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**“Agricultural Intensification for Sustenance
under Natural Disaster”**



**STATE AGRICULTURAL TECHNOLOGISTS' SERVICE ASSOCIATION
WEST BENGAL**

SATSA BHAWAN

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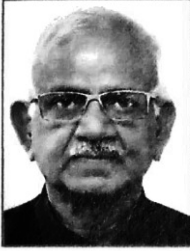
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Sobhandeb Chattopadhyay
Minister-in-Charge
Agriculture Department
Government of West Bengal



শোভনদেব চট্টোপাধ্যায়
মন্ত্রী
কৃষি বিভাগ
পশ্চিমবঙ্গ সরকার



Message

I am glad to know that the State Agricultural Technologists's Service Association, West Bengal is going to publish its annual publication titled '*SATSA Mukhapatra - Annual Technical Issue, Volume-27*' on 18.02.2023. The issue will contain valuable articles on the topic : '*Agricultural Intensification for Sustenance under Natural Disaster*'. The matter has great significance in today's development in agri sector in the context of climate change and extreme weather events witnessed across the globe. Our technologists working with the State government shall update themselves continuously to cope up with these challenges and stand with the farming community.

I wish the publication every success and convey my heartiest greetings to all members of the association.

(Sobhandeb Chattopadhyay)

Dated, Nabanna, January 13, 2023

Shri Goshto Nayban
General Secretary
State Agricultural Technologists Service Association
West Bengal

প্রদীপ কুমার মজুমদার
ভারপ্রাপ্ত মন্ত্রী
পঞ্চায়েত ও গ্রামোন্নয়ন দপ্তর এবং
খাদ্য প্রক্রিয়াকরণ শিল্প ও উদ্যানপালন দপ্তর
পশ্চিমবঙ্গ সরকার



Pradip K. Mazumdar
MINISTER-IN-CHARGE
Department of Panchayats &
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30th January, 2023

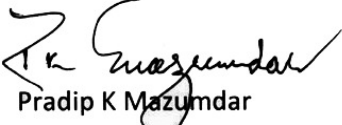
MESSAGE

I am delighted to know that State **Agricultural Technologists' Service Association, West Bengal, (SATSA)** is going to publish its annual publication "SATSA Mukhapatra – Annual Technical Issue, Volume – 27" on the 18th February, 2023.

I have seen that the Annual Technical issues of SATSA always contain important articles on agriculture. This year the technical issue also covers an exciting topic on "**Agricultural Intensification for Sustenance even in Natural Disaster.**"

Incidentally, between April 2019 & December 2021, six major cyclones hit West Bengal – either during pre Kharif sowing season or Kharif harvest severely threatening the crops in the field. Yet our committed agricultural technologists in the Government stood by our toiling farmers with timely guidance and technological support to ward off potential damage to the crops largely protecting the yield and thus the livelihood of our farmers.

I wish every success of SATSA's endeavour and that of the publication 'Mukhapatra' – their Annual Technical Issue, Vol-27.


Pradip K Mazumdar

Shri Goshto Nayban,
General Secretary,
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सत्यमेव जयते

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MESSAGE

I am happy to learn that the State Agricultural Technologists Service Association (SATSA), West Bengal is going to bring out **SATSA Mukhapatra-Annual Technical Issue Vol. 27 (2023)** with the focal theme, “**Agricultural Intensification for Sustenance under Natural Disaster**” on the occasion of their General Meeting at Vidyut Bhavan, Salt Lake, Kolkata during 18-19th February, 2023.

In the present context of the society, the compound impacts of the COVID-19 pandemic, cyclones and flood highlighted the need to build new perspectives on disaster risk reduction in the context of multi-hazard risk into sustainable development programs. Agriculturists have to focus on the pertinent issues and challenges afflicting Indian agriculture. SATSA, WB is in the right direction to choose the focal theme of their annually published scientific journal.

I like to place on record my appreciation and best wishes to the SATSA family for their best endeavour.

(Himanshu Pathak)



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MESSAGE

I feel pleasure to learn that the State Agricultural Technologists' Service Association, West Bengal, is going to publish *SATSA Mukhapatra-Annual Technical Issue* Vol. 27 (ISSN 0971-975X) with the focal theme, "Agricultural Intensification for Sustenance under Natural Disaster" on the occasion of its State Biennial General Meeting.

The agriculture sector, specifically in eastern India, is very vulnerable to natural disasters, which cause direct economic loss to farmers, cascade along the entire value chain, and affect agricultural growth and rural livelihoods. Since resources are becoming increasingly scarce, it is equally important to target our investments in resilience, preparedness and mitigation effectively. Frontier technologies along with situation-specific interventions are obvious measures for optimizing the productivity, profitability, and resilience through sustainable intensification (SI) of rice-based agri-food systems. Moreover, they also equally help in addressing emerging challenges due to yield gaps, postharvest losses, climatic vulnerabilities, natural disasters, malnutrition, depleting natural resources, declining profit margins, etc. We must encourage our peerless farmers to adopt the SI technologies, including climate-smart agricultural practices, to make the farming business a profitable and sustainable enterprise. This publication focusing on all these important issues together will serve as a guide for all stakeholders.

I like to place on record my appreciation and best wishes to the SATSA Family for their best endeavour.

(Sudhanshu Singh)

Dated, Varanasi
The 21st January 2023

IRRI aims to improve livelihoods and nutrition, abolishing poverty, hunger, and malnutrition among those who depend on rice-based agri-food systems. In doing so, IRRI's work protects the health of rice farmers and consumers, and the environmental sustainability of rice farming in a world challenged by climate change. IRRI's work promotes the empowerment of women and supports opportunities for youth in an equitable agri-food system.

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From the Desk of General Secretary

Out of adversity comes opportunity -Ben Franklin

The COVID-19 pandemic is the greatest global philanthropic challenge the world has confronted since World War II. Over the past two years. Lockdowns have resulted in economic costs and ripple effects across all segments of society. However, the agricultural sector continues to be flourishing amidst this pandemic, the prioritization of agricultural sector at this juncture needed to be ensured for steady recovery of economy throughout the country.

Not only the COVID pandemic, the entire world experienced several natural disasters during the period 2020-21 continued to 2022. To name a few deadlier one are volcanic eruptions of Philippines (2020) & Indonesia (2021), Earthquakes in China-India-Iran-Philippines-Russia-Turkey-The Caribbean – 2020, Swarms of Locusts in Asia-East Africa-India-Middle East – 2020, Forest Fires of Uttarakhand – 2020, Green Snow at Antarctica – 2020, Tornado of Kentucky (2021), Flash floods in India and Nepal (2021), Floods in Germany-Belgium (2021) and Pakistan-Brazil-Nigeria (2022), Drought in Africa (2022), Landslides of China (2021), Earthquakes in Haiti (2021) & Indonesia-Afghanistan (2022), Tropical storm-flooding in the Philippines (2022), Super Typhoon Rai in Indonesia (2021), Cyclone Tauktae of India (2021) & Seroja of Western Australia (2021), Hurricane Ian in the United States of America (2021, 2022) and lastly winter storm in USA (2022). In West Bengal, the consequences of COVID-19 pandemic were exacerbated by additional hazards such as coastal storms, cyclones and flood. In May, 2020 the coastal region (especially Sundarban region and other coastal parts of West Bengal) of this state was worst hit by Cyclone Amphan. Amphan destroyed most of the crops of the coastal areas including a cash crop betel vine leaves (crops). The combined impact of pandemic and cyclone severely affected the demand/supply chain for the farmers. As a result of lockdown, lack of access to markets, labor shortages, various logistical issues whereas the lands flooded by saline water due to cyclone made poor farmers even more vulnerable to the risks associated with fishing and aquaculture losses which may subsequently affect trade and food security. Not only Amphan, this state also experienced another devastating cyclone “YAAS” on May, 2021 which impacted as rain water breached embankments, saline water entered the fields, destroying the standing crops with full inundation. Lastly some parts of Paschim Midnapore district also suffered twin flood effects due to frequent rainfall which also caused extensive damage to *Aman* and to some extent to the sowing of early *Rabi* crops in these affected areas during 2021. The compound impacts of the COVID-19 pandemic, cyclone and flood highlighted the need to build new perspectives on disaster risk reduction (DRR) in the context of multi-hazard risk into sustainable development programs enforced by the government as well as other establishments specializing on economic resilience through investment in business, technology and infrastructure. But recovery efforts ought to conjointly incorporate the protection of ecosystems, providing ecosystem services, the upkeep of embankments to mitigate increasing saltwater intrusion, and the protection of native cultural heritage.

Reducing the risks of agriculture to hazards at all points in food supply/value chain is essential to ensuring the resilience of the global food systems. Food is produced and consumed

in an increasingly complex global system, where shocks and surprise in one part of the system can have significant implications in others. Agricultural disasters are one type of risk that limits the ability of the global food system to provide complete food and nutritional security; a risk that can lead to issues of national security and internal stability in some vulnerable nations.

The best option to address all these issues is by adopting Sustainable Agricultural Intensification (SAI). SAI strategies should provide the means to achieve that, but this will require a thorough, global redesign of agricultural systems and is highlighted in the Sustainable Development Goals. Life on Land, which aims to sustainably manage forests, combat desertification, halt and reverse land degradation and halt biodiversity loss and zero hunger which seeks to ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, help maintain ecosystems, strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality and maintain genetic diversity. Agricultural intensification is more specifically a technique for increasing per-hectare yields rather than expanding the area of land under cultivation by making better use of inputs. In a nut shell agricultural intensification can provide improved economy, food security, employment opportunities, decision-making, labour division, local institutions and leaderships.

With the aim of the Agricultural intensification in the perspectives of natural disaster inclusive of the pandemic, the SATSA Mukhapatra, Annual Technical Issue is dedicated and fabricated as **“Agricultural Intensification for Sustenance under Natural Disaster”** in order to derive way out from all these odds. This issue is endowed with topics like Challenges of Bulging Population, livelihood security, and environmental protection for assessment and impact analysis; Decision Support System for micro-planning in agriculture, Sustainable intensification of crop production under the drought condition, Satellite imagery for cropping intensity mapping, artificial intelligence in rice pest and disease management, bio-effectiveness of organic inputs, molecular host-pathogen interaction and disease management, antimicrobial peptides (Amps) and their role in insect immunity in favour of agricultural intensification; medicinal health benefits from medicinal plants, phytochemicals (nutraceuticals) use to combat natural disasters like covid-19; Crop selection and management strategies to combat weather related vagaries in coastal Bengal to combat natural disaster; sustenance in production through use of nanotechnology, hybrid variety, hormone, herbicide for weed management, crop diversification through pulses cultivation whereas Government initiative for Agribusiness based on Organic Farming in respect of Sustainable Development in West Bengal, etc. For sure this issue will enlighten us with varied dimension towards this important topic.



(Gostho Nayban)
General Secretary,
SATSA, West Bengal

SATSA MUKHAPATRA-ANNUAL TECHNICAL ISSUE 27 : 2023

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About the Authors of Invited Papers

Prof. Biswajit Kundu is a renowned authority in the field of Biotechnology and protein science. An alumnus of Bidhan Chandra Krishi Viswavidyalaya, he had undergone M.Sc. in Biotechnology from Madurai Kamaraj University, Madurai, India, doctoral degree from Institute of Microbial Technology, Jawaharlal Nehru University, India in Protein Science and post-Doctoral fellowship from Case Western Reserve University, Cleveland, Ohio, USA. Since 2003 he served his motherland as an Assistant Professor in Ambala College of Engineering and Applied Research, Ambala, Haryana, Center for Human Genome Studies and Research, Punjab University, Chandigarh, Department of Biochemical Engineering and Biotechnology, in IIT Delhi and Kusuma School of Biological Sciences, IIT Delhi, India. From December 2010 he served as Associate Professor and from 2018 to till date as professor in Kusuma School of Biological Sciences, IIT Delhi, New Delhi, India. As an academician he guided 22 students for pursuing their doctoral degree, 6 students for Post-doctoral degree and 3 students under M.S. (Research). Sixty five papers contributed by him were published in esteemed journals at national and international level. He also co-authored a book titled 'Protein engineering: Methods and applications, Advances in Protein Molecular and Structural Biology Methods'. In the field of scientific invention, he headed the team of scientists for discovery of In-house developed, cost-effective, highly efficient COVID detection kit, protein domain as a molecular chaperone for aggregation

prevention, enzyme activity enhancement, and L-asparaginase as effective molecular target against various intracellular pathogens. Various publications on understanding protein aggregation fetched a research award at the National Academy of Sciences USA 2002. The technologies were transferred to various companies. His areas of Specialization are Protein Science, Biotechnology, Enzyme Engineering, Protein aggregation and diseases and Molecular biology. As professional recognition for his commendable contribution throughout the years, he was awarded Junior Research Fellowship, Senior Research Fellowship by CSIR, Govt. of India, Travel award at KEYSTONE Symposium, Colorado, USA and Protein society symposium Boston, USA, Founder member, Protein Society, India, Member, Biophysical Society, USA, Life Member, Biophysical Society, India and Association of Microbiologists, India.

Dr. Debashis Chakraborty has obtained his M.Sc. and Ph.D. degrees in Agricultural Physics from the Indian Agricultural Research Institute (IARI), New Delhi. He has joined as Research Scientist (ARS) in 2001 at IARI, and is presently the National Fellow of the ICAR with a programme on regional root-zone soil moisture mapping using satellite information. His research interests are soil-plant-water relations, geo-informatics and big data analysis, primarily in areas of alternate tillage practices, and remote sensing of soil moisture. He worked as Post-Doctoral Fellow at Rothamsted Research, UK, with IRRI, Philippines and CIMMYT, India on a

number of programmes. He was principal investigator in DST and ICAR sponsored projects, and worked with University of Sydney, Australia under the DFAT Fellowship. He was awarded NAAS Associateship in 2011. Dr.Chakraborty is a faculty, Post Graduate School, IARI since 2001, and is primarily involved in teaching soil physics and geo-informatics courses. He has guided six students, published 90 peer-reviewed publications (h-index 25) and a book on Geographical Information System. He has also been awarded as Fellow of National Academy of Agricultural Science.

Prof. (Dr.) Sankar Kr Acharya, former Head, Dept. of Agril Extension and Director, Extension Education, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, WB, born on 6th October, 1960, started his career as Assistant Professor at BCKV in 1988 and has been in teaching, research and extension over 30 years. An erudite teacher as well as an elegant speaker, is internationally acclaimed for his unique research domain of Social Entropy and Energy Metabolism, Social Ecology and Environmental Sociology, Enterprise Ecology Framework, Farm Stewardships: The Transition from Conservation, Technology Socialization Process, and The Social Ecology of Livelihood, which have got tremendous policy as well as scholastic importance. Research Publication: 238 in National and International Journals. Book Publication: 107 books authored / co-authored, covering areas Participatory Extension Planning and Management; Value, Extension Strategy for Natural Resource

Management; Social Metabolism, Farm Energy Metabolism, Community Perception on Climate Change , Social Entropy and Chaos, Decision ecology Commission; Marketing and Extension Sub Committee, Govt. of West Bengal; Expert member WWF projects in BTR (Buxa Tiger Reserve Project); Expert member; DFID project on Primary Education (DPEP); Rapid Environment Impact Analysis, Visited Italy, France, Germany, China, Sri Lanka and Bangladesh. Delivered 21 Key note addresses, 13, invited and lead speakers in International Congress, Chaired 19 Sessions in International conferences, and Editors of a score of national and international journals. He has so far been awarded with 13 best paper awards in National and International Conferences Organizing Secretary of two International Conferences, held in the years, 2016 & 2018, Jointly Organized by Department of Agricultural Extension, BCKV, WB and Krishisanskriti, New Delhi. He has also been honoured to be selected as the Convener of Panel (PE- 32) entitled The hunger , poverty and silence, of IUAES, University of Manchester, UK, 2013 .Co-PI of ICAR, NAHEP and World Bank funded project on Conservation Agriculture. So, far he has successfully guided 19 Ph D scholars, of which one awarded with DAAD fellowship, Germany and two other placed as visiting scholars at Ohio State University and Cornel University, 2020-21, USA; 83 M Sc students from BCKV CU, KU, Vidyasagar University. He is the fellow of ISEE, IARI, New Delhi. He is now acting as editor, reviewer of a good number of national and international journals.

Dr. Anannya Chakraborty was born on 8th May 1992. She has completed her UG, PG and Ph.D degree from Bidhan Chandra Krishi Viswavidyalaya. She has got UGC NET Junior research fellowship at the time of her persuasion of the doctoral degree. The author has published 20 research papers so far. She has taken part in 8 national and international conferences and has bagged 2 best paper awards. She has 3 books and 5 book chapter under her authorship. Currently she is working as an Assistant Professor at Seacom Skills University, Bolpur in the Department of Agricultural Extension. Formerly she has worked in Lovely Professional University, Jalandhar, Punjab.

Dr. Chandrasekhar Chatterjee is working as Seed Testing Officer (WBAS-RESEARCH) at the State Seed Testing Lab, Burdwan since 2017 as Head of Office and Drawing and Disbursing Officer in the dept. of Agriculture, Govt. of west Bengal. He completed his B.Sc. (Ag.) Hons. in 2009 (University Gold Medal), M.Sc. (Ag.) in Genetics in 2011 (secured OGPA 8.07 out of 10) and Ph.D. (Ag.) in Genetics in 2019 (secured OGPA 8.22 out of 10). Worked as Assistant Botanist in Pulses and Oilseeds Research Station, Berhampore, West Bengal (March 2016- May 2017) and as Senior Research Fellow in DAC-ICARDA-ICAR funded project on Grasspea (2012-2016). His awards and recognitions include University Gold Medal in 2009, Qualified NET in Genetics and Plant Breeding in 2012 and worked as Breeder in the notified Lathyrus variety "Bidhan Khesari in 2011-16. He published Ph.D Thesis works in reputed International

Journal Springer Publications (*Genet Resour Crop Evol.*, DOI 10.1007/s10722-019-00809-2). Dr. Chatterjee published research paper in various referred journals-10, general technical/popular articles- 6 (in Bengali); Akashvani Live Progm.-1. He completed Professional Training from NSRTC, Varanasi (5 days), Administrative training from ATI, Govt. of West Bengal, Workshop (2 days) -3 and seminar/Symposium/Conference: 8 (International and National). He conducted training and served his expertise as trainer to Govt. Officers in CRIJAF and SAMETI, Narendrapur, acted as External Examiner in DAESI course, Classes (including practical) for KPS Trainees (20 nos), DAESI Classes in Dept of Agriculture-100 nos (ATC Burdwan) and in hundreds of Field Day, NFSM, ATMA and various other Govt. schemes for farmers. His official and corresponding address is o/o The Seed Testing Officer, State Seed Testing Laboratory, D.S.F., Kalna Road, Purba Bardhaman-713101.

Dr Manoj Kumar Nanda is the Professor and Head of the Department of Agricultural Meteorology and Physics, Bidhan Chandra Krishi Viswavidyalaya. Besides teaching Agrometeorology and Geoinformatics at UG and PG level and supervising, he has been involved in several research in collaboration with different organizations like ICAR, ISRO (Govt. of India), DSTBT (Govt. of WB) and ACIAR (Australia). His research interests include on Micrometeorological Modelling, Open-Source GIS application and Satellite Remote Sensing for agricultural applications.

Miss Adrija Dutta is presently working in the Department of Earth Sciences in IIT, Gandhinagar. She has completed Masters degree in Agricultural Meteorology in BCKV. Her research interests include, Climate Science and application of Remote Sensing in environmental studies.

Miss Debolina Sarkar is the presently working as a Senior Research Fellow in CSI4CZ-ACIAR project on Mitigating risk and scaling out profitable cropping system intensification practices in the salt-affected coastal zones of the Ganges Delta. She is pursuing Ph.D. in the Department of Agricultural Meteorology and Physics, Bidhan Chandra Krishi Viswavidyalaya. Her research interests includes, application of Remote Sensing and Geostatistical modelling.

Miss Momsona Mondal is Research Fellow is a Research Scholar in the Department of Agricultural meteorology and Physics, BCKV. Her research interests include application of Remote Sensing in disaster monitoring and agriculture.

Dr. Koushik Brahmachari is a Professor of the Department of Agronomy, Bidhan Chandra Krishi Viswavidyalaya (BCKV) in West Bengal, India. He has more than 25 years of experience in on-farm research and technology dissemination in the East-India plateau and Coastal Sundarbans region of West Bengal, India. He has supervised and guided 22 Masters students and 20 PhD students in Agronomy. Dr. Brahmachari has supervised sixteen national and international research projects as Principal Investigator. He also shouldered the

responsibilities of the Registrar, BCKV; Associate Director, Farmers' Academy and Convention Centre (FACC), BCKV and also the Director of Extension Education, BCKV

Dr. Argha Ghosh is working as Technical Officer in Gramin Krishi Mousm Seva (GKMS) under the Department of Agricultural and Food Engineering, I.I.T., Kharagpur. He has worked as Research Fellow in ACIAR sponsored Research Project on "Cropping system intensification in the salt-affected coastal zones of Bangladesh and West Bengal, India". His research interests include Agrometeorology, climatology, Remote sensing and GIS applications.

Mark Glover is a Senior Experimental Scientist in CSIRO's Agriculture and Food Business Unit with experience in Australia, Asia and the Pacific. His research interests include investigating the spatial variability of key soil properties e.g. Carbon stocks and Plant Available Water Capacity. Mark employs proximal and remotely sensed data, geospatial analytical techniques and statistics. This work provides and understanding of how soil properties vary with subsoil constraints, landscape position, and plant available water to optimise crop and pasture productivity.

Dr Jorge Peña Arancibia is a Senior Research Scientist in CSIRO Environment, Australia. He has more than 10 years working in remote sensing of evapotranspiration and land cover mapping for the purpose of water resources assessments via hydrological modelling. He developed blending and machine learning workflows to efficiently map irrigated

agriculture and water use in irrigation which are now used in several projects both in Australia and internationally. Actively engaged, as a team member or leading a team, in 4 international projects in India, Bangladesh, Pakistan and Australia.

Dr Mohammed Mainuddin, Principal Research Scientist, is Leader of Water and Society Team within the Water Security Program of CSIRO Environment based in Canberra, Australia. Prior to joining CSIRO in 2004, he worked with International Water Management Institute (IWMI), Sri Lanka and Asian Institute of Technology (AIT), Thailand. Dr. Mainuddin is currently leading projects in Bangladesh and India dealing with cropping system intensification in the coastal zone, sustainable groundwater management for food security and, improving agricultural productivity.

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 127 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.

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.

Namrata Balasaheb Kokare, born in 1988 had completed primary and secondary education from Vidya Pratishthans Bal Vikas Mandir, Baramati. Completed higher education from Sharda Bai Pawar Mahila Mahavidyalaya, Sharda Nagar, Baramati. A graduate from College of Agriculture, Pune. Worked as an Agriculture field officer in Central Bank of India during 2013-2014. Presently working as Young Professional I at ICAR- National Research Centre for Grapes, Pune. Adept in field trials and lab work having 1 research paper (IF 6.064), 3 popular articles and 3 research abstracts.

Dr. Soumendra Chakraborty, Associate Professor, Department of Genetics and Plant Breeding is currently working in the department of Genetics and Plant Breeding, Uttar Banga Krishi Viswavidyalaya, Pundriabari, Coochbehar. He worked earlier in All India Co-ordinated Research Project in Medicinal and Aromatic Plants. His work was on *Swertia chirayita*, *Valeriana jatamansi*, *Centella asiatica* etc. He developed different lines of *S. chirayita*, *V. jatamansi* in

Regional Research Station Kalimpong under Uttar Banga Krishi Viswavidyalaya where IC number were allocated for each line. Later he worked in spices like turmeric, ginger in All India Coordinating Research Project in Spices. He developed Ginger variety as a plant breeder Mohini (UBKV AADA-1) which is notified for national release throughout India in ginger growing states by Department of Agriculture and Farmers Welfare, Govt. of India on 16th January, 2018. He also Co-operated in developing Turmeric Variety (name included as breeder) ACC-48 from IISR (Indian Institute of Spices Research) which is recommended for national release throughout India in 27th Workshop on AICRP on Spices held in NRCSS, Ajmeer, Rajasthan. He developed on Variety ‘Uttar Rupanjana’ which was released from the state variety, Department of Agriculture, Govt. of West Bengal. He registered a turmeric variety in NBPGR. He has more than 40 published papers in different national and international journals and wrote 5 books and 1 book chapter. He reviewed different papers in different journals like Elsevier, Springer etc. He won different awards like i) Bharat Jyoti Award 2011, International Gold Star Award 2012, Outstanding Scientist Award 2015 by Venus International Ltd. Many M.Sc. students passed under his guidance.

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. His research area is climate change effect on insect pest, bio-pesticides including plant extracts and sustainable pest management (sustainable Agriculture) especially in vegetable crops, protection of natural enemies. He is attached with the permanent institutional project AINP on Agriculture Acarology. 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 30 academic professional bodies as life member, fellow member etc. He has published 90 peer review research article/papers in national and international well reputed journals and 15 conference papers in India and abroad. He has also published 20 book chapters in national and International level. He has published two international books. He has delivered about 300 TV-talk in Bengali version. He has physically attended and presented research papers in 48 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. He has achieved International level award “i-Proclaim Annual Research Award (ARA-2017)” for “Distinguished Scientist (award for publication excellence) from Malaysia. He has successfully completed 6 research projects. He has guided 2 Ph.D. scholars and 6 M.Sc students. He has physically visited 20 countries for academic activities with 13 nos. scholarship/fellowship/travel grant including 9 nos. foreign scholarships. He has physically visited 4 countries for research courses in Netherlands, S.Africa, China and Nigeria. He has physically visited 17 countries for presentation of research paper/invited talk/session chairman in Germany, Bangladesh, Thailand, Sri Lanka, Nepal, Republic of Korea, Malaysia, Philippines, Egypt(session chair person), UK, China, Vietnam (invited talk and session chair person), Bhutan (invited talk), Singapore (invited talk and session chair person), UAE (Dubai), Indonesia (invited talk) and Maldives. Present Research Gate score of Dr. Ghosh is 26.95 with citation 950.

Dr. Manas Kumar Bag, Principal Scientist (Plant Pathology) at ICAR – National 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 > 170 that include, about 60 peer reviewed research articles, 20 book chapters and around 65 popular articles, training manual and research notes. Google Scholar Citations: 1042; *h*-index: 17; *i10*-index: 24. He presented more than 50 papers in international and national conferences that include memorial lecture, lead lecture and invited lectures. *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 Memorial Lecture, 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 received Outstanding Scientist Award 2016 in 4th International Conference at Jodhpur and Anandprakash award 2020 at UAS, Raichur awarded best paper presenter in International conference at Kolkata 2013, International Conference at UAS, Raichur, 2020 and in National Conference organized by Indian Phytopathological Society, New Delhi, 2021; awarded best poster presenter by International Plant Nutrition Institute, Georgia, USA and Visva-Bharati, West Bengal, India, 2012; He was Faculty Member of Post Graduate School,

IARI New Delhi, guest lecturer of Ramakrishna Mission Vivekananda University, West Bengal and guest lecture of Institute of Agricultural Sciences, Calcutta University. He acts as External Examiner and moderator for BCKV, West Bengal; UBKV, West Bengal; OUAT, Odisha, Biswabrati Biswavidyalaya, West Bengal and Sri Sri University, Odisha. He is regular reviewer of many journals published from India like Journal of Mycopathological Research, Indian Phytopathology etc. and also review many journals having high impact factor published by Elsevier, Springer, MDPI, and Academic etc.

Dr. Raghu S, presently working as Scientist (Plant Pathology) at Crop Protection Division of ICAR-National Rice Research Institute (NRRI), Cuttack. He has completed his graduation in Agriculture from University of Agricultural Sciences, Bangalore, M. Sc (Agriculture) & Ph D in Plant Pathology from the University of Agricultural Sciences (UAS) Dharwad, Karnataka. Secured All India 5th Rank in Plant Pathology, in ARS Exam during 2013-14. He, Joined ARS as Scientist (Probationer) at ICAR-National Academy of Agricultural Research Management (NAARM), Hyderabad on January 2015 to March-2015. Started working as Scientist (Plant Pathology) at ICAR-National Rice Research Institute (NRRI), Cuttack, Odisha, from April-2015 till date. He, has been awarded with best oral and poster presentations at various National and International conferences/Symposia/Seminars. His area of specialization is Mycology & Plant Pathology; Rice Plant

Pathology, Molecular Plant Pathology and Biotechnology, host-pathogen interaction, *Fusarium*-Rice, *Rhizoctonia*-Rice Interactions, Molecular diagnosis. He is the life member of Indian Phytopathological Society (IPS), New Delhi, Association of Rice Research Workers (ARRW), Cuttack, Odisha, Society of Biological Advancement (SBA), Bangalore, Karnataka. He is presently leading several externally aided projects (EAPs) as Principal Investigator. He published number of research papers, book chapters, technical bulletins and popular articles in reputed journals. He has been recognized as reviewer of several national and international journals.

Dr. S. R. Prabhukarthikeyan is Scientist (Plant Pathology) at Crop Protection Division, ICAR-National Rice Research Institute, Cuttack, India since July 2015. He completed his Ph. D in Plant Pathology from Tamil Nadu Agricultural University, Coimbatore, India and awarded with the best PhD thesis award. He has published 55 research articles in peer reviewed journals. Also he has published 15 popular articles, 2 books, 3 technical bulletins, 3 research bulletins and 16 book chapters. His research work mainly focuses on plant-microbe interaction, molecular plant pathology, proteomics, biological control and host-plant resistance. He has lot of experience in evolving eco-friendly methods of managing fungal plant pathogens particularly using *Bacillus* spp. and fluorescent pseudomonads strains. He is serving as a reviewer and editorial board member in international journals. He is life member of the Indian Phytopathological Society, Society for Biocontrol

Advancement and Association of Rice Research Workers.

Dr. Jeevan B. Scientist (Plant Pathology) in the Crop Protection Division, ICAR-National Rice Research Institute, Cuttack, India. I started the University studies in Bachelor of science with Agriculture as major subject at the University of Agricultural Sciences, Bangalore, India and continued my masters in plant pathology at University of Agricultural Sciences, Bangalore, India where I isolate and characterized the Begomovirus associated with Pole bean yellow mosaic disease. I started my carrier as Scientist – B at Central MugaEri Research and Training Institute, Jorhat, Assam where I worked on the management of silkworm host plants using microbial bioinoculants. Before moving to NRRI, I worked at ICAR-Vivekananda Parvatiya Krishi Anusandhan Sansthan, Almora, where I worked on blast disease in multiple cereal host aiming at population biology and disease resistance. Currently, I am working as Scientist in Crop Protection Division, ICAR- National Rice Research Institute, Cuttack, India. At present, I am working on exploring unknown defense mechanisms of rice plants against blast disease in *Magnaporthe* - Rice Pathosystem. I have published several research articles, review papers, book chapters in the national and international literature.

Sri Partha Sarathi Roy has pursued his Bachelor of Science (Hons.) degree in Agriculture from Bidhan Chandra KrishiViswavidyalaya in 1994 and M.Sc. degree in Genetics and Plant Breeding with specialization in Allopolyploidy in 1996

from the same University. He joined the post of Agricultural Development officer in 1998 under the Department of Agriculture, Government of West Bengal, India. Presently he is serving the Department as Joint Director of Agriculture(Personal) (Administration). Since joining Sri Roy is engaged in dissemination of new technologies for cultivation of different crops to farmers' level through training and publication of different booklets within the ambit of different ongoing schemes of the Department of Agriculture under the Government of West Bengal and Government of India. His thrust area is Integrated Nutrient Management, Integrated Pest Management and Integrated Weed management to maintain sustainability in crop production.

Dr. Sanjoy Saha obtained B.Sc. (Ag.) Hons Degree during 1987 degree securing First class First position and M.Sc. (Ag.) Degree during 1989 in Agronomy with First class First position from Bidhan Chandra Krishi Viswavidyalaya, Mohanpur (West Bengal) and completed Ph.D in Agronomy during 1994 from BCKV. He joined Agricultural Research Service (ARS) in 1993, served as Scientist (1993-98), Scientist Sr. Scale (1998-2002), and Senior Scientist (2002-2008) at the then Central Rice Research Institute (Indian Council of Agricultural Research), Cuttack. Presently, he is working as Principal Scientist (Agronomy) and Head (Crop production Division) at ICAR-National Rice Research Institute, Cuttack. He was conferred Vice Chancellor Gold Medal (1987) for securing First position in B. Sc.(Ag) Hons; University Top merit Certificate for securing First

position in M. Sc.(Ag); also IRRI Best Presentation Award (2005), Best Poster Award (2003, 2004, 2010, 2019, 2020), ICAR-NRRI Best Scientist Award (2010 and 2016); NIWS Recognition Award (2011); CWSS-Fellow Award (2011), ISWS – Fellow Award (2012). He serves as Coordinator-India for Direct Seeded Rice Consortium for South Asia. He worked as Area Coordinator, National Invasive weed surveillance (2008-11); Secretary, Association of Rice Research Workers, Cuttack (2011-13 and 2022-contd.); Member in Editorial Board of Journal viz., Indian Society of Coastal Agricultural Research and Crop & Weed Science Research. He guided 3 Ph.D and 2 M.Sc.(Ag) students. Dr. Saha has made outstanding research contributions in the field of Weed management in rice, Production technology for Direct seeded rice (DSR), Production technologies for rice and rice-based cropping system in coastal saline areas, Integrated farming system for rainfed lowlands. He has nine rice varieties in his credit along with development of Single row dry land powerweeder, Wet land single row power weeder, Self-propelled 2 row weeder and Power operated rice seeder; Herbicide Applicator, creation of NRRI Mobile App 'riceXpert' and 'riceNxpert'. He standardized 16 low dose high efficacy novel herbicides and developed 10 herbicide mixtures for broad spectrum weed control in rice and published 132 research articles in international and national reputed journals; 46 book chapters; 28 popular articles; 15 training manuals; 5 research bulletin; 59 technology bulletin; and 104 research papers presented in National and International

Seminars/Symposia. He visited International Rice Research Institute, Philippines many times for attending Conferences, Meetings, Workshops, Project formulations etc. He also visited Thailand and Bangladesh for attending Conference sand Workshops. He handled 35 Institutional Projects (ICAR) and 40 National and International Funded Research Projects sponsored by IRRI, ADB, CP&WF, B&MGF, BMZ, DAC&FW, DST, CSIR, NATP, NAIP and ICAR. He has organized many Training program, Workshops, Press meet, Review meeting and National and International Symposia in different capacities.

Dr. Ashirbachan Mahapatra, born on 2nd July 1992 at Daspatha, Nayagarh in Odisha. He obtained his B.Sc. Ag. Hons.(2015) degree with First class from Odisha University of Agriculture and Technology, Bhubaneswar (Odisha), M.Sc. Ag.(2017) in Agronomy with First class First position and Ph.D. in Agronomy (2021) from Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh). He qualified ICAR NET for the subject of Agronomy in 2017 and 2021. He was conferred with a University Top merit Certificate for securing First position in M.Sc. (Ag) Agronomy; NRRI-IRRI Fellow Award; DST/INSPIRE Fellow Award; Best Poster Award (2018 and 2019); ISWS Student Travel Grant Award (2018); Scientist Associate Award (2018). He organized an International Conference on Advances in Agriculture Technology and Allied Sciences (ICAATAS 2022) from 4th to 5th June 2022 at Centurion University of Technology and Management,

Paralakhemundi, Odisha. He worked as National General Secretary in the All-India Agricultural Students Association in 2018. He published 20 research papers in international and national reputed journals; 1 book; 2 book chapters, 3 technology bulletins; 2 lead papers; 9 popular articles; 20 abstracts; and presented 5 research papers in National and International Seminars/Symposia. He present working as Assistant Professor, Department of Agronomy and Agroforestry, M. S. Swaminathan School of Agriculture, Centurion University of Technology and Management, Odisha, India

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), CRRRI, 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 (CO₂) 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).

Dr. Soumen Maitra was born on 29.09.1971 at Nabadwip, West Bengal. Presently he is serving as Professor and Head of the Department of Floriculture, Medicinal and Aromatic Plants in the Faculty of Horticulture under Uttar Banga Krishi Viswavidyalaya, Pundibari, CoochBehar, West Bengal. He has ten different awards to his credit. He visited Cornell University, USA (2013); CAAS, PR of China (2010); HuaJhong Agriculture

University, PR of China (2012) and UTAEM, Republic of Turkey (2014) to receive training in different aspects of Horticulture, namely – floriculture, protected cultivation, biodiversity conservation etc. Dr. Maitra is closely associated to UG & PG teaching in floriculture, landscaping, nursery management, protected cultivation, medicinal plants and aromatic plants in the University. He has published around 50 research papers in journals and proceedings, a number of popular and research articles in both English and Bengali, 5 book chapters; handled five projects funded by external agencies as Principal Investigator, participated in several national and international seminar and symposium and acted as resource person in several workshops. He has organized a number of farmers' training programmes, delivered lectures for more than 150 times in training programmes, acted as resource person in several TV and Radio programmes and performed as judge in fruit, flower and vegetable shows for more than 15 times.

Mr. Yegireddy Ashok was born on 07.03.1995 at Parvathipuram, Andhra Pradesh. He has completed his B. Sc. (Horticulture) and M. Sc. (Horticulture) Degree programmes from Dr. Y. S. R. Horticultural University. Presently he is pursuing his Doctoral Degree programme in Floriculture and Landscape Architecture from Uttar Banga Krishi Viswavidyalaya, Pundibari, CoochBehar, West Bengal. Now, he is doing research work on bulbous ornamentals.

List of Referees

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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.

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

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- To cultivate agricultural knowledge and disseminate modern scientific principles of agriculture
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- 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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