



# C-MASC Newsletter

Winter | 2023

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## Dr. Lal Joins the Adventures of AGRIman in New Comic

Be sure to grab your copy of AGRIman Adventures, Issue 3 featuring our very own Dr. Lal. This colorful and fun adventure is a perfect learning tool for soil enthusiasts of all ages. Agriman is published by WHYFARM in partnership with the Climate Change and Natural Resources Program of the Inter-American Institute for Cooperation on Agriculture (IICA).

You can download your electronic copy for free by clicking the link to the right.



[Download the PDF](#)

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**C-MASC is Hiring:** Postdoc, Lab Technician, and Research Scientist positions available! Email [CMASC@osu.edu](mailto:CMASC@osu.edu) for more info.



**THE OHIO STATE UNIVERSITY**  
COLLEGE OF FOOD, AGRICULTURAL,  
AND ENVIRONMENTAL SCIENCES

## C-MASC Staff & Students



From left to right, back row: Dr. Klaus Lorenz, Kyle Sklenka, Muhammad Nawaz, Alec Ogg, Dr. Rattan Lal, Nick Johnson Front row: Connor Johnson, Brittany Multer, Sydney Lally, Anna Kolganova, Jason Phillips, Jyoti Bhatta, Naba Raj Amgain

## C-MASC Working Groups Update

### Agroforestry



**Dr. Roger Williams**  
Chair, C-MASC Agroforestry  
Working Group

The Forest Carbon Working Group has received financial support from CFAES Rattan Lal Center for Carbon Management and Sequestration to fund a graduate student to study the extent and the potential for Ohio's forests to sequester carbon. This includes understanding the variations in forest cover/ conditions and the variations employed in forest management, and how this influences the carbon flux in Ohio's forests. Once this is better understood, then the appropriate next steps can be formulated in working with landowners in Ohio to increase the carbon stocks in Ohio's forests.

The final report produced from this study, which will last one year, will provide a road map for the next steps that the working group should take to improve the carbon sequestration and storage in Ohio's forests, what incentives might be offered to landowners to improve carbon sequestration in their forests, and how carbon markets can play a role.

## Agricultural Soils

The Agricultural Soils Group secured a CFAES equipment grant for the purchase of a Gaset GT5000 Terra Portable FTIR Multiple Component Gas analyzer. The GT5000 quantifies CO<sub>2</sub>, CO, CH<sub>4</sub>, N<sub>2</sub>O, NH<sub>4</sub>, and H<sub>2</sub>O concentrations and when paired with a chamber, can be used to calculate fluxes of those gases. Along with the GT5000 gas analyzer we will also be acquiring two Eosense chambers, which are dynamic chambers that close for the flux measurement and then reopen, and a 12-port multiplexer. With this suite of components, we envision the following three uses:

1) Survey type flux measurements where the GT5000 analyzer is taken from point to point for treatment or landcover comparisons. PVC collars can be pre-installed at the measurement points and then one of the Eosense chambers placed on the collar for a measurement. Depending on flux intensity and gases of interest, measurement time varies from 4-11 minutes.

2) Longer-term continuous measurements. The GT5000 gas analyzer along with the multiplexer can connect up to 12 chambers. In this initial purchase, we will have two of the dynamic Eosense chambers, but in the future as funds become available, further chambers can be purchased or made. This continuous measurement mode would be useful to monitor highly dynamic short temporal events, e.g. freeze-thaw, manure application, tillage, flooding, rainfall, etc. The chambers can be placed up to 30 meters from the multiplexer location. The limitations of continuous measurement mode would be that the instrument typically needs to be zeroed every second day and power would need to be provided.

3) Lab incubation experiments. With the GT5000 and multiplexer, tubing can be attached to sample the headspace of multiple mesocosms or incubation vessels. Based on other researchers' experiences and guidance from the company, they recommend ca. 700-900 ml of headspace to sample, which is about the size of a quart Mason jar.

Once the gas analyzer and components arrive (hopefully late winter), we plan on organizing as a group a process whereby we can optimally, and equitably allocate equipment time across different experiments and investigators of existing ongoing experiments where these types of flux measurements would be useful and for new project proposals.



**Dr. M. Scott Demyan**  
**Chair, C-MASC Agricultural**  
**Soils Working Group**



**Jason Phillips**  
**Associate Director**  
**C-MASC**

## New Arrival

Please join us in welcoming C-MASC's new Associate Director, Jason Phillips. Prior to this role, Jason served five years as a Director of Foundation Relations, working with faculty across Ohio State to secure philanthropic grants to support research. Jason is a co-founder of the non-profit Student Success Stores which works to put free stores and food banks in underresourced schools across Columbus. Prior to joining OSU, Jason worked in development and programing for Godman Guild, City Year, and United Way, and served as a board member for City Music Columbus. Jason earned BAs in Strategic Communication and Political Science at Ohio State University.

Over the past three years, Jason led the fundraising effort to launch the C-FARM project at Ohio State. As part of our team, he will be helping to manage and grow this project across the U.S. and around the world.

## Celebrating the Launch of C-FARM



**Pictured left:** OSU President Kristina Johnson addresses guests at the C-FARM Launch. **Pictured above,** from left to right: Eugenia Saini, FONTAGRO; Lloyd Day, IICA; Kelly Gillespie, Bayer U.S. - Crop Science; Allison Thomson, Foundation for Food and Agriculture Research.

On November 2, 2022, over 70 guests gathered in the new Controlled Environment Agriculture Building on Waterman to help celebrate the launch of the Carbon Farming Alliance for Research and Management, C-FARM. The program featured remarks from OSU President Kristina Johnson, Dean Cathann Kress, and C-MASC Director Dr. Rattan Lal. Guests heard from a panel of some of C-FARM's sponsors, moderated by Allison Thomson, AgMission program director, FFAR. During the program, Dr. Lal and the C-FARM team were also treated to a special video message of congratulations from former U.S. Vice President, Al Gore (pictured right).

For more information on C-FARM or to learn how you can support this initiative, please email [CMASC@osu.edu](mailto:CMASC@osu.edu).



C-MASC is grateful to all who joined us to celebrate the launch of this vital project.



*Director Dorothy Pelanda, Ohio Department of Agriculture & Lillian Labus, C-MASC graduate student*



*Dr. Rattan Lal, OSU President Kristina Johnson, Allison Thomson, FFAR AgMission program director; & CFAES Dean Cathann Kress*



*Brittany Multer, C-MASC graduate student & Amarjit Basra, PhD, director, chief scientist, OCP North America Inc.*

## About C-FARM

The primary goal of C-FARM is to quantify how on-farm adoption of specific conservation and innovative management practices affect the total stock and depth distribution of soil carbon under cropland, grassland, and rangeland uses across a diversity of major land resource areas in the U.S. On-farm data are urgently needed to:

- (i) refine soil carbon prediction models that were developed from datasets mainly from research experiment sites,
- (ii) improve predictions of how much soil carbon may be sequestered with adoption of soil carbon farming approaches throughout the conterminous U.S., and
- (iii) assess how soil carbon stocks and associated soil health functions may change in the future.



### Specific objectives of the project:

1. Identify representative farm sites (and targeting those having adopted innovative conservation approaches) informed by robust geospatial analysis.
2. Quantify soil carbon stocks and other soil health properties from conservation chrono-sequences and paired land uses (conventional cropping, conservation cropping, grassland management, and woodlands) on similar soil types.
3. Establish associations between soil carbon stock and soil health indicators relevant to a variety of ecosystem services, including plant production, water capture and storage in soil, water quality, GHG exchange, and soil microbial biodiversity.
4. Extrapolate field-observed soil health indicators to continental US croplands using an ensemble of three biogeochemical models.
5. Estimate the impact of projected climate extremes on soil carbon change, crop productivity, GHG emissions, and soil health indicators of continental U.S. croplands by 2100.
6. Assess the suitability of portable hand-held devices and remote sensing technology (in cooperation with Microsoft) to monitor changes in soil carbon stocks for some sites in Ohio and Michigan.
7. Explore the socio-economic, legal, and political factors limiting the adoption of carbon-farming practices on farms and ranches.
8. Assess the role of Extension in identifying and partnering with farms sites for on-farm research, designing and implementing outreach activities for increasing the adoption of carbon farming practices; and evaluating adoption of BMPs.
9. Cooperate with international organizations and the private sector to develop opportunities for expanded adoption of soil carbon farming approaches to enhance soil carbon storage.
10. Make results available to all stake holders including land managers, private sector, policy makers, the general public, and the global data bank involving other international initiatives.



**Project Management Team - The Ohio State University**



**Dr. Rattan Lal,**  
PI



**Dr. Klaus Lorenz,**  
Lead Co-PI



**Jason Phillips,**  
Assistant Project Director



**Nick Johnson**  
Project Manager



**Kyle Sklenka**  
Research Manager

**Project Co-PIs**



**Marília Chiavegato**  
Assistant Professor  
The Ohio State University



**Verónica Ciganda**  
Research Program Director  
INIA Uruguay



**M. Scott Demyan**  
Assistant Professor  
The Ohio State University



**Alan Franzluebbers**  
Professor  
USDA - Agricultural  
Research Service



**Sagar Gautam**  
Postdoctoral Researcher  
Sandia National  
Laboratories



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Assistant Professor  
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Jennifer Reeve  
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Utah State University



Virginia Rich  
Assistant Professor  
The Ohio State University



Maninderpal Singh  
Assistant Professor  
Michigan State University



Brent Sohngen  
Professor  
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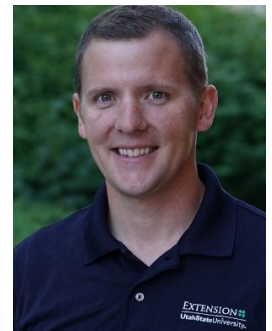
Peter Tomlinson  
Associate Professor  
Kansas State University



Jacqueline K. Wilkins  
Associate Dean and Director,  
OSU Extension  
The Ohio State University



Roger Williams  
Associate Professor  
The Ohio State University



Matt Yost  
Associate Professor  
Utah State University

**C-FARM Co-PIs Drs. Alan Franzluebbers and Umakant Mishra participated in the Foundation For Food and Agriculture Research's COP27 webinar, AgMission's Efforts to Cultivate Climate Smart Solutions.**

[Click here to watch the video](#)



## THANK YOU



### Sponsors & Collaborators

The Foundation for Food and Agriculture Research, the Inter-American Institute for Cooperation on Agriculture, FONTAGRO, Bayer U.S. – Crop Science, Microsoft, Cotton Incorporated, Corteva, Ohio Corn and Wheat Growers Association, Ohio Soybean Association, Kansas Corn, United Sorghum Checkoff Program, National Sorghum Producers, Utah Department of Agriculture & Food, Kansas State University, Michigan State University and Utah State University. The project will also be supported through scientific collaborations with the USDA Agricultural Research Service, Sandia National Laboratories, the U.S. Geological Survey and the National Agricultural Research Institute of Uruguay. Further project support is provided by Ohio State’s Office of Research, Graduate School, and the CFAES Office for Research and Graduate Education.

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## All about AgMission

Agricultural production contributes roughly 13 percent of global greenhouse gas (GHG) emissions, but the sector also has the potential to be a powerful climate solution. At the same time, agriculture is increasingly under threat from extreme weather events and changing climate patterns, posing risks to global food security and farmer livelihoods. To combat these emerging threats, the [Foundation for Food & Agriculture Research](#) (FFAR) and the [World Farmers’ Organisation](#) (WFO) launched [AgMission™](#), a global collaboration between scientists and farmers to advance research and increase adoption of climate-smart solutions that can achieve net-zero GHG emissions. This initiative is directly connecting farmers and scientists to ensure that research is actionable and new technologies can be rapidly adopted. By including farmers as collaborators throughout the research process, AgMission aims to design novel solutions that improve climate resiliency on farms while reducing emissions.



Cultivating climate-smart solutions



**Author**  
**Allison Thomson,**  
**FFAR AgMission**  
**Program Director**

Ultimately, AgMission is developing and deploying climate-smart technologies that can help ensure net-zero, resilient agriculture globally.



## Rattan Lal, Special Envoy of IICA to COP27: “Farmers are the major implementers of the concept of how to make agriculture a solution to climate change.”

October 31, 2022  
San José, (IICA).



**H**umanity cannot do without agriculture since the activity is the main source of food, a basic right of all people that depends on the existence of healthy soils to produce, assured Rattan Lal, a scientist considered the greatest global authority in environmental sciences. soil and Special Envoy of the Inter-American Institute for Cooperation on Agriculture (IICA) to COP27, the UN Conference of the Parties, the world’s most important annual meeting on climate action.

The soil can also become a sink for atmospheric carbon and limit global warming, for which it is necessary to turn science into action, said Lal, 2020 World Food Prize Laureate.

“We hope that COP27 will help us achieve this,” further stated the Director of the Ohio State University Carbon Management and Sequestration Center (C-MASC) and IICA Goodwill Ambassador.

At the next COP27 of the United Nations Framework Convention on Climate Change (UNFCCC), Rattan Lal will lead, together with the Director General of IICA, Manuel Otero, the support of this organization for the efforts that the countries of the Americas will carry out to raise the voice of agriculture on the global stage of climate discussions.

“Farmers around the world are the greatest stewards of the land. There are more than 500 million small producers, so they are the major implements of the concept of how to make agriculture a solution to climate change. Our policies at all levels, district, county, state, national, regional and international must be pro-farmer, pro-agriculture and pro-nature,” said Rattan Lal.

IICA’s Special Envoy to COP27 participated in Costa Rica in September in the meeting in which the Ministers of Agriculture of the Americas agreed on messages to take to COP27, focused on the relevance of the agricultural sector and the need for its role in global efforts for adaptation, mitigation and resilience to climate change.

“The concept I propose is to farm carbon. So farmers, land managers, ranchers and those who manage plantations can grow carbon in the land, in the trees and in the soil and be rewarded. In the same way that they can sell milk, poultry, beef, corn and soybeans, they should also be able to sell carbon, so that it becomes a commodity,” added the scientist.

“Can the carbon commodity in the soil be given a price that is fair, transparent and directed at the farmer? Most of the money allocated to that price should actually go to farmers. That would help us translate science into action and make agriculture the solution to climate change,” he said.

[Read the full article here](#)

## COP27 Viewpoint by Rattan Lal

Last month, Egypt welcomed the world to the coastal city of Sharm El-Sheik for the 27th United Nations Climate Change conference, COP27, from November 6th to the 22nd of 2022. The first COP event was hosted in Berlin in 1995 and has been held annually ever since, apart from 2020's cancellation due to COVID. This year's event was attended by several heads of state, including President Biden of the U.S., as well as diplomats, private sector representatives, NGOs, journalist, and additional delegates of the United Nations Framework Convention on Climate Change. I was very grateful to attend at the invitation of the Inter-American Institute for Cooperation on Agriculture (IICA).

While delegates negotiate collective action that can be taken within their countries, a wide range of events is simultaneously hosted in both the conference's Blue Zone, where government officials meet, and Green Zone, dedicated to representatives from NGOs and the private sector. COP27 included an Agricultural Day on November 12th, specifically devoted to agricultural and food-related issues. This is an important outcome of COP27 which focused on making agriculture (crops, livestock, and forestry) a solution for adaptation and mitigation of atmospheric climate change.

Expectedly, the size of COP's attendance has increased progressively since 1995, with this year's event estimated at 45,000 participants. This size has its own merits and limitations. Because numerous events of a similar thematic focus are occurring simultaneously over large distances and within different venues, it is a challenge to attend and participate in all the activities aligned to one's interest.

Notable outcomes of the 27 COPs include the Kyoto Treaty, which required the developed countries (37 industrialized countries plus the European community) to reduce emissions by 5% below the 1990 level between 2008 and 2012. However, developing countries (including China and India) were not required to cut emissions. Consequently, the U.S. did not agree to implement the reduction plan and the Kyoto Treaty failed. In 2015, COP21 in Paris proposed all nations reduce



*Dr. Rattan Lal; Lloyd Day, subdirector general, IICA; and Eric Mittenthal, chief strategy officer, North American Meat Institute*

emissions so that the atmospheric warming does not exceed 2 degrees Celsius (preferably 1.5 degrees Celsius) above the pre-industrial level (circa 1750). The Paris Accord also implemented the so called “4 per 1000” initiative, sequestering organic carbon in world soils at the annual rate of 4-per-thousand (0.4%) to 40cm depth. Innovative and useful as this soil-based solution is, it has not yet been implemented because of the lack of funding to support land managers. There have been other initiatives (i.e., Adaptation of African Agriculture, AAA, at COP21; the Platform of Latin American and Caribbean Agriculture Climate Action, PLACA, at COP25; and the Food and Agriculture for Sustainable Transitions Initiative, FAST, at COP27) but the implementation of these noble and innovative ideas has become a serious problem.

### **Humanity is running out of time.**

While the annual COP events are important to enhancing awareness about the problem, the voluntary implementation of the plans has not occurred. It is time to consider compulsory implementation of schemes to both reduce emissions and sequester emission. By adopting land-based solutions and developing non-carbon fuel sources, global warming can still be limited to below 2 degrees Celsius.

# Photos from COP27



All Photos, left to right: Dr. Rattan Lal and Former U.S. Ambassador to Italy and San Marino David Thorne



Luis Alberto Villegas, Undersecretary for Rural Development, Columbia; Moisés Santiago Bertoni, Minister of Agriculture and Livestock of Paraguay; and Dr. Rattan Lal



Enrique José Arturo Parada Rivas, Minister of Agriculture and Livestock of El Salvador and Dr. Rattan Lal.



Dr. Rattan Lal; Cleber Soares, Undersecretary of Innovation, Ministry of Agriculture of Brazil; and Fernando Mattos, Minister of Agriculture of Uruguay.



Dr. Rattan Lal and CEO for Bayer Latin America, Mauricio Rodrigues



Sarney Filho, Secretary for Environment from the Federal District of Brazil; and Dr. Rattan Lal

## New book, Organic Agriculture and Climate Change, from Drs. Klaus Lorenz and Rattan Lal, Now Available

Concerns have emerged regarding negative effects of the use of synthetic fertilizers and pesticides, and genetically modified organisms in agriculture. In response, the demand for agricultural products produced by organic agriculture (OA) is increasing. However, the net effect of OA on the climate compared to that of conventional practices is uncertain.

Crop yields under OA at experimental plots are up to 25 percent lower than those under conventional management. Thus, increasing OA production needs relatively more land area to maintain equal overall yield. This may exacerbate climate change. Instead, site-specific OA and conventional practices should be combined to reduce overall climate impacts of agricultural production and food systems.

This book presents an introduction to the history of OA, its recent developments, and its practices and



**Klaus Lorenz, Ph.D., is Senior Research Associate and Assistant Director, C-MASC**

principles. The effects of OA practices on the SOC and soil inorganic carbon (SIC) stocks, and on GHG emissions are discussed subsequently. The biogeophysical and biogeochemical effects on the climate are also presented. The book concludes with a chapter on how a combination of OA with conventional practices may contribute to lessen the impact of agriculture and food systems on the global climate.

[Click to learn more and purchase.](#)

## A Note from The Herbert W. Hoover Foundation

The Herbert W. Hoover Foundation is proud to be supporting C-MASC and the cutting-edge, world-changing science that comes from it. As a foundation, we are continuously looking for initiatives that push knowledge forward, benefit communities, and lead to a healthier environment. All of this can be found at C-MASC. Though we are headquartered in Stark County, our founder was instrumental in the creation of Biscayne National Park, an ocean-based National Park in Southeast Florida, and he had an immense passion for enhancing water quality, which is an area of research the foundation continues to focus on and fund. Through water, Stark County and the ocean are connected. The ocean relies on responsible environmental decisions by inland populations, and inland populations rely on the ocean for oxygen and as a global food source. This connection provides a framework for the projects funded by The Herbert W. Hoover Foundation. Soil health is imperative to water quality, which led us to supporting one of the world's leading soil scientists, Dr. Rattan Lal.

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**Author: Kaitlyn Cowley, Ohio Operations Associate, Herbert W. Hoover Foundation**

We are funding a project studying and enhancing soil health and carbon sequestration on 12 small farms in Stark County. We are thrilled to be supporting this initiative that is leading to knowledge gain in the field, improved soil health, and the education of many people in Stark County. We continue to be appreciative of the work that Dr. Lal and his team do and the accomplishments they achieve and look forward to the future of C-MASC.

# Climate-Smart Farming Starts and Ends with Good Data

by Kelly Gillespie, Ph.D.



There are certain practices we know drive a more robust, sustainable environment and healthier soils. Conservation or strip tillage, crop rotation, the usage of cover crops – these practices are ones that we know enhance soil organic carbon (SOC) levels in the soil. But we also know there is a lot of variability in the SOC sequestration potential due to soil types, the environment and other agronomic management decisions. To drive on-farm impact for growers and for society, we are committed to improving the knowledge base.

What we know about the specific and measurable effects of carbon-smart farming practices on the soil is growing every season, but it just scratches the surface of what's possible. This is the backbone rationale behind our 10-year sustainability trials, started in 2021, and is the essence of what we're best at: using well-characterized trials at scale to generate the data we need to improve on-farm decision making, drive a deeper knowledge of soil health and quantify the positive impact agriculture on the planet .

This is why I'm particularly pleased for Bayer's donation of our 10-year sustainability trial data to become part of the FFAR- and AgMission-sponsored, OSU-led study on the environmental effects of soil management practices. Not only will this study be led by OSU and its partner to further our understanding overall, but it's in good hands and led by Dr. Rattan Lal, Distinguished Professor of Soil Science and Recipient of the 2020 World Food Prize.

Under the auspices of this study, in a way rarely possible at this scale, researchers at partner universities will work to better quantify the SOC-sequestering effects of farm practices, in the context of real farm operations and the real challenges farmers face every year.

The effects of our – and other industry partner – participation in this study are numerous. Not only do researchers gain the benefit of access to well-characterized, diverse research data, but the value for the broader scientific community is immense. Data analyzed in this study becomes public, and publishable, which builds a rich database and new knowledge to enhance soil and environmental science for years to come.

From the perspective of society and public policy, the benefits also extend well beyond enabling our customers to make informed decisions for their operations. Those responsible for public policy decisions can, as a simple example, use this data to drive programs that potentially incentivize the adoption of climate-smart farming practices.

We're in a unique position in conducting the research that we do. I celebrate our ability to facilitate and enable this exciting opportunity for OSU and other partner universities; we have the potential to leverage our expertise in digital tools, the use of advanced farming technologies and approaches to collaboratively address knowledge gaps and advance critical science towards understanding how agriculture can be a part of the solution to climate change.

[Read the full article here](#)

## About the Author

Kelly Gillespie serves as Vice President of Digital Ecosystem Services for Climate. Kelly leads the development of infrastructure and relationships that pave the way for new beyond-the-farm value pools. Kelly's team drives and delivers Ecosystem Services strategies for our environmental and sustainability-focused products, including carbon sequestration and water use efficiency.

# 2022 Publications and Presentations

## Books Written

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1. Lorenz, K. Lal, R. 2022. Soil Organic Carbon Sequestration in Terrestrial Biomes of the United States. Springer. ISBN 978-3-030-95192-4, 201pp. <https://doi.org/0.1007/978-3-030-95193-1>
2. Lorenz, K. and Lal, R., 2023. Organic Agriculture and Climate Change. Springer Nature SBN:978-3-031-17214-4, 232pp. <https://doi.org/10.1007/978-3-031-17215-1>

## Books Edited

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3. Lal, R. (Ed). 2022. Soil Organic Matter and Feeding the Future: Basic Soil Processes. 1st ed. CRC Press LLC, Boca Raton, Florida. 338pp <https://doi.org/10.1201/9781003102762>
4. Lal, R. 2022. Soil Organic Carbon and Feeding the Future. CRC Press. ISBN: 9781000513004, 1000513009, 323pp <https://doi.org/10.1201/9781003243090>

## Referred Journal Articles

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5. Acharya, U., Lal, R., & Chandra, R. 2022. Data driven approach on in-situ soil carbon measurement. Carbon Management, 13(1), 401–419. <https://doi.org/10.1080/17583004.2022.2106310>, 323pp
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## Chapters in Multi-Authored Books

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53. Lal, R. 2022. Promoting carbon sequestration in soils: the importance of soil, region and context-specific interventions. In: *Understanding and fostering soil carbon sequestration*. Burleigh Dodds Science Publishing. ISBN: 978-1-78676-969-5. <https://doi.org/10.19103/AS.2022.0106.20>
54. Das, A., Layek, J., Yadav, G.S. Lal, R. et al. 2022. Managing soil organic carbon in croplands of Eastern Himalaya, India. In R.Lal (Ed) "Soil Organic Matter and Feeding the Future: Environmental and Agronomic Impacts", Taylor and Francis/CRC, Boca Raton, FL. 279-303. <https://doi.org/10.1201/9781003102762>
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## Keynote Presentations

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57. Lal, R. 2022. *Managing Physical Properties of Soils of India for Food and Climate Security*. Dr. B.P.Ghildyal Memorial Lecture, ICAAR New Delhi, India. 22 February 2022.
58. Lal, R. 2022. *Sustainable agriculture data: What's missing, what can be improved, and what needs validation? Strategizing to improve soil health data in agricultural surveys*. 50x2030 Initiatives Methods and Tool Development. Rome, Italy 25 February 2022.
59. Lal, R. 2022. *Bringing Soil-Centric Green Revolution to Sub-Saharan Africa*. Climate Soil Community of Practice: 4 per Thousand and GIZ Event. Bonn, Germany. 24-25 March 2022.
60. Lal, R. 2022. *Soil Carbon Sequestration as a Mechanism for Reducing Emissions*. Bioenergy Workshop. Bioenergy Technology Office, DOE, Washington, D.C. 28-29 March.
61. Lal, R. 2022. *Revisiting Global Food Systems During the Era of Changing Climate and Degrading Soils*. Webinar of the Dale Bumpers College of Agric. Food and Life Sciences University of Arkansas. Fayetteville, AR. 30 March 2022.
62. Lal, R. 2022. *Living in Harmony With Nature*. The Torch Club Seminar. Faculty Club, OSU. Columbus, OH. 7 April 2022.
63. Lal, R. 2022. *Nature-Positive Agriculture: Addressing Global Issues by Innovations in Agriculture and Forestry*. U.S. Farmers and Ranchers, HtH. St. Louis, MO. Spring Webinar. 21 April 2022.
64. Lal, R. 2022. *Earth Day 2022: Restore Our Earth*. C-MASC Earth Day. SENR-OSU. Columbus, OH. 22 April 2022.
65. Lal, R. 2022. *Managing Soils for Healing the Land. State of the Planet*. Earth Day Event. IUGS Earth Day. 22 April 2022.
66. Lal, R. 2022. *Feeding Humanity and Healing the Land*. Ohio Youth Institute. CFAES, OSU, Columbus, OH. 25 April 2022.
67. Lal, R. 2022. *Negative Emission Farming: Managing Soils of Agro-Ecosystems for Sequestration of Atmospheric Carbon Dioxide*. Webinar on Soils and Climate Change. National University of Science and Technology. Islamabad, Pakistan. 27 April 2022.
68. Lal, R. 2022. *Regenerative Agriculture for Soil Carbon Management and Sequestration*. Regenerative Society Foundation Meeting. Milan, Italy. 4 May 2022.
69. Lal, R. 2022. *Making Soils of Small Landholder Farmers Input- Responsive*. Research Committee of the IFDC. Muscle Shoals, AL. 10 May 2022.
70. Lal, R. 2022. *Managing Soil for Food and Climate Security and Advance SDGs of the U.N*. National Workshop on Innovative Agriculture, (Azadi Ka Amrut Mahotsav). ICAR, New Delhi, India. 10 May 2022.
71. Lal, R. 2022. *Managing Soils for Human and the Planet*. National Workshop on Innovative Agriculture, (Azadi Ka Amrut Mahotsav). Vigyan Bhawan, New Delhi. 10 May 2022.
72. Lal, R. 2022. *Healthy Soil and Food for Healthy Planet*. UNCCD-CA4SH Side Event. Abdijan, Ivory Coast, West Africa. 12 May 2022.
73. Lal, R. 2022. *The Need for Soil Health Action*. CA4SH –UNCCD COP-15 Side Event. Abdijan, Ivory Coast, West Africa. 13 May 2022.
74. Lal, R. 2022. *Managing Soils for Sustainable Production of Soybean in Brazil*. IX Brazilian Soybean Congress. Iguassu Falls, Brazil. 15-17 May 2022.
75. Lal, R. 2022. *Negative Emission Farming: Managing Soils of Agro-Ecosystems for Sequestration of Atmospheric Carbon Dioxide*. Distinguished Scientist Seminar Series (DSSS), Lawrence Berkeley National Laboratory (LBNL). Berkeley, California. 20 May 2022.
76. Lal, R. 2022. *Climate and Soil Carbon Sequestration: What are Key Questions? Making Climate Smart Agriculture Work*. 24 May 2022.
77. Lal, R. 2022. *The role of scientific research in the promotion of sustainable development and peace*. Academy of Sciences of Moldova, Science for Peace Forum. Chisinau, Moldova. 25 May 2022.

78. Lal, R. 2022. *50th World Environmental Day 2022: only One Earth*. WED. Stockholm, Sweden. 5 June 2022.
79. Lal, R. 2022. *NC 1178 Ohio 2022 Annual Report*. College Station, Texas A&M University. 8 June 2022.
80. Lal, R. 2022. *Managing Soil Health for Carbon Farming and Sustainability*. Bayer Webinar on “Innovations for Crop Science.” St. Louis, Missouri. 10 June 2022.
81. Lal, R. 2022. *Nature-Positive Agriculture and Soil-Centric Farming*. Corteva Webinar. Des Moines, IA. 10 June 2022.
82. Lal, R. 2022. *Sustainable Soil Management For Food and Climate Security*. Pepsico/IICA Webinar. 14 June 2022.
83. Lal, R. 2022. *Managing Soil for Climate-Resilient Agriculture*. 7th International Conference on “Climate Smart Agriculture: Innovations and Adaptations. Rawalkot, Pakistan. 15-17 June.
84. Lal, R. 2022. *Carbon Sequestration and its benefits to the small and marginal farmers*. Sustainable Food Production Systems for Self Reliant and Climate Resilient Agriculture. Dharwad, India. 16-18 June.
85. Lal, R. 2022. *No-Tillage System, Improving Soil Life, Environmental Sustainability and Social Wellbeing*. 18th National Meeting on Direct Planting in Straw and First World Meeting of the Direct Planting System. Grand Carima Resort and Convention Center, Iguasu Falls, Brasil. 5 July.
86. Lal, R. 2022. *Food Security & Self Sustenance: Indian Agriculture and Indigenous and Global Prosperity*. Harnessing Indian Agriculture Indigenous and Global Prosperity. Bhartiya Kisan Sangh, ICAR Complex. New Delhi, India. 22 June 2022.
87. Lal, R. 2022. *Managing soil as a nature-based solution to tackle climate plant biology*. 2022. Portland, OR. 9-13 July 2022.
88. Lal, R. 2022. *Managing soil for food security*. OCP Cultivating Conversation, Feeding the Earth: Understanding Soil Health. 13 July 2022.
89. Lal, R. 2022. *Soil health management and education for climate and food security*. Sustainable Agriculture Education Association (SAEA). OSU, Columbus, OH. 20-22 July 2022.
90. Lal, R. 2022. *Soil-Plant-Human nutrition nexus in Africa*. IICA. Inter-Ministerial Meeting. San Jose, Costa Rica. 27-29 July 2022.
91. Lal, R. 2022. *Restoring Soil Health & Returning Land to Nature*. 22nd World Congress of Soil Science. WCSS, Glasgow. 31 July- 5 Aug, 2022.
92. Lal, R. *Importance of Soil for the present and future of humanity*. 30th Aapresid Annual Congress. 10-12 Aug 2022.
93. Lal, R. 2022. *Soil Health*. Adaptation and Mitigation of Climate Change, Academy of Sciences of Moldova.
94. Lal, R. 2022. *Role of Basic Sciences*. 23 Aug 2022.
95. Lal, R. 2022. *Soil Carbon Dynamics under changing climate*. Climate Speaker Series, Sandia National Laboratory. California. 29 Aug 2022.
96. Lal, R. 2022. *Sustaining soil health for posterity*. National Symposium of Food, Nutrition, and Environment Security, Achieving Sustainable Development Goals. NASC Complex, New Delhi, India. 29-30 Aug. 2022.
97. Lal, R. 2022. *Carbon Trading: Calculating Carbon Footprint: Payment for Ecosystem Services*. Engro Fertilizer Ltd. Pakistan. 30 Aug 2022.
98. Lal, R. 2022. *Priming Africa's farming through regenerative agriculture*. Sasakawe/ JIRKAS Webinar on Potential of Regenerative Agriculture in Africa. 5 Aug 2022.
99. Lal, R. 2022. *Soil health and carbon sequestration*. *Symposium on Agriculture, Food Systems and Climate Change*. North Carolina State University. Raleigh, NC, USA. 11 Aug 2022.
100. Lal, R. 2022. *Functional relationship among soil, water, and climate and its role in adaptation and mitigation on of climate change*. ISCARES 2022. Dublin, Ireland. 28-31 Aug 2022.

## Keynote Presentations Continued...

101. Lal, R. 2022. Farming Carbon in Global Drylands. *Impact of Climate Change on Food Production in Dry Areas*. Ain Shams University, Egypt. 3-5 Sept. 2022.
102. Lal, R. 2022. *Address Global Issues through Gandhian Philosophy*. Gandhi Memorial Society, The American Legion, Westerville OH, 8 Sep 2022.
103. Lal, R. 2022. *Integrating Science in with Spirituality for enhancing the coping and adaptive capacity through human and physical infrastructure*. In *Impact of Climate Change on Food Production in Dry Areas*, RACC/IDDC/ICARDA/ALARI Hybrid Webinar, Ain Shams University, Egypt. 3-5 Sep 2022.
104. Lal, R. 2022. *Soil Health and Sustainability*. Ernesto Illy Colloquia, Sustainable Challenges in Coffee Growing Worldwide, Trieste, Italy. 27-29 September 2022.
105. Lal, R. 2022. *Soil Carbon Sequestration for Food Climate and Security and advancing sustainable Development Goals of the United Nations*. Webinar at the Faculty of Forestry, University of Banja Luka, Republic of Srpska, Bosnia and Herzegovina, 29-30 Sep 2022.
106. Lal, R. 2022. Podcast Recording. Inter-American Institute for Cooperation on Agriculture. 13 Sep 2022.
107. Lal, R. 2022. *Soil as a Source and Sink of Greenhouse Gases*. Colloquium, Dept. of Physics, Ohio State University. 13 Sep 2022.
108. Lal, R. 2022. Interview with FAO. FAO Science and Innovation Forum. 14 Sep 2022.
109. Lal, R. 2022. *Regenerative Agriculture*. International Crops Research Institute for the Semi-Arid Tropics. 15 Sep 2022.
110. Lal, R. 2022. *Managing Soil Health for Food, Nutritional and Climate Security*. Symposium on Complex Science of Soil Health, Food and Nutritional Security and Climate, ASA/CSSA/SSSA Meeting, Baltimore. 8 Nov. 2022.
111. Lal, R. 2022. *Managing Soil Health to Sequester Carbon for Adaptation and Mitigation of Anthropogenic Climate Change*. International Conference “Climate Change: Impacts and Solutions”. Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad, Pakistan. 7-9 Nov, 2022.
112. Lal, R. 2022. *Soil Health for Food Security and Sustainability*. Sustainability Institute Seminar. 2 Nov. 2022.
113. Lal, R. 2022. *Soil Health for Food and Sustainability*. Ernesto Illy Colloquia. 29 Sep. 2022. Trieste, Italy.
114. Lal, R. 2022. Westheimer Peace Symposium. Wilmington College. 28 Sep. 2022.
115. Lal, R. 2022. *Sustainable Management of Inland Systems for Restoring and Sustaining Soil Health and Re-carbonization of the Terrestrial Biosphere*. National Conference on “Innovative Resource Management Approaches for Coastal and Inland Ecosystems to Sustain Productivity and Climate Resilience. Navsari Agricultural Gujrat, Navsari, Gujarat, India. 13th Oct. 2022.
116. Lal, R. 2022. *C-FARM*. C-FARM Launch. The Ohio State University. Columbus, Ohio, USA. 2. Nov. 2022.
117. Lal, R. *Basic Laws of Soil Management for Food Security and Sustainable World*. C-Farm Launch. The Ohio State University. Columbus, Ohio, USA. 2 Nov. 2022.
118. Lal, R. 2022. *Making Agriculture as a Solution to Environmental Issues through the LiSAM Project*. Ministerial Meeting, IICA Pavilion, COP 27, Sharm El-Sheikh, Egypt. 12 Nov. 2022.
119. Lal, R. 2022. *Biofertilizers for Sustainable Soil Management and Producing More from Less*. Brazil Pavilion, COP 27, Sharm El-Sheik, Egypt. 14 Nov. 2022.
120. Lal, R. 2022. *Managing Soil Organic Matter Content to Restore and Enhance Soil Health*. Iowa State University. Ames, Iowa, USA. 2 Nov. 2022.
121. Lal, R. 2022. *Ecosystem Services Provisioned by Soil for Nature and Human*. World Soil Day Celebration, Shoolini University of Biotechnology and Management Sciences, Bajhol, PO Sultanpur, Distt. Solan, India. 5 Dec. 2022.

## Keynote Presentations Continued...

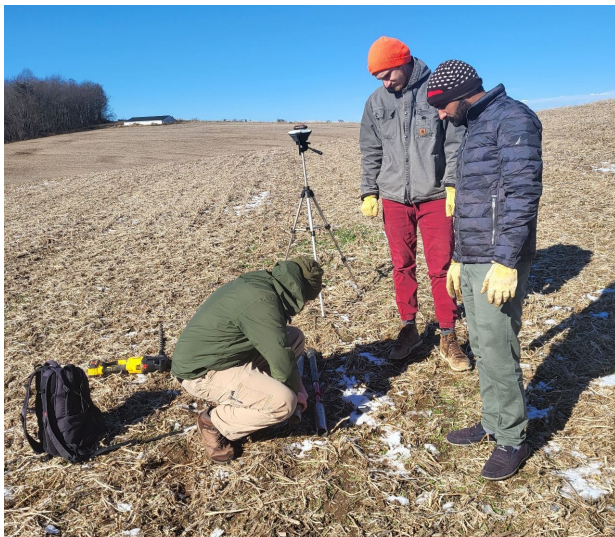
122. Lal, R. 2022. *Soil and Water Management in Arid Lands*. INRAA, Algiers, Algeria. 9 Dec. 2022.
123. Lal, R. 2022. *Managing Soil for Safe, Healthy and Nutritious Food*. World Soil Day Panel, Environmental Professionals Network, The Ohio State University, Columbus, Ohio, USA. 5 Dec. 2022.
124. Lal, R. 2022. *Managing soil health to address global issues of 21st Century*. British Ecological Society Annual Meeting, Edinburgh, Scotland, 18-21st December 2022.

## Miscellaneous Publications

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125. Lal, R. Jimenez, M. Martin, C. Witkowski, K. et al. 2022. Instituto Interamericano de Cooperación para la Agricultura (IICA), *Countries of the Americas and Agrifood Companies, Together with Rattan Lal and IICA, Evaluated the Progress and Challenges of the Living Soils of the Americas Program*. 25 Mar. 2022, <https://repositorio.iica.int/handle/11324/19990>.
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## Pictures from the Field



*Dr. Scott Demyan demonstrating soil core sampling with Kyle Sklenka and Hafiz Waleed.*



*Nick Johnson taking biomass samples and Kyle Sklenka taking a soil core sample in Coshocton, Ohio.*

## Ambassador Sandhu Visits Ohio State, his Parent's Alma Mater

On December 19, 2022, India's ambassador to the U.S., Taranjit Singh Sandhu visited OSU to see where his parents attended university. Dr. Lal presented Ambassador Sandhu with copies of his parents' listing in the commencement programs and a photo of his parents, Bishan Singh Sandhu ('57) and Jagjit Kaur Sandhu ('58), featured in the January 1964 edition of OSU's monthly magazine.

C-MASC would like to thank Michelle Drobrik of the OSU Libraries University Archives; Gil Latz, Padmini Roy-Dixon, and Elizabeth Angerman from OSU's Office of International Affairs, as well as President Kristina Johnson for their assistance, coordination, and support of the event.



*Above: Dr. Rattan Lal and Ambassador Taranjit Singh Sandhu. Below: President Kristina Johnson, Ambassador Sandhu, and Dr. Lal.*



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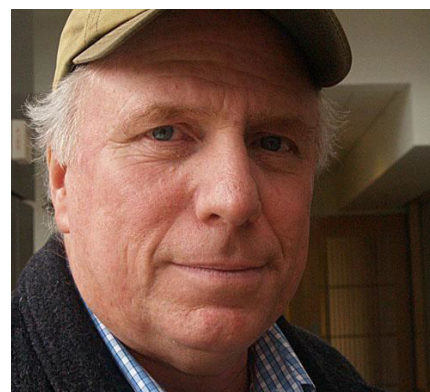
## Cleveland's Ian Frazier Gives a Shout Out to Soil in The New Yorker

In his comedic holiday poem, "Greetings, Friends!", published in the December 26, 2022 issue of The New Yorker Magazine, humorist Ian Frazier took the opportunity to mention Dr. Lal's soil research along side many of the names that captured headlines in 2022.

The poem features Brittney Griner, Vladimir Zelensky, Amartya Sen, and Guillermo del Toro, among many others who made an impact on the world this past year.

Ian Frazier was born in Cleveland, Ohio and attended Harvard University and has twice received the Turber Prize for American Humor.

You can access Ian's poem on The New Yorker website by [clicking here](#).



*Ian Frazier, writer and humorist.*

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