

SAHILA BEEGUM

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[USDA-Sahila Beegum](#) | [LinkedIn](#) | [ResearchGate](#) | [Google Scholar](#)

Research expertise:

With expertise in soil, groundwater, and mechanistic-process-based crop modeling, my research interest lies in developing and improving the mathematical representation of soil-crop-atmospheric interactions. Specifically, my research focuses on various aspects of soil (dynamics of soil carbon, nitrogen, and gas transport in soil and soil carbon dioxide respiration from agricultural regions) and crop modeling (mainly cotton and maize). I am proficient in simulation model conceptualization and development and utilize the Visual Studio interface with Team Foundation and GitHub for version control. Additionally, I have data analysis and statistics skills, enabling me to analyze and interpret research data. I also possess expertise in spatial data analysis, allowing me to integrate geographic information into my research.

Degrees received			
Degree	Institution	Specialization	Year
Ph.D.	IIT Madras	Hydraulics & Water Resources Engineering	2019
M-Tech	Kerala University	Hydraulics Engineering	2013
B-Tech	CUSAT University	Civil Engineering	2011

Professional positions			
Position/title	Institution		Year
Post-doctoral research associate	University of Nebraska Lincoln, USA		2020- present
Senior research associate	IIT Madras, India		2019-2020
DAAD-IGCS visiting researcher	Helmholtz AGRC, Julich, Germany		2018
Fulbright visiting researcher	University of California, Riverside, USA		2016-2017
Teaching assistant	IIT Madras, India		2015-2018
Research project Associate	IIT Madras, India		2013
Teaching assistant	Kerala University, India		2011-2013
Project associate	CWRDM, India		2011

Awards and honors			
Award	Details		Year
Fulbright fellowship	Visiting researcher at the University of California Riverside, USA		2016-2017
DAAD-IGCS fellowship	Visiting researcher Forschungszentrum Jülich, Helmholtz Association of German Research Centres, Jülich, Germany		2018
Berkner fellowship	Funding received for travel and presentation at the American Geophysical Union's (AGU) 2014 Science, Policy Conference, Washington, DC, USA		2014
HRD scholarship	Scholarship for carrying out Ph.D. at IIT Madras, India		2014-2018

Best presentaiion award	National Conference on Emerging Technologies, Kerala University, India	2013
First rank holder	M Tech, Kerala University, India	2014
MCM scholarship	Scholarship for carrying out M-Tech, KU, India	2011-2013
Second rank holder	B-Tech, CUSAT university	2013

Grants

USGS 104b grant, as Co-PI, Managing irrigated cropping systems for drought resilience and vadose zone nitrate control: Field evaluation and modeling; amount awarded: \$29,962.00.

Professional societal associations

Details	Since
Soil Science Society of America (SSSA)	2022
American Society of Agronomy (ASA)	2022
American Geophysical Union (AGU)	2014, 2023
Association of Agricultural Scientists of Indian Origin (AASIO) member	2023
American Society of Agricultural and Biological Engineers (ASABE)	2017, 2023

Leadership and service activities

Mentoring a visiting scholar, University of Nebraska Lincoln, USA	2023
Mentored a Master's student at IIT Madras, India	2015
Peer reviewer (13 manuscripts)	2017-2023
Delivered invited lectures at three different organizations.	
Coordinated SWAT international conference, IIT Madras, India	2018
Section chair International Conference ICITES, India	2021
Technical committee member ICITES conference, CUSAT, India	2021
External member in the advisory committee for TIST, CUSAT, India	2021-2022
Volunteered for San Diego Foodbank Food for Thought, San Diego, USA	2017
Volunteered to be a mentor in the ASA-CSSA-SSSA Mentorship Program	2022
Volunteered to evaluate Gerald O. Mott Award nominee (external member)	2022
Co-developed three simulation models and made available for public use	2018, 2023

Academic/professional collaborations (current)

Dr. Raja Reddy, William Giles Distinguished Professor, MSU, MS, USA
 Dr. Daran Rudnick and Dr. Abia Katimbo, University of Nebraska Lincoln, USA
 Dr. Jirka Simunek's lab at UC Riverside, USA

Other recognitions

A research work I co-authored was selected as a spotlight in the Water Resource Research Journal and published in EOS research news ([Modeling Mulch to Understand Agricultural Soil](#)).

A simulation model (unsaturated-saturated soil zone model) that I developed during my Ph.D. is currently being taken up by a research group at the University of California, Riverside, to extend to a large watershed scale, including hillslope processes. ([software webpage](#))

Research Accomplishments

Publications	23
Peer-reviewed journal articles	20
Book chapters	3
Presentations in conference	16
Volunteered presentations	12
Invited presentations	4
Academic profile (based on Google Scholar)	
Citations	117
h-index	5
i-10- index	4
Professional contributions	
Three Soil-Crop-Atmospheric Continuum-related software/source codes were co-developed and added to the publically available platforms (1 , 2 , 3).	3
Invited talks	3

Journal publications

1. **Beegum, S.**, Reddy, V., & Reddy, K. R. (2023). Development of a cotton fiber quality simulation module and its incorporation into cotton crop growth and development model: GOSSYM. *Computers and Electronics in Agriculture*, 212, 108080. <https://doi.org/10.1016/j.compag.2023.108080>
2. **Beegum, S.**, Sun, W., Timlin, D., Wang, Z., Fleisher, D., Reddy, V. R., & Ray, C. (2023). Incorporation of carbon dioxide production and transport module into a Soil-Plant-Atmosphere continuum model. *Geoderma*, 437, 116586. <https://doi.org/10.1016/j.geoderma.2023.116586>
3. **Beegum, S.**, Truong, V., Bheemanahalli, R., Brand, D., Reddy, V., & Reddy, K. R. (2023). Developing functional relationships between waterlogging and cotton growth and physiology-towards waterlogging modeling. *Frontiers in Plant Science*, 14. <https://doi.org/10.3389/fpls.2023.1174682>
4. Sun, W., Fleisher, D., Timlin, D., Ray, C., Wang, Z., **Beegum, S.**, & Reddy, V. (2023). Projected long-term climate trends reveal the critical role of vapor pressure deficit for soybean yields in the US Midwest. *Science of The Total Environment*, 878, 162960. <https://doi.org/10.1016/j.scitotenv.2023.162960>
5. Timlin, D., Fleisher, D., Tokay, M., Paff, K., Sun, W., **Beegum, S.**, Li, S., Wang, Z., & Reddy, V. (2023). CLASSIM: A Relational Database Driven Crop Model Interface. *Smart Agricultural Technology*, 100281, <https://doi.org/10.1016/j.atech.2023.100281>
6. **Beegum, S.**, Timlin, D., Reddy, K. R., Reddy, V., Sun, W., Wang, Z., ... & Ray, C. (2023). Improving the cotton simulation model, GOSSYM, for soil, photosynthesis, and transpiration processes. *Scientific Reports*, 13(1), 7314 <https://doi.org/10.1038/s41598-023-34378-3> .
7. **Beegum, S.**, Malakar, A., Ray, C., & Snow, D. D. (2023). Importance of snowmelt on soil nitrate leaching to groundwater—A model study. *Journal of Contaminant Hydrology*, 255, 104163. <https://doi.org/10.1016/j.jconhyd.2023.104163>

8. Wang, Z., Timlin, D., Liu, G., Fleisher, D., Sun, W., **Beegum**, S.,. (2023) Coupled heat and water transfer in heterogeneous and non-rigid soils: simulation using mixed finite element method, *Water Resources Research* (submitted)
9. Sun, W., Fleisher, D., Timlin, D., Li, S., Wang, Z., **Beegum**, S., & Reddy, V. (2022). Evaluation of models for simulating soybean growth and climate sensitivity in the US Mississippi Delta. *European Journal of Agronomy*, 140, 126610. <https://doi.org/10.1016/j.eja.2022.126610>
10. Wang, Z., Timlin, D., Fleisher, D., Sun, W., **Beegum**, S., Li, S., Chen, Y., Reddy, V. R., Tully, K., & Horton, R. (2022). Modeling vapor transfer in soil water and heat simulations: A modularized, partially-coupled approach. *Journal of Hydrology*, 608, 127541. <https://doi.org/10.1016/j.jhydrol.2022.127541>
11. Jahangeer, J., Yadav, B. K., **Beegum**, S., (2023) Modeling of nitrate transport in the vadose zone by considering the mobile-immobile approach using sand tank experiment, *Journal of Hazardous, Toxic, and Radioactive Waste* (manuscript accepted and in production)
12. Mwabumba, M., Jahangeer, J., **Beegum**, S., Yadav, B. K., & Rwiza, M. J. (2022). Assessment of Groundwater Quality under Changing Climate in Ngorongoro Conservation Area, Tanzania. *Journal of Irrigation and Drainage Engineering*, 148(10), 04022032. [https://doi.org/10.1061/\(ASCE\)IR.1943-4774.0001702](https://doi.org/10.1061/(ASCE)IR.1943-4774.0001702)
13. **Beegum**, S., Jainet, P. J., Emil, D., Sudheer, K. P., & Das, S. (2022). Integrated Simulation Modeling Approach for Investigating Pore Water Pressure Induced Landslides. Preprint (Version 1) available at Research Square <https://dx.doi.org/10.21203/rs.3.rs-1186263/v1> (submitted)
14. Jeyalakshmi, S., & **Beegum**, S. (2022). Climate change impacts on agriculture-dominated Canadian watersheds. *Sustainability, Agri, Food and Environmental Research*, 10.
15. Jeyalakshmi, S., & **Beegum**, S. (2022). Scenario analysis of fluoride contamination in the groundwater in Kerala. *Sustainability, Agri, Food and Environmental Research*, 10(1).
16. Wang, Z., Thapa, R., Timlin, D., Li, S., Sun, W., **Beegum**, S., Fleisher, D., Mirsky, S., Cabrera, M., & Sauer, T. (2021). Simulations of Water and Thermal Dynamics for Soil Surfaces With Residue Mulch and Surface Runoff. *Water Resources Research*, 57(11), e2021WR030431. <https://doi.org/10.1029/2021WR030431>
17. **Beegum**, S., Vanderborght, J., Šimůnek, J., Herbst, M., Sudheer, K. P., & Nambi, I. M. (2020). Investigating atrazine concentrations in the Zwischenscholle aquifer using MODFLOW with the HYDRUS-1D package and MT3DMS. *Water*, 12(4), 1019. <https://doi.org/10.3390/w12041019>
18. **Beegum**, S., Šimůnek, J., Szymkiewicz, A., Sudheer, K. P., & Nambi, I. M. (2019). Implementation of Solute Transport in the Vadose Zone into the "HYDRUS Package for MODFLOW." *Groundwater*, 57(3), 392–408. <https://doi.org/10.1111/gwat.12815>
19. **Beegum**, S., Šimůnek, J., Szymkiewicz, A., Sudheer, K. P., & Nambi, I. M. (2018). Updating the Coupling Algorithm between HYDRUS and MODFLOW in the HYDRUS Package for MODFLOW. *Vadose Zone Journal*, 17(1), 1–8. <https://doi.org/10.2136/vzj2018.02.0034>

20. Szymkiewicz, A., Gumuła-Kawęcka, A., Šimůnek, J., Leterme, B., **Beegum**, S., Jaworska-Szulc, B., Pruszkowska-Caceres, M., Gorczevska-Langner, W., Angulo-Jaramillo, R., & Jacques, D. (2018). Simulations of freshwater lens recharge and salt/freshwater interfaces using the HYDRUS and SWI2 packages for MODFLOW. *Journal of Hydrology and Hydromechanics*, 66(2), 246–256. <https://doi.org/10.2478/johh-2018-0005>

Book chapters

1. **Beegum**, S., & Das, S. (2022). 17—Nanosensors in agriculture. In S. Ghosh, S. Thongmee, & A. Kumar, (Eds.), *Agricultural Nanobiotechnology* (pp. 465–478). Woodhead Publishing. <https://doi.org/10.1016/B978-0-323-91908-1.00012-2>
2. Das, S., & **Beegum**, S. (2022). 13—Nanofertilizers for sustainable agriculture. In S. Ghosh, S. Thongmee, & A. Kumar (Eds.), *Agricultural Nanobiotechnology* (pp. 355–370). Woodhead Publishing. <https://doi.org/10.1016/B978-0-323-91908-1.00005-5>
3. Sudheer, K. P., Thomas, J., Jainet, P.J., Nizar, S., **Beegum**, S., Emil, D., Jesna., Pai, D. S. (2022) From science to policy- towards an approach linking extreme rainfall events to climate resilience and policy development, accepted for publication in the Elsevier book series: *Modeling and Mitigation Measures for Managing Extreme Hydrometeorological Events Under a Warming Climate* <https://doi.org/10.1016/B978-0-443-18640-0.00015-8>

Presentations at conferences (listed 10 out of 16)

1. **Beegum**, S., Sun, W., Timlin, D., Wang, Z., Fleisher, D., Reddy, V. R., & Ray, C. (2023). Incorporation of Carbon Dioxide Production and Transport Module into a Soil-Plant Atmospheric Continuum Model. ASA, CSSA, SSSA International Annual Meeting, Nov. 6 to 9, Baltimore, Maryland
2. **Beegum**, S., Timlin, D., Fleisher, D. H., & Reddy, V. (2021). Integration of a Farquhar Photosynthesis Model, a Leaf Level Energy Balance Model, and 2DSOIL, a Finite Element Model for Soil Processes, into the Cotton Simulation Model Gossym. ASA, CSSA, SSSA International Annual Meeting, Nov. 7 to 10, Salt Lake City, Utah
3. Sun, W., Fleisher, D. H., Timlin, D., Li, S., Wang, Z., **Beegum**, S., Reddy, V. R., & Ray, C. (2021). Inter-Comparison of Different Crop Models for Simulating Soybean Growth and Yield in the US Mississippi Delta. ASA, CSSA, SSSA International Annual Meeting, Nov. 7 to 10, Salt Lake City, Utah
4. **Beegum**, S., Vanderborght, J., Herbst, M., & Šimůnek, J. (2019). Simulation of the long-term evolution of pesticide concentrations in the Zwischenscholle aquifer using the coupled soil-groundwater model MODFLOW-HYDRUS-MT3DMS, XVI Symposium on Pesticide Chemistry. *Advances in Risk Assessment and Management*, Sept. 3, Piacenza, Italy.
5. **Beegum**, S., Sudheer K. P, Nambi, I. M., & Berlin M. (2018). Investigating Strategies for Safe Reuse of Treated Textile Wastewater for Irrigation: A Comprehensive Study. Global Water Security Conference for Agriculture and Natural Resources, ASABE Global Initiative Conference, Indian Society of Agricultural Engineers (ISAE), October 3-6, Hyderabad, India.
6. **Beegum**, S., Sudheer K. P., & Nambi, I. M. (2018). Implementation of Solute Transport in the Vadose Zone into the 'HYDRUS Package for MODFLOW.' International Soil and Water

Assessment Tool Conference, January 10-12, Chennai, India.

7. Šimůnek, J., **Beegum**, S., Sudheer, K. P., Szymkiewicz, A., & Nambi, I. M. (2017). Implementation of Solute Transport in the Vadose Zone into the 'HYDRUS Package for MODFLOW' 2017 AGU Fall Meeting, Dec. 13, New Orleans, USA.
8. **Beegum**, S., Sudheer, K. P., Šimůnek, J., Szymkiewicz, A., & Nambi, I. M. (2017). Integration of Solute Transport and Water Flow Model for Unsaturated and Saturated Soil Zone. Proceedings of the Annual International Meeting of ASABE, July 16-19, Spokane, Washington, USA.
9. **Beegum**, S., Sudheer, K.P, Nambi, I. M., Šimůnek, J., & Szymkiewicz, A. (2017). Integration of Solute Transport and Water Flow Models for Unsaturated and Saturated Soil Zones using the HYDRUS Package for MODFLOW and MT3DMS. Proceedings of the MODFLOW and More 2017 Conference, May 21 - 24, Integrated Groundwater Modelling Centre, Colorado School of Mines, Colorado, USA.
10. **Beegum**, S., & Suja, R. (2014). Urban stormwater flood mitigation-A requirement in India. American Geophysical Union's (AGU), Science Policy Conference, Jun. 16-Jun. 18, Washington, DC, USA.

Invited talks

1. **Sahila Beegum**. 2018. Integrated water flow and solute transport modeling in unsaturated and saturated soil zones, Faculty and Staff, and students, Gdansk University of Technology, Gdansk, Poland.
2. **Sahila Beegum**. 2018. Updates in HYDRUS package for MODFLOW, Faculty and Staffs, The Katholieke Universiteit Leuven, Belgium.
3. **Sahila Beegum**. 2018. Water smart cities-challenges and opportunities in Kerala. International conference by Translational Research and Professional Leadership Centre, TPLC, in association with IIT Madras, India.

Research activities in doctoral and post-doctoral programs:

Ph.D.: (2014-2019): Indian Institute of Technology Madras, India (IITM); Visiting scholar at University of California Riverside, USA (Fulbright fellowship); Visiting scholar at Forschungszentrum Jülich, Helmholtz Association, Jülich, Germany (Indo-German Centre for Sustainability, DAAD fellowship)

1. During my Ph.D., I worked on developing a coupling algorithm to integrate unsaturated and saturated soil zone models (HYDRUS-1D and MODFLOW). The developed software is publicly available as modeling software. The model facilitates the simulation of unsaturated and saturated soil zone water flow and solute transport dynamics in a computationally efficient way. Currently, this model is being utilized and updated by various groups. ([software webpage](#) and Relevant publications [1](#), [2](#), [3](#), [4](#)).

Post Doctoral Research Associate (2020- present): Nebraska Water Center, University of Nebraska Lincoln, working conjunctively with Adaptive Cropping Systems Laboratory, USDA-ARS, Beltsville, Maryland

Post-doctoral research has been primarily focused on improving and developing soil-plant-atmospheric interactions in mechanistic process-based crop models. Since September 2020, I have been engaged in the following research activities as part of my post-doctoral work.

1. **Development of soil carbon dioxide respiration model:** A carbon dioxide (CO₂) production and transport module has been developed and integrated into the 2DSOIL model. This module enables the simulation of CO₂ production from both microbes and roots and the modeling of diffusion-based CO₂ transport and soil respiration. The module considers factors such as soil moisture, temperature, microbial activity, and organic matter content to simulate the dynamics of CO₂ in the soil accurately. The newly developed model allows for investigating how various soil, crops, and environmental factors influence CO₂ production, transport, and soil respiration ([publication](#)).
2. **Improving soil, photosynthesis, and transpiration process in GOSSYM:** The existing process-based cotton simulation model, GOSSYM, has been enhanced to improve its soil, photosynthesis, and transpiration process simulations. This improvement involved replacing the Rhizos-based soil simulator and RUE-based photosynthesis model in GOSSYM with 2DSOIL and Farquhar biochemical model and Ball-Berry leaf energy balance model ([publication](#)).
3. **Model for fiber quality:** A simulation modeling component for modeling cotton fiber quality was developed and successfully incorporated into GOSSYM. This achievement is particularly noteworthy as no other process-based cotton simulation model currently includes a fiber quality simulation capability. The developed model enables the determination of the influence of temperature, water, and nutrients on the four major fiber quality indicators ([publication](#)).
4. **Development of CLASSIM graphical user interface:** I work as a team member in developing CLASSIM, a newly developed crop and soil modeling software package graphical user interface (GUI). As part of this project, I contributed to integrating the revised cotton model and the newly developed CO₂ production and transport models into the user-friendly GUI- CLASSIM ([publication](#)).
5. **Developing cultivar-dependent parameter estimation algorithm:** I am developing an efficient algorithm to optimize the existing crop models for the newly developed cultivars. The main focus is determining cultivar-dependent parameters, considering the model's conceptualization, and exploring ways to ensure the algorithm's applicability for future cultivars.
6. **Miscellaneous projects:** I have also collaborated on projects focussing on (a) modeling mulch processes, (b) conducting intercomparisons of multiple models for simulating soybean growth and yield in the Mississippi Delta, and (c) investigating the influence of vapor pressure

deficit on soybean yield. Furthermore, I have conducted (d) modeling analyses to gain insights into the impact of snow on nitrate leaching into groundwater (Relevant publications [1](#), [2](#), [3](#), [4](#)).