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"Regenerative Agriculture : Key to Future Farming"

STATE AGRICULTURAL TECHNOLOGISTS' SERVICE ASSOCIATION
WEST BENGAL

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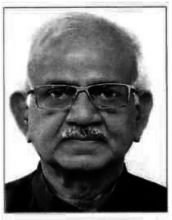
Sobhandeb Chattopadhyay
Minister-in-Charge
Department of Agriculture & Parliamentary Affairs
Government of West Bengal

শোভনদেব চট্টোপাধ্যায়
মন্ত্রী
কৃষি ও পরিষদীয় বিষয়ক বিভাগ
পশ্চিমবঙ্গ সরকার



Message

It's a pleasure to know that the annual scientific journal of State Agricultural Technologists's Service Association, West Bengal titled 'SATSA Mukhapatra – Annual Technical Issue, Volume-29' is going to be published on the occasion of its Biennial General Meeting on 08.02.2025. *'Regenerative Agriculture : Key to Future Farming'* will be the theme of the publication which is expected provide an insight into the highly relevant subject. It is expected to generate awareness on sustainable farming addressing the environmental issues.

I express sincere thanks to the editorial team for bringing out this issue and convey my best wishes to the members of the association.

Dated, Nabanna, January 14, 2025

(Sobhandeb Chattopadhyay)

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ভারপ্রাপ্ত মন্ত্রী
পঞ্চায়েত ও গ্রামোন্নয়ন দপ্তর এবং
সমবায় দপ্তর
পশ্চিমবঙ্গ সরকার

Pradip K Mazumdar
MINISTER-IN-CHARGE
Department of Panchayats &
Rural Development and
Department of Co-operation
Govt. of West Bengal

18/01/2025

MESSAGE

I am happy to learn that State Agricultural Technologists' Service Association (SATSA), West Bengal is going to publish its annual publication **"SATSA Mukhapatra-Annual Technical Issue Vol. 29 (2025)" on 8th February, 2025 at Kolkata.** I have seen that this journal always contains important articles on agriculture and allied sectors. This year technical issue covers an important topic on **"Regenerative Agriculture: Key to Future Farming".**

Regenerative agriculture is fundamentally about farming in balance with the environment focussing on Soil Health. It encompasses natural inputs, minimum tillage and multi cropping. Regenerative farming can improve health of soil, soil's ability to retain moisture, increase crop yield and reduce soil erosion. It has the potential to reduce emissions from agriculture and turn the crop fields and the pastures into carbon sinks benefitting farmers economically while protecting the environment. It's a need of the hour !

I compliment SATSA, WB for choosing an appropriate focal theme for their annual scientific journal.

I convey my appreciation and best wishes to each members of the SATSA family and wish continuing success of their endeavours and of the publication **"SATSA Mukhapatra-Annual Technical Issue Vol. 29 (2025)".**

(Pradip K Majumdar)

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MESSAGE

I am happy to know that State Agricultural Technologists' Service Association (SATSA), West Bengal is bringing out its annual publication "SATSA Mukhapatra-Annual Technical Issue Vol. 29 (2025)" on 8th February, 2025 at Kolkata. The journal is actively publishing various important issues on agriculture and allied sectors and the present technical issue covers an important topic on "Regenerative Agriculture: Key to Future Farming".

In the present context of the society, the compound impacts of the climatic aberrations highlighted the need to build new perspectives on regenerative agriculture for restoring and conserving agricultural and food systems. Regenerative agriculture represents a paradigm shift that offers the promise of more sustainable, resilient, and climate-friendly farming systems. Regenerative agriculture is often viewed as a key approach for the future of farming, focusing on practices that restore and enhance soil health, biodiversity, and ecosystem resilience. Unlike conventional farming, which can degrade the soil over time, regenerative agriculture seeks to reverse this damage and promote long-term sustainability.

I appreciate the efforts of SATSA family and best wishes for the publication.

(Himanshu Pathak)

Dated the 15th January, 2025
New Delhi

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From the Desk of the General Secretary

If the conservation of natural resources goes wrong, nothing else will go right

- M.S. Swaminathan

India is a global agricultural powerhouse. It is the world's largest producer of milk, pulses and spices, and has the world's largest cattle herd (buffaloes), as well as the largest area under wheat, rice and cotton. It is the second largest producer of rice, wheat, cotton, sugarcane, farmed fish, sheep & goat meat, fruit, vegetables and tea. However, the effects of climate change affect farmers' ability to grow the food we all need.

Increasing urbanisation and rising incomes in India are being reflected in changes in food consumption patterns. Growth in consumption of food grains has slowed, while consumption of meat and livestock products is increasing. The greatest growth is in the consumption of fruit and vegetable products.

Increasingly volatile weather and more extreme events – like floods and droughts – change growing seasons, limit the availability of water, allow weeds, pests and fungi to thrive, and can reduce crop productivity. In this context, agro-ecology, permaculture, organic farming, conservation agriculture... all these are "analogs" of sustainable agriculture that share a large number of common practices, and regenerative agriculture is no exception.

Regenerative agriculture is a method of restoring and conserving agricultural and food systems. Topsoil regeneration, biodiversity enhancement, water cycle improvement, ecosystem services enhancement, bio-sequestration support, climate change resilience, and agricultural soil health and vitality are the main focus areas of regenerative agriculture. The goal is to farm and ranch in a way that benefits both the land and people, with different methods used by different growers and in different areas. Although there isn't a set of rigid guidelines, the overall goals of the dynamic system of regenerative agriculture are to improve the health of our soil and ecosystems, alleviate inequality, and leave our land, seas, and climate in a better state for coming generations.

Regenerative agriculture is fundamentally about farming and ranching in balance with the environment. Practitioners consider their place in the world from a wider perspective, particularly about the cycles of nutrients and soil. The industrial agricultural system that controls the supply chains for food and fiber, on the other hand, encourages activities that lead to soil erosion more quickly than soil formation, nutrient runoff, toxic algal blooms in freshwater and coastal systems, mono-cropping, and other threats to local biodiversities, such as important pollinators. These systems concentrate on the yields of individual crops while dividing up natural resources. Further, planting a range of crops, intercropping, and utilizing cover crops are ways

to do this. Regenerative agriculture promotes soil health by minimizing soil disturbance, keeping the soil covered, and utilizing cover crops. Cover crops can help enhance soil structure, fix nitrogen, and control weeds. It also seeks to limit the need of chemical inputs. It seeks to protect water quality while conserving water resources. This can be accomplished by using a more deliberate approach to watering, such as drip or sub-service irrigation. Through regenerative agriculture, we can nurture biodiversity, restore grassland, revitalize local economies, preserve traditional knowledge, improve yield, reverse climate change through increasing soil carbon stock, and many more.

Our future survival is seriously threatened by the loss of the world's biodiversity and fertile soil, as well as by the extinction of native seeds and knowledge. According to soil scientists, if soil degradation continues at the current rate (decarbonization, erosion, desertification, and chemical pollution), we will literally run out of arable topsoil to feed ourselves in 50 years, in addition to suffering significant health harm from a food supply that is qualitatively degraded with reduced nutrition and essential trace minerals lost. It will be impossible to feed the world, avoid global warming, or stop the loss of biodiversity unless we preserve and regenerate the soil.

In conclusion, agriculture scientists and extension workers have to be always focused for conservation of quality genetic resources of crop, intensification of farm mechanization in farmer's field, weather based forecasting, smart irrigation practices (through sprinkler, drip, rain water harvesting), zero tillage & reduced tillage, awareness campaign regarding the evil effects of burning of crop residues, land shaping especially in the saline tract, diversified cropping systems, organic farming, INM & IPM practices, financial boosting to the farmers threatened by the natural disaster and last but not the least use of mobile networking farmer's advisory services.

Keeping the above mentioned aspects, the present issue (Vol.29; 2025) of SATSA Mukhapatra-Annual Technical Issue has been accomplished and shaped in the form of "**Regenerative Agriculture: Key to Future Farming"** with the hope to be smart enough to conserve what we can't create and get the message right from the policy-makers desk to the peasant's farmstead....

(Suman Sen)
General Secretary,
SATSA, West Bengal

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About the Authors of Invited Papers

Debashis Chakraborty currently holds the position of Senior Cropping Systems Agronomist at CIMMYT, Dhaka, Bangladesh. He has Master's and Ph.D. degrees from IARI, New Delhi specializing in Soil Physics, Soil and Water Management and Geoinformatics, and received a Gold Medal for Academic Excellence, and Best Doctoral Thesis Award. Commencing his career as a Research Scientist, Dr Chakraborty progressed to the position of National Fellow at ICAR. He has been involved in various R&D projects as the Principal Investigator, focusing on LULC dynamics, water and nutrient dynamics and participatory-GIS, and collaborated with IRRI and CIMMYT on long-term experiments and conservation agriculture. Additionally, he has also worked as a post-doctoral fellow Rothamsted Research, UK and at the University of Sydney, Australia under the DFAT fellowship. Notable acknowledgement included 12th International Congress Commemoration and Dr KG Tejwani Awards for Management of Natural Resources; esteemed as a Fellow of the National Academy of Agricultural Sciences, India, and Academy of S&T, West Bengal. Since 2001, Dr Chakraborty is a PG Faculty of IARI and has supervised Masters, Doctoral, and Post-doc students. He has to his credit 80 research papers with 7627 citations and an h-index of 40, and a book on 'Fundamentals of GIS'.

Tridiv Ghosh is a Research Scientist at North Eastern Space Applications Centre (NESAC), Meghalaya, specialized in satellite remote sensing, GIS, digital soil mapping, machine learning modelling, R programming, Google Earth Engine and crop simulation modeling. He earned his Ph.D. in Irrigation Scheduling using satellite remote sensing at Indian Agricultural Research Institute (IARI), New Delhi. His research aims to advance agricultural studies through innovative technology and data analysis.

Moin Us Salam is an internationally recognized academia, researcher, and project developer, who served renowned universities and organizations in Bangladesh, Australia, Japan, the UK, and the USA. He is highly experienced in the area of agricultural systems (including agrometeorology, crop modelling, development and dissemination of decision-aiding tools including early warning systems, quantitative epidemiology of crop diseases, data analysis and interpretation, project development, management and evaluation, policy and strategic planning and agricultural transformation. Dr. Salam served the Department of Agriculture and Food Western Australia (DAFWA) for 17 years and held the position of a Principal Research Officer, which was the highest level attainable for a practicing scientist in the public service of the Government of Western Australia. He studied at Reading University, UK, for PhD and University of Florida, Gainesville, USA, for a postdoc. He published over 100 refereed journal papers, developed five government strategic plans, and delivered 25 consultancy reports.

Mahesh Gathala was born into a farming family in Rajasthan and earned his BSc and MSc from Rajasthan Agricultural University. He completed his PhD in Soil Science at Maharana Pratap University of Agriculture and Technology (MPUA&T) in Udaipur. Since 2011, Dr. Gathala has been working with CIMMYT's Sustainable Intensification Program as a Senior Systems Agronomist based in Bangladesh. His work has significantly contributed to researching, developing, and deploying Conservation Agriculture-based Sustainable Intensification, crop production systems, and small-scale mechanization. He has also pioneered innovations supporting youth and women in micro-entrepreneurship and capacity building for thousands of farmers and partners. Dr. Gathala's expertise is focused on developing CA-based management solutions to tackle issues such as resource degradation, soil health, abiotic stresses, and climate change in South Asia.

Femi Francis is currently pursuing a PhD in Plant Pathology at the ICAR - Central Rice Research Institute (CRRI) in Cuttack, Odisha. She completed her graduations in Agriculture from Kerala Agricultural University and awarded degree in M.Sc. (Ag.) Plant pathology at the University of Agricultural Sciences, Raichur, Karnataka. Throughout her academic journey, she has explored various aspects of pathogenomics, including microbiome research and potential biocontrol methods for managing false smut disease. She awarded for her presentation in National PG Conference, 2023 at UAS, Raichur. She has qualified for the UGC NET with Junior Research Fellowship (JRF).

Dr. Shyamaranjan Das Mohapatra completed his Ph.D. in Entomology & Agricultural Zoology from Banaras Hindu University in 2001, following an M.Sc. in Entomology from G.B. Pant University in 1998 and a B.Sc. in Agriculture from Odisha University of Agriculture & Technology in 1996. He is currently serving as the Head, Division of Crop Protection, ICAR-Central Rice Research Institute, Cuttack, Odisha. With over 20 years of research experience, Dr. Mohapatra has specialized in remote sensing applications in pest management, ecological engineering-based pest control, and the use of artificial intelligence in pest forecasting. He holds a patent for the Alternate Energy Light Trap device and has developed two products, the Solar 24x7 Insect Trap and Eco-Friendly Solar Light Trap, which collectively generated over ₹ 80 crores in business and royalty earnings of more than ₹ 3 crores. Dr. Mohapatra has published over 60 peer-reviewed research papers, authored three books, and co-developed more than 10 rice varieties and mobile apps like Ricexpert and Ricepestlab. A recipient of prestigious awards including the ICAR NanajiDeshmukh Outstanding Team Award, he is also a Fellow of various scientific societies. Additionally, he serves as a reviewer for journals such as Scientific Reports and Industrial Crops and Products and has guided three Ph.D. and six M.Sc. students. His leadership and innovative contributions have significantly impacted pest management and rice research.

Dr. Manas Kumar Bag Principal Scientist (Plant Pathology) at ICAR – Central Rice Research Institute, Cuttack, India since 2015 and also worked as Senior Scientist at ICAR- National Bureau of Plant Genetic

Resources, New Delhi during 2011-2014, Rice Research Station, Chinsurah, Dept. of Agriculture, Govt. of W.B.and having research experience of >22 yrs. He received Ph.D.degree in Plant Pathology from ICAR-Indian Agricultural Research Institute, New Delhi in 2001 and graduated in Agriculture & post graduated in Mycology & Plant Pathology from Bidhanchandra Krishi Viswavidyalaya, West Bengal. Major area of research is host resistance to plant diseases, identification of resistant genotypes, bio-intensive pest management, molecular pathology, rice disease management. He has publications of > 175 that include**,** about **65**peerreviewed researcharticles,20 book chapters and around 65 popular articles, training manual and research notes. Google Scholar Citations: 1455; ***h*-index: 21**; *i*10-index: 31. He presented more than 50 papers in international and national conferences that include memorial lecture, lead lecture and invited lectures. Presently he is FacultyMember of Post Graduate School, IARI New Delhi, and also served as guest lecturer of Ramakrishna Mission Vivekananda University, West Bengal and Institute of Agricultural Sciences, Calcutta University. He guided twoPh.D and sixM.Sc students.*For his contribution in the field of plant pathology / crop protection*, he has been bestowed with various awards and Fellow. Delivered 11th Prof. S.B. Chattopadhyay MemorialLecture,IMS, Kolkata; **Fellow**of Indian Phytopathological Society, New Delhi; Crop and weed Science Society, BCKV and many others. Awarded Prof. M.J. Narasimhan Gold Medal 2003 for best paper by IPS, New Delhi; He acts as External Examiner and moderator for BCKV, West Bengal; UBKV, West Bengal; OUAT, Odisha, BiswavratiBiswavidyalaya, West Bengal and Sri Sri University, Odisha.He is editorial board member of Indian Phytopathology and J. of Appl. Zool. Res. and reviewer of many journals published by Elsevier, Springer, Frontiers, MDPI, and Academic etc.

Dr Gopal Shukla is currently working as a Professor & Head of the Department of Forestry at North Eastern Hill University, Tura, Meghalaya. Before joining as Professor, he worked as a faculty member in the Department of Forestry at Uttar Banga Krishi Viswavidyalaya, Cooch Behar, West Bengal. Gopal Shukla has over 13 years of experience in forestry teaching, research and extension. He has guided eleven masters and four doctoral students. He has published over 100 papers and articles in refereed journals, 30 book chapters, and eight books, attended various conferences, and handled three ad-hoc/extramural projects as PI and six as Co-PI.

Shalini Pradhan is an M.Sc. Forestry student with a specialization in Silviculture and Agroforestry at North-Eastern Hill University, Tura Campus, Meghalaya, and holds a B.Sc. in Forestry from Hemwati Nandan Bahuguna Garhwal University. Her master's research focus on "Diversity, Utilization Patterns, and Economics of Forest Resources in Fringe Villages of Nokrek Biosphere Reserve, Meghalaya,".

Gemo Tacha is an M.Sc. Forestry student specializing in Silviculture and Agroforestry at North-Eastern Hill University, Tura Campus, Meghalaya, with a B.Sc. in Forestry from Hemwati Nandan Bahuguna Garhwal University. His master's research focuses on the

"Assessment of Fuelwood Diversity and Energy Consumption Pattern among the Forest Fringe communities in Nokrek Biosphere Reserve of Meghalaya".

Sajitha Siril is a research scholar specialising in silviculture and agroforestry with a fellowship from the University Grants Commission (UGC) at the College of Forestry, Kerala Agricultural University. Her research interests include traditional agroforestry systems, ecosystem services, carbon sequestration and biodiversity conservation. Currently, she is working on characterising traditional homegardens in Kerala as nature-based solutions to enhance ecosystem services. She worked as a project fellow at Kerala Forest Research Institute to assist in the Kerala government-funded project that monitors eco-restored sites in Kerala.

Dr. Khulakpam Apshahana is currently serving as a Guest Lecturer in the Department of Forestry at North-Eastern Hill University, Tura Campus, Tura. She holds a B.Sc., M.Sc. and Ph.D in Forestry from HNB Garhwal University, Uttarakhand and Forest Research Institute, Dehradun respectively. addition to her academic credentials, she has qualified the National Eligibility Test (ASRB NET) in Agroforestry. She also possesses a Postgraduate Diploma in Remote Sensing and GIS from Jamia Millia Islamia, New Delhi. She has accumulated significant research and teaching experience, including her tenure as a Junior Research Fellow (JRF) at the Forest Research Institute, Dehradun, from 2019 to 2020.

Ram Gopal is an accomplished agroforestry and tree physiology author and works as an assistant professor at North Eastern Hill University, Tura Campus, Meghalaya. He completed his doctoral degree in Forest Botany from Forest Research Institute (Deemed to be University), Dehradun and his master's degree in Forestry from Veer Chandra Singh Garhwali Uttarakhand University of Horticulture and Forestry, Uttarakhand. Ram Gopal has authored 11 national and international papers, three book chapters, one information booklet, and two popular articles. He has presented numerous papers at national and international conferences.

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Dr. Sumit Chakravarty is currently working as a Professor, Department Forestry in Uttar Banga Krishi Viswavidyalaya, Cooch Behar, West Bengal, India. He has more than 100 peer reviewed national and international publications, edited five national and international books and 25 book chapters. He has guided twelve masters and ten doctoral students. He has conducted research on forestry, agroforestry, medicinal plants and climate change. The focus of his research and development work is on forest biodiversity assessment,

forest ecology, conservation, and restoration of degraded lands. Dr. Chakravarty also delivered invited lectures in seminars/conference/ training program and also chaired technical session in conferences.

Dr. Bishal Mukherjee has completed PhD in Agronomy from Bidhan Chandra Krishi Viswavidyalaya and presently working as a Research Associate on temporary post in the project "Climate Resilient Agriculture Programme (CRAP) funded by Department of Agriculture, Govt. of Bihar. He is responsible for research trial supervision, data collection, preparation of Annual Report, training and demonstration of improved climate resilient interventions among farmers of 11 districts of Bihar. Earlier he worked as Senior Research Fellow (SRF) in the project entitled "Enhancing Lentil, Lathyrus and Chickpea productivity through improved technology under rice fallow areas of West Bengal" funded by ICARDA-IFAD, New Delhi. Dr. Mukherjee is a distinguished scholar who secured the 10th rank in the Matriculation (10+) examination across West Bengal and successfully cleared the ICAR-NET conducted by ASRB. He possesses extensive expertise in rice cultivation and pulse production technologies, particularly under targeted rice fallow systems. With exceptional proficiency in modern agronomic tools and techniques, Dr. Mukherjee specializes in conservation agriculture, nutrient management, and addressing challenges related to climate change. His academic contributions include the publication of 47 articles in renowned international and national journals and magazines, achieving a commendable h-index of 5 with 154 citations to his work.

Mr. Manish Kumar Naskar has submitted his Ph.D. thesis in Agricultural Meteorology from Bidhan Chandra Krishi Viswavidyalaya and is currently working as a Young Professional-II (YP-II) at the All India Coordinated Research Project on Agrometeorology, Mohanpur Centre. In this role, he oversees research trial supervision, data collection, preparation of annual reports, uploading weather data, providing weekly agro-advisories, and organizing farmers' awareness programs. Previously, he worked as a Junior Research Fellow (JRF) in the networking project titled "Revival of Village Ponds through Scientific Interventions," funded by the Department of Science and Technology (DST), Government of India. Mr. Naskar has successfully cleared the ICAR-NET conducted by ASRB and possesses specialized expertise in climate model downscaling, time series analysis, agroclimatic analysis, crop-weather relationships, pest-weather relationships, and modelling. He has published 25 articles in prestigious international and national journals and magazines, earning a commendable h-index of 4 with 60 citations to his work.

Dr. Rajib Nath has completed Ph.D in Agronomy from Bidhan Chandra KrishiViswavidyalayaand subsequently joined as Lecturer(Research) in 1993.Dr. Rajib Nath presently engaged in teaching and research in the post of Professor in Agronomy, BCKV, Mohanpur, Nadia, West Bengal and discharging additional duty as Associate Director of Research (Red and Laterite Zone) BCKV, Jhargram. Apart from

teaching Dr. Nath guided 14 post-graduate and 11 Ph.D student and facilitate 44 PG and 39Ph.D students for completing their dissertation work under different national (sponsored by Govt. of West Bengal and Govt. of India funded) and international collaborative projects (ICARDA funded). Dr. Nath published 260 research publication in different national and international journal including 11 book chapter. Dr. Nath now actively involved in pulses seed production, research and development since 2010 and facilitated transfer of new technology of pulses production to approximately 20 thousand farmers across ten (10) South Bengal districts under ICARDA, ATMA and Agricultural Marketing department, Govt. of West Bengal sponsored projects, where more than 3000 farmers were trained through 50 farmers training programme. Dr. Nath visited five countries viz. Canada, Morocco, Bangladesh, Nepal and Malayasia, presented papers in different international workshops. Dr. Nath also acted as a resource person as external examiner and paper setter of different University in India and abroad.

Dr. Sujoy Saha born in 1970 at Kolkata, West Bengal had his secondary and higher education at St. Joseph's College, Kolkata. Graduated from Bidhan Chandra Krishi Viswavidyalaya and after completion of Ph. D. in Plant Bacteriology from the ICAR-Indian Agricultural Research Institute, New Delhi served as an Assistant Plant Pathologist with the Department of Agriculture, Govt. of West Bengal, the main area of research being disease management of cereal crops, potatoes and vegetables from 2000-2008. Served as Senior Scientist, Plant Pathology at the ICAR-Indian Institute of Vegetable Research, Varanasi where the primary area of research was new generation fungicides, PGPRs and disease dynamics in relation to climate change from 2008-2015. Identified by APEDA to develop package of practices for exportable vegetables. Presently serving as a Principal Scientist at the ICAR-National Research Centre for Grapes, Pune where he is entrusted to look into key matters of export, food safety and bio security. Coordinates several research projects with APEDA, FSSAI, MPKV, MIT-ADT and UHS as well as with the pesticides industry. Published around 164 research papers in journals of national and international repute, one compendium, 22 books chapters, 15 manuals, 81 research abstracts, 20 leaflets/Folders and more than 84 popular articles. Being life members of APIV, IMS, INS, ISVS and ISCA has delivered several keynote and lead lectures in national and international conferences and functions as a reviewer of several journals of national and International repute. Promulgated three technologies duly recognized by ICAR and was nominated as an expert by ICAR for TBT & SPS issues to assist Ministry of Commerce, GOI regarding pesticide residues and CODEX. He has guided 3 PhD students and 16 MSc dissertations.

Sneha Bhosale born in 1996 at Sangli, Maharashtra, had her secondary and higher education at Army Public School, Ahmednagar, Maharashtra. Completed her graduation from Willingdon College, Sangli and post-graduation from K.J SomaiyaCollege of science and commerce, Mumbai, Maharashtra. Currently doing

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Dr. Ratna Thosar, born in 1987 at Ratnagiri, Maharashtra had her secondary education at R. B. Shirke Prashala, Ratnagiri and higher education at Gogate-Jogalekar College, Ratnagiri. A graduate from Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra, completed her Ph. D. in Plant Pathology from the Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra. Served as a lecturer for two years in COA, Sangulwadi affiliated to DBSKKV, Dapoli, Maharashtra. Presently serving as a Senior Research Fellow at the ICAR-National Research Centre for Grapes, Pune under project "Application of micro-organism in Agriculture and Allied Sectors" where she is entrusted to look into standardization of formulation of bio-control agents, *In vitro* and field evaluation of bio-efficacy of microbial formulations, statistical analysis and its report writing. Published 12 research papers in journals of national and international repute, 1 book, 2 book chapters, 15 research abstracts and more than 15 popular articles. She is a life member of IPS.

Dr. Sunil Kumar Ghosh is distinguished Associate Professor grew up in India achieved his Bachelor's degree in Agriculture from Bidhan Chandra Krishi Viswavidyalaya (BCKV-Agriculture University) in 1993, Mastered degree in Agriculture Entomology with specialization in Insect Toxicology in 1995 and Ph.D in Agricultural Entomology from the same University. He joined as Assistant Professor in the University UBKV-Agriculture University in 2002 and Associate Professor in the University BCKV in 2014. Previously, he held Agriculture Development officer (ADO/ADA-1999-2002), Govt, of West Bengal, India. Since his joining Dr. Ghosh is engaged in teaching in the Deptt. of Agricultural Entomology (both UG and PG level), Research and extension work.

Dr. Ghosh has acted as Head in the Department of Agricultural Entomology for about 7 years in the Uttar Banga Krishi Viswavidyalaya (UBKV-Agriculture University). Presently he is acting as Officer-in-Charge of the research projects AINP on Agril. Acarology in BCKV. He is associated with about 40 academic professional bodies as life member, fellow member etc. He has published 98 peer review research article/papers in national and international well reputed journals and 15 conference papers in India and abroad. He has also published 29 book chapters in national and International level. He has published three international books. He has delivered about 300 TV-talk. He has physically attended and presented research papers in 52 national and International conferences including 9 invited talk. He has achieved about 23 awards including five foreign awards. He has achieved young scientist award at national level and best presentation award

for oral presentation form a conference in Cairo, Egypt, and Bangladesh. He has physically visited 25 countries for academic activities like presentation, invited talk, keynote speaker, session chair etc with 13 nos. scholarship/fellowship/travel grant including 9 nos. foreign scholarships. The countries visited are -Germany (two times), Thailand, Sri Lanka, Nepal, Republic of Korea, Malaysia, Philippines, Egypt, Netherlands, Belgium, UK, S. Africa, China, Vietnam, Bhutan, Singapore, UAE (Dubai), Nigeria, Indonesia, Fiji, Laos, Taiwan, Maldives, Turkey, Bangladesh (Two times). His academic research profile on Research Gate citation is 1350 with H-index 23.

Gauranga S. Mondal is distinguished Asstt Professor grew up in India achieved his Bachelor's degree in Agriculture from Bidhan Chandra Krishi Viswavidyalaya (BCKV-Agriculture University), Mastered degree and Doctoral degree in Genetics and Plant Breeding from the same University. Since his joining Dr. Ghosh is engaged in teaching in the Deptt. of Agricultural Entomology (both UG and PG level), Research and extension work. He has published 35 peer review research article/ papers in national and international well reputed journals and 2 conference papers. He has also published 4 book chapters in national and International level.

Samimul Islam Seikh is a Research Scholar in Agril Entomology, Bidhan Chandra Krishi Viswavidyalaya (BCKV-Agriculture University) grew up in India. He has achieved his Bachelor's degree in Agriculture from Bidhan Chandra Krishi Viswavidyalaya (BCKV-Agriculture University), Mastered degree in Agril Entomology from the same University. He has published 4 peer review research article/papers in national and international well reputed journals and 1 conference papers. He has also published 3 book chapters in national and International level.

Dr. Hirak Banerjee is working as Associate Professor, Department of Agronomy, BCKV, Mohanpur, Nadia, West Bengal. He completed his Madhyamik Pariksha in 1992 (marks obtained 70.77%); Higher Secondary in 1994 (marks obtained 72.30%); B.Sc. (Ag.) Hons. in 1998 (secured OGPA 8.05 out of 10); M.Sc. (Ag.) in Agronomy in 2000 (secured OGPA 8.86 out of 10) and Ph.D. (Ag.) in Agronomy in 2005 (secured OGPA 8.90 out of 10). He worked as Project Assistant at Science and Technology Entrepreneurs' Park (STEP), IIT Kharagpur, West Bengal (05.04.2005 to 30.09.2005), Subject Matter Specialist (Agronomy) at Nadia KVK, Gayeshpur, Bengal (24.10.2005 to 05.09.2006), Lecturer (Research) in Agronomy at AICRP on Agroforestry, Regional Research Station, BCKV, Jhargram, West Bengal (06.09.2006 to 30.06.2011), Assistant Professor in Agronomy at AICRP on Potato, Directorate of Research, BCKV, Kalyani, West Bengal (01.07.2011 to 06.11.2014), Associate Professor in Agronomy, Regional Research Station (CSZ), BCKV, Kakdwip-743347, South 24-Parganas, West Bengal (07.11.2014 to 2.3.2020) and as Associate Professor, Department of Agronomy, BCKV, Mohanpur, Nadia, West Bengal (3.3.2020 to 20.9.2021). He guided Ph.D – 4 (Awarded) & 3 (Working) ; M.Sc. (Ag.) - 4 (Awarded) students. He has been awarded Awarded 'Certificate of Merit' by National

Scholarships Scheme in H.S. level in 1994, Awarded 'Certificate of Merit' and 'Gold Medal' in M.Sc. (Ag.) level in 2000 and Qualified NET in Agronomy in 2001. He published Research paper in referred journals- 112 (International- 40 and National- 72); Full paper in Conference Proceedings- 4, Book published as single author (or as Editor)- 3, Book published as Co-author - 3, Articles/Chapters published in Books- 9, Online publications- 1, Review Papers in Journal- 6, General technical/popular articles- 13 (in English) and 5 (in Bengali); Technical bulletins- 6. He has attended Winter/ summer school (21 days)-2; Professional training (5 days)-1,Workshop (3 days)- 1; Seminar/Symposium/Conference: 10 (International) and 29 (National) in his career. He acted as External Examiner and Question Paper setter of College of Agriculture, Tripura, Visva-Bharati, Birbhum (WB); UBKV, Coochbehar (WB); OUAT, Bhubaneswar (Odisha); College of Horticulture, Chiplima (Odisha); Bihar Agriculture University, Sabour (Bihar); Central Agricultural University, Imphal; RKMVERI, Narendrapur (WB), West Bengal Council of Higher Secondary Education, Kolkata (WB) and West Bengal Central School Service Commission. He is a respected member of Indian Science Congress Association (ISCA), Kolkata, West Bengal; Indian Society of Agronomy (ISA), IARI, New Delhi; Association of Rice Research Workers (ARRW), CRRI, Odisha; The Agricultural Society of India (ASI), Kolkata, West Bengal; Indian Society of Agroforestry, Jhansi, UP; Crop and Weed Science Society (CWSS), BCKV, West Bengal; Eastern India Horticulture & Biotechnology Centre, Baharu, West Bengal; Association for Advancement in Plant Protection (AAPP), BCKV, West Bengal etc. He handled Ad-hoc project as Principal Investigator: 2 (Govt. project, RKVY, BRNS) and 8 (Private project), as Co-Principal Investigator: 5 (Govt. project) and 12 (Private project) and as Participatory Scientist: 2 (Govt. project). His important activities include development of agro-techniques of hybrid sunflower for three agro-climates (Old alluvial zone, new alluvial and red & laterite zone) and standardize the processing unit for oil extraction, establishment of RKVY laboratory for soil and plant sample analysis in 2011, establishment of the superiority of potato cultivar 'Kufri Himalini' over local check 'Kufri Jyoti' under West Bengal situation. He is working on agro-techniques of processing-grade potato cultivar 'Kufri Chipsona -3' and exploring the cultivation possibilities in West Bengal, working with International Plant Nutrition Institute (IPNI) South-Asia Programme since 2012 to validate the software 'Nutrient Expert'- a computer based tool used for fertilizer recommendation (SSNM) under small holder systems, More than 50 lectures delivered as a resource person in various International and National Agricultural Seminar / Symposia / Conferences and Training / Awareness Programmes / Akashbani, Doordarshan and is now working on potato, hybrid maize, hybrid sunflower and hybrid rice [Standardization of agro-techniques, Energetis, GHG emission (CO_2) etc.]. His additional job include reviewer of the NAAS rated journals namely Oryza, Indian Journal of Agricultural Sciences, Journal of Crop and Weed, International Journal of Bio-

resource and Stress Management etc., Resource Person of training programmes (90) conducted by BCKV, Govt. of West Bengal, SAMETI, KVKs, NABARD, ATC Fulia, ATC Narendrapur etc., Conducted FLDs (6), on-farm testing (4), on-station trials (6), training (on-campus 8, off-campus 7, FLD training 4, field days 5*)* at Nadia KVK and Participated in development of literatures like booklets and folders (6) in Bengali, documentary CDs (16) on different agricultural technologies (in Bengali).

Aditi Pahari was born in Haldia town of East Midnapore district of West Bengal. Shecompleted her Secondary and Higher Secondary from Chakdwipa High School, Haldia. Shestudied UG and PG courses in agricultural science from BCKV, Mohanpur, Nadia, West Bengal. After that, she started doing Ph.D. in Agronomydiscipline from BCKV in December, 2021. Research areas ofher interest are crop production, nutrient management and organic manure. She has published6 research articles, 1 book chapter, 2 review articles and 1 extended summary in referred journalsof national and international repute.

Abhisek Banik was born in Siliguri town of Darjeeling district of West Bengal. Hecompleted his Madhyamik and Higher Secondary from Siliguri Boys' High School. Hestudied UG and PG courses in agricultural science from BCKV, Mohanpur, Nadia (West Bengal) and Dr. PDKV, Akola (Maharashtra) respectively. Then he started doing Ph.D in Agronomydiscipline as URS from BCKV inDecember 2021. He has been selected for the post of "Senior Technical Assistant",General Central Services, Group "B", Non-Gazetted, Non-Ministerial at the office of theRegional Fodder Station, Suratgarh (Rajasthan) under the Ministry of Fisheries, AnimalHusbandry and Dairying, GoI in January 2025. Research areas of his interestare crop production, nutrient management and nano-fertilizers. He has published 7 researchpapers in referred journals of national and international repute, 1 review article, 3 bookchapters, 1 extended summary and 10 popular articles.

List of Referees

1. Dr. Amitava Paul, Professor (Genetics and Plant Breeding), Department of Genetics and Plant Breeding and Crop Physiology, Institute of Agriculture (Palli Siksha Bhavana), Visva-Bharati, Sriniketan 731 236, Birbhum, West Bengal
2. Dr. Arremsetty Subramanyam Hari Prasad, Principal Scientist (Hybrid Rice), ICAR-Indian Institute of Rice Research, Rajendranagar 500 030, Hyderabad, Telangana
3. Dr. Buddhadeb Duary, Associate Professor (Agronomy), Department of Agronomy, Institute of Agriculture (Palli Siksha Bhavana), Visva-Bharati, Sriniketan 731 236, Birbhum, West Bengal
4. Dr. Sanjay Saha, Principal Scientist (Agronomy), ICAR-Central Research Institute for Jute and Allied Fibres, Barrackpore, Kolkata 700 120, West Bengal
5. Dr. Narayan Chandra Sahu, Sr. Scientist & Head, Sasya Shyamala Krishi Vigyan Kendra, Ramakrishna Mission Vivekananda Educational and Research Institute, Arapanch, Sonarpur 700 150, South 24 Parganas, Kolkata, West Bengal
6. Dr. Nirmal Mandal, Head and Professor, Department of Biotechnology, Instrumentation and Environmental Science, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur 741 252, Nadia, West Bengal
7. Dr. Pabitra Kumar Mani, Professor, Department of Agricultural Chemistry and Soil Science, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur 741 252, Nadia, West Bengal
8. Dr. Paresh Chandra Kole, Professor (Genetics and Plant Breeding), Department of Genetics and Plant Breeding and Crop Physiology, Institute of Agriculture (Palli Siksha Bhavana), Visva-Bharati, Sriniketan 731 236, Birbhum, West Bengal
9. Dr. Ranjit Kumar Sarkar, Emeritus Professor, Former Khaira Professor of Agriculture, Former Director (Institute of Agricultural Science), Former Dean (Faculty of Agriculture and Veterinary Science), University of Calcutta, 51/2 Hazra Road, Kolkata 700 019, West Bengal
10. Dr. Subrata Dutta, Associate Professor, Department of Plant Pathology, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur 741 252, Nadia, West Bengal
11. Dr. Sudhanshu Singh, Director, IRRI South Asia Regional Centre (ISARC), NSRTC Campus, Collectry Farm, Industrial Estate, Varanasi 221 106, Uttar Pradesh
12. Dr. Tapash Dasgupta, Professor (Genetics and Plant Breeding), Ramakrishna Mission Vivekananda Educational and Research Institute, Arapanch, Sonarpur 700 150, South 24Parganas, Kolkata, West Bengal

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The State Agricultural Technologists' Service Association, West Bengal (SATSA, W.B.) brings out every year an official publication in the form of an annual scientific journal, "*SATSA Mukhapatra-Annual Technical Issue*" (ISSN 0971-975X) with a view to update the knowledge base of scientific as well as farming communities about the latest technological advancement in the field of Agricultural Science on a particular theme. The journal publishes review papers (invited from eminent scientists / personalities of India and abroad) as well as original research papers (full length and short communication both). But the paper should not have been published or communicated elsewhere. The focal theme of each volume is decided time to time by the editorial board. Authors will be solely responsible for the factual accuracy of their contribution.

The paper should be organized as: Title, Author(s) with affiliating address including E-mail ID, Abstract, Key words, Introduction, Various Sub-heads in the Running Text (For review papers), Materials and Methods, Results and Discussion (For research papers), Epilogue/ Conclusion, Acknowledgement (if any), References and Tables/ Figures (if any). The manuscript should neatly be typed in Times New Roman (12 pt.) on one side of the standard A-4 size bond paper (approx. 21 cm x 29 cm) only and double spaced with sufficiently side margins (4-5 cm) and page numbers. The text should be prepared using standard software (Microsoft Word). Authors are advised to consult a recent copy of the journal for correct style and format.

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Anonymous. 2009. CIA World Factbook. South Asia, India. Available at: https://www.cia.gov/library/publications/the-world-factbook/geos/in.html (Accessed on Oct. 30, 2009).

Castaneda, A. R., Bouman, B. A. M., Peng, S. and Visperas, R. M. 2004. Mitigating water scarcity through an aerobic system of rice production. *New directions for a diverse planet. Proceedings of the 4th International Crop Science Congress*, Sept. 26 - Oct. 1, 2004, Brisbane, Australia. pp. 1-6.

Hobbs, P. R. and Gupta, R. K. 2003. Resource conserving technologies for wheat in the rice–wheat system. (in) *Improving the productivity and sustainability of rice–wheat systems: Issues and impact* (Ladha, J. K., Hill, J., Gupta, R. K., Duxbury, J. M. and Buresh, R. J., eds.), ASA, WI, USA, Madison. pp. 149-171.

Varshney, J. G. and Prasad Babu, M. B. B. 2008. Future scenario of weed management in India. *Indian Journal of Weed Science* **40** (1&2): 1-9.

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STATE AGRICULTURAL TECHNOLOGISTS' SERVICE ASSOCIATION WEST BENGAL

(Registration No. S/30120 of 1980-81)

The State Agricultural Technologists' Service Association, West Bengal (SATSA, W.B.) has been registered under the West Bengal Societies Registration Act, 1961 on December 02, 1980. It has the following broad objectives :

- To cultivate agricultural knowledge and disseminate modern scientific principles of agriculture
- To meet together periodically for exchange of views and experience for the furtherance of agricultural policies of the state
- To act for protecting and strengthening the interest of agriculture, agriculturist and farmers as a whole at state, national and international levels
- To strive for collaborate interaction and programme with the Association/ Organization working in the protection and furtherance of farming community as a whole
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