written in the programming language Java™, and the new Nitrogen Index smartphone application, are new tools that are used for assessing nitrogen management practices of agricultural systems and efficiency of reducing atmospheric, surface, and leaching losses of nitrogen. These are new tools and concepts that are effective in helping users assess risk of nitrogen losses across landscape and cropping systems to conserve the environment and increase on-farm nitrogen use efficiencies for farmers (e.g., commodity savings through reduced use of nitrogen fertilizer).

Figure 1. Harvesting potatoes using an Andean field site at low altitude near a Trinquel, near the site of Cochabamba, Bolivia.

Figure 2. Dr. Jorge A. Delgado, Soil Scientist (USDA-ARS, and Carlos Monar, Agricultural Engineer (Universidad Estatal de Boliviar visited farmers during a field day-the field day addressed the importance of conservation practices and soil quality. The field day was conducted at the Huaynaputina region.

Figure 3. Example of zone of grass-fallow combination with water-collecting ditches across the slopes as a key soil and water conservation practice in the USAID-funded projects conducted at the Maruca Putuy farming systems located in the Huaynaputina watershed area in above zone.

Figure 4. Interview with Dr. Jorge A. Delgado for the Channel 5 Program, TV Ecuadoreño (Ecuador). Ankeny and Dr. Delgado was interviewed about the potential to improve nitrogen management and conservation practices in the agricultural landscape in Ecuador. The program aired August 19, 2011 from 7:00–9:00 p.m. local time on Channel 5 in Guaránda, Ecuador.

Figure 5. Dr. Delgado conducting a one-day training in the use of the Ecuador Nitrogen Index with a Sustainability Index. Training attendees included individuals from the USAID project (INIAE and Universidad Estatal de Bolívar). Participants of the training brought their own laptop computers. Using their laptops they were able to conduct the Nitrogen Training Tool from the USAID-ARS server located in Fort Collins, Colorado, and the students were able to participate in the training.

Figure 6. Nitrogen Index v.4.4 (2012 version) written in the programming language Java™ is available in the English and Spanish languages.

Figure 7. Nutrient uptake (lb N/Acre) vs. soil texture in the USAID-funded projects conducted at the Maruca Putuy farming systems located in the Huaynaputina watershed area in above zone.

Figure 8. Harvesting potatoes using an Andean field site at low altitude near a Trinquel, near the site of Cochabamba, Bolivia.

Figure 9. Smartphone app used for the Andean farmer’s context. The smartphone app allows farmers to: (a) observe the level of nitrogen loss to the environment, and (b) know the level of sustainability of their farms.

Figure 10. Sustainability Index for North American cropping systems.

Summary

Many scientific advances of the last decades are contributing to the development of viable management practices that can reduce nitrogen losses to the environment. Yet, there are still significant nitrogen losses, with average use efficiencies of around 30 to 49% still being reported. The nitrogen indices for Bolivia and Ecuador can serve as a tool for evaluating nitrogen management in this region. Nitrogen indices can use these new tools that will assist in making decisions that can contribute to increased nitrogen use efficiencies and related losses of reactive nitrogen to the environment. The preliminary results suggest that there is potential to use these new technologies and conservation practices to promote sustainability in the Andean region of South America. These results show that there is also potential to use this tool to help farmers to make decisions in the field. The tool will be used by professors and students to assist in the transfer of scientific knowledge, and by agronomists and conservationists to improve conservation in the field.

The testing and development of this tool was supported by the USDA-SANARE-Venezuela Polytechnic Institute and Star University Project: this project is focusing on an ongoing impact and determines the potential use of soil and crop nitrogen conservation. This project is contributing to the training of farmers and the farmers are currently using the tool to help reduce the factor that will have economic benefits for farmers.

References


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For additional information, a complete list of references, questions, reprint, or permissions, please email to Dr. Jorge A. Delgado at Jorge.Delgado@ars.usda.gov.