

▶ **HEALTHY SOILS: THE BEDROCK OF SUSTAINABLE FOOD SYSTEMS IN LATIN AMERICA AND THE CARIBBEAN**

AN INPUT FOR DISCUSSIONS IN THE AMERICAS LEADING UP THE UN FOOD SYSTEMS SUMMIT 2021^a

Inter-American Institute for Cooperation on Agriculture (IICA) 2021



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1. ABSTRACT/SUMMARY

The UN Secretary-General will convene the Food Systems Summit in October 2021 to discuss, consolidate and operationalize actions to transform the way the world produces and consumes food¹. This initiative is part of the Decade of Action that seeks to accelerate progress on all 17 Sustainable Development Goals (SDGs), which requires advancing to healthier, more sustainable, resilient and equitable agrifood systems. This paper argues that actions aimed at improving soil health offer the greatest return on investments for creating and sustaining healthy agrifood systems in the Latin America and the Caribbean (LAC) Region.

^a. Karen Montiel (IICA); Chaney St. Martin (IICA); Kelly Witkowski (IICA); Rattan Lal (The Ohio State University).

Informed by the dictum that “people are the mirror image of the soils on which they live”^b, we assert that farmers play a key role in developing climate resilient, equitable and sustainable agrifood systems. As such, functional systems for valuing and incentivizing their stewardship of ecosystem services, including those linked to soil health, should be mainstreamed. We further rationalize the LAC region as a catalytic pivot for strengthening global agrifood systems and achieving SDGs because of its rich bio-resource diversity and emerging initiatives that prioritize action on soils and value ecosystem services. While agrifood systems can be improved by consolidating actions on investments (public and private), research and governance, opportunities for addressing socio-economic (poverty, food and nutritional security) and environmental challenges (climate change, pollution, biodiversity loss, and deforestation), and achieving SDGs, require better understanding, suasion and action by decision-makers to implement soil-centric programs. Such actions should focus on “returning some soil and land to nature” and sustainable intensification and regeneration of agricultural systems.

2. SOILS AS A PILLAR OF SUSTAINABLE AGRIFOOD SYSTEMS

Agrifood systems link processes from production, processing, packaging, distribution of food, marketing and consumption.² These complex, multi-scalar systems face a myriad of challenges, including limited research and extension services, outdated agrologistic infrastructure, poor knowledge and practices, food losses and waste, climate change, limited access to finance services, insecure land tenure, food-borne illnesses and zoonotic diseases, as well as limited social security and decent labor³.

Healthy soils are the basis for creating and maintaining sustainable agrifood systems and the ecosystem services that support them. Ninety-five percent of food is produced in soil^{4 5}, with soil fulfilling functions that are crucial for the complex agrifood system linkages. The connections between soil, plant, animal, ecosystem and human health are clear (Lal 2021), though perhaps undervalued. Soils are pivotal for primary production and ensuring high quality, nutritious food for animals and humans. The status of soils has direct effects on food quantity and quality, and human health. To the extent that soil health is well managed, the sustainability of the system and ecosystems is enhanced⁶.

b. Dr. Rattan Lal (The Ohio State University). IUBS Centenary Webinar Series: Lecture, 1 Oct. 2020

Soil loss, degradation and desertification compromise the resilience of agrifood systems. Problems such as erosion (water, tillage, chemistry, etc.), nutritional imbalances, salinization, soil carbon loss and pollution, among others, affect soil functions and the services it provides to support food and nutrition security as well as climate change mitigation and resilience. Estimates by FAO and ITPS (2015)⁷ indicate that 33 % of the world's soils are degraded to varying degrees, almost half of which are agricultural soils. In Latin America alone, more than half of the 576 million hectares of arable land is being affected by degradation processes. Such degradation (high to very high levels) accounts for 48% of soils in the Caribbean, 50% in Mesoamerica and 18% in South America^{8,9}, representing a significant economic and environmental loss for these regions. According to ELD estimates (2015)¹⁰, in 2008, annual worldwide losses due to deforestation and land degradation reached 1.5 to 3.4 trillion Euros, corresponding to 3.3% to 7.5% of world GDP. Specifically, with respect to changes in land use and land cover, Nkonya et al. (2016) indicated that the annual costs of land degradation in 2007 were about US\$231 billion per year, or about 0.41 % of the global GDP¹¹.

These losses can be reversed through restoration practices, regeneration and agroforestry systems - an investment that pays off in multiple ways, including economically. Based on data from Latin America and the Caribbean, Vergara et al. (2016) found that investing in restoration efforts could yield an estimated net present value of around \$23 billion over a 50-year period (\$1,140/ha for the regional average), highlighting the viability and economic return of such investments in the region.

The Agenda 2030 of the U.N.

Healthy soils can make a significant contribution to the global development goals. Although soils are not necessarily visible in the 17 SDGs, their contribution extends far beyond what is indicated in the 15th goal, which specifically refers to the fight against desertification and land degradation.

Soils contribute to six major global issues that are in turn related to the SDGs (1,2,6,7,13,15): food security, water security, land management (including its restoration), human health, climate change, and the preservation of land biodiversity.^{12 13}

Soil degradation is a global problem, yet Gardi et al. (2014)¹⁴ indicate that Latin American soils have a better state of conservation compared to those of other regions of the world, and the region presents opportunities for becoming a global breadbasket.¹⁵ While opportunities abound to increase agricultural production, it

is imperative to close yield gaps and enhance productivity while limiting further expansion of the agricultural frontier, particularly in forested areas. Assessing the contribution that the adoption of sustainable soil management strategies, with a focus on soil recarbonization or sequestration of carbon as soil humus, will likely offer cost-effective means to achieve multiple benefits, feed a growing population and contribute to global targets in accordance with the 17 SDGs.^{16 17}

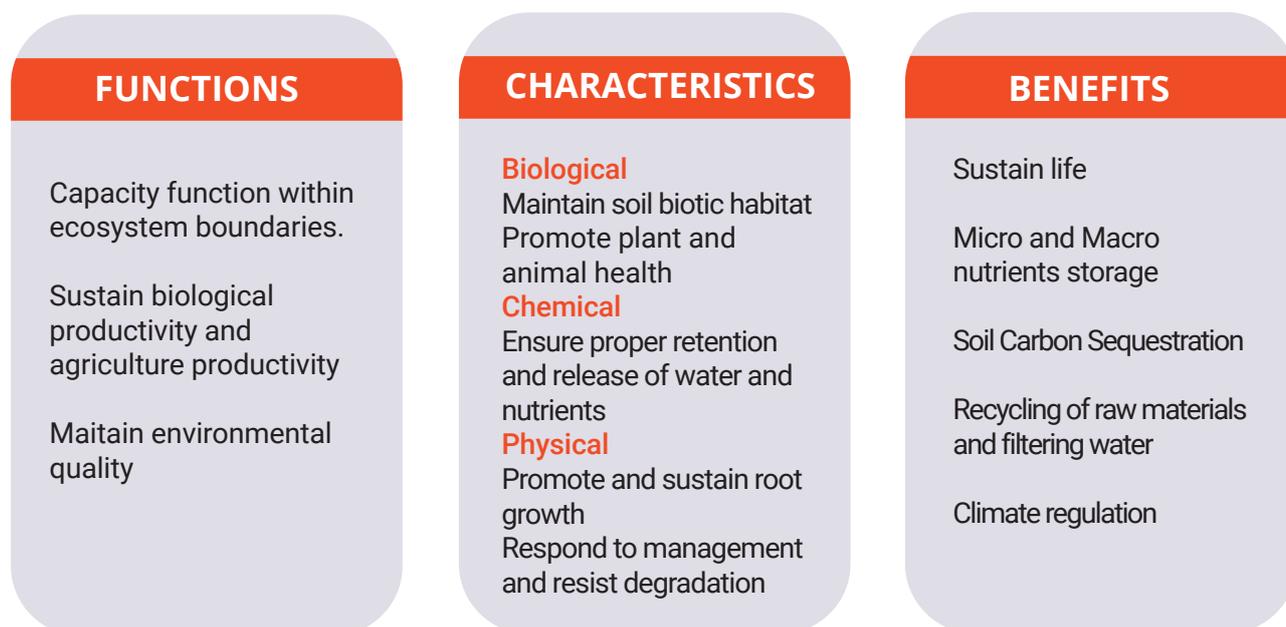
Investing in healthy soils can provide positive returns in the short, medium, and long term. This investment is fundamental to underpin the transformation of sustainable agrifood systems and the achievement of SDGs. Achieving this will require a multi-pronged implementation strategy that creates a solid bridge between science, policy, and development work.

3. SOIL HEALTH

Soil health is determined by chemical, biological and physical factors. The conditions of soil have direct and indirect impacts on living beings, making it necessary to ensure healthy soils or “the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans”.¹⁸ The term healthy soil is often used synonymously to refer to soil quality; however, conceptually, soil health emphasizes a “living” component (soil biota), which is intrinsically linked to soil carbon cycling and broader sustainability functions.¹⁹ Soils have a direct effect on human health (for example, through nutrition, safety, infrastructure), plant and animal health, and environmental variables (water quantity and quality, land use, GHG emissions, air quality) and healthy ecosystems (Figure 1).

Optimizing the benefits of healthy soils on farm or at the landscape level is an important goal which, on its own, will not likely achieve the desired changes in the agricultural systems and NDC targets, without broader systemic actions. Integrated landscape approaches have been demonstrated to balance ecological and productive interactions, trade-offs as well as coordination and collaboration among resource users and managers for planning, mobilizing investments from different stakeholders and achieving development goals²⁰.

■ FIGURE 1. WHAT IS HEALTHY SOIL?



Source: Own elaboration based on Eudoxie, G. (2016).²¹

4. CHALLENGES IN DEVELOPING SUSTAINABLE, RESILIENT AGRIFOOD SYSTEMS IN LAC

Some of the major challenges faced by agrifood systems are poverty reduction, hunger and malnutrition (including undernourishment and excessive eating), unhealthy diets (cost and unaffordability), climate change and water and soil use inefficiencies.

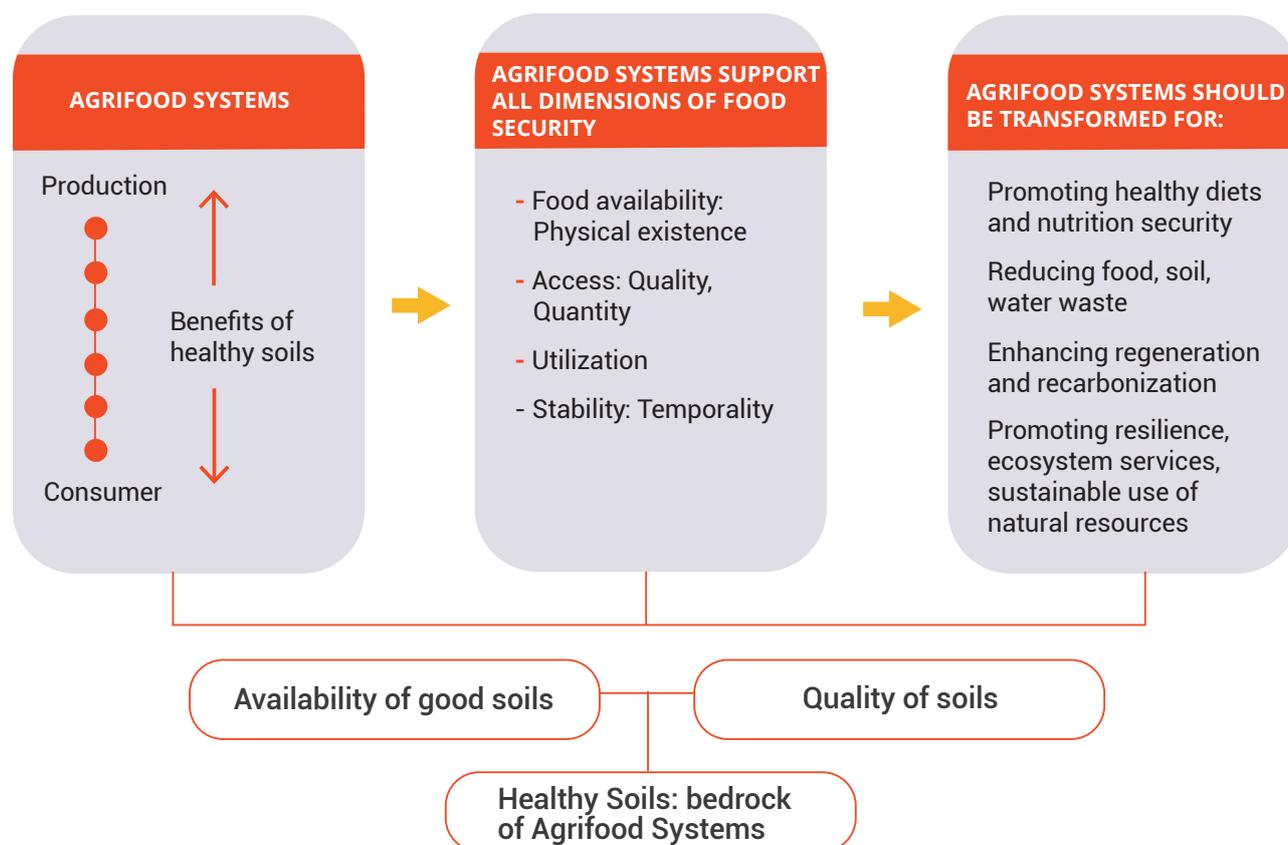
Soils can help address these challenges due to its multiple functions that help maintain:

- Diversification of food groups: soils are media for producing most of the crops needed to feed the world. Despite the existing agricultural biodiversity, food has been concentrated on a few products and varieties. Soils can help serve as a foundation for increasing crop productivity. Diversification promoted by farmers will have positive effects on food availability and affordability, human health and environmental sustainability.

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- Enabling higher nutritional quality of foods: micro and macronutrients available in soils, such as nitrogen, phosphorus, potassium, magnesium, iron, zinc and copper, are crucial for plant growth and development. Sufficiency of soil nutrients strengthens plant quality, crop yield, protein and micronutrients in food and food quality (Lal 2009)²².
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- Climate resilience and sustainability: Soils are involved in several key cycles and dynamics related to climate regulation (GHG emissions), water availability and quality, nutrient cycles (Lal 2019).²³ Increasing soil organic carbon not only supports climate change resilience and mitigation goals, but also enhances productivity, ecosystem services, water retention and nutrient supplies, and can also help close yield gaps. Emphasizing these multiple benefits can potentially accelerate the adoption of soil organic carbon sequestration strategies (Amelung et al. 2020)²⁴, that contribute to goals under the three major environmental conventions: climate change, land degradation and biodiversity.
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Collectively, these multifunctional roles²⁵ allow for investments and action on soil to contribute to all components of food security as well as all five of the action tracks of the United Nations Food Systems Summit (see figure 2). Additionally, the One Health Approach and the interface behind that relates people, animals, plants, and their shared environment has strong linkages with soils for their development. This is an example that substantiates why action tracks cannot be viewed and operationalized as separate, particularly when addressing wide-reaching issues, which mandate trade-off analyses. Moreover, soil as a common tangible and relatable medium or core provides a powerful reference point and space to accommodate multiple perspectives to leverage change on diverse down and upstream issues such as human security, human rights, empowerment of women and youth, innovation and financial resilience. These multiple linkages and relationships support increasing the prioritization of promoting soil health in policy and decision making.

■ FIGURE 2. CENTRAL ROLE OF SOILS AS A FOUNDATION FOR FOOD SECURITY, AGRIFOOD SYSTEMS AND THEIR TRANSFORMATION



Source: Own elaboration.²⁶

Gender dimensions of soil management

Women have a central role in the provision and production of food and natural resources management; however, they do not have the same resources as their male peers, such as land, information, technical training, technologies, access to credit (Casas 2017)ⁱ, financial services and political capital or decision-making, which deepens inequalities between men and women. At present, women continue to be highly dependent on forest goods and services such as firewood, fodder, soils, water (Aguilar et al. 2011)ⁱⁱ.

The perspective of women for the management and conservation of natural resources, as well the implementation of cost-effective practices is different. For example, initiatives promoted by UN Women and the CHIRAPAQ Center in Laramate, Peruⁱⁱⁱ have supported indigenous women farmers to take up ancestral techniques for selecting and conserving seeds and cultivating the land. Thus, women select healthy seeds, rotate crops to restore soil fertility, irrigate more efficiently and fertilize soils with manure from livestock. This has allowed for an increase in the productivity of their crops, which are both healthier and more nutritious.

i Casas, M. 2017. La transversalización del enfoque de género en las políticas públicas frente al cambio climático en América Latina. Estudios del cambio climático en América Latina. CEPAL Unión Europea.

ii Aguilar et al. 2011. Forests and Gender. IUCN.

iii ONU Mujeres. 2016. Las mujeres indígenas en Perú combaten el cambio climático e impulsan su economía (on-line, website).

5. KEY ASPECTS FOR ENSURING SOILS CAN CONTINUE TO SUPPORT AGRIFOOD SYSTEMS

- **Support land tenure:** While it is necessary to conduct more research on the effect of land tenure on the decision-making of tenants or landlords, and better understand the incentives and barriers that they encounter in implementing sustainable agricultural practices and natural resource management, land owners are likely to invest in soil health, which oftentimes brings benefits at longer timeframes.^{27 28}

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- **Strengthening public policies:** Development and update of national and regional soil health policies to provide incentives for farmers to enhance their stewardship and adopt better soil management practices, such as payments for ecosystem services or other market-based mechanisms.
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- **Strengthening soil innovation and technology:** Support progress on participatory research, innovation and technology for increasing soil quality, and its properties for N fixation and sequestration of greenhouse gas emissions, for instance, in projects promoting the use of legumes in South American livestock systems²⁹. A farmer centric approach can help to overcome some of the socio-cultural barriers that inhibit a change in practices.
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- **Catalyzing finance to facilitate action:** Investing in soils can provide positive returns in the short, medium and long term. Politicians and policy makers may have the perception that investments in soils provide long term impact (beyond the political cycle); however, there are case studies showing that it is possible to receive economic, environmental, social and political returns (monetary and non-monetary returns) in the short term from soil investments due to increase in yields (income), decrease in costs such as nutrient and pesticide savings, reduced machinery costs, that represent returns on investments in soil health practices.³⁰
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- **Public-private coordination:** : Private and public sector funding and coordination is critical to achieve this through public policies, research, information systems²⁴, developmental work and investment in scaling-up and framing interventions as entrepreneurial ventures.
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- **Connection at the local, national and international levels:** Initiatives in soils must be considered at different levels such as the three sister Rio Conventions for sustainable development, national and sub national policies as well as local and community initiatives to help maintain our soils. To accelerate action in the region, it is necessary to ensure a connection between the different actions, regulations and global initiatives, such as 4p1000 which provides aspirational goals.
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6. CONCLUSION: A COLLECTIVE CALL TO ACTION

- Without soils, there is no agrifood system; most of the food is produced on soils, and without caring for them, food production cannot improve. We must join our efforts and capacities to maintain healthy soils through sustainable management.
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- People are the mirror image of the soils they live on. When people are poverty stricken, desperate, and starving, they pass on their suffering to the soil, and the degraded soil reciprocates (Lal 2020)³¹. Marginal soils cultivated with marginal inputs produce marginal yields and support marginal living (Lal 2007; 2009)^{32 33}. Therefore, we must use the best of the best methods, and save any marginal soils for nature conservancy.
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- The Americas (LAC) represents a critical region where this work must be done and will have tremendous impact due to its richness in environmental and bioresources vis-à-vis the extent of degradation and loss of biodiversity that is occurring, as well as its socioeconomic dynamics.
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- While there is increasing interest, understanding and actions on soils as a best return on investment option for sustaining healthy agrifood systems and achieving SDGs, there is still need for substantial coordination, research and development work, as well as effective governance and policy informing the use and management of the soil. We must strengthen the connection between science, policy and development work on soil health restoration in LAC for multiple purposes.
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NOTES

1. United Nations Food Systems Summit 2021(on-line, website). Consulted on February 2021. Available at <https://www.un.org/en/food-systems-summit>
2. CEPAL, FAO, IICA (Comisión Económica para América Latina y el Caribe, Organización de las Naciones Unidas para la Agricultura y la Alimentación, Instituto Interamericano de Cooperación para la Agricultura). 2017. Perspectivas de la agricultura y del desarrollo rural en las Américas: una mirada hacia América Latina y el Caribe 2017-2018. San José, C.R.
3. Morris, Sebastian y Perego. 2020. Panoramas alimentarios futuros. Reimaginando la agricultura en América Latina y el Caribe. Grupo Banco Mundial. Washington DC.
4. Weigelt J. et al. 2015. Land and soil governance towards a transformational post-2015 Development Agenda: an overview. *Current Opinion in Environmental Sustainability* 2015, 15:57–65.
5. FAO (Food and Agriculture Organization of the United Nations). 2015. Los suelos sanos son la base para la producción de alimentos saludables. Roma.
6. Sulaeman and Westhoff. 2020. The Causes and Effects of Soil Erosion, and How to Prevent It. WRI.
7. FAO and ITPS. 2015. Status of the World's Soil Resources (SWSR) – Main Report. Food and Agriculture Organization of the United Nations and Intergovernmental Technical Panel on Soils, Rome, Italy
8. UNEP. 2016. GEO-6 Regional Assessment for Latin America and the Caribbean. United Nations Environment Programme, Nairobi, Kenya.
9. UNCCD. 2014. La tierra en cifras los medios de subsistencia en su punto de inflexión. Bonn, Alemania.
10. ELD Initiative (Economics of Land Degradation Initiative). 2015. Report for policy and decision makers. Reaping economic and environmental benefits from sustainable land management.
11. Nkonya E. 2016. Global cost of land degradation. In *Economics of land degradation and improvement - A global assessment for sustainable development*, ed. Ephraim Nkonya, Alisher Mirza-baev, and Joachim von Braun. Chapter 6, pp. 117 - 165.
12. Keesstra et al. 2016. Supplement of the significance of soils and soil science towards realization of the United Nations Sustainable Development Goals. *Supplement of SOIL*, 2, 111–128, 2016.
13. Lal, R., Horn, R. Kosaki, T. (eds) 2018. *Soils and Sustainable Development Goals*. Catena-Schweizerbart, Stuttgart.
14. Gardi, C; Angelini, M; Barceló, S; Comerma, J; Cruz Gaistardo, C; Encina Rojas, A; Jones, A; Krasilnikov, P; Mendonça, S; Brefin, ML; Montanarella, L; Muñiz Ugarte, O; Schad, P; Vara Rodríguez, MI; Vargas, R. (eds), 2014. *Atlas de suelos de América Latina y el Caribe*. Luxemburgo, Oficina de Publicaciones de la Unión Europea. p. 13.
15. Zeigler M. and Truitt Nakata, G. 2014. *The Next Global Breadbasket: How Latin America Can Feed the World: A Call to Action for Addressing Challenges & Developing Solutions*.
16. Lal, R.; Horn, R.; Kosaki, T. *Soil and Sustainable Development Goals*; Schweizerbart: Stuttgart, Germany, 2018

17. Keesstra, S., Mol, G., De Leeuw, J., Okx, J., De Cleen, M. and Visser, S., 2018. Soil-related sustainable development goals: Four concepts to make land degradation neutrality and restoration work. *Land*, 7(4), p.133.
18. USDA. 2021. Natural Resources Conservation Service Soils. United States Department of Agriculture <https://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/>
19. Maikhuri, R. K., & Rao, K. S. 2012. Soil quality and soil health: A review. *International Journal of Ecology and Environmental Sciences*, 38(1), 19-37.
20. Winterbottom, R; Reij, C; Garrity, D; Glover, J; Hellums, D; MCGahuey, M; Scherr, S. 2013. Installment 4 of "Creating a Sustainable Food Future". Improving land and water management. Working paper. World Resources Institute.
21. Eudoxie, G. 2016. Integrated Soil Management for Sustainable Agriculture. slides. Kingston Jamaica. Ppt presentation. Management of degraded soils using organic matter training course. Eudoxie, G. 2016. Soil Properties. slides. Kingston Jamaica. Ppt presentation. Management of degraded soils using organic matter training course.
22. Lal,R. 2009. Soil degradation as a reason for inadequate human nutrition. *Food Sec.* 1:45-57
23. Lal,R. 2019. Managing soils for resolving the conflict between agriculture and nature: The hard talk. *Eur.J.Soil Sci.* DOI:10.1111/ejss.12857
24. Amelung, W. et al. 2020. Towards a global-scale soil climate mitigation strategy. *Perspective-Nature Communications.* 11:5427.
25. CEPAL, FAO, IICA. 2017. *Perspectivas de la agricultura y del desarrollo rural en las Américas: una mirada hacia América Latina y el Caribe 2017-2018.*
26. Lal, R., C. Cerri, M. Bernouze, K.J. Etchevers, C.E. Cerri (Eds). *Carbon sequestration in Soils of Latin America.* The Howarth Press, West Hazelton,PA. pp 554 (2006); Moraes Sá, J.C; Lal, R; Cerri, C.C; Lorenz, K; Hungria, M; Carvalho, P.C. Low-carbon agriculture in South America to mitigate global climate change and advance food security. *Environment International* (2017) Jan; 98:102-112.
27. Carolan, M. 2005. Barriers to the Adoption of Sustainable Agriculture on Rented Land: An Examination of Contesting Social Fields. *Rural Sociology* 70(3), 2005, pp. 387–413
28. Fraser, E. 2004. Land tenure and agricultural management: Soil conservation on rented and owned fields in southwest British Columbia. *Agriculture and Human Values* 21: 73–79, 2004
29. PROCISUR: INIAS del MERCOSUR y el IICA formulan proyectos en temas estratégicos.
30. USDA. 2021. Case Studies: Economic Benefits of Applying Soil Health Practices (on-line, web site). Natural Resource Conservation Service.
31. Lal, R. 2020. Managing soil quality for humanity and the planet. *Front. Agr. Sci. Eng.* 7(3): 251-253. <https://doi.org/10.15302/J-FASE-2020329>
32. Lal, R. 2007. Technology without wisdom. *CSA News* 52(8): 12-13
33. Lal, R. 2009. Ten tenets of sustainable soil management. *J. Soil Water Conserv.* 64 (1): 20A-21A



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