THE OHIO STATE UNIVERSITY

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CFAES DR. RATTAN LAL CARBON MANAGEMENT AND SEQUESTRATION CENTER

C-MASC NEWSLETTER

IN THIS ISSUE:

Welcome Spring!

As the world welcomes spring, remind yourselves of "renewal." Much like the 'Newport' Cherry Plum (prunus cerasifera) growing outside of Kottman Hall, we have persevered through the seasons. We have lived through uncertain times, hardships, pain, and tears. But remember that the new season will bring forth change.

"Not everything that is faced can be changed, but nothing can be changed until it is faced." -James Baldwin

Image courtesy of Jeremiah Turiaga

C-MASC Congratulations Dr. Seijan

A dream comes true...

Selected as Dean at the Rajiv Gandhi Institute of Veterinary Education and Research, Pondicherry, India.

The journey began at C-MASC, OSU ….

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Undoubtedly visiting OSU for the three month international training program on carbon management under the guidance of Prof Rattan Lal at CFAES, Rattan Lal Center for Carbon Management and Sequestration, was the most crucial and best decision of my scientific career. Whatever I am today, I owe a lot to Prof Rattan Lal and C-MASC because that's where the seed was sown to yield some of the best records. The punctuality, sincerity, hard work, dedication and discipline are the hallmarks of Prof Lal and that's what I tried to imbibe in all these 12 years.

The training that he imparted during my visit from 4th April to 3rd July 2010 had made the real difference of what I am today. During this short visit, I have accomplished more than what a regular researcher would accomplish in one or maybe 2 years.

Specifically, I have conducted multidisciplinary and multi-institutional research on process, factors and causes affecting enteric fermentation in ruminants at OSU. The research was multidisciplinary because it involved Veterinary Science, Animal Science, Soils, Forage Agronomy, and system analyses. It was multi-institutional, because it involved The Ohio State University, Michigan State University, OARDC, USDA, and others. I also visited OARDC and Michigan State University and established personal contacts with professionals there.

On the basis of my three-month stay at OSU, I published four peer reviewed and refereed articles in high impact journals. I also published 8 Springer book chapters, 2 Taylor and Francis book chapters and one UNESCO chapter with Prof Lal. I also edited a book entitled "Environmental Stress and Amelioration in Livestock Production" with Springer Verlaag publisher. The co-authors of these articles and co-editors of the book are the OSU faculty members with whom I worked. I also co-edited another book with Prof. Rattan Lal on the title "Sheep production adapting to climate change" which was published in 2017.

Personal milestones achieved….

In such a short research career, I was able to accomplish incredible milestones which undoubtedly would be unimaginable for many. I was selected as the best scientist (Lal Bahadur Shasthri Outstanding Young Scientist award) among 5000 scientists in 2012 by the Indian Council of Agriculture Research, New Delhi. I also did my post doctorate from The University of Queensland, Australia in 2015. In 2018, I was awarded as the Outstanding Research Faculty & One of the Top 10 Scientists in India. Another proud moment was being enlisted as the World's top 2% scientists by Stanford University, USA for two consecutive years 2019-20 & 2020-21. Further to this I am also among the world's top 1% scientist in my area of research on heat stress and livestock production published by Pubmed. Additionally, I am ranked third among the four veterinarians in India in the list of 1000 most productive veterinarians in the world in 2022.

On the research front, I have published 5 international

Congratulations Dr. Seijan

A dream comes true...

Springer books; 162 peer reviewed articles; 110 book chapters; 171 conference papers and delivered 284 lead/invited talks. I have also handled 17 major projects including 3 Indo-Australia projects, one Indo-French project, one Indo-German project and one International Livestock Research Institute project. Additionally, I also work with complete dedication to develop the next generation of researchers, in this view I have mentored 18 students and two post doctorates. Lastly, but not the least, I have developed four technologies and have one patent to my credit.

These are just a glimpse of some of the top milestones accomplished so far among the long list of credentials that I hold.

My aspirations for RIVER is to make it as an internationally acclaimed institute

As I start this new venture I envision taking RIVER to the greater heights which no one would have thought of, because this was something that I have been dreaming of since years. Over the years, I had already begun preparing myself for this legendary moment. Brief overviews of my primary goals for RIVER are depicted in in

Figure 1: Target Areas to Improve RIVER Visibility.

I am probably the only Dean that the country would have witnessed who is the alma mater of the same college. This accomplishment in itself would have inspired the current generation and many more to come.

The main aim here would be to make RIVER as an Independent and Self Sustainable Institution. For this, I will primarily focus on improvising the Educational Programs, Research Programs, Critical Livestock Production Inputs and Promoting Livestock start-ups / entrepreneurs. Furthermore, being an internationally acclaimed researcher, I am a firm believer of building fruitful scientific collaborations globally My entire journey so far would have already inspired many and my message to everyone out there would be to hold on because my best is yet to come. My personal vision for the institute is reflected in (Figure 3).

This journey is to now to uplift over 400 students and also all the staff under me. I will not leave any stone unturned to reach to the ultimate target of making RIVER an international par excellence institute.

Hence this journey is certainly going to be beautiful and exemplary. As I march along in my new pathway, I seek the blessings of Prof. Lal for he is my role model and he is the primary influential factor in my successful professional career. My entire journey so far would have already inspired many and my message to everyone out there would be to hold on because my best is yet to come. This journey is to now to uplift over 400 students and also all the staffs under me. I will not leave any stone unturned to reach to the ultimate target of making RIVER an international par excellence institute. Hence , this journey is certainly going to be beautiful andexemplary. As I march along in my new pathway, I seek the blessings of Prof. Lal for he is my role model and he is the primary influential factor in my successful professional career.

A dream comes true...

Fig. 2 International Universities collaborting which could be explored for Signing MOU and Proposing Joint Projects for Funding

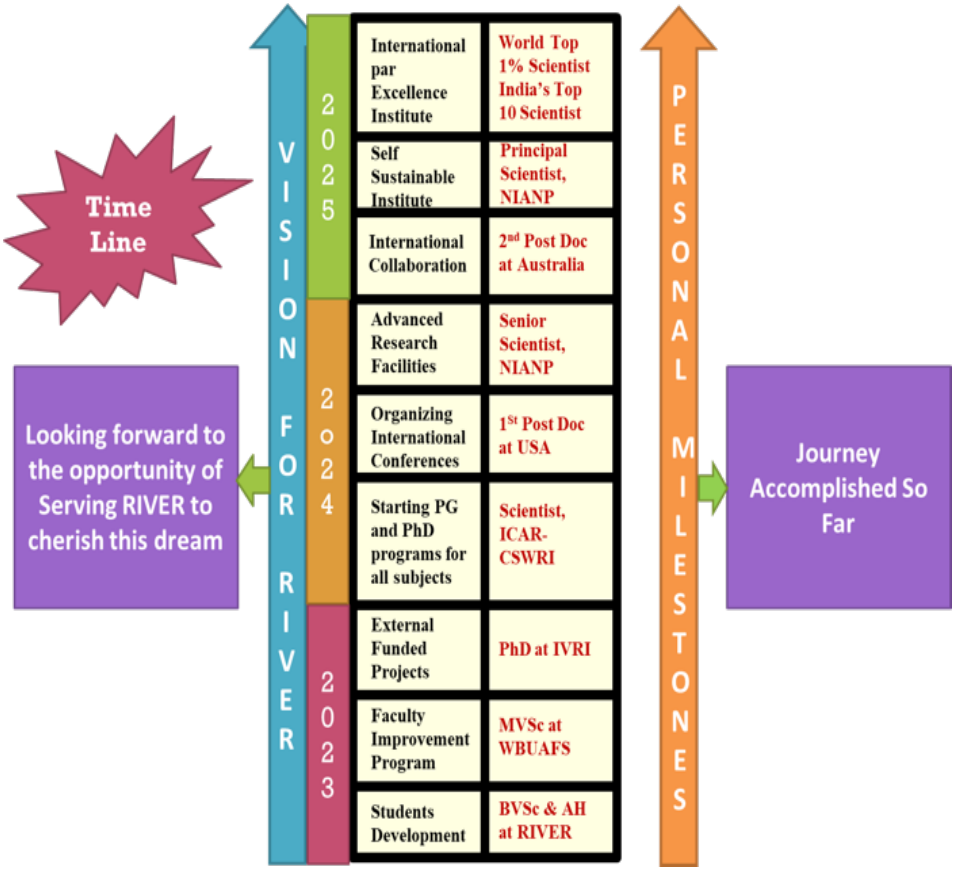

Fig 3: My future vision for RIVER during my tenure as DEAN

C-MASC Brittany Multer

Brittany Multer, *a first-year master's student in the School of Environment and Natural Resources, was recently awarded a $4,800 grant from the Ohio State Sustainability Institute to support her master's thesis work. The Sustainability Institute works to advance education, research, innovation, and partnerships related to sustainability and furthers these goals with funding support to student research which focus on sustainability and resilience. Brittany's research will study concrete weathering and its potential as a soil amendment to sequester atmospheric carbon.*

Emissions from the production of concrete account for approximately 10% of global annual carbon dioxide (CO2) emissions; the majority of these emissions are from the production of cement. Cement is produced by heating up calcium carbonate (CaCO3) to an extremely high temperature, resulting in CO2 emissions and calcium oxide (CaO), the main ingredient in cement. When exposed to rain, concrete experiences a type of chemical weathering called carbonation. Carbonation is a reaction between carbonic acid (formed from rainwater and atmospheric CO2) and CaO in concrete. This reaction creates mineral CaCO3, essentially reversing the reaction undertaken to produce CaO. This process, called mineral carbonation, is the most stable, long-term solution to capture and sequester atmospheric CO2. In fact, chemical weathering is the main geological sink of CO2 occurring in nature.

In her experiment, Brittany will be mixing concrete into soil columns and exposing the samples to water to induce carbonation. The funding will be used to finance physical, chemical, and biological tests done on the soil, soil air, and leachate. Comparisons between experimental samples and control samples will be completed to determine if concrete carbonation is a viable process to sequester atmospheric CO2 and what impacts concrete carbonation has on soil health. If proven effective, concrete carbonation has immense potential to reduce concrete waste and sequester atmospheric CO2 to mitigate climate change.

C-MASC Niloofar Sadeghi

The promise of carbon markets for the agriculture sector in the US.

Can the promise of carbon markets unlock the potential of soil carbon sequestration? U.S. farms have the capacity to sequester millions of metric tons of C02 every year. In a recent study, by applying the 2019 IPCC guidelines for estimation of GHG emissions in the United States , the increase in total potential soil organic carbon (SOC) from improved agricultural practices was estimated to reduce atmospheric GHG emissions by 47.3 megatons of Carbon per year for at least 20 years. If properly incentivized and financially compensated, farmers can adopt simple practices that result in sequestration of huge amounts of carbon in soils for long periods of time.

With her experience of working in several countries across Asia, Niloofar is convinced that the most effective incentive for farmers to engage in carbon capture and sequestration is that they see the clear economic return linked to the activity and market stability. Generally, farming practices are inherited from one generation to another, and farmers are skeptical to adoption of new approaches. However, if they clearly see the economic return that would secure a revenue stream for their families and possibly future generations, they are likely to adopt some changes in their practices. With this in mind, Niloofar has been looking into the effective structure for a carbon credit market in the US that would not only generate additional revenue streams for farmers but would also contribute to climate change mitigation by removal of carbon from the atmosphere and storage in soil (known as soil carbon sequestration).

There are two types of carbon markets: compliance markets and voluntary markets. Compliance carbon markets (also known as “mandatory markets”) are usually organized by governments to target certain industries or sources that emit GHGs. Unlike compliance markets, voluntary markets are incentive-based markets that allow individuals and private entities to purchase carbon offsets or credits on a voluntary basis (Brown, n.d.) . In a carbon market, the currency is carbon credits that are transacted between the sellers (project developers) and buyers (investors). The important aspect of a carbon market is that carbon credits have to be generated according to vigorous verification standards and third-party certifiers approve their validity. Carbon credits are recorded in registries to monitor their accumulated impact on reduction of GHGs.

Carbon markets are a new concept and obviously an untested area for farmers to enter. Project developers are companies who help farmers understand what is required to enter a carbon market and provide technical assistance on the practices that the farmers need to adhere to for qualifying for the carbon credit validation. Project developers are also linked to global buyers of the credits. There are several project developers presently working in the US such as Bluesource & Element Market , IndigoAg , Evergreen Carbon , and RenewWest and accredited verifiers such as SES are already verifying agriculture carbon credits in the US.

C-MASC Niloofar Sadeghi

The promise of carbon markets for the agriculture sector in the US.

Typical buyers in the US are corporations who have pledged to net-zero emission goals in which the corporation has committed to reduce emissions by a certain time. If the corporation cannot attain its net-zero emissions goal within the fence of its own organization, it will need to buy credits from other sources such as credits generated by farmers. The movement towards net-zero pledge by corporations is causing massive increase in demand for carbon-offset projects. At this point in time, farmers are in a privileged situation to generate extra revenue streams by participating in carbon offset projects. And more importantly, the economic incentive will lead to farming practices that result in less GHG emissions and many other co-benefits for soil health as well as improving the resiliency of cropping systems to climate change. Another advantage for US farmers is that, compared to farmers from developing countries, they are better positioned to sell their credits with a higher price tag. This is because of the good data availability in the US which gives confidence to investors about quality of the generated credits and avoidance of greenwashing.

Mentored and guided by Prof. Rattan Lal, Niloofar has been reviewing different aspects of an effective carbon market for the agriculture sector in the US and has concluded that if designed and implemented properly,

an agricultural carbon market in the US can bring tremendous benefits to farmers while mitigating the impacts of climate change. She suggests a 'voluntary' market structure would be used for the US agriculture carbon market rather than 'compliance' markets. USDA's role in overseeing this market is crucial. USDA sets standards for issuance of carbon credits from the agriculture sector, then credits are transacted on voluntary basis in existing emission trading systems or sold directly to investors. USDA's main role will be a "Standard Setter" as well as a "Clearing House" where information about farms and farming practices, the issued credits, trends in markets, standards for verification & monitoring of credits, requirements for project developers/technical assistance providers, third-party verifiers, and other technical as well as institutional information are provided in one place. In fact, this is one of the requirements of Biden's Act which instructs USDA to set-up and administer a new website, which will serve as a "One Stop Shop" of information and resources for producers and foresters who are interested in participating in carbon markets (Senate Agriculture Committee, 2021).

In setting standards, USDA's biggest challenge will be to establish robust verification standards for measuring and monitoring how much carbon is being exactly sequestrated in the soil.

USDA can avoid double-counting by establishing a registry for US farmers and the plots participating in a carbon credit project. Project developers must cross-check with the list of registered projects to ensure a credit is not issued for the same practice in each farm/plot. To avoid non-additionality, verification standards should develop a mechanism that ensures the change in practices are only because of the carbon offset credits otherwise farmers would not be adopting the practices linked with the carbon credit projects (additionality). In case disturbance occurs during the lifetime of a carbon credit project (e.g., practice of tillage or extensive periods of follow in a credit project that was agreed otherwise), the model applied by IndigoAg is recommended to be followed in which the project developer is held accountable for the lost carbon through disturbance. The company accounts for this lost carbon (called a "reversal") by deducting that carbon emission from any new credits being issued.

Niloofar is hoping that her deep dive in agricultural carbon markets for the US would help her design investments by the Asian Development Bank (ADB) that would contribute to both climate adaptation and mitigation while improving livelihood of communities. Niloofar is a Team Leader in the Southeast Asia department of ADB leading projects in climate-smart agriculture, climate change, and water management under extreme weather events in Indonesia, Lao PDR, and Vietnam.

The promise of carbon markets for the agriculture sector in the US.

Her research on agricultural carbon markets was part of her second Master of Science degree that she completed with the Johns Hopkins University on "Energy Policy and Climate." She feels extremely honored to have had the opportunity to work with and learn from Prof. Rattan Lal who was the mentor of her research and guided her throughout the process.

Prior to joining ADB, Niloofar was largely involved in upstream policy development through her work with the United Nations in Central and West Asia. She worked for the World Food Programme (WFP) in Iran to help design and implement sustainable livelihood programs. For over 13 years, Ms. Sadeghi worked at the UNESCO sub-regional office covering Afghanistan, Iran, Pakistan and Turkmenistan. During this time, she worked on upstream policies related to water, environment and climate change, particularly transboundary water management between Afghanistan and Iran. She started her career as a water expert in consulting companies working on projects financed by the World Bank as well as the Islamic Development Bank.

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C-MASC Graduate Student Anna Kolganova

War and the Carbon Cycle

People have been affecting nature in a variety of different ways, but it is hard to imagine an activity more threatening and destructive to the environment than war. Different armed confrontations have been happening around the world, influencing natural ecosystems' processes and mechanisms. Wars have a huge impact on the functioning of the natural nutrients' cycles in the environment, and the influence of military activity on the carbon cycle is an object of particular interest.

There are many different factors that influence the natural carbon cycling during wars. One of the most frequent and important of them Is bombing. Even though the explosion itself does not lead to carbon – containing compounds release, it does damage the soil system, violating soil structure. Soil is considered one of the carbon sinks since it is able to sequester carbon. However, when the soil structure gets disturbed, the soil is no longer able to hold this carbon and it comes to the atmosphere in the forms of methane and carbon dioxide, which are greenhouse gases. In 1999, there was a conflict in Yugoslavia. As the result, NATO forces bombed the Yugoslavian territory, which led to the agricultural and urban soils structure destruction, and emissions of greenhouse gases by the local soil system.

Tanks also impact the carbon cycle. The large territories in different parts of the world have been experiencing the pressure of heavy machinery on local ecosystems. Tank movements lead to soil compaction, which basically blocks the soil system for carbon dioxide fluxes income and deprives the soil of the ability to sequester greenhouse gases. Moreover, tanks are sources of air pollutants, including carbon oxide, which has a poisoning effect on the biosphere.

One of the sources of carbon oxide is fires which always occur due to military activity. The Zaporizhzhya nuclear power plant in Ukraine is the largest one in Europe and it is standing on the coast of the river Dnieper. The ongoing conflict between Russia and Ukraine provoked a huge fire near the power plant which lasted for a day. According to literature, during 1 day of fires, about 1.1 million metric tons of carbon oxide get emitted into the. The Zaporizhzhya nuclear power plant became a spot of temporary but harmful and intense carbon oxide emissions in Eastern Ukraine. It is also important to keep in mind that military airplanes and helicopters crashes are also a reason for fire occurrence during wars. More than 30 airplanes have already crashed during the Russian – Ukrainian crisis and have generated areas of carbon oxide emissions.

During wars, urban territories are always under high pressure. With bombs explosion and rockets strikes, living buildings get ruined and broken particles of concrete appear. Damaged concrete pieces can work as carbon dioxide sources since it includes carbonates in their chemical composition. More than 109,393 urban structures have been damaged during the military crisis in Syria since 2011. Large urban areas there were covered by concrete pieces, which are emitting carbon dioxide into the atmosphere, catalyzing climatic shifts.

Military conflicts have damaged global ecosystems heavily and caused violations of the natural carbon cycle functioning. Wars lead to the release of additional carbon into the environment in the form of different chemical compounds. These additional incomes of the element cause climate change process pace increase, contamination of the biosphere, and carbon content exceeding in water bodies and the atmosphere.

C-MASC Awards

Enhanced Soil Carbon Farming as a Climate Solution

by Klaus Lorenz, PHD

C-MASC, together with Co-PIs from Ohio State University and from Universities across the country and from Latin America are launching the project 'Enhanced Soil Carbon Farming as a Climate Solution.' This 5-year project is funded by the Foundation for Food & Agriculture Research (FFAR) with matching funds from Ohio Soybean Council, Ohio Corn and Wheat, Cotton Inc., The Ohio State University, the Inter-American Institute for Cooperation on Agriculture (IICA), Microsoft, Bayer Crop Science, Fondo Regional De Technología Agropecuaria (FONTAGRO), Kansas Corn, United Sorghum Checkoff, National Sorghum Producers, Utah State University, Michigan State University, Kansas State University, and the Department of Agriculture and Food of the State of Utah. Another private sector partner is Corteva.

The project will measure rates of SOC sequestration from on-farm conditions using traditional and enhanced carbon-farming methods under croplands, grasslands, and cattle rangelands of the conterminous U.S. On-farm evaluations provide direct evidence of the effect of management on SOC sequestration based on the complexity of crop, livestock, and forage systems deployed by farmers and ranchers.

Study sites under on-farm conditions will be selected for Major Land Resource Areas (MLRAs) in the conterminous U.S. Sites will be sampled on the basis of typical chrono-sequences and paired land uses for representative farms and ranches under traditional and innovative farming practices (e.g., cover crops, reduced/no-tillage, diversified crop rotations including legumes and perennials, improved and strategic grazing management, organic amendments) to assess changes in SOC stock, soil health/quality, and agronomic productivity.

The project will establish a relationship between SOC stock and adaptation/mitigation of climate change as intervened by soil health, plant production, management practices, fertilization, and irrigation. Changes in agroecosystem SOC stocks with implementation of enhanced carbon farming practices will be projected across Land Resource Regions (LRRs) and MLRAs by refining, calibrating, and validating multi-ensemble process-based models based on data from these on-farm evaluations. The project will also test methods of assessment of SOC stock by portable hand-held devices and remote sensing techniques. It will explore the socio-economic factors and policies limiting the adoption of carbon-farming practices for both commercial and family farms. The project will assess how extension and outreach activities can contribute to enhancing the adoption of SOC-sequestering practices by farmers and ranchers.

https://foundationfar.org

Quarterly Review

From the Desk of Rattan Lal

Returning Land to Nature and Re-Carbonizing the Biosphere

There are 8.7 million species on the Earth and only a small fraction of these have been identified and studied. Human ,the most dominant species, consume a large proportion of the net primary productivity. Human appropriation of net primary productivity (HANPP), which is an aggregate impact of land use on biomass available each year in ecosystems, is estimated at 15.6 Pg C /yr or about 23.8% of net primary productivity. Yet, human population is growing and estimated to increase from 7.9 B in 2022 to 9.8 B in 2050 and may be as much as 11.4 B by 2100. Human population, with growing economy , is also getting rich and affluent with tremendous demands on the finite natural resources. Land area under agriculture (growing crops and raising livestock) is already more than 5 B ha and there is a call for bringing more land under agriculture. Yet, 30 to 40% of all food produced is wasted. Of the 3 B tons of food grains produced, 1.2 B ton are wasted. In the meantime, inappropriate agricultural practices and indiscriminate use of inputs (e.g., fertilizers, pesticides, irrigation, plowing) along with deforestation and conversion of natural to managed ecosystems is changing climate, degrading soils, polluting water, contaminating air and dwindling biodiversity. World's food systems are responsible for about 30% of all anthropogenic emissions. Despite all this , 820 M people are food-insecure and prone to hunger or under-nutrition, 2 B are suffering from malnutrition or hidden hunger due to deficiency of micronutrients, protein or vitamins, 3 B cannot afford safe and healthy food.In developing countries(i.e., Sub Saharan Africa,South Asia, Central America,Caribbean,Andean regions), there is a large yield gap .Therefore, the world population should be fed from the food already produced by reducing waste, increasing access to food, encouraging plant-based diet, minimizing conflicts and civil strife, addressing poverty and inequality, and narrowing the yield gap by translating science into action.

Humanity must plan to return some land to nature. Of the 5 B ha of land, cropland area can be decreased to 750 M ha and grazing land to 1.5 B ha. The remaining land (~ 2.5 B ha) must be returned back to nature. There should be a time table on a decadal scale to return land to nature between 2025 and 2100.

Rather than try to dominate, human must learn to live in harmony with nature. Returning some land back to nature will re-carbonize the biosphere, enhance biodiversity, create a safe zone for human and improve the environment.

Sincerely,

Distinguished University Professor of Soil Science, SENRDirector
CFAES Dr. Rattan Lal Carbon Management and Sequestration Center (C-MASC)
IICA Chair in Soil Science & Goodwill Ambassador for Sustainable Development Issues
Adjunct Professor at the University of Iceland and the Indian Agricultural Research Institute (IARI)

International Decade of Soils 2015-2024

C-MASC Updates and Arrivals

Jeremiah Turiaga

The CFAES Rattan Lal Center for Carbon Management and Sequestration (C-MASC) is excited to welcome Jeremiah Turiaga as the new Office Associate. They are an Alumni of The Ohio State University with a Human Resources degree from The Fisher College of Business. They have been in Human Resources roles throughout Columbus, Ohio in various industries, most recently working in the Audio/ Visual industry. A recent accomplishment they had was implementing pronouns in employee email signatures while working for Nationwide. They are non-binary and go by (They/ Them) pronouns. They are passionate about diversity and inclusion and hope to bring kindness, tolerance, and support everywhere they go. They are prominent member of Columbus' LGBTQ+ art scene and have been a panelist at Comicon in New York and here in Ohio. They look forward to all the wonderful things they will learn at CMASC and hope to be a great contribution to the team.

Soil Science Events

- ICGSS 2022: 16. International Conference on Geology and Soil Science- May 05-06, 2022- Singapore, Singapore (https://waset.org/geology-and-soil-science-conference-in-may-2022-in-singapore)
- Union Soil and Water Conservation District- May 12/ 2022- Marysville, OH (https://www.unioncountydailydigital.com/events/events/union-swcd-board-meeting-5/)
- ICSSM 2022: 16. International Conference on Soil Science and Management- June 02-03, 2022- New York, New York (https://waset.org/soil-science-and-management-conference-in-june-2022-in-new-york)
- 77th Soil and Water Conservation Annual Conference- July 31-August 3, 2022- Denver, Colorado (https://www.swcs.org/events/conferences/2022-annual-conference)
- Soil Science- Crossing Boundaries, Changing Society- July 31-August 05, 2022- Glasgow, Scotland (https://22wcss.org/)
- UNFCCC COP27 (Climate Change Conference 2022)- November 8-20, 2022- Sharm El-Shikh, Egypt (https://sdg.iisd.org/events/2021-un-climate-change-conference-unfccc-cop-27/)

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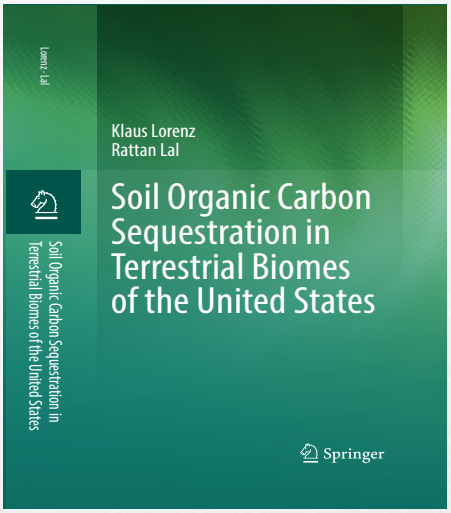

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