TAMIL NADU AGRICULTURAL UNIVERSITY

PROCEEDINGS

10th SCIENTISTS MEET ON NON CROP SPECIFIC PROJECTS - 2022
(06.09.2022)

Lead Centre

Directorate of Natural Resource Management
Tamil Nadu Agricultural University
Coimbatore – 641 003

Directorate of Research
Tamil Nadu Agricultural University
Coimbatore 641 003

2022

PROCEEDINGS

10th Scientists' Meet on Non-Crop Specific Projects 2022

(6th September, 2022)

The 10th Scientists' Meet on Non-Crop Specific Projects was conducted on 06.09.2022 at Committee room, Directorate of Research, TNAU through hybrid mode. A total of 300 scientists participated in the meeting.

Dr. M. Raveendran, Director of Research, TNAU, emphasized the need for conducting multi-disciplinary research to address the issues of farmers and other stake holders. He insisted the scientists to popularize the technologies developed out of various programs. SoPs for drone spray of Agricultural inputs may be developed for major crops and in medium range forecast, the forecast output of different agencies and models may be compared and verified.

The meeting was conducted as per the program detailed below

Time	Title	Presenters
Presentation by Technical Directors – 06.09.2022 (Tuesday)		
10.00 – 10.10 AM	Welcome & Flagging Off Issues	**Dr. M. Raveendran**, Director of Research
10.10 – 10.20 AM	Opening Remarks	**Dr. V. Geethalakshmi**, Vice Chancellor
10.20 – 10.40 AM	Action Taken Report	**Dr. P. Balasubramaniam**, Director (NRM)
10.40 – 10.50 AM	WTC	**Dr. S. Pazhanivelan**, Director (WTC)
10.50 – 11.00 AM	Nanotechnology	**Dr. K.S. Subramanian**, P & H, NST
11.00 – 11.10 AM	RS & GIS	**Dr. D. Muthumanickam**, P & H, RS & GIS
11.10 – 11.20 AM	Environmental Science	**Dr. M. Maheswari**, P & H, ENS
11.20 – 11.30 AM	Microbiology	**Dr. U. Sivakumar**, P & H, Microbiology
11.30 – 11.40 AM	SS & AC	**Dr. R. Santhi**, P & H, SS & AC
11.40 – 11.50 AM	Meteorology	**Dr. S.P. Ramanathan**, P & H, ACRC
11.50 – 12.00 Noon	IFS	**Dr. S. Panneerselvam**, P & H, Agronomy
12.00 – 12.10 PM	Honey Bees	**Dr. S.V. Krishnamoorthy**, P & H, Entomology
Concluding Session		
12.10 – 12.20 PM	Wrap up	**Dr. M. Raveendran**, Director of Research
12.20 – 12.30 PM	Concluding Remarks	**Dr. V. Geethalakshmi**, Vice Chancellor

Based on the discussion, the recommendations and action plans pertaining to the Department of Centre for Agricultural Nano Technology, Remote Sensing and GIS, Environmental Sciences, Soil Science and Agricultural Chemistry, Agricultural

Microbiology, WTC, ACRC, Dept. of Agronomy and Dept. of Agrl. Entomology are furnished under the following headings

A. Decisions made on Adoption / OFT/ Information
B. Action plan 2022 – 23
C. Research projects and remarks on the ongoing Research Projects
D. Remarks
E. Participants

CENTRE FOR AGRICULTURAL NANOTECHNOLOGY

A1.For Adoption

Foliar Diagnostic Kit for On- Site Detection of Nitrogen and Moisture Status in Crops (DST-Device Development Project)

- **Moisture Sensor:** A hand held moisture sensor device was developed using impedometric principle with Alagappa University, Karaikudi. The proto type is ready and recommended for field evaluation and validation. The product is recommended for filing patent.

- **Nitrogen sensor:** A hand held moisture sensor device was developed using optical principle with Alagappa University, Karaikudi. The proto type is ready and recommended for field evaluation and validation. The product is recommended for filing patent.

A2.For OFT

OFT1: Encapsulated pyrazosulfuron ethyl herbicide in transplanted rice.

Crop: Rice
Centers and Scientists:

Coordinating Centre	**:**	Centre for Agricultural Nanotechnology, TNAU, Coimbatore Dr.S. Marimuthu, Assistant Professor (Agron.)
Sub Centre	**:**	TRRI, Aduthurai Dr.S. Elamathi, Assistant Professor (Ento.) ARS, Bhavanisagar Dr.N. Sakthivel, Assistant Professor (Agronomy)

Treatments

T_1: Pre emergence application of commercial formulation of pyrazosulfuron ethyl @ 30 gha^{-1}
T_2: Pre emergence application of encapsulated formulation of pyrazosulfuron ethyl @ 15 gha^{-1}

T_3: Pre emergence application of encapsulated formulation of pyrazosulfuron ethyl @ 20 gha^{-1}
T_4: Pre emergence application of encapsulated formulation of pyrazosulfuron ethyl @ 30 gha^{-1}

OFT 2 (Technology validation in coordination with industries): Infusing biomolecules & Harmones in seeds through nano fibre technology

Treatment

T1: Control (without nano fiber encapsulation)
T2: With nanofibre encapsulation Functional molecules to be validated: Probiotic and beneficial microbes and seed priming compounds

Centre and Scientists:

Centre **:** Centre for Agricultural Nanotechnology, TNAU, Coimbatore
Scientists:
Dr.K. Raja, Assistant Professor (SST), DNST, Coimbatore
Dr.M. Senthilkumar, Assistant Professor, AC&RI, Eachangkottai
Dr.K. Sabarinathan, Assistant Professor, AC&RI, Killikulam

Thetechnologywillbevalidatedincoordinationwithseedindustriesandothersstake holders

A3.For Information

- Flexible and Adhesive surface Enhanced Raman Spectroscopy Based Nano structures Device for Efficient Detection of Multi component Pesticide Residues in Fruits and Vegetables. Detection of pesticides and ardized with a detection limit of 25ng/Cm^2 for thiram, 21ng/cm^2forchlorpyrifosand 18 ng/Cm^2methyl parathion

- Developing cost effective and biodegradable mulching sheet, grow bags from bagasse fibres and value addition of grow medium through hydrogel and nanonutrients.NFC can be effectively synthesized from sugarcane bagasse and can be used as filler in bio nano films and mulching sheet.

- Developing advanced formulation for botanical insecticide (*Azadirachtin*) using nano porousbiogenic silica from sugarcane bagasse for high bioefficacy. SilicaNanoparticlesynthesisprocessfrombagassestandardizedandthereleasepatter nstudies confirmed the sustained release upto96 hrs.

B. Action Plan

NST – Action plan proposed during NCSM, 2022						
Action Plan 1						
Theme 4		Biosafety and Toxicity Studies of Nano Materials				
Project Leader		Dr. K. S. Subramanian, NABARD Chair Professor, Director of Research, TNAU, Coimbatore - 3				
Scheme title		Insights and Biosafety of IFFCO Nano Fertilizers in Agricultural Production System (IFFCO)				
S. No.	**Activities**	**Scientists**	**2019-20**	**2020-21**	**2021-22**	**Deliverables**
1	• To characterize IFFCO nano-fertilizer formulations (Nano-N, Nano-Zn and Nano-Cu)as per the stipulated guidelines of Government of India (size, shape, stability, functional groups) • To study the insights into the mechanisms, transport, compartmentalization, fate of nano-fertilizer inplant system • Uptake, utilization anduse efficiency of nutrients in selected major crops in Tamil Nadu • Biosafety and toxicokinetics of nano-fertilizers in plant system using standard OECD protocols and guidelines set by the Government of India Project Duration: One year(Feb. 2020 to Jan. 2021)	Dr. K. S. Subramanian, NABARD Chair Professor & Director of Research Dr. R. Shanthi, Director (DNRM) Dr. A. Lakshmanan, Professor and Head, (NST) Dr. C. Sharmila Rahale, Asst. Professor, NST Dr. S. K. Rajkishore, Asst. Professor, ENS Dr. S. Margatham, Assoc. Professor (SS&AC)	-	To characterize IFFCO nano-fertilizer formulations (Nano-N, Nano-Zn and Nano-Cu) asper the stipulated guidelines of Government of India (size, shape, stability, functional groups) To study the insights into the mechanisms, transport, compartmentalization, fate of nano-fertilizer in plant system	Uptake, utilization and use efficiency of nutrients in selected major crops in Tamil Nadu Biosafety and toxicokinetics of nano-fertilizers in plant system using standard OECDprotocols and guidelines set by the Government of India	• The complete characterization insights and mechanisms involvein translocation and internalization can be determined for the IFFCO nano- fertilizers. • Uptake, utilizationand nutrient balance can be assessed for the innovative nano-fertilizer formulations • Biosafety of nano fertilizer formulations can beevaluated at various trophic levels in accordance to the stipulated guidelines of DBT and as per OECD protocols

Action Plan 2.						
Theme No 3	Development of Biosensor / Engineering Nano devices for the smart delivery of active molecules into soil, plant and other bio systems					
Scheme Title	Flexible and Adhesive Surface Enhanced Raman Spectroscopy Based Nanostructures Device for efficient Detection ofMulticomponent Pesticide Residues in Fruits and Vegetables					
Scheme Leader	Dr. S. Thirumalairajan, DBT- Ramalingaswami Re-entry Faculty Fellow, Dept. of Nanoscience and Technology, TNAU,Coimbatore					
S. No.	**Activities**	**Scientist**	**2020-2021**	**2021-2022**	**2022-2023**	**Deliverables**
1	To prepare controlled size and different shape of metal(Ag, Au and metal-semiconductor hybrid nanostructure using facile wet chemical and modified physical method. To perform a complete studyon the morphological, structural, surface area for invention prepare sample. Fabricate and determine SERS Substrate To analysis and perform ofSERS sensing substrate for pesticide residues in fruits and	Dr. S. Thirumalairajan DBT-Ramalingaswami Re-entry Faculty Fellow, Dept. of Nano science & Technology, TNAU	To synthesis controlled size and different shape of metal and metal-semiconductor hybrid nanostructure samples by surfactant-assisted wet chemical routes. To prepare different shape nanostructure samples at different calcination temperature To improve crystalline qualityand achieve smooth surface morphology, controlled size.	To study the effect of reactiontime, temperature andvarious pH on the controlled size of the different nanostructure samples and alsoto investigate the physico-chemical properties. Analyze the samples for XRD, TEM, SEM, XPS and surfacearea analysis.	Fabricate and determine SERS Substrate To analyze andperform of SERS substratefor pesticide residues (thiram and TBZ) in fruits (apple) and vegetables (cabbage) To investigate and analyses prepare SERS substrate for the selectivity, sensitivity, stability, molecular information, LOD, and reproducibility.	Detection of pesticide on various fruits and vegetable surfaces: The dynamic range of chlorpyrifos was found to be 10^{-2} to 10^{-9}M with a detection limit of 2 ng/cm^2 for grapes and 5 ng/cm^2 (S/N=3) for tomatoes, through a correlation coefficient of 0.9983 and 0.9966, respectively. The correspondi ng limit of detection in acetamiprid on the surface of okra, cabbage, and cucumber was 3 ng/cm^2, 7ng/cm^2,

	vegetables To investigate and analyze prepare SERS substrate for the selectivity, sensitivity, stability, molecular information, LOD, and reproducibility					and 10 ng/cm^2 through a correlation coefficient of 0.9896 and 0.9952, respectively.

Action Plan 3.						
Theme No. 1		Design and fabrication of nano-agri inputs				
Scheme Title		**Smart Nano – bio pesticide for the sustained Release of active ingredients for the eco safe management of Coffee White Stem Borer (Sponsored by Coffee Board)**				
Scheme Leader		**A. Lakshmanan, M. Kannan**				
S. No.	**Activities**	**Scientist**	**2021-2022**	**2022-2023**	**2023-2024**	**Deliverables**
1	➢ Standardizing the protocolfor the synthesis of Polymeric nano system asdelivery vehicle ➢ Developing film forming nano-formulation using multi-functional (bio and phyto) molecules encapsulated in polymeric nano carrier to aid smart and prolonged delivery ➢ Characterizing the nano-	Dr. A.Lakshmanan, Dr. M.Kannan DNST, TNAU, Coimbatore	➢ Standardizing the protocol for the synthesis of Polymeric nano system as delivery vehicle ➢ Developing film forming nano-formulation using multi-functional (bio and phyto) molecules encapsulated in polymeric nano carrier to aid smart	➢ Characterizing the nano-formulation for enhanced stability and assessing bio-efficacy against CWSB under *in vitro* and *vivo* conditions ➢	Confirming the bio safety of the nano formulation and up scaling the inventioninto commercial formulation in coordination with stakeholders to manage CWSB	Eco friendly bio nano formulation would be available for the management of Coffee White Stem borer

	formulation for enhanced stability and assessing bio-efficacy against CWSBunder *in vitro* and *vivo* conditions ➢ Confirming the bio safetyof the nano formulation and up scaling the invention into commercial formulation in coordination with stakeholders to manage CWSB Project Duration : 2021-2022(18 months)		and prolonged delivery			

Theme No. 4	Bio-safety studies of nanomaterials / Nano systems for pollution management and Eco system health					
Scheme Title	Greenhouse gas emissions from farm waters : Assessing magnitudes, variability and opportunities for mitigation					
Scheme Leader	B.Sivakiruthika , A.Lakshmanan and V.Geethalakshmi					
S. No.	**Activities**	**Scientist**	**2021-2022**	**2022-2023**	**2023-2024**	**Deliverables**

1	➢ To Quantify greenhouse has (GHG) emissions from various types of farm waters in south India ➢ Assess the influence of design and management on emissions of methane and nitrous oxide ➢ Develop strategies to minimize GHG emission from farm waters Project Duration : 2021-23	B.Sivakiruthika , A.Lakshmanan , DNST, TNAU, Coimbatore and V.Geethalakshmi DCMS, TNAU, Coimbatore	➢ Quantify greenhouse has (GHG) emissions from various types of farm waters in south India	➢ Assess the influence of design and management on emissions of methane and nitrous oxide	➢ Develop strategies to minimize GHG emission from farm waters	Green house gases inventory for agro ecosystems will be developed and validated

Action Plan 5.						
Theme No. 1		Design and fabrication of nano-agri inputs				
Scheme Title		Establishing Pilot plant for the production of Nano bio polymer (bio plastic) from agro residues (DBT Sponsored)				
Scheme Leader		A. Lakshmanan C. Sharmila Rahale				
S. No.	**Activities**	**Scientist**	**2021-2022**	**2022-2023**	**2023-2024**	**Deliverables**
1	• Setting up the Bio Resource Centre (BRC) and fine tuningthe protocol for the synthesis of bio polymer as raw material for the production of variousvalue added products • Value addition	A.Lakshmanan C.Sharmila Rahale DNST, TNAU, Coimbatore	Setting up the Bio Resource Centre (BRC) and fine tuning the protocol for the synthesis of bio polymeras raw material for the production of various value added products	Value additionsuch as biodegradable Carry bags/ cling film / grow bags andother packing material	Linking science and industriers and creating a commercial link for the TOT.	Agro cellulosic residues can be value added and alternate livelihood source to farm families can be

	such as biodegradable Carry bags/ cling film / grow bags andother packing material • Linking science and industriers and creating a commerciallink for the TOT. Project Duration : 2021-22					created

Action Plan 6.						
Theme No. 1	Design and fabrication of nano-agri inputs					
Scheme Title	Double encapsulated nano-composite granules for the staged delivery of herbicides and growth stimulant to control Striga.(Sponsored by DST- Nano Mission)					
Scheme Leader	Dr. S.Marimuthu					
S. No.	**Activities**	**Scientist**	**2021-2022**	**2022-2023**	**2023-2024**	**Deliverables**
1	• To design a controlledrelease system for thestaged delivery of growth stimulants and herbicides (NCL) • To characterize the controlled release formulation for efficient encapsulationof growth stimulant and herbicide (TNAU and NCL) • To test the efficacy of the nanocomposites based formulation bothin *in vitro* and pot culture studies using sugarcane as Model crop (TNAU) Project Duration : 2021-23	Dr. S. Marimuthu Assistant Professor (Agron.), DNST,TNAU, Coimbatore	To design a controlled release system for the staged delivery of growth stimulants and herbicides (NCL)	To characterize thecontrolled release formulation for efficient encapsulation of growth stimulant and herbicide (TNAU and NCL)	To test the efficacy of the nano composites based formulation bothin *in vitro* and pot culture studies using sugarcane as Model crop (TNAU)	A nano formulation for the effective management of Striga would be available

Action Plan 7.						
Theme No. 2	Nano-Food Systems					
Scheme Title	Nanoformulation of plant bioatcives from Ashwagandha (*Withania somnifera*) and Kalmegh (*Andrographis paniculata* Nees.) for enhanced Immunoboosting activity					
Scheme Leader	Dr.S.Haripriya					
Action Plan	8.					
S. No.	**Activities**	**Scientist**	**2021-2022**	**2022-2023**	**2023-2024**	**Deliverables**
1	1. Extraction of Plant bioactives of *Withania somnifera* and *Andrographis paniculata* using green solvent extraction technique and quantification of major marker compounds 2. Development and characterization of novel nano formulation with enhanced bioavailability with sustained release mechanism 3. Assessing the immune boosting activity, *in vitro* release pattern and biosafety studies through *in vitro* cell line studies Project Duration:	Dr.S.Haripriya, Assistant Professor (Hort.), DNST, TNAU, Coimbatore	Extraction of Plant bioactives of *Withania somnifera* and *Andrographis paniculata* using green solvent extraction technique and quantification of major marker compounds	Development and characterization ofnovel nano formulation with enhanced bioavailability with sustained release mechanism	Assessing the immune boosting activity, *in vitro* release pattern and biosafety studies through *in vitro* cell line studies	• Recommended for closure. Completion Report may be submitted at the earliest.

	Three year (2021 to 2024)					

C. Research Projects and Remarks

URP	Core Project	EFP	Private	Action PlanProjects	Total
3	-	13	-	-	**16**

C1.Remarks on the ongoing University Research projects/ Externally Funded Projects/ Core Projects

S. No.	Project No. and Title	Scientistsin-charge	Duration	Remarks
Externally funded projects				
1.	Development of Foliar Diagnostic kit for on-site detection of Nitrogen and moisture status in crop	**Principal Investigator** Dr. K. S. Subramanian **Co-Principal Investigators:** Dr. S. Marimuthu, Dr.Pon Sathya Moorthy,Dr. K. M. Sellamuthu, Dr. C. Sekar (Alagappa Univ.),Dr. R. S. Viswanathan (Alagappa Univ.)	May, 2019 to May2020 DST Device Development Program, DST (Nano Mission), New Delhi	Completion report may be submitted
2.	Transforming coconut waste into High value Carbon Dots (C-Dots) and Development of Nano-based Technology for Disinfection of water.	**Principal Investigator** Dr. S. K. Rajkishore **Co-Principal Investigators** Dr. A. Lakshmanan Dr. C. Sharmila Rahale Dr. R. Sunitha	Oct.2019 to Sept.2021 Coconut Development Board, Kochi	Completion report may be submitted
3.	Rice Micro-biome studies to understand the connect between rhizosphere and atmosphere in response to changing climate. (BRIFS)	**Principal Investigator** Dr. A. Lakshmanan	Nov.2018 to Oct.2021 DST - SPLICE - CCP	Completion report may be submitted

4.	Flexible and Adhesive surface Enhanced Raman Spectroscopy Based Nanostructures Device for Efficient Detection of Multicomponent Pesticide Residues in Fruits and Vegetables	**Principal Investigator** Dr. S. Thirumalairajan	Dec. 2018 to Dec.2023 DBT, New Delhi	The project may be continued
5.	Insights and Biosafety of IFFCO Nano fertilizer in Agricultural Production System (Phase 1 and Phase II)	**Overall Coordinator & LeadPrincipal Investigator** Dr. K. S. Subramanian **Principal Investigators** Dr.R.Santhi, Dr. A. Lakshmanan Dr.S. Pazhanivelan **Co-Principal Investigators** Dr. C. Sharmila Rahale, Dr.S.K.Rajkishore, Dr.S.Maragatham	Feb.2020 to Jan.2022 IFFCO - New Delhi	The project may be continued
6.	Nano-fiber encapsulation of Methyl bacterium for Groundnut Seed invigoration to improve productivity under rain fed ecosystem	**Principal Investigator** Dr. K. Raja	Feb.2020 to Jan. 2023 DST – SERB, New Delhi	The project may be continued
7.	Nano - Bio hybrid using Halloysite Nanotube Hydrogel and Microbial Consortium for Methane Oxidation and Carbon sequestration in Rice soils to promote Low carbon and sustainable agriculture.	Dr. R. Abhinayaa **Mentor**: Dr. A. Lakshmanan	Jan. 2020 to Jan.2022 DST - SERB New Delhi	Completion report may be submitted
8.	Developing cost effective and biodegradable mulching sheet, grow bags from bagasse fibres and value addition of grow medium through hydrogel and nano nutrients	**Principal Investigator** Dr. A. Lakshmanan **Co-Principal Investigator** Dr. C. Sharmila Rahale	July 2020 to June 2022 EID Parry (I) Ltd., India	The project may be continued

9.	NanoBeeLure – A novel nano based honeybee lure dispense mechanism to increase pollination in vegetable crops	**Principal Investigator**Dr. M. Praghadeesh **Project Mentor** Dr. K.S.Subramanian	Oct. 2020 to Sept. 2023 DST- Young Scientist	The project may be continued
10.	Double encapsulated nano composite granules for the staged delivery of herbicides and growth stimulant to control Striga, a parasitic weed in Sugarcane	**Principal Investigator** Dr.S.Marimuthu	Sept. 2020 to August2023 DST, New Delhi.	The project may be continued
11.	Establishing Rural Bio Resource Centre for the production of Nano Bio Polymer (bioplastic) from agrocellulosic wastes and dry land succulent plants.	**Principal Investigator** Dr. A. Lakshmanan **Co-Principal Investigator** Dr. C. Sharmila Rahale	Jan 2021 to December 2022 DBT,New Delhi.	The project may be continued
12.	Smart nano bio pesticides for the stimuli based sustained release of active ingredients for the safe management of Coffee White Stem borer	**Principal Investigator** Dr. A. Lakshmanan **Co-Principal Investigator** Dr. M. Kannan	April 2021 to Sept.2022 CoffeeBoard	The project may be continued
13.	Greenhouse gas emissions from farm waters - Assessing magnitudes, variability and opportunities for mitigation	**Ramanujan fellow**Dr. Sivakiruthika **Mentors** Dr. A. Lakshmanan Dr.V.Geethalakshmi	April 2021 to March 2026 Ramanujan Fellowship GOI-SERB	The project may be continued

University Research Projects				
14.	NRM/CBE/NST/PHY/2020/01 Developing advanced formulation for botanical insecticide (*Azadirachtin*) using nanoporous biogenic silica from sugarcane bagasse for high bioefficacy.	Dr.D.Jaya Sundara Sharmila, Asst. Prof. (Phy.)	September 2019to August 2021	The project may be continued with set objectives

15.	NRM/CBE/NST/ 2021/001 Synthesis and characterization of CuO & Fe_2O_3 quantum dots to improve seed quality in important agricultural crops.	Dr. Pon. Sathya Moorthy, Asst. Prof. (Phy.) Dr. K. Raja, Asst. Prof. (SST)	September 2020to August 2022	The project may be continued with set objectives
16.	NRM/CBE/NST/HOR/2019/01 Nano-formulation of Annonaceous Acetogenins from *Annona muricata* for better delivery	Dr.S. Haripriya, Asst. Professor (Hort.)	2019-2022	Recommended for closure. Completion Report may be submitted at the earliest.

DEPARTMENT OF REMOTE SENSING AND GIS

A1.For Adoption

1. Comprehensive drone spraying protocols for various inputs in rice

The comprehensive drone spraying protocols in rice for various inputs *viz*., pre emergence herbicide - Pyrazosulfuran ethyl 10% WP, pesticide for sucking pests Fipronil, Pesticide application for Leaf folder and stem borer pests – Cholrantranilliprole and fungicide application for disease management zineb (68%) and hexaconazole (4% WG) were applied through battery-operated drone with a flat jet nozzle and a hybrid drone with atomizer nozzle with spray fluid volume of 10 and 30 L /ac respectively on 3, 25, 60 and 90 DAT. The inputs namely Pyrazosulfuran ethyl, Fipronil, Cholrantranilliprole and Zineb (68%) and hexaconazole (4% WG) were applied through battery-operated drone with a flat jet nozzle @ 10g/ L, 6 ml/ L, 6 ml /L and 25 g / L for and hybrid drone with atomizer nozzle @ 3.3g/ L, 2 ml/ L, 2 ml /L and 8.3 g / L respectively on 3, 25, 60 and 90 DAT. The spraying was compared with conventional power spraying @ 80 L /ac and there is no phytotoxicity symptoms were noticed irrespective of the chemicals and spraying methods.

2. Comprehensive drone spraying protocols for various inputs in maize

The comprehensive drone spraying protocols in maize for various inputs *viz*., pre-emergence herbicide – Atrazine, Pesticide for Fall Army worm -Emmamectin Benzoate, Pesticide application for Fall Army worm and Leaf folder Cholrantranilliprole were applied on 3, 25, 40 and crop booster maize maxim for nutrient management on 50 and 65 days after sowing were applied through battery-operated drone with a flat jet nozzle and a hybrid drone with atomizer nozzle with spray fluid volume of 10 and 30 L /ac respectively. The inputs *viz*., Atrazine, Emmamectin Benzoate, Cholrantranilliprole @ 20 g/ L, 10 g / L ,6 ml /L, and Maize maxim @ 120 g /L and 120 g / L were applied through battery-operated drone with flat jet nozzle and @ 6.6 g/ L, 3.33 g / L, 2 ml /L and Maize maxim @ 40 g /L and 40 g / L for and hybrid drone with atomizer nozzle respectively on 3, 25, 40, 50 and 65 DAS. The spraying was compared with conventional power spraying @ 80 L /ac and there is no phytotoxicity symptoms were noticed in irrespective of the chemicals and spraying methods.

3. Comprehensive drone spraying protocols for various inputs in cotton

The comprehensive drone spraying protocols in cotton for various inputs consisting of pre-emergence herbicide – Pendimethalin, Pesticide for sucking pest - Fipronil, Pesticide application Thrips, white flies and Green Leaf Hopper - Dinotiferon were applied on 3, 35 and 80 DAS and crop booster Cotton Plus for nutrient management on 45 and 65 DAS were applied through battery-operated drone with a flat jet nozzle and a hybrid drone with atomizer nozzle with spray fluid volume of 10 and 30 L /ac

respectively. The inputs *viz*., Pendimethalin, Fipronil, Dinotiferon @ 100 ml/ L, 6ml / L, 6 g /L were applied through battery-operated drone with flat jet nozzle and @ 33.3 ml/ L, 2ml / L , 2 ml /L for and hybrid drone with atomizer nozzle respectively on 3, 35 and 80 DAS. The crop booster Cotton Plus @each 250 g /L was applied through battery-operated drone with a flat jet nozzle and 83.3g /L for a hybrid drone with an atomizer nozzle respectively on 45 and 65 DAS. There is no phytotoxicity symptoms were noticed in irrespective of the chemicals and spraying methods.

4. Comprehensive drone spraying protocols for various inputs in Groundnut

The comprehensive drone spraying protocols in groundnut for various inputs *viz*., pre-emergence herbicide – Pendimethalin, Pesticide for sucking pest - Fipronil, Pesticide application – Chlorantranilliprole were applied on 3, 30 and 75 DAS and crop booster Groundnut Rich for nutrient management on 45 and 60 days after sowing were applied through battery-operated drone with a flat jet nozzle and a hybrid drone with atomizer nozzle with spray fluid volume of 10 and 30 L /ac respectively. The inputs viz., Pendimethalin, Fipronil, Dinotiferon @ 100 ml/ L, 6ml / L, 6 g /L were applied through battery-operated drone with flat jet nozzle and @ 33.3 ml/ L, 2ml/ L , 2 ml /L for and hybrid drone with atomizer nozzle respectively on 3, 35 and 80 DAS. The crop booster Groundnut Rich @each 200 g /L was applied through battery-operated drone with flat jet nozzle and 66.7 /L for hybrid drone with an atomizer nozzle respectively on 45 and 65 DAS. There is no phytotoxicity symptoms were noticed in irrespective of the chemicals and spraying methods.

5. Comprehensive drone spraying protocols for various inputs in blackgram

The comprehensive drone spraying protocols in blackgram for various inputs *viz*., Pesticide - Imidacloprid, crop booster TNAU Pulse wonder and Pesticide application– Chlorantranilliprole were applied on 20, 40 and 50 DAS through battery-operated drone with a flat jet nozzle and a hybrid drone with atomizer nozzle with spray fluid volume of 10 and 30 L /ac respectively. The inputs viz., Imidacloprid, TNAU Pulse wonder and Chlorantranilliprole @ 6 ml/ L, 200 g / L and 6 ml/L were applied through battery-operated drone with flat jet nozzle and @ 2 ml/ L, 66.7 g/ L and 2 ml /L for and hybrid drone with atomizer nozzle respectively on 20, 40 and 50 DAS respectively. There is no phytotoxicity symptoms were noticed irrespective of the chemicals and spraying methods.

6. Comprehensive drone spraying protocols for various inputs in greengram

The comprehensive drone spraying protocols in greengram for various inputs *viz*., Pesticide - Imidacloprid, crop booster TNAU Pulse wonder and Pesticide application – Chlorantranilliprole were applied on 20, 40 and 50 DAS through battery-operated drone with a flat jet nozzle and a hybrid drone with atomizer nozzle with spray fluid volume of 10 and 30 L /ac respectively. The inputs *viz*., Imidacloprid, TNAU Pulse wonder and

Chlorantranilliprole @ 6 ml/ L, 200 g / L and 6 ml/L were applied through battery-operated drone with flat jet nozzle and @ 2 ml/ L, 66.7 g/ L and 2 ml /L for and hybrid drone with atomizer nozzle respectively on 20, 40 and 50 DAS respectively. No phytotoxicity symptoms were noticed irrespective of the chemicals and spraying methods.

A2.For OFT: Nil

A3. For Information

1. Digitization of cadastral maps in the Ariyalur district is completed using ArcGIS software, and 169 villages have been completed covering six blocks in the Ariyalur district. The details on the Survey number of farms, villages, blocks, districts, and areas are joined as attributes.
2. Artificial intelligence and machine learning techniques were used to extract soil parameters digitally. Forty-two environmental covariates on climate, organism, relief and parent material were developed for Tamil Nadu. On a pilot basis, a digital soil class map for Tamil Nadu was generated utilizing decision tree and 'r' programming with an accuracy of 80 per cent.
3. To quantify the soil nutrients through remote sensing techniques, 200 samples representing various locations were collected and analyzed for soil nutrient status. The soil samples were subjected to spectral reflectance measurement and the measured spectral signatures of various soils were organized to develop a spectral library and various spectral indices are correlated with soil properties. The spectral Indies *viz.,* 1/sum 400-700 nm (wavelength) and 1/slope 400-600 nm (wavelength) were correlated with estimated soil properties. The early results suggest that the spectral indices derived in the Visible & NIR regions suggest a moderate correlation between Soil Organic Carbon and 1/slope 400-600 (0.526) & 1/sum 400-700 (0.534).
4. The village-wise Rice area map and statistics were generated at 12 days intervals for 11,911 villages. Start of the season, rice area, leaf area index and dB stack was developed during the Samba season. The methodology for estimating end-of-season Rice yield was integrated with varietal information and satellite-derived weather products. Yield aggregates at district, block, and village levels were generated.
5. Spatial rice yields were estimated for the Cauvery delta region (Thanjavur, Thiruvarur, Nagapattinam and Mayiladuthurai) during the Samba season 2020 – 2021. Three spatial rice yield techniques *viz*., spectral indices-based regression analysis, semi-physical approach and integrating remote sensing products DSSAT model were used. Among the different yield estimation methods, remote sensing products with crop growth model recorded the highest mean R^2(0.86), followed by spectral indices-based regression analysis (0.81). Similarly, remote sensing with crop modeling registered the highest agreement percent of 90.57, followed

by spectral indices-based regression analysis (90.52 %) and semi-physical approach (85.47 %).

6. Maize and Cotton area maps and statistics pertaining to Perambalur, Ariyalur, districts were generated. The area under Maize was assessed to be 61,309 ha and 13,989 ha in Perambalur and Ariyalur districts, respectively. The Cotton area was estimated to be 11,753 ha and 10,319 ha in Perambalur and Ariyalur districts, respectively. An increase of 12000 ha in the area under maize cultivation was observed in the Perambalur district, favoured by conducive weather and accelerated market price during 2020-21 compared to 2019-20. However, the Cotton area in the districts of Ariyalur and Perambalur suffered a major setback in yield due to heavy and unseasonal rainfall during the cropping period.
7. *Rabi* groundnut area was estimated using Sentinel 1A SAR data. The area under groundnut in Tiruvannamalai district was found to be 32,290 ha during Rabi 2020-21. DSSAT PEANUTGRO model was used to simulate the LAI and yield of groundnut. The estimated yield ranged from 2190 to 3077 kg/ha, while the potential yield ranged from 3711 to 4306 kg/ha. The yield gap was assessed from 928 to 1521 kg/ha
8. Object-based classification methodology was developed using e-cognition software to generate information on mango growing areas in Salem, Dharmapuri and Krishnagiri districts.Sentinel-2A is the optical satellite data product available free of source and with a high spatial resolution of 10 m in the visible and infrared region was utilized. The study reveals that mango growing area of 5053.46 ha, 25137.87 ha and 36072.22 ha was recorded in Salem, Dharmapuri and Krishnagiri districts, respectively, with an accuracy of 88 per cent.
9. Drought assessment is done for Agriculture as a whole. Drought conditions in Tamil Nadu are effectively monitored using meteorological indices *viz*., Rainfall Departure from normal and Standardized Precipitation Index showing historical deviation. Rainfall data from IMD and AWS of TNAU are utilized for this analysis. In addition, to assess the impact on vegetation conditions, satellite-derived indices like Normalized Difference Vegetation Index (NDVI) and Normalized Difference Water Index (NDWI) were generated for 2021-22. The moisture Adequacy Index is generated once in 10 days to assess the balance between actual and required precipitation. The database will give a clear picture of agricultural drought's occurrence, progress and impact.
10. Flood inundated areas and crop damages due to heavy downpours in the coastal districts of Tamil Nadu during November 2021 were analysed. The flood inundated agricultural fields are monitored from October to January through Sentinel 1A SAR satellite data and Drone images using a threshold approach. Flood-affected areas in coastal districts covering the Agro-climatic zone of North Eastern, Cauvery Delta and Southern were mapped using Sentinel 1A SAR data. The crop signatures were extracted, showing three types of incidences, i.e., total crop failure at an early stage, partial recovery after inundation and full recovery

without any damages. Fixed wing and Copter type Drones were employed to assess the extent of crop damages in terms of lodging

11. Spatio-temporal water spread from March 2021 to March 2022 was assessed using Synthetic Aperture Radar satellite data in 4334 PWD tanks in sub basins. The analysis of water spread in the lower palar sub-basin revealed a reduction in the spread of water compared with the start-of-season during May to mid of Season Oct-Nov in the Sub basin attributing to more use of tank water for Agriculture and other purposes. The month of November, total water spread area is 8046 ha, is the highest water spread area in the entire season. At the same time, the remaining peak water spread was noticed in December with 7730 ha and January with 7347 ha. The comparison between Nov-Dec and after that in the end-of-season January, there was a decrease in the spread of water with February recording 6627 ha of water spread area and March having 5787 ha of the area under water covered. This trend reveals the increased usage towards the end-of-season for agriculture during Nov-Dec-Jan.
12. A mobile application and web interface were developed to monitor water resources and irrigated agriculture interventions. The data collected from the mobile application with satellite data is used for assessing the impact on irrigated area expansion, crop intensification and diversification. Around 2271 users have registered with the app from line departments *viz*., TNAU, Agriculture, Horticulture, AED, Animal Husbandry, WRD, Marketing and fisheries. In total, 19543 interventions were geo-tagged, covering a wide range of interventions and line departments up to May 2022. In addition, map representations in the web interface were updated with new entries of interventions and NDVI images.
13. Foliar application of TNAU Maize Maxim to maize through drone @ 3 % (900 g/ 30 lit) at the tasseling and silking stage has enhanced the yield parameters and grain yield by 17-20 %.
14. The application of a recommended dose of Atrazine (1.0 kg/ha) - Tembotrione (120 g/ha) - 2, 4-D (1.0 kg/ha) with spray fluid 80 L/ha could be recorded the better droplet size and uniformity of spray deposition, reduce the weed density, weed dry weight below the economic threshold level and enhance the yield, net return and benefit-cost ratio, reduced the time requirement and energy requirement in irrigated maize. The persistence of all three herbicides did not vary between drone spraying and conventional spraying. Residues of all the studied herbicides in soil and plant at harvest were found below the detection limit of 0.01 mg/kg.
15. The field experiment was conducted at Kallapuram, Kinathukadavu, Coimbatore District, with tomato crop and hybrid Sivam to standardize Panchagavya application through drone spraying. The highest tomato yield of 66.2 t ha^{-1} was recorded in UAV Drone spray with atomizer @ 4% concentration. An increase of 2 to 6 % in fruit yield of tomato was recorded in UAV Drone spray with atomizer @ 4% concentration over power and manual spraying of panchagavya. In addition, the UAV spray method reduces the quantity of panchagavya used for

spraying in tomato fields and reduces the cost incurred by manual and power sprayer operations with more coverage of land areas.

16. The spray equipment, *viz*., drone spraying using an atomizer nozzle, drone spraying using a jet nozzle and high-volume spraying (knapsack sprayer), was evaluated in maize crop using the insecticide chlorantraniliprole 18.5 SC @ 60g ai/ha. The results from tagged plants showed that drone application with either atomizer was as effective as a high-volume spraying battery-operated knapsack sprayer.

University Research projects

S. No.	Project Number	Title	Period	Project scientist	Remarks
1.	NRM/CBE/RSG / SAC/2020/001	Digital Soil Mapping using machine learning algorithms and expert system approach	October 2019 – September 2022	Dr. R. Kumaraperumal, Asst Prof (SS&AC)	May be continued
2.	NRM/CBE/RS&GIS/NON/001	Quantification of Soil Nutrients using Hyperspectral Remote Sensing Techniques	November 2021 to October 2023	Dr. R. Jagadeeswaran, Assoc. Prof. (SS&AC) D. Muthumanickam Professor (SS&AC) Dr. Bakiyathu Saliha, Assoc. Prof. (SS&AC), AC&RI, Madurai	May be continued
3.	NRM/CBE/RSG/HOR/2021/001	Standardizing Drone Spraying of Nutrients and Plant Protection Chemicals in Agricultural and Horticultural Crops	December 2020 to March 2023	**Team Leader** Dr. Santhi, Director (NRM) **Team Co-ordinator & Principal Investigator:** Dr. S. Pazhanivelan, Prof. & Head (RS&GIS) Dr. R. Kumaraperumal Asst. Prof.(SSAC) **Lead Project Leaders:** Dr. K.P. Ragunath AP (SSAC)	May be continued
4.	NRM/CBE/RSG/SAC/2022/New	Inter-comparison of satellite derived soil moisture products and their validation using ground based observations	June 2022 to May 2024	Dr. D. Muthumanickam Professor and Head (RSGIS) Dr. R. Kumaraperumal Asst. Prof. (SSAC)	May be continued

B. Externally Funded project					
1.	TNIAMP (F36NT)	Tamil Nadu Irrigated Agriculture Modernization Project (TNIAMP) Phase I	Sep 2017 to March 2023	Dr. S. Pazhanivelan Professor and Head (RS&GIS) Dr. K.P. Ragunath, Asst. Prof. (SS&AC), RS&GIS Dr. R. Kumaraperumal, Asst. Prof. (SS&AC), RS&GIS	May be continued
2.	NRSC/NRM/CBE/RSG/2021/R001	Remote Sensing based ET and Soil Moisture Assessment	April 2021-March 2024	Dr. S. Pazhanivelan Professor & Head (RS&GIS) CoPI: Dr. K.P. Ragunath, Asst. Prof. (SS&AC), RS&GIS Dr. R. Kumaraperumal, Asst. Prof. (SS&AC), RS&GIS	May be continued
3.	NRM/IGB/RSGIS/2022/R001	Innovative Climate Risk Insurance	December 2021 – June 2023	Dr. S. Pazhanivelan Professor & Head (RS&GIS)	May be continued
4.	NRM-FWL/NRM/CBE/RSGIS/2021/T002	Standardizing Drone spraying protocols for varius inputs in selected field crops.	January 2022 – Nov 2022	Dr. S. Pazhanivelan Professor and Head (RS&GIS) Dr. R. Kumaraperumal, Asst. Prof. (SS&AC), RS&GS	May be continued

B. Action Plan Proposed for 2022-23

S. No.	Action plan proposed
1	**Geospatial Technologies for Digital Agriculture** **Activities:** • **Developing TNAgri Spatial Information Platform** to provide insight on crop condition using Geo-spatial analytics (Land use land cover map, Soil Data,28 Environmental Covariates, LGP, Soil moisture and PET,NDVI,NDWI,SPI, Rainfed area map, Salt affected soils, Land degradation, Impacts of Agriculture disasters- Drought, Flood, cyclone, Digital maps of Water bodies and Crop information) • Digital farming with IoT and sensors • AI and image based weed detection Creating TNAU survey database and image library with geospatial information using mobile app Duration: Three Years (2021 – 2024)

	Linkages established: TNeGA, TCS, GIZ, DoA and TNDRRA Centres with Scientist WTC: Dr. S. Pazhanivelan, Director (WTC) Dr. K.P. Ragunath, Asst. Prof.(SS&AC) Department of RS&GIS: Dr. D. Muthumanickam, Prof. & Head (RS&GIS), Dr. R. Jagadeeswaran, Assoc. Prof.(SS&AC) Dr. R. Kumaraperumal, Asst. Prof.(SS&AC) ACRC : Dr. V. Geethalakshmi, Vice-Chancellor Dr.S.P. Ramanathan, Prof. & Head Department of Agronomy: Dr. P. Murali Arthanari, Associate Professor Department of Plant Pathology: Dr. G. Karthikeyan, Prof. & Head Expected outcome ▪ TNAgri Spatial Information Platform ▪ Methodology for Digital Farming for automated irrigation and nutrient management ▪ Image and Spectral library ▪ AI based tools for weed detection ▪ Mobile app and Historic and real time database on survey information on incidence of pest and diseases, weeds and other ground truth information
S. No.	**Action plan proposed**
2	**Deep learning based Digital Soil Mapping and quantification of soil nutrients** **Activities:** • Digital soil mapping of Tamil Nadu using deep learning tools • Quantification of soil nutrients using hyperspectral remote sensing • Digitization and generation of cadastral Maps and soil nutrient mapping Duration: Three Years (2021 – 2024) Linkages established: SLUB, NBSS&LUP and DOA **Centres with Scientist** Department of RS&GIS: Dr. D. Muthumanickam, Prof. & Head (RS&GIS), Dr. R. Kumaraperumal, Asst. Prof. (SS&AC) Dr. R. Jagadeeswaran, Assoc. Prof. (SS&AC)AC&RI, Madurai Dr. B. Saliha, Assoc. Prof. (SS&AC) Expected outcome ▪ Cadastral level soil nutrient map ▪ Block level soil available nutrient status ▪ Digital Soil Maps ▪ Spectral library on soil nutrients
S. No.	**Action plan proposed**
3	**Crop Area Mapping and Yield Estimation** **Activities:** • Sustaining rice area and yield monitoring • Developing Automated crop information system for generating maps and area statistics in cotton, maize, pulses, groundnut, sugarcane at state level

	• Mapping horticultural crops and plantations using object based classification Duration: Three Years (2021 – 2024) Linkages established: MNCFC, NRSC, SAC, IRRI, and Sarmap Centres with Scientist WTC: Dr. S. Pazhanivelan, Director (WTC) Dr. K.P. Ragunath, Asst. Prof. (SS&AC) Department of RS&GIS: Dr. D. Muthumanickam, Prof. & Head (RS&GIS) Dr. R. Kumaraperumal, Asst. Prof. (SS&AC) Dr. R. Jagadeeswaran, Assoc. Prof. (SS&AC) Expected outcome ▪ Real time area statistics and maps on crop area, yield and losses at District, Block and village level for rice, cotton, maize, pulses, groundnut, sugarcane and millets ▪ Automated crop information system ▪ Maps and statistics on tomato, onion and turmeric

S. No.	Action plan proposed
4	**Crop loss assessment, climate change and environmental monitoring using geospatial technologies** **Activities:** • Developing methodology for crop loss assessment due to flood, cyclone, drought and hail storm • Spatial estimation of ET and Soil moisture and its impact on crop growth • Spatial estimation of methane emission using remote sensing and GHGs as influenced by land use and agronomic practices Duration: Three Years (2021 – 2024) Linkages established: MNCFC, NRSC, SAC, IRRI and Sarmap Centres with Scientist Department of RS&GIS: Dr. R. Kumaraperumal, Asst. Prof.(SS&AC) Dr. D. Muthumanickam, Prof. & Head (RS&GIS) Dr. R. Jagadeeswaran, Assoc. Prof. (SS&AC) WTC: Dr. S. Pazhanivelan, Director (WTC) Dr. K.P. Ragunath, Asst. Prof.(SS&AC) ACRC: Dr. S. P. Ramanathan, Prof. & Head ORS, Tindivanam: Dr. S. Thiruvarasan, Asst. Professor (Agron) Expected outcome ▪ Methodology for crop loss assessment during disasters ▪ Maps and statistics on ET and soil moisture ▪ Spatial estimation and quantification of methane emission from rice ecosystem.

S. No.	Action plan proposed
5	**Water resources monitoring and irrigation water management** **Activities:** • Developing methodology and tool for volume analysis in PWD tanks using drones • Water Bodies Information System hosted at web portal for PWD tanks • Assessing the impact on crop yield and intensity of cropping • Mobile and Web application for monitoring interventions and assessing impact Duration: Three Years (2018 – 2023) Linkages established: MNCFC, NRSC, SAC, IRRI, and Sarmap Centres with Scientist Department of RS&GIS: Dr. R. Kumaraperumal, Asst. Prof. (SS&AC) Water Technology Centre: Dr. S. Pazhanivelan, Director (WTC) Dr. K.P. Ragunath, Asst. Prof. (SS&AC) Expected outcome ▪ Crop area maps for Sub Basins and crop cover change ▪ Information on water storage in major tanks ▪ Water resource mapping – water spread & duration of water availability in tanks & its impact on crop yield and intensity of cropping
S. No.	**Action plan proposed**
6	**Developing drone based comprehensive spraying protocol for major crops** **Activities:** • Developing comprehensive drone spraying protocol for various inputs • Standardize spray dynamics by selecting right drone model and nozzles • Validation of drone spraying with conventional spraying through field experiments Duration: Three Years (2022 – 2024) Centres with Scientist Department of RS&GIS: Dr. R. Kumaraperumal, Asst. Prof.(SS&AC) Dr. D. Muthumanickam, Prof. & Head (RS&GIS), Dr. R. Jagadeeswaran, Assoc. Prof.(SS&AC) WTC: Dr. S. Pazhanivelan, Director (WTC) Dr. K.P. Ragunath, Asst. Prof.(SS&AC) Dr.A.P. Sivamurugan, Asst. Prof.(Agronomy) Physiology: Dr. Babu Rajendra Prasad, Asst. Prof. (CRP) Pathology: Dr. Senthilvel, Asst. Prof. (Pathology) Entomology: Dr. T. Srinivasan, Asst. Prof. (Entomology) Expected outcome • Comprehensive standardized spraying protocol for Rice, Maize, Cotton, Sugarcane, Pulses and Groundnut
S. No.	**Action plan proposed**

7	**Setting up of Drone production unit, Service centres and Establishing Remote Pilot Testing Organisation.** **Activities:** • Establishment of Kissan Drone Production unit and Service centre • Training persons for drone operation and with technicalities to handle various oprations. • Imparting Entrepreneurship skills in Agricultural Drone Operation. Duration: Three Years (2022 – 2024) Centres with Scientist WTC: Dr. S. Pazhanivelan, Director (WTC) Dr. K.P. Ragunath, Asst. Prof.(SS&AC) Department of RS&GIS: Dr. D. Muthumanickam, Prof. & Head (RS&GIS), Dr. R. Kumaraperumal, Asst.Prof.(SS&AC) Dr. R. Jagadeeswaran, Assoc. Prof.(SS&AC) **Expected outcome** • Persons trained will become empowered on the usage of Drones in Agriculture • Enhanced Employment opportunities as drone pilots for using Kisan drones and trainees with entrepreneurial skills to start their own business.

DEPARTMENT OF ENVIRONMENT SCIENCES

A1. Technology for adoption

Best management practice for oil palm: Drip fertigation of 0.6:0.3:0.6 kg NPK palm^{-1} year^{-1} along with co-composted oil palm residue application @ 30 kg palm^{-1} year^{-1} is recommended for higher carbon sequestration and mitigating global warming. The highest biomass build up (1528 kg palm^{-1}) and CO_2 sequestration (400.6 t ha^{-1}) was observed in 15 year old oil palm plantations under drip fertigation.

A2.For OFT

OFT 1: *In situ* decomposition potential of TNAU Biomineralizer on crop residues [year: 2022-2023]

Objective: To study the *in situ* decomposition potential of TNAU biomineralizer on rice residues

Location	**:**	TNAU, Coimbatore
Lead Centre and Scientists in-charge	**:**	**Department of Env. Sciences, TNAU, Coimbatore** Dr. P. Kalaiselvi, Asst. Professor (Env. Sciences) Dr. V. Davamani, Asst. Professor (Env. Sciences)
Co-ordinating Centres and Scientists in-charge	**:**	**AC&RI, Kudumiyanmalai** Dr. S. Paul Sebastian, Asst. Professor (Env. Sciences) **KVK, Needamangalam** Dr. M. Selvamurugan, Asst. Professor (Env. Sciences)
Treatments	**:**	

T1 : Crop residues – Natural degradation (Control)
T2 : Crop residues incorporated in soil using rotavator and applied with TNAU Biomineralizer @ 2 kg/ton of residue
T3 : Crop residues incorporated in soil using rotavator and applied with TNAU Biomineralizer @ 2 kg/ton of residue + balancing C:N ratio with urea

A3.For Information:

1. Recycling of sewage sludge for hydrochar production and its energy potential

- For production of hydrochar from sewage sludge, optimum condition was found as 200^{o}C with duration of 6 h.
- Heating value of the sewage sludge increased after hydrothermal carbonization (16.24 to 19.41 MJ kg^{-1}), confirming energy densification (1.19) due to the process.
- Thermogravimetric analysis exhibited that the proportion of 50% coal and 50% sewage sludge derived hydrochar exhibited extended heat generation along with higher heating value of 23.16 MJ kg^{-1} which confirms the efficacy of hydrochar as an energy alternative.

- Chemical activation of hydrochar with H_3PO_4 showed promising results which recorded Particle size (286 nm), Zeta potential (-38.6 mV) and BET surface area (376 m^2 g^{-1}) for its utilization in removal of Per Fluro Octanoic Acid (PFOA).
- Post activated hydrochar achieved a higher PFOA removal percentage of 98.65 at pH 4 at an equilibrium period of 30 minutes and it showed the adsorption capacity of 236.38 mg/g which was established by Freundlich isotherm model.

2. *Vetiver* grass technology for heavy metal reduction and carbon sequestration in tannery effluent contaminated soils

Vetiver grass grown in the tannery effluent contaminated soil and amended with organic manures *viz.,* vermicompost and bio compost along with 100% STCR showed heavy metal reduction (chromium) to the tune of 21.5%. Both Biomass and Carbon sequestration potential were found to increase up to 25%. Hence, *vetiver* grass can be recommended for restoration of tannery effluent contaminated soils.

3. Flowering annuals and vegetables suitable for sodic soil

Performance of crops in sodic soil was in the order of *Marigold*> Globe *amaranthus*>Cocks comb>*Amaranthus*>Cluster beans

4. Antibiotics residue in soils and crops under intensive organic farming system

Analysis on antibiotic residue in agricultural fields with more than three years of organic cultivation applied with organic manures *viz*., FYM, composted farm residues and poultry manures indicated the presence of residues of antibiotics *viz.,* Oxytetracycline (0.14 µg g^{-1}), Enrofloxacin (0.12 µg g^{-1}) and Chlorotetracycline (0.27 µg g^{-1}).

5. Impact of Pulp and Board Mill treated effluent along with sludge on soil health and crop productivity

Irrigation of treated paperboard mill effluent through sub-surface (drip method) along with application of ETP sludge vermicompost @ 5 t ha^{-1} in pearl millet (CO 10) has exhibited 43% increase in grain yield (3.00 - 3.45 t ha^{-1}) and 21% increase in straw yield (147 – 178 kg ha^{-1}) over well water irrigation through surface (flood method) along with soil application of ETP sludge @ 5 t ha^{-1}.

- Higher nutrient availability in soil was recorded under 50% STCR NPK along with 50% MLSS under paper board mill effluent irrigation.

  In paper mill effluent irrigated soil, the cultivation of *S. portulacastrum*, a halophyte at 5 X 5 cm spacing along with pressmud compost @ 5 t ha^{-1} + CSR BIO @ 35 kg ha^{-1} for two sequence reduced the salt built-up up to 33 per cent and the soil ESP by 11.8 per cent.

  The application of amendments increased the uptake of sodium by *S. portulacastrum* by 38.89 per cent at first sequence and 49.7per cent at second sequence.

  Application of Pressmud compost @ 5 t ha^{-1} +CSR BIO @ 35 kg ha^{-1} along with phytoremediant (5x5 cm spacing) resulted in 2.04 times increased flower yield

(7.84 kg ha^{-1}) in African marigold over control (3.85 kg ha^{-1}) (no phytoremediant and no amendment).

6. Development of microbial consortium for enhancing the remediation potential of *Sesuvium portulacastrum* in paper mill effluent irrigated soil

Microbial cultures were isolated from the rhizosphere and endosphere of *Sesuvium portulacastrum*, a halophyte for developing microbial consortium to sustain the growth and yield of crops cultivated in paper and pulp mill effluent irrigated soil.

It was observed that the three microbial strains tolerated upto 7% NaCl and were compatible with each other. These compatible and efficient cultures were used for the formulation of consortium.

The cultures used in the consortium recorded plant growth promotion activities like Ammonia production (3.4 to 5.2 µg ml^{-1}), Siderophore production index (1.9 to 2.5), IAA production (11.2 to 23.6 µg ml^{-1}), Phosphate solubilisation index (2.3 to 2.6) and ACC deaminase activity (0.4 to 1.2 µM of α-ketobutyrate released mg^{-1} of protein h^{-1}).

Under laboratory scale experiment, inoculation of microbial consortium through root dipping increased the number of lateral roots (2.5%), root network depth (33%), total biomass (33.2%) and the phytodesalination potential of halophyte, *S. portulacastrum* (33.3%)

The inoculation of the microbial consortium on non-host plant (Black gram) improved the grain yield by 45.4% and plant dry matter production by 10.6% under paper and pulp mill effluent irrigation.

7. Color removal from textile dye effluent using modified coconut shell activated carbon

Zinc chloride impregnated coconut shell based activated carbon along with coir fiber and geotextile (5 kg + 5 kg + 3 kg) in the filtration system removed the color of textile dye effluent by 99.8 % (7021 HU), BOD by 82.15 % (600 to 83 mg L^{-1}) and COD by 91.24 % (2500 to 190 mg L^{-1}).

8. Impact of treated sewage irrigation on soil and fodder quality

Quality of treated sewage from TNAU STP unit I and II installed with activated sludge treatment system was found to be suitable for irrigation.

Due to continuous irrigation of treated sewage for three years, an improvement was observed in organic carbon by 30.36% and available NPK contents by 20.17, 16.13, and 13.33%, respectively in sewage irrigated soil over well water irrigated soil at 0-30 cm depth, whereas, they were higher by 20.75, 19.75, 21.88 and 14.60 %, respectively at 30-60 cm soil depth.

The forage grown soil irrigated with TNAU STP water, forage samples, milk samples collected from cows fed with STP water irrigated forage were found to contain below detectable limits of heavy metals.

Forage crop grown in treated sewage irrigation found to record 12.85, 21.42, 1.98 and 12.45 % crude protein, crude fibre, fat and ash content, respectively. The oxalate content was 2.32 % which is below the permissible limit of 4 % and also it has no heavy metals in it.

9. Impact of COVID 19 on river water quality

In River Cauvery, during lock down period (June, 2020 to April 2021), the water quality parameters like TDS, BOD, COD and coliforms population were reduced to the tune of 35.6, 61.1, 34.5, 70.5% respectively compared to pre-covid period (2019) and they were increased to the tune of 11.5, 14.5, 15.5 and 18.8%, respectively during post Covid period (June 2021 to April 2022).

In River Thamirabharani, during lock down period (June, 2020 to April 2021) the water quality parameters like TDS, BOD, COD and Coliforms were reduced to the tune of 51.7, 86.7, 88.7 and 56.3%, respectively compared to pre-lockdown period (2019) and increased to the tune of 12.12, 49.53,38.37 and 33.33 %, respectively during Post lockdown period (June 2021 to April 2022).

10. Mercury removal from wastewater with Natural Adsorbents

Natural adsorbents *viz.,* Rice husk biochar, Coir pith biochar and Water hyacinth biochar were found to have BET surface area of 5.22, 4.51 and 4.12 m^2 g^{-1}, pore volume of 0.25, 0.30 and 0.28 cc/g, Cation Exchange Capacity of 33, 34.5 and 35 c mol $[p^+]$ kg^{-1}, respectively and they were having the mercury removal efficiency of 44.8 to 46.2 %.

11. Effective Microbial (EM) formulation for waste treatment

Four EM formulations were prepared by using egg, fish waste, earthworms and fruit wastes. EMEg and EMFh formulations were selected and subjected to metagenomic analysis to study their bacterial diversity profile. The EMFh and EMEg formulations recorded highest percentage of bacteria belonging to Lactobacillaceae family (86.06 and 71.08% respectively).

The biochemical profiling of the EMFh and EMEg formulation revealed the presence of beneficial metabolites such as n-Hexadecanoic acid, 9, 12, 15-Octadecatrienoic acid and methyl ester and the functional groups like naphthoquinones, guanidines, hydrazones and amides.

The sewage water applied with EM formulation (EMFh) @ 3% reduced BOD up to 65%, COD upto 66% and total coliforms content up to 38%. In compost heaps with vegetable waste, 71% odour removal when applied with 3% EM formulation (EMFh).

12. Aerosol characteristics over High Altitude in Southern India

Diurnal variations of Aerosol Black Carbon (ABC) revealed a bimodel peak at morning and evening hours during summer (Mar to May), whereas winter and monsoon seasons showed a single peak at evening hours.

Sources of ABC mass concentration were apportioned based on the fossil fuel (BC_{ff}) and biomass burning (BC_{bb}). The contribution of fossil fuel was higher during Winter, Summer and Monsoon seasons with 0.679 µg m^{-3}, 1.127 µg m^{-3} and 0.188 µg m^{-3} respectively and contribution of biomass (0.001 µg m^{-3} at all the seasons) to the total ABC concentration. The Values of $\alpha_{abs} \sim 1$ in most cases also remained ≤ 1.1 indicating the dominance of fossil fuel aerosols in modifying aerosol absorption properties at Ooty.

13. Atmospheric trace gases over High altitude

At higher altitude (Ooty), ground level ozone exhibited a diurnal variation with higher concentrations (112 ppb) during night time and lower concentrations (6 ppb) during day time. Contrastingly, other precursors like NOx (NO and NO_2), SO_2 and CO were found to be higher during day time.

Frequency distribution of daily mean ozone at different seasons showed that during summer more than 90% of ozone values remain above the annual mean of 39 ppb. The monthly maximum O_3 values were recorded during February to May (63.12 ± 5.17 µg m^{-3}); while the highest AOT 40 value was recorded during March (11.126 ppm h^{-1}).

Monthly maximum NOx value was observed during April (2.13 ± 0.57 ppb), whereas minimum value was observed during August (0.37 ± 0.31 ppb).

14. Impact of tropospheric Ozone on field crops and its alleviation

Among the rice cultivars screened, Anna (R) 4 was found tolerant and TRY 2 was found sensitive to elevated tropospheric ozone concentration of 100 ppb.

In Black gram, VBN 8 was found tolerant and VBN 3 was found sensitive to 100 ppb of ozone.

(i) Rice

For alleviating ozone stress in Rice (100 ppb), various antioxidants, *viz.*, calcium acetate, neem coated urea, ascorbic acid, neem oil, panchagavya and PPFM besides EDU were tried. Among the antioxidants, application of 1 % neem coated urea in Rice (TRY (R2)) exhibited highest activity in alleviating ozone stress by increasing the physiological traits, (photosynthetic rate (36.23%; 16.90 µmol CO_2 m^{-2} s^{-1}), stomatal conductance (25% ; 0.40 mol H_2O m^{-2} s^{-1}) , chlorophyll content (18.96%; 28.38)), growth (plant height (13.01; 68.99 cm), number of tillers (32.86 %; 10) and number of effective tillers (46%; 8) and yield (number of spikelets per panicle (43.64%; 118), number of filled spikelets per panicle (45%; 110) and 1000 grain weight (15.68%; 21.52 g) traits.Application of 0.1% *ascorbic* acid also exhibited the same response.

(ii) Black gram

At 100 ppb ozone stress, the black gram variety VBN 3 was found to be sensitive; while VBN 8 was tolerant to ozone stress. Application of EDU significantly enhanced the physiological, growth and yield attributes of black

gram cultivars and the effect was highly pronounced in VBN 3 compared to VBN 8.

(iii) Bush beans

The annual mean value of ozone registered at Ooty was 39 ppb which depicts systematic pattern with the lowest during July – Nov. (15 ppb) and the highest during Feb. – May (68 ppb). The AOT 40 value observed was 11,126 ppb during March 2021 which coincides with the pod initiation stage and found to be above the critical level of ozone (5000 ppb for horticultural crops).

The high level of ozone reduced the stomatal conductance by 12.5 % (0.42 to 0.37 mol H_2O m^{-2} s^{-1}), photosynthetic rate by 31.3 % (19.33 to 13.27 µmol CO_2 m^{-2} s^{-1}) and chlorophyll content by 10.48 % (32.83 to 29.39 %), which incurred a yield loss of 11.95 % (20.49 to 18.00 t ha^{-1}), irrespective of varieties grown under ambient conditions.

15. Particulate matter deposits on trees around Thermal Power Plant in Thoothukudi Region

In 1 km radius of TTPP, highest Air Pollution Tolerance Index (APTI) was exhibited by *Milletia pinnata* (8.74) followed by *Azadirachta indica (*8.27). The same trend was also observed in 2.5 km zone around TTPP. Least APTI value was exhibited by the tree *Syzigium cumini* (7.79). Trees grown in TTPP areas exhibited 3.7 – 6.7% increase in APTI values compared to trees grown in non-polluted zone.

Particulate matter deposits in tree leaves ranged from 0.131 µg/cm^2 (*Terminalia* sp.) to 0.377 µg/cm^2 (*Syginium* sp.) and these values were within the prescribed limit of 100 µg / m^3 in 24 hours.

16. Minimising nitrous oxide emissions through N inhibitors

In tomato, STCR based neem coated urea application reduced the N_2O emissions by 38% over control and recorded 14% increased yield (63.2 t ha^{-1}) with enhanced NUE.

17. Effectiveness of TNAU biomineraliser on lignocellulosic wastes degradation

Application of improved TNAU Biomineralizer @2 kg ha^{-1} effectively degraded both low lignin (paddy straw) and high lignin (areca palm waste) agro-residues.

The duration of the paddy straw composting (low lignin agro-residue) was 60-90 days with a C:N ratio of 18:1and 120-150 days for areca palm waste (high lignin agro-residues) with a C:N ratio of 15.18:1.

TNAU Biomineralizer added with newly isolated microbial strains are effective for preparation of biocompost from the lignocellulosic agro residues.

18. Sustainable Management of Human Waste

Septage samples inoculated with EM culture @ 5 ml per litre along with aeration for four hours showed a reduction in BOD by 70.82 %, COD by 75 % and coli form population by 84.29 % respectively.

The dewatered sludge composted with municipal solid waste and coir dust at 2:1:1 ratio with TNAU Biomineralizer @ 2 kg per tonne of waste recorded a pH of 7.02, EC of 3.68 (dS m^{-1}), C/N ratio of 21.58:1, P and K contents of 0.60 and 0.72 per cent with heavy metals within the permissible limits.

Application of septage sludge compost @ 5 t ha^{-1} along with treated septage irrigation increased the organic carbon by 26.98 per cent, microbial population and enzyme activities as well as fruit set and fruit yield of tomato by 37.67 and 32.22 per cent, respectively over control.

In Marigold, septage sludge compost @ 5 t ha^{-1} along with treated septage irrigation enhanced the flower yield by 37.2 per cent over control. It also recorded higher total chlorophyll and xanthophylls contents (2.48 mg/g and 2.62 g/100g)

19. *In situ* decomposition of crop residues with TNAU biomineralizer

Field experiments conducted at TNAU, Coimbatore and KVK, Needamangalam documented that *in-situ* decomposition of rotavator thrashed rice stubbles with TNAU biomineralizer @ 2 kg/tonne of residue along with urea @ 25 kg /ha significantly decreased the CN ratio from 56.88 to 33.05 and from 54.54 to 32.21 in TNAU, CBE and KVK, Needamangalam respectively at 45 DAI. Furthermore, the soil microbial population and soil enzyme activities were found to be increased significantly.

The plots in two locations incorporated with crop residues using rotavator and TNAU Biomineralizer (@ 2 kg/ton of residue) along with application of urea for balancing C: N ratio recorded the highest grain yield of 6587 and 6590 kg ha^{-1}. The recorded yield was 18 and 17 % higher than control in TNAU, Coimbatore and KVK, Needamangalam, respectively.

20. Screening trees for higher reduction of noise

Among the 40 tree species studied, tree species namely *Azardirachta indica*, *Thespesia populenea*, *Neolamarckia cadamba* and *Pithecellobium dulce* reduced more than 20 dB noise level at a width of 25 m plantation.

Mixed tree species under high density plantations of 30 m width at three locations reduced the noise level up to 24.0 dB.

21. Ecological services rendered by high density plantations

An increase in 10 % relative humidity and a decrease in 2^0C in air temperature is reported inside Miyawaki plantations. Better noise reduction was observed upto 20.5 dB in a strip of 30 m width of Miyawaki plantations.

Invasive weed species (*Lantana camara, Parthenium hysterophorus and Eupatorium perfoliatum*) was absent inside Miyawaki plantations. Shannon diversity index of insects and arthropods is 2.26 in Miyawaki and 2.22 in normal plantation.

Cassia siamea, Pongamia pinnata, Thespesia populenea, Delonixregia, Azardirachta indica, Cassia siamea and *Peltophorum pterocarpum* sequesters more carbon in high density plantations.

22. Assessment of Microplastics in Agricultural Soils

Amongst various agricultural soil samples under study, microplastics were identified in sewage irrigated soil. The pink fibre polyethylene, blue fibre styrene maleic anhydride and pink fibre poly acetal microplastics were found to be present in sewage irrigated soil, amongst which polyethylene (PE) are the dominant type of microplastics recorded.

The results of the incubation experiment to evaluate to effect of Polyethylene (PE) microplastics (60µm to 600µm) on soil indicates that increasing concentration of microplastics increased the pH and electrical conductivity of the soil; while the bulk density was observed to decline.

B. Action plan proposed for 2022-2023

Action plan 1 (New)

Title of the Action plan	:	Assessing the fate and remediation of mixed contaminants in soil
Name of the scientists in charge	:	Dr. E. Parameswari, Asst. Professor (Env. Sciences) Dr. P. Kalaiselvi, Asst. Professor (Env. Sciences) Dr. A. Bharani, Associate Professor (Env. Sciences)
Duration	:	One year (2022 – 2023)
Rationale	:	Contaminated sites often contain a mixture of different organic and inorganic compounds that necessitates more complex remediation processes.
Objectives	:	To study the fate of co- contaminants (Heavy metals and PFAS) in soil To develop an integrated biosystem to manage co –contaminants in soil
Activities		**Incubation Experiment:** To study the fate of mixed contaminants in soil To assess the interaction, speciation and bioavailability of mixed contaminants along with amendments **Pot Culture Experiment:** To evaluate the potentials of organic amendments and plants in accelerating the phytoextraction efficiency To analyze the phytoextraction potential of marigold **Field Experiment:** To develop an integrated biosystem to manage mixed contaminants in soil
Outcome	:	Interaction effects of mixed pollutants in soil will be identified Development of an integrated biosystem to manage mixed contaminants in soil.

Action plan 2 (New)

Title of the Action plan	**:**	Study on release of toxicants by *Ipomoea carnea* in Kodikulam water tank in Madurai and Singanallur tank in Coimbatore
Name of the scientists in charge	**:**	Dr. R. Jayashree, Asst. Professor (Env. Sciences) Dr. A. Bharani, Associate Professor (Env. Sciences)
Duration	**:**	One year (2022 – 2023)
Rationale	**:**	*Ipomoea* is an invasive weed, which would choke any water body at any fresh water at a given time period. *I. carnea* releases some toxic substances in summer that affect the adult goats and all animals showed disorders of behaviours and consciousness as well as abnormalities of gait, ability to stand, and death
Objectives	**:**	Assessing the seasonal influence of toxicants release by *Ipomoea carnea*
Activities		Water sample collection from Kodikulam water tank of Madurai District and Singanallur tank of Coimbatore District at every three month interval. Analysis of water samples for water quality parameters (pH, EC, Na, K, Calcium, Magnesium, Chlorides, carbonates and bicarbonates, BOD, COD and others) Identification of toxicants by GC-MS in water samples of Kodikulam and Singanallur water tanks
Outcome	**:**	Identification of alkaloids and assessing the health impact on the ecosystem.

Action plan 3 (New)

Title of the Action plan	**:**	Estimating the Aerosol Radiative Forcing efficiency over Nilgiris Biosphere
Name of the scientists in charge	**:**	Dr. R.M. Jayabalakrishnan, Asst. Professor (Env. Sciences) Dr. R. Kumaraperumal, Assistant Professor (SS&AC), Dept. of RS&GIS Dr.P.Raja, Asst. Professor (AGM), HRS, TNAU, Ooty
Duration	**:**	Two years (2022 – 2024)
Rationale	**:**	• Atmospheric aerosols play an important and complex role in the regional/global climate system through scattering and absorption of incoming solar radiation
Objectives	**:**	• To study the aerosol optical properties and their contribution to radiative forcing over Nilgiris Biosphere

Activities	**:**	**To study the Aerosol Optical Depth (AOD) at Nilgiris biosphere** • AOD is a key atmospheric parameter and is among the most commonly used aerosol properties to determine the atmospheric aerosol loading and characteristics • Information about the aerosol size distribution is contained in the spectral AOD which is used to compute two other important aerosol parameters, Angström exponent (α) and turbidity coefficient (β) **To estimate the Radiative Forcing efficiency at Nilgiris biosphere** • To estimate and determine the radiative impacts or ability to modify the Earth's radiation budget and regional climate forcing of aerosols, the microphysical and optical properties of atmospheric aerosols such as the aerosol optical depth (AOD), size distribution, single scattering albedo (SSA), scattering (s) and extinction coefficients, as well as information on their spectral dependencies will be retrieved for comparison through open access satellite data. • SBDART can compute the radiative effects of several common boundary layer and upper atmosphere aerosol types. • SBDART model is a well appropriate for broad range of atmospheric radiative energy balance calculation and remote sensing.
Outcome	**:**	Estimation of radiative forcing efficiency of Nilgiris Biosphere Reserve

Action plan 4 (New)

Title of the Action plan	**:**	Assessment of fluoride transportation in food chain continuum
Name of the scientists in charge	**:**	Dr. P. Jothimani, Associate Professor (Env. Sciences) Dr. E. Parameswari, Asst. Professor (Env. Sciences) Dr. R.M. Jayabalakrishnan, Asst. Professor (Env. Sciences)
Duration	**:**	One year (2022 – 2023)
Rationale	**:**	• Fluoride contamination in water can be considered as a double-edged sword and globally, it is estimated that more than 70 million people are affected from fluorosis. • Tamil Nadu – 16 districts more than permissible limit of 1.5 ppm - groundwater
Objectives	**:**	• Assessing the fluoride transportation in food chain (Agroecosytem)
Activities		• Collection and analysis of groundwater – soil – plant samples from various places of Coimbatore district to identify the hotspots • Laboratory experiment to find out the fluoride accumulation in

		food chain.
Outcome	**:**	▪ Identification of hot spots of fluoride contamination in Coimbatore district

C. Research Projects and Remarks

(i) Theme Wise Research Projects

S. No.	Theme Area	Number of Projects			Projects recommended for closure
		URP	EFP	Total	
1.	Bioremediation of polluted habitats	04	02	06	01
2.	Wastewater Treatment and recycling	06	04	10	02
3.	Air pollution monitoring and mitigation	05	02	07	01
4.	Integrated solid waste management	04	03	07	02
5.	Agro-ecology and ecosystem services	02	-	02	-
	Total	**21**	**11**	**32**	**06**

A6. Remarks on the ongoing University Research projects/ Externally Funded Projects/ Core Projects

S. No.	Project Number and Title	Scientist in Charge	Duration	Remarks
Theme Area 1 – Bioremediation of polluted environments				
1	SDPC/NRM/CBE/ENS/2020/R013 *Vetiver* Grass Technology (VGT) for restoring the tannery effluent contaminated areas and carbon sequestration for combating climate change	Dr. K. Suganya Asst. Prof. (Env. Sci.)	April, 2021 to June, 2022	The project may be closed and completion report may be submitted for approval.
2.	NRM/TRY/ENS/FLO2020/001: Evaluation of flowering annuals and vegetables suitable for sodic soil	Dr. C. Prabakaran Asst. Prof. (Env. Sci.)	June, 2020 to March, 2023	The field evaluation may be carried out.
3.	NRM/CBE/ENS/NON/2021/001: Studies on antibiotics residue in soils and crops under intensive organic farming systems of Tamil Nadu	Dr. V. Davamani, Asst. Prof. (Env. Sci.) Dr. S. Paul Sebastian, Asst. Prof. (Env. Sci.) Dr. A. Christopher Lourduraj, Professor (Env. Sci.)	August, 2021 to July, 2023	Control may be included for comparison and the project may be continued as per the objectives
4.	NRM/MDU/ENV/NON/2022/001 Assessing the potential of biostimulants on soil health and crop growth in polluted soils	Dr. R. Jayashree Asst. Professor (Env. Sci.)	April, 2022 to May, 2024	The project may be continued as per the objectives

S. No.	Project Number and Title	Scientist in Charge	Duration	Remarks
5.	NRM/CBE/ENS/NON/2022/001 Enhancement of phytoextraction potential through chelators and subsequent recovery of chromium using Bamboo (*Bambusa balcooa*)	Dr. A. Bharani, Assoc. Professor (Env. Sci.)	April, 2022 to March, 2024	The project may be continued as per the objectives
6.	NRM/TNSLURB/CBE/ENS/2022/R001 Eco-Restoration of Coimbatore lakes with Floating Wetlands	Dr. K Sara Parwin Banu, Professor (Env. Sci.)	April, 2022 to March, 2023	The floating wetlands technology may be standardized for effective restoration The project may be continued as per the technical programme
Theme Area 2 – Wastewater Treatment and Recycling				
1.	NRM/CBE/ENS/2020/006 Evaluating the impact of COVID19 on river water quality	Dr. K. Suganya, Asst. Prof. (ENS) Dr. P. T. Ramesh Assoc. Professor (Env. Sci.)	June, 2020 to May, 2022	The project may be closed and completion report may be submitted for approval.
2.	NRM/CBE/ENS/2018/003 Evaluation of Natural adsorbents for removal of Mercury from wastewater	Dr. K. Suganya Asst. Prof. (Env. Sci.)	June, 2020 to May, 2022	The project may be closed and completion report may be submitted for approval.
3.	TNPL/NRM/TRY/SAC/2019/R001 Environmental quality assessment in the use of Paper Board Industry (TNPL Unit II) waste water for agro-forestry system	Dr. P. Balasubramaniam, Prof. & Head (SS & AC) ADAC & RI, Trichy. Dr. D. Jawahar, Professor (SS & AC), TNAU, Coimbatore. Dr. S. Shenbagavalli, Asst. Prof. (Env. Sci.) ADAC & RI, Trichy. Dr. T. Umamaheswari, Asst. Professor (Agrl. Microbiology), ADAC&RI, Trichy	April, 2019 to Sept 2022	The project may be continued as per the technical programme

S. No.	Project Number and Title	Scientist in Charge	Duration	Remarks
4.	NRM/CBE/ ENS/2019/002 Rhizo filtration of micro pollutants using vetiver	Dr. K Sara Parwin Banu, Professor (Env. Sci.)	October 2019 to October, 2022	Vetiver technology may be standardized and optimized for efficient filtration of pollutants
5.	NRM/CBE/ENS/2020/001 Impact of treated sewage irrigation on soil and fodder quality	Dr. M. Maheswari, Prof. & Head (Env. Sci.) Dr. S.D. Sivakumar, Assoc. Professor. (Agr.), Dept. of Forage Crops	January, 2020 to December, 2022	The project may be continued as per the technical programme
6.	SPBL/NRM/CBE/ENS/2014/R005 Eco-friendly utilization of Seshasayee paper mill effluent and solid wastes of Unit I, Pallipalayam, Erode, Namakkal district and Unit II, Elanthaikulam, Thirunelveli district and monitoring its impact on soil and groundwater	Dr. M. Maheswari Prof. and Head (Env. Sci.) Dr. V. Davamani, Asst. Professor (Env. Sci.)	April, 2022 to March, 2023	The project may be continued as per the technical programme
7.	ITC/NRM/CBE/ENS/2014/R003 Studies on the impact of ITC-Kovai Paper Board Mill treated effluent along with sludge on soil health and crop productivity	Dr. M. Maheswari Prof. and Head (Env. Sci.) Dr. G. Balasubramanian Professor (Env. Sci.) Dr. K. Suganya Asst. Prof. (Env. Sci.)	July, 2020 to June, 2023	The project may be continued as per the technical programme
8.	NRM/TVM/ENS/2021/001 Synthesis of carbon nano sheet from groundnut shell as potential agent for sewage wastewater treatment	Dr. P.C. Prabu, Asst. Prof. (Env. Sci.), RRS, Paiyur Dr. K. Raja, Asst. Professor (SST), DNST, TNAU	October, 2020 to September, 2023	The project may be continued as per the technical programme
9.	TNPL/NRM/CBE/ENS/2021/R008 Evaluation of long term effect of using treated TNPL Unit I (Karur) effluent water for irrigation and remediation of effluent irrigated soil habitat	Dr. M. Maheswari Professor & Head Dr. M. Prasanthrajan Professor (Env. Sci.)	April, 2021 to March, 2024	The project may be continued as per the technical programme
10.	NRM/PKM/ENS/NON/2021/001 Development of Effective Microbial (EM) formulation and	Dr. P. Kalaiselvi Asst. Prof. (Env. Sci.) Dr. E. Parameswari	November, 2021 to	The project may be continued to

S. No.	Project Number and Title	Scientist in Charge	Duration	Remarks
	assessing its potential in waste treatment	Asst. Professor (Env. Sci.) Dr. M. Maheswari Prof. and Head (Env. Sci.)	October, 2023	generate adequate scientific data to release as a formulation
Theme Area 3 – Air Pollution Monitoring and Mitigation				
1.	NRM/CBE/ENS/BGR/2019/001 Impact of Tropospheric Ozone on Black gram	Dr. P. Dhevagi, Professor (Env. Sci.)	October 2019 To July,2023	The combined effect of elevated levels of Ozone and CO_2 may be studied for different crops
2.	ISRO/NRM/KKM/ENS/2014/D002 Establishment and Maintenance of Environmental Observatory at Wood House, HRS, Ooty for Atmospheric Trace gases Chemistry Transport Modelling (ATCTM)	Dr. M. Maheswari, Prof. & Head (Env. Sci.) Dr. P. Dhevagi, Assoc. Professor (Env. Sci.), Dr. D. Keisar Lourdusamy, Prof. & Head (HRS, Ooty)	April, 2008 to March, 2024	The project may be continued as per the technical programme
3.	NRM/KKM/ENS/2020 /001 Impact evaluation of particulate matter deposits around Thoothukudi Thermal Power Plant (TTPP) on trees	Dr. P. T. Ramesh Assoc. Professor (Env. Sci.) Dr. A. Kavitha Pushpam Asst. Prof. (BIC) AC & RI, Killkulam	September 2020 to August, 2022	The project may be closed
4.	NRM/MTP/ENS/ 2020/002 Assessing the air pollution tolerance of various tree species for urban forestry and improved air quality	Dr. M. Prasanthrajan Professor (Env. Sci.)	October, 2020 to September, 2023	The trees with high oxygen emitting capacity suitable for smart city and domestic purpose may be identified
5.	NRM/CBE/ENS/VEG/2020/001 Assessing the impact of troposphere ozone on the growth and yield of bush beans under Nilgiris biosphere	Dr. R. M. Jayabalakrishnan, Asst. Professor (Env. Sci.) Dr. S. Karthikeyan, Asst. Professor (Hort.)	October, 2020 to September, 2022	The project may be closed
6.	NRM/KDM/ENS/SNF/2020/001	Dr. K. Boomiraj	September,	The project

S. No.	Project Number and Title	Scientist in Charge	Duration	Remarks
	Info Crop model for sunflower to sustain the production under changing climate	Asst. Professor (Env. Sci.) Dr. T. Selvakumar Asst. Professor (Agronomy)	2021 to August, 2023	may be continued as per the technical programme
7.	ISRO/NRM/CBE/ ENS/2012/D001 Establishment and maintenance of Aerosol Observatory at HRS, Ooty for assessing the Aerosol Radiative forcing over India (ARFI)"	Dr. M. Maheswari, Prof. & Head (Env. Sci.) Dr. R. M. Jayabalakrishnan Asst. Professor (Env. Sci.) Dr. K. Boomiraj, Asst. Professor (Env. Sci.),ODL Dr. D. Keisar Lourdusamy, Prof. & Head (HRS, Ooty)	April, 2022 to March, 2024	The project may be continued as per the technical programme
Theme Area 4 – Integrated Solid Waste Management				
1.	SPDC/NRM/CBE/ENS/2020/R012 Sustainable Management of Human Waste for Better Sanitation and Resource Utilization in Agriculture	Dr. M. Maheswari Prof. & Head (Env. Sci.) Dr. S. K. Raj Kishore, Asst. Professor (Env. Sci.)	July, 2020 to June, 2022	The project may be closed and completion report may be submitted for approval.
2.	NRM/CBE/ENS/2020/003 Assessing the *In situ* decomposition potential of TNAU Biomineralizer on crop residues	Dr. P. Kalaiselvi Asst. Professor (Env. Sci.) Dr. V. Davamani Asst. Professor (Env. Sci.) Dr. M. Selvamurugan Asst. Professor (Env. Sci.)	August, 2020 to July, 2022	The project may be closed and completion report may be submitted for approval. The On Farm Trial (OFT) may be conducted as per approved programme
3.	NRM/CBE/ENS/2020/002 Recycling of sewage sludge for synthesis of functional nanomaterials and its environmental applications	Dr. E. Parameswari Asst. Professor (Env. Sci.)	March, 2020 to February, 2023	The project may be continued as per the technical programme
4.	NRM/PKM/ENS/2020/001	Dr. J. Kannan,	October,	The project

S. No.	Project Number and Title	Scientist in Charge	Duration	Remarks
	Strategy to increase the organic carbon content and micronutrient status of soils of AC&RI, Madurai	Professor (Env. Sci.) AC & RI, Madurai	2020 to September, 2023	may be continued as per the technical programme
5.	NRM/TRY/SSAC/RIC/2021/001 Studies on hydrochar derived from sewage sludge and water hyacinth and its application in Rice cultivation	Dr. S. Paul Sebastian Asst. Professor (Env. Sci.)	November, 2020 to October, 2022	The project may be continued as per the technical programme
6.	NRM/DBT/CBE/ENS&REE/2022/R 002 Sustainable Management of tea waste to transform tea industry to carbon neutral and zero waste industry	Dr. M. Maheswari Prof. & Head (Env. Sci.) Dr. S. K. Raj Kishore Asst. Professor (Env. Sci.)	March, 2022 to February, 2025	The project may be continued as per the technical programme
7.	SFI/NRM/ CBE/ENS/2022/R003 Developing human excreta based bioproduct and evaluating its effect on the quality of soil and crop produce	Dr. M. Maheswari Prof. and Head (Env. Sci.) Dr. S. K. Raj Kishore Asst. Prof. (Env. Sci.) Dr. G. Sridevi Asst. Professor (SS&AC)	July 2022 to June 2024	The project may be continued as per the technical programme
Theme Area 5 – Agro ecology and Ecosystem Services				
1.	NRM/CBE/ENS/2020/004 Assessment of Microplastics in Agricultural Soils	Dr. P. Dhevagi Professor (Env. Sci.)	April, 2020 to September, 2023	The project may be continued as per the technical programme and the pot culture experiments may be taken up
2.	NRM/CBE/ENS/2019/001 Ecological impact of Miyawaki plantations in TNAU Campus	Dr. M. P. Sugumaran, Professor (Env. Sci.)	August, 2020 to July, 2023	The project may be continued as per the technical programme.

DEPARTMENT OF SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

A1.For Adoption: Nil

A2.For OFT:

Validation of Electrochemical Sensor tool for soil health analysis
Objective
To validate the efficient, low cost, user friendly electro chemical (EC) based Sensor Kit for assessing soil health conditions.

Validation Details
T_1- Analysis of soil samples adopting Standard Method
T_2- Analysis of soil samples adopting Sensor Kit Method

Number of soil samples to be analyzed
50 Neutral soil samples
25 Acid soil samples
25 saline and sodic soil samples

Soil properties to be analyzed
SoilpH, EC, Available N, P & K
Period: 1 Year (2022-2023)

Lead Centre and Scientist in charge
Dr. P. Kannan, Assistant Professor (SS&AC), Dept.of S&E, AC&RI,Madurai.

Coordinating scientists and centres

Location & Scientists
Dr. G. Sridevi, Assistant Professor (SS&AC), Dept. of SS&AC, DNRM, TNAU, Coimbatore
Dr. D. Janaki, Assistant Professor (SS&AC), Dept. of SS&AC, ADAC&RI, Tiruchirappalli

A3.For Information:

1. **Effect of Long term fertilization practices on dynamics of low dose herbicides in soil**

The herbicide (bensulfuron methyl) leaching experiment was conducted using the treatment wise (Ten) soil samples collected from Long Term Fertilizer Experiment (LTFE) using bensulfuorn methyl (BSM) @ 0, 45, 90 g *a.i* /ha. After 14 days, the soil of each column was dissected depth wise viz., 0-15, 15-30 and 30-45 cm and analysed for BSM residue with HPLC-DAD. Results showed the increased residue with increase in soil depth irrespective of fertilization practices and herbicide rates. About 10, 31 and 59 percent and 11, 30 and 58 percent residue was retained at 0-15, 15-30 and 30-45 cm depths respectively at 45 and 90 g/ha rates. Among the different long term fertilization

practices, high residue was detected in the 100% NPK+FYM columns at all depths and was followed by the 100% NPK (-S), 100% NPK and 150% NPK treatments respectively. Though the BSM is found to be high leacher in sandy clay loam soil, retention of more BSM by the long term fertilization practices viz.,100% NPK+FYM, 100% NPK, 150% NPK and 100% NPK (-S) than the other practices will help to provide efficient weed control beside reducing the water bodies contamination.

2. Soil Physical Properties and Water Quality of RRS, Paiyur Farm

`Regional Research Station, Paiyur farm comprises eight blocks with 106 fields. For the development of geospatial map for crop suitability analysis, GPS aided surface (15 cm) and subsurface soil samples (30 cm) were collected at three locations in all the fields of A, B, C, D, E, F, G and H blocks of RRS by adopting the standardized soil sampling procedures. Irrigation water samples were also collected during *Rabi* season for the determination of water quality. The soil samples (surface and subsurface) have been analysed for bulk density, particle density, porosity, soil texture and water holding capacity by adopting standard procedures. Except D block (D7 & D10-Clay loam) all the soil samples collected from the farm belongs to sandy loam. Both the open and bore well water samples collected from D block is slightly salinein nature (EC 1.1 to 2.1 dSm^{-1}), whereas other water samples are low in salinity and has low sodium hazard.TheBulk Density was recorded to be 1.11 to 1.52 Mg m^{-3} , Particle Density was 1.71 to 2.34 Mg m^{-3} and Total porosity was 31.7% to 40.4% . The blocks A, B,, G and H blocks have soil compaction. A and B blocks are suitable for paddy cultivation due to low lying and water stagnation. C and D blocks aresuitable for dryland, garden land &Horticultural crops. E and F blocks are suitable for arable crops and G and H blocks are suitable for paddy and ragi

3. Identification and mapping of soil constraints for sustained crop production in Red and Laterite Soils of Pudukkottai

Three hundred soil samples (surface -150 and subsurface -150) were collected from four major soil series *viz.,* Vayalogam, Vallam, Madukkur and Pattukottai representing 70 per cent of red and lateritic soils of Pudukottai district with an objective of preparing thematic maps and assessing the potentiality of these soils for crop production based on FCC. The soil samples were processed and analyzed for pH, EC, SOC and DTPA-Micronutrients. The results showed that 63 percent of the samples were slightly acidic and 37 per cent were moderately acidic in nature and were non-saline. The soil organic carbon values of the samples revealed that 25 per cent of the samples were low (< 5.0 g kg^{-1}) and 75 per cent of the samples were medium in status (5.0 to 7.5 g kg^{-1}). The micronutrient analysis of the soil samples showed that the DTPA-Fe content was high and ranged from 8.26 to 14.6 mg kg^{-1} in the surface samples whereas in the subsurface samples the values ranged from 7.56 to 12.67 mg kg^{-1} with an average value of 13.7 and 11.9 mg kg^{-1}, respectively. The DTPA-Zn values ranged from 0.29 to 3.12 mg kg^{-1} in the surface samples and in the subsurface samples the values ranged from 0.15 to 2.18 mg kg^{-1} with an average value of 1.24 and 0.76 mg kg^{-1}, respectively which is in deficient category.

4. Demonstration of Soil Science Technology for Management of Sub-soil hard pan soils of Coimbatore

Demonstration was undertaken with CO 8 red gram with the treatments *viz.,*.(i) Farmers' practice (Cultivator twice)and (ii) Chisel plough and cultivator twice (chiseling the field at 0.5 m initially to a depth of 60 cm at criss cross manner) and farm yard manure @ 12.5 t ha^{-1}. The CO 8 red gram seeds were sown in a non- saline, slightly alkaline pH sandy clay loam calcareous soil with low- high - medium NPK fertility status. Higher bulk density and higher penetration readings coupled with low hydraulic conductivity as well as low infiltration rates at deeper layers *viz.,* 20 - 40 and 40 - 60 cm were indicative of presence of sub-soil hard pan.Land preparation using Chisel ploughing with the application farm yard manure @ 12.5 t ha^{-1} had recorded thehighest plant height (172.87 cm) compared to farmer's practice (156.72 cm). The influence of chisel plough and farm yard manure @ 12.5 t ha^{-1} resulted in 14.0 per cent increase in grain yield of red gram over farmer's practice. Chisel ploughing further improved the soil physical properties such as bulk density, porosity, hydraulic conductivity and infiltration rate upto 60 cm of soil depth.

5. Fertility mapping of the farm soils of HRS, Ooty using GIS

Sixty number of soil samples were collected from six blocks of Wood House Farm, HRS, Ooty along with GPS points for the preparation of the thematic maps and analysed for various soil properties. The soil samples were analysed for organic carbon. Range of Organic C as per 2022 analysis is 3.68 to 8.68 g kg^{-1}. The soils of HRS, Ooty Wood House farm are acidic to neutral in soil pH and EC is non-saline. The available N, P and K status is medium to high, low to high and high respectively. Thematic maps were generated for soil pH, EC, OC, available N, P and K.

6. Soil resource inventory and Fertility mapping of Farm soils of AC&RI, Vazhavachanur using GIS

Base map of AC&RI, Vazhavachanur was generated using opensource satellite data. GPS aided surface samples (grid size of 50 x 50 m) were collected covering various blocks of AC&RI, Vazhavachanur. Totally 118 samples were collected and analysed for their physico-chemical properties. Six mapping units were identified and the soils belong to Kurumbalur series. Based on the properties, the soils were grouped under *Inceptisol* and *Alfisol*.The pH of surface soils varied from 6.31 to 7.84. Organic carbon status ranged from low to high (0.8 to 8.70 g kg^{-1}) and the available nitrogen status is low (162 to 275 kg ha^{-1}). The available phosphorus ranged from low to medium (6.00 to 21 kg ha^{-1}) and the available K content ranged from 168 to 392 kg ha^{-1}.

7. GIS based Fertility Mapping of the Farm soils of Oilseeds Research Station, Tindivanam

The results of the soil analysis of Tindivanam farm showed that the soil texture was sandy loam to sandy clay loam with neutral to slightly alkaline pH and non - saline to saline condition. The available N status was found to be low, P was medium to high and K was low to medium in A Block. The micronutrient content (Zn, Fe, Mn & Cu) was

sufficient in all blocks and though the soil was calcareous the Fe content seems to be slightly low in all the blocks (except B, part of A, C &E). The pH of the water samples ranged from 7.3 to 7.9 and the EC was Non saline and SAR was less than the critical limit for the open well and bore well. The GIS co-ordinates have been taken for the individual fields and this will ensure digitization of the soil fertility map.

8. Fertility status of farm soils of KVK, Pongalur

Soil samples have been collected from the fields of the Pongalur KVK farm and the soil available nutrient values were recorded. The total area of the farm is divided to 16 fields according to convenience of cultivation and irrigation. Soil reaction (pH) was slightly alkaline (7.49 to 8.65) and EC of the soil was non-saline (0.11 to 0.29 dSm^{-1}). Available N status of the soil ranged from 151 to 227 kg ha^{-1} and the status is Low. Available P (Olsen) status were low to medium and ranged from 7 to 16 kg ha^{-1}. Available K status of the soil samples were high ranging from 300 to 755 kg ha^{-1}.Organic carbon content of the soil samples was low to medium ranging from 0.27 to 0.60 per cent.

9.Management of Soil constraints at AC & RI, Eachangkottai, Thanjavur

The major problem in soils of this College farm is it's poor physical properties associated with their textural composition. The surface texture is sandy with inappropriate ratio of sand, silt and clay *viz.,* 45 % fine sand, 5 % coarse sand, 42 % silt and 7 % clay, which leads to number of soil physical constraints. The predominant soil physical constraints, which the farm facing are surface compaction, crusting and hardening, poor soil permeability, poor water retention, transmission and poor soil structure *etc.* The soil becomes fluffy, upon irrigation and become hard mass, when it is dried. In order to overcome this problem, a soil breeding experiment has been programmed as one time measure, as it happens to alter the soil textural composition, which leads to better soil texture, structure and ultimately the other soil physical properties. The different soil amendments *viz*., heavy clay, coarse sand, FYM and their combinations registered a significant influence on soil physical properties and rice yield. Among the treatments, a combination of FYM @12.5 t ha^{-1}+ Clay @50.0 t ha^{-1}+ Coarse sand @ 50.0 t ha^{-1} recorded significantly higher reduction in soil bulk density and improvement in soil pore space, infiltration and hydraulic conductivity. This particular treatment combination recorded 31 per cent enhanced rice grain yield over control in last two years (2020 - 22).

10. Soil Management technologies for the cultivation of groundnut in Theriland (Red sand dunes)

This research works aims at finding out suitable amendments for theri soil towards groundnut farming. Based on growth parameters obtained, tank silt in combination with fly ash @ 20 t/ha and recommended fertilizer application produced higher plant height (64.6 cm), number of branches (5 nos.), haulm yield (24.7 g) and pod yield (14.3 g). Yield and soil parameters will be worked after the harvest of the

crop. The improvement in textural property of this sandy soil might be the major reason for the yield enhancement under tank silt addition.

11. Effect of K fertilization on K^+:Na^+ homeostasis, K acquisition efficiency and grain quality of crops in saline and alkali soils under rainfed condition

To study the effect of K fertilisation on exchangeable K and Na ratio in saline-alkali soils, soil samples were collected from Ramnad (Saline soil), ADAC&RI, Trichy (Sodic soil 1), Valappady, Salem (Sodic soil 2) and Singipuram, Salem (Neutral soil). K fixing capacity of soils increased linearly with increase in K addition levels up to 600 mg kg^{-1}. The K fixing capacity of the soils are in the order of Neutral >Sodic soil 1 > Saline soil >Sodic soil 2.Ratio of (K/Na) showed that the exchangeable Na increased with K fertilizer addition irrespective of soil types and levels of K fertilization. Release of Exchangeable Na increased with increased K up to 125 % Soil Test based level and then decreased irrespective of soil types. Effect of K fertilization levels on influencing the (K/Na) ratio was in the order of Saline soil >Sodic soil 1>Sodic soil 2 > Neutral soil.The results showed that the excess K should be applied in saline and sodic soils than the recommended level to decrease the higher uptake of Na and its adverse effect on plants. Hence detailed studies will be conducted with the maize and greengram test species to explore the positive effect of K fertilization to overcome the adverse effect of Na in saline and sodic soils.

12. Non-conventional halophytes for reclamation of salt affected soils

Two leafy vegetables *viz*., *Talinium fruticosum* and *Salicornia brackiata* were identified for assessing salt removal potential. In addition to this, few wild edible / alternate / underutilized crops *viz*., *Cissus quadrangularis, Pennisetum purpureum, Atriplex sp.* (*Yerichakeerai*) and *Aloe barbadens*are selected for salt removal potential. *Sesuvium portulocastrum is* considered as control plant for evaluating other plants for salt removal. In order to evaluate these plants, pot experiment has been conducted using alkali soil (pH: 8.65; EC: 0.32 dS m^{-1}; ESP: 9.6). Totally 14 treatments (with and without fertilizers for seven plants) were tested using completely randomized block design. The plant height and biomass of the plants were assessed and tabulated. Characterization of mineral composition of the crops and assessment of salt removal from the soil are the objectives of this study. Considering biomass production, *Pennisetum purpureum* is superior (301.9g/plant) over other plants followed by *Talinum fruitcosum* (157.7g/plant) and *Sesuvium portulocastrum* (151.2 g/plant)under fertilizer applied conditions. The above identified crops have significant potential in meeting out the fodder and vegetable demand for the regions with alkali soils. In long run, the selected crops will aid in reclaiming the soil naturally besides augmenting farm income.

13. Development of electrochemical sensor tool for soil health analysis

A simple electrochemical sensor kit was developed in collaboration with the Central Electrochemical Research Institute, Karaikudi. pH and EC were found equivalent in both the methods and showed less variance of 5 and 6 per cent respectively. Water-soluble nitrogen and potassium results showed a wider variation of 37 & 32 percent

respectively and water-soluble phosphorus showed less variance of 8 percent. Universal extractant at 1:6 ratio was found as better extractant for P and K in neutral and calcareous soil. It showed less variation of 7 and 10 percent for phosphorus and potassium respectively, which is comparable with the standard method. In acid soil, the same extractant reported 45 and 8 percent of variation for phosphorus and potassium respectively.

14.GoI: GoTN - NMSA - Strengthening Soil Analytical Laboratories of TNAU at various Agro-climatic zones for Sustaining Soil Health and Farm Income

The sanctioned budget amount of Rs.228.8/- lakhs has been utilized for the purchase of all necessary equipments, chemicals, glasswares, apparatus and facilities for housing the equipments at all the eight centres of TNAU across various Agro Climatic Zones. The strengthened TNAU laboratories are providing soil and water analytical and advisory services to farmers and other stakeholders in the form of soil and water health cards.The analytical services are linked to the ongoing VCS of the respective centres for revenue generation.

15. INM for mulberry

Seriwaste compost was prepared using the waste collected from the silkworm rearing farmby two composting methods through EM and earthworms and major and micronutrient contents were estimated. Biometric parameters and leaf yield were recorded significantly higher in T_2 (75% of RDF + 25% Seriwaste compost), T_7(75% of RDF + 25% Vermicompost) and T_1 (100% of Recommended Dose of Fertiliser) followed by T_3(50% of RDF + 50% Seriwaste compost)andT_8(50% of RDF + 50% Vermicompost) regarding G_4 cultivar. The same trend was recorded in S36 cultivar. The leaf quality, nutrient availability, nutrient uptake and silkworm rearing parameters were found to be significantly higher in T_2(75% of RDF + 25% Seriwaste compost)and it was comparable with T_7(75% of RDF + 25% Vermicompost) & T_1followed by T_3(50% of RDF + 50% Seriwaste compost)andT_8(50% of RDF + 50% Vermicompost).

16. Secondary and micronutrients fertility status in the soils under different crops in Coimbatore and Tiruppur Districts

The availability of secondary and micronutrients status in the soils under sorghum, maize, coconut, tomato and banana in Tiruppur (243 samples) and Coimbatore districts (308 samples) showed, sufficient status of Ca and Mg in soils irrespective of crops grown. However, the S deficiency (30.1%) was considerable in the soils of Coimbatore district and the soils under coconut were having maximum S deficiency (58.3%) followed by maize (27.3%) and tomato (24.1%). As far as micronutrients are concerned, Cu (44.7%) and B (76.9%) deficiencies were predominantly observed in the soils grown with all the crops. Next to this, Zn deficiency was higher in soils grown with maize (42.1%) and coconut (37.3%). The Mn status was sufficient in all the soils under various crops of both the districts, but the soils under millets and tomato crops in Coimbatore district (37.1%) had considerable Fe deficiency. As a whole, the B and Cu deficiencies were higher in soils of both the districts irrespective of crops grown which needs attention.

17. Spatial and Temporal Variability of Micronutrient status and Water quality parameters of Tamiraparani river basin

A total of 84 ground water samples near Tamiraparani river (fourteen sampling sites) were collected during the period of Nov-I Fortnight 2020 to Feb-II Fortnight 2021 and analyzed for pH, EC and micronutrients status and then their minimum, maximum and mean were worked out.The spatial variation of pH at different sites and the temporal variation of pH at different periods (using regression) were found to be 64 and 72 per cent whereas in case of EC the spatial variation was found to be 58 percent and the temporal variation at different periods was found to be 66 percent respectively. In case of Fe, Zn, Cu and Mn concentration in the ground water samples, the spatial and temporal variation was found to be 62 and 70 percent; 55 and 75 percent ; 45 and 68 per cent ; 56 and 60 percent respectively. A total of 96 water samples in Tamiraparani river water (sixteen sampling sites) were collected during the period of Nov-I Fortnight 2021 to Feb-II Fortnight 2022 and analysed for pH, EC and micronutrients status and then their minimum, maximum and mean were worked out. The spatial variation of pH at different sites and the temporal variation of pH at different periods were found to be 45 and 62 per cent whereas in case of EC, the spatial variation was found to be 48 percent and the temporal variation at different periods was found to be 56 percent respectively. In case of Fe, Zn, Cu and Mn concentration in the ground water samples, the spatial and temporal variation was found to be 32 and 40 percent ; 51 and 60 percent ; 45 and 52 per cent ; 36 and 50 percent respectively.The water quality parameters were excellent. The micronutrients of the samples were of safe limit.

18. Survey and characterization of ground water of Coastal districts of Tamil Nadu for Irrigation Villupuram and Pudukottai districts

A study was undertaken to assess the groundwater quality in Villupuram district by collecting 143 groundwater samples using GPS and analyzed for pH, EC, anions *viz* ., HCO_3^-, CO_3^-, Cl^-, SO_4^{2-} and cations *viz.,* Ca^{2+}, Mg^{2+}, Na^+ and K^+ by adopting standard procedures and thematic maps were prepared using Arc GIS software 10.1. The investigation revealed that groundwater samples with respect to pH ranged from 7.0 to 8.4 with mean of 7.7 and EC ranged from 0.27 to 4.35 dSm^{-1} with mean of 1.14 dSm^{-1} respectively. Residual Sodium Carbonate (RSC) varied from nil to 11.10 meq L^{-1} and Sodium Adsorption Ratio (SAR) ranged from 0.26 to 20.31 with a mean SAR of 0.93. In the coastal blocks surveyed, the frequency of good quality water was more in Marakkanam block based on the CSSRI, Karnal water quality classification. The Vanur block had the highest alkalinity (75%) and the lowest alkalinity was found in Marakkanam block (63.63%). Based on the results of this investigation, only 9.09 per cent of samples were of good quality in the coastal blocks of Villuppuram district. Alkali accounted for 69.3 per centamong all samples with 12.87 per cent (marginal Alkali), 8.71 per cent (marginal saline) and 4.54 per cent (marginal saline). The largest percentage of alkali water samples were found in Vanur. In the Marakkanam block, there was an equal percentage of good water, marginal saline, high SAR saline and

marginal alkali. 95.455 per cent of samples in Villuppuram district's coastline blocks had varying salinity levels, which could be related to the district wide coastal line and the district's prolonged drought.

A study was undertaken to assess the groundwater quality in Pudukkottai district by collecting 149 groundwater samples using GPS and analysed for pH, EC, cations *viz.,* Ca^{2+}, Mg^{2+}, Na^{+} and K^{+} and anions *viz.,* CO_3^{2-}, HCO_3^{-}, Cl^{-} and SO_4^{2-} by adopting standard procedures and thematic maps were prepared using Arc GIS software 10.1. The investigation revealed that groundwater samples with respect to pH and EC ranged from 7.28 to 8.62 and 0.06 to 78.25 dSm^{-1}. Residual Sodium Carbonate (RSC) varied from nil to 13.67 meq $L^{-1}$and Sodium Adsorption Ratio (SAR) ranged from 0.19 to 44.61. According to CSSRI, Karnal water quality classification, 45 per cent of groundwater found under good quality, Marginally saline(12%), Saline(1%), High-SAR saline (4%) and Marginally alkali (14%). The cationic and anionic order of different blocks in Pudukkottai district are followed as $Na^{+}>Mg^{2+}>Ca^{2+}>K^{+}$ and $Cl^{-}> HCO_3^{-}> CO_3^{2-}> SO_4^{2-}$respectively. Among the different blocks investigated, the highest percentage of samples with good quality was found inThiruvarankulam (75%), Viralimalai (62.5%), Gandarvakottai (55%), Arantangi (55%), Arimalam (55%), Annavasal (50%) and Thirumayam (50%). Similarly, the poor-quality water recorded *viz.,* Marginal saline from Manamelkudi (36%) and Ponnamaravathi (35%), Saline from Avadaiyurkovil block (6.7%) and High SAR saline from Avadaiyurkovil (33%). Marginally alkali from Karambakudi (40%) and Gandarvakottai (36.4%), Alkali from Thiruvarankulam and Thirumayam (25%), High alkali from Pudukkottai (50%) and Manamelkudi (35%). Among the different blocks of Pudukkottai district, Avadaiyurkovil (40%) and Manamelkudi (35%) recorded the high level of possible seawater intrusion which was near to the sea coast.

B. New Action Plan

Title : Field Scale evaluation of *Talinum fruticosum* on sodic soil

Project leader(s) / Project Leader(s): Dr. K. Manikandan**,** Assistant Professor (SS&AC), TRRI, Aduthurai
Duration : Two years - 2022-2024

Objectives:

- ✓ To evaluate the growth performance of *Talinum fruitcosum* in sodic soil
- ✓ To assess the influence of *Talinum fruticosum*on sodic soil properties

Treatments:

T_1: *Talinum fruticosum* without fertilization
T_2: *Talinum fruticosum* with fertilization
T_3: *Sesuvium portulocastrum* without fertilization
T_4: *Sesuvium portulocastrum* with fertilization

Soil Type: Sodic soil

Observations to be recorded

- ✓ Plant height, biomass yield, nutritional value

Lab analysis

- ✓ Initial and post-harvest soil properties

Co-ordinating centres

FRS, Thovalai

- ✓ Dr.S.Suresh, Prof. and Head, AC&RI, Killikulam
- ✓ Dr. R.Swarnapriya, Prof. and Head, FRS, Thovalai
- ✓ Dr. K. Manikandan**,** Assistant Professor (SS&AC), TRRI, Aduthurai

ADAC&RI, Trichy

- ✓ Dr. D. Janaki, Assistant Professor (SS&AC)

CSRC, Ramanathapuram

- ✓ Dr. J. Prabaharan, Assistant Professor (SS&AC)

C. Remarks of the individual Non- Crop Specific Projects (NCSP) - 2022

S. No.	Project No. and Title	Project leader(s) / Co Project Leader(s)	Duration	Remarks
Action Plan Projects				
1.	Effect of Long term fertilization practices on dynamics of low dose herbicides in soil	Dr. P. Janaki, Professor (SS&AC) Dept. of SS&AC, TNAU, Coimbatore Dr. D. Jayanthi, Assoc. Prof. (SS&AC) Dept. of SS&AC, AC&RI, Karur.	2021-2023	• The Project work has to be speeded up so as to complete the technical programme on time with salient outcome.
2.	Development of Geospatial map for soil fertility and crop suitability analysis of RRS, Paiyur (NRM/PAI/SAC/VEG/2021/001)	Dr. P .C. Prabu, Asst. Prof (ENS), Paiyur. Dr. M. Vijayakumar, Assistant Professor (SS&AC), AC&RI, Kudimiyanmalai Dr. R.Kumaraperumal, AP (SS&AC), Dept of RS&GIS, TNAU, Coimbatore	2021-23	• Profile sample may be collected and analysed for important soil fertility parameters • The Project is to be continued as per technical programme and to be completed on time.

3.	Identification and Mapping of Soil Constraints for sustained crop production in Red & Laterite Soils	Dr. P. P. Mahendran, Dean, AC&RI, Madurai. Dr. R. Jagadeeswaran, Assoc. Prof. (SS&AC) Dept. of RS&GIS, Coimbatore Dr. M. Vijayakumar, Asst. Prof. (SS&AC) Dept. of DCM, AC&RI, Kudumiyanmalai	2021-23	The research work is to be continued and completed on time as per technical programme
4.	Demonstrations of Soil Science Technology for the Management of Subsoil Hard Pan soils of Coimbatore.	Dr. N. Chandra Sekaran, Professor (SS&AC) TNAU, Coimbatore	2021-23	Project work to be continued and completed as per approved programme by taking up demonstration in another location.
5.	Fertility mapping of the Farm soils of HRS, Ooty using GIS.	Dr. D. Selvi, Professor (SS&AC), Dept. of SS&AC Dr. K. Sivakumar, Asst. Prof, (SS & AC), Dept. of RS & GIS TNAU, Coimbatore	2020-22	✓ Mapping work should be done. ✓ Project has to be completed
University Research Projects				
6.	**NRM/VAZ/SSAC/2021 /001** Soil resource inventory and Fertility mapping of farm soils of AC&RI, Vazhavachanur using GIS.	Dr. V. Arunkumar, Assistant Professor (SS&AC)AC & RI, Vazhavachanur	June 2021 to May 2023	✓ Micronutrients content of soils may be estimated and mapping to be completed. ✓ The AAS facility at TNAU – I&TC, Chennai may be utilized for the analysis. ✓ The findings emanated so far may be given for information in NCSP Meet 2022
7.	**NRM/TVM/ENS/2020/ 001** Fertility mapping of the farm soils of Oilseeds Research Station of Tindivanam using GIS	Dr. P .G. Lavanya**,** Professor (SS&AC) (Retd.) Oilseeds Research Station, Tindivanam. Dr.R.Kumaraperumal Assistant Professor	January, 2020 to April, 2022	✓ The project work to be completed with mapping activity and completion report to be submitted

		(SS&AC), Dept of RS & GIS, TNAU, Coimbatore.		
8.	**NRM/CBE/SAC/2020/001.** Mapping Spatial Variability of soil physico-chemical properties andavailable nutrient status and assessment of irrigation water quality of KVK farm, Pongalur.	Dr. D. Jawahar**,** Professor (SS&AC), (Retd.) Dept. of SS&AC, TNAU, Coimbatore.	April 2020 to March 2022	• Soil fertility maps may be prepared. • The project work may be completed on time as per technical programme and completion report to be submitted.
9.	**NRM/ECK/SSAC/2021/OO2** Management of Soil constraints at Agricultural College and Research Institute, Eachangkottai, Thanjavur	Dr. S. Mohandas, Professor (SS&AC) & Head, Dept. of crop management AC&RI, Eachangkottai, Thanjavur	January 2021 – December 2024	• Pooled analysis may be done and the results may be given for information in NCSP 2022. • To be continued.
10	**NRM/KKM/SAC/2020/003** Sustainable soil development for cultivation of groundnut (*Archis hypogea* L.) and soil quality of Theri land (Red sand dune)	Dr. K. Manikandan, Asst. Prof. (SS&AC) TRRI, Aduthurai.	April, 2021 – March, 2024	• The Project is to be continued as per technical programme. • Midterm correction for the project may be proposed by inclusion of field trials in the third year as the same pot experiment is repeated for the entire project period.
11.	**NRM/CBE/SAC/2020/002** Effect of K fertilization on K^+:Na^+ homeostasis, K acquisition efficiency and grain quality of crops in saline and alkali soils under rainfed condition.	Dr. P. Janaki, Professor (SS&AC) Dept. of Soil Science &Agrl. Chemistry, TNAU, Coimbatore	January, 2021 – Dec,2023	• The Project work to be continued and speeded up so as to bring salient outcome.
12.	**NRM/KKM/SAC/2020/001** Exploring the	Dr. K. Manikandan, Asst. Prof.	December 2019 –	• Pot experiment may be

	nonconventional halophytes for reclamation of salt affected soils	(SS&AC),TRRI, Aduthurai	August 2022	continued and conclusion may be arrived based on biomass, utility and sodium removal. • An Action plan to be proposed for field scale evaluation of the best performing halophyte on sodic soil.
13.	**NRM/MTP/SAC/2019/ 001** Status and dynamics of soil nutrients with organic manures in mulberry growing soil	Dr. R. Rajeswari, Asst. Prof., (SS&AC), Dept. of SS&AC , TNAU, Coimbatore.	March 2019 to February 2022	• The project may be taken for adoption in discussion with the Professor & Head, Sericulture, FC&RI, Mettupalayam. • The project completion report has to be submitted through the Dean, FC&RI, Mettupalayam.
14.	**NRM/ KKM/ SAC/ 2021/ 001** Spatial and Temporal Mapping of Micronutrient status of Thamiraparani river basin	Dr. D. Leninraja, Asst. Prof. (SS&AC), Dept. of SS &AC, AC&RI, Killikulam.	Dec 2020 to Nov. 2022	• Mapping of the micronutrient status of Thamiraparani river basin may be completed at the earliest.
15.	**NRM/ECK/SSAC/ 2021/001** Management technologies for surface crust in red soils of Thanjavur District	Dr. A. Anuradha, Asst. Professor (SS&AC), AC&RI, Kurukkathi, Keezhvelur, Nagapattinam Dr. K.Venkatalakshmi, Assistant Professor (Agronomy), SWMRI, Thanjavur.	June 2021 to May 2024	• The Project is to be continued as per technical programme.
	Externally funded Projects			
16.	**NASF/ACRI/MDU/DSE /2020/R007** Development of electrochemical sensor	Dr. P. Kannan, Assistant Professor (SS&AC), Dept. of Soils and Environment,	Feb 2020 to January 2023	• Water-soluble N, P and K results showed moderate

	tool for soil health analysis	AC&RI, Madurai		variation with a high coefficient of variation. • The methodologies for chromophore development need to be relooked to get numerically equivalent data in both standard and sensor methods • Validation of the electrochemical sensor tool may be proposed in the NCSP 2022.
17.	**IFFCO/NRM/CBE/NST /2022/R02** IFFCO funded project - Insights and Impacts of IFFCO nano fertilizer products in Agri food System" (SS&AC Component)	Overall Project Coordinator: Dr. K. S. Subramanian Principal Investigators: Dr. R. Santhi, Dr. A. Lakshmanan, Dr. S. Pazhanivelan Co-PIs: Dr. S. Maragatham, Dr. C. Sharmila Rahale, Dr. S. K. Rajkishore	2021-2023	The project is continued as per the technical programme in co-ordination with Department of Nano Science and Technology.
AICRP Projects				
18.	**AICRP/NRM/CBE/SAC /004** Delineation and reassessment of micro and secondary nutrients deficient areas and updating soil fertility maps of Tamil Nadu	Dr. T. Chitdeshwari, Professor (SS&AC) Dr. D. Jegadeeswari, Assoc. Prof. (SS&AC)Dept. of SS&AC, TNAU, Coimbatore.	Continuous	Findings may be given for information To be continued as per AICRP technical programme.

19.	**AICRP/NRM/TRY/005** Survey and characterization of ground water of Coastal districts of Tamil Nadu for Irrigation.	Dr. P. Balasubramaniam, Director (NRM), TNAU, Coimbatore	2020 - 2021	✓ Ground water quality assessment is completed for 11 districts out of 13 districts. ✓ Currently Tiruvallur and Chengalpattu are in progress and after the completion a compendium may be prepared ✓ Soil characterization to be carried out.

DEPARTMENT OF AGRICULTURAL MICROBIOLOGY

A1. Technology for adoption:

Phyllosphere yeast consortium for enhanced growth and yield of rice

- Foliar application of 1% yeast consortium at critical growth stages of rice along with 75% RDF recorded highest antioxidant enzyme activity, grain yield (9 per cent increase) and B:C ratio.

- Yeast consortium (1%) effectively controlled the incidence of foliar pathogens of rice (*Helminthosporium oryzae, Xanthomonas oryzae* pv*. oryzae* and *Sarocladium oryzae*)

A2. OFT: Nil

A3. Technologies for Information

- A simple color-based gel probe to assess soil health in terms of soil respiration was developed. This gel turns its color from violet to magenta (low), orange (medium), and yellow (high) depending on the amount of CO_2 evolved within 8 hours of incubation. This method does not require many scientific skills, quick and straightforward to set up the device; interpreting the results would be simple and can be performed by the farmer himself. Further, this method does not require any sophisticated tools or equipment to derive soil health values. The color-change of the gel is positively correlated with the soil biological quality index and hence, it can presumably be used to assess soil health.
- The experimental soils collected from organic and inorganic nutrient management-adopted farmers' fields of Maharashtra state had significant differences among them. Significant improvement in soil organic carbon, microbial biomass carbon, dehydrogenase, soil labile carbon, protein index, and respiration was observed due to two years of organic management practices (10% cow urine application; seedling dip in raw milk and Haldi powder; Jeevamirit spray twice; Panchagavya spray) as compared to inorganic chemical fertilizer applied soils (nursery bed: 2-3 g urea; 2 g SSP; 1 g of MOP per m^2; Field: 100:50:40 kg/ha N, P_2O_5,K_2O).
- *Bacillus altitutidinis* FD48, a multi-functional plant growth-promoting bacterium was tagged with GFP protein marker for plant colonization studies and its fluorescence intensity was measured. Furthermore, in an effort to develop nano formulation of FD48, nano emulsions with droplets particle size of 27.1 nm and PDI of 0.986 was achieved under the applied sonication power the active ingredient (Pectin) mixed with surfactant (tween 80), and of solvent (glycerol).

- In order to produce laccase using coir pith as a substrate, the highest laccase producing *Hexagonia hirta* MSF2 was evaluated for laccase production and registered an activity of 1877.46 U/g db of coir pith under the optimized conditions of substrate at 90% moisture level, pH 4.5 (1208.08 U/g db) and temperature of 32°C (1292.85 U/g db).Of the five different carbon sources viz.,

glucose, fructose, maltose, sucrose, and xylose at 1% concentration, xylose had the highest laccase activity of 1676.45 U/g. Among the five different nitrogen sources *viz*., ammonium chloride, ammonium sulphate, peptone, urea, and yeast extract. The laccase activity of yeast extract (1629.43 U/g) was higher than that of the other nitrogen sources. The laccase activity of *H. hirta* MSF2 was highest (1485.9 U/g) at 0.5mM $CuSO_4$ concentration among the varied concentrations of copper sulphate. Experimental designs (RSM) for optimization was carried out and the results revealed that, the maximum laccase activity of 1585.24 U/g db was achieved in the coir pith substrate containing 1% carbon source, 0.5% nitrogen source, 0.25 mM of copper sulphate concentration, moisture content of 75% at pH 4.6 and temperature 28 ^{o}C.

- While evaluating the thermophilic bacterial cultures for the production of cellulase and xyanases, *Bacillus licheniformis* (VCB4, VCB3, KBFB3) showed better cellulase and xylanase enzyme activity.

- Microbial consortia developed for lignocellulolytic biomass degradation consisting of nine isolates of bacteria, fungi and actinobacteria was observed to be significantly superior in terms of compost parameters such as optimum C:N ratio, increased macro and micronutrient content, reduced cellulose, hemicellulose, lignin and heavy metal content in the matured compost

- A modified procedure was developed to authenticate the putative competitive endophytes during the characterization of plant-growth-promoting endophytes for inoculant development. The advantages of the present method over the standard method are 1) Precise identification of putative competitive endophytes from the opportunistic and passenger endophytes being isolated during the investigation; 2) DNA fingerprinting assay offers further authentication of inoculated strain by fulfilling Koch's postulate; 3) Relatively quicker method (requires 14 days to complete the assay). 4) This modified procedure can be adopted for endophytes of any plant [Student thesis work].
- One hundred ml oil (*Hydnocarpus* / sea weed) with 97% formic acid and 30% hydrogen peroxide; <40°C; extraction with ether; cross linker styrene was found to be ideal for obtaining resin from *Hydnocarpus* and seaweed oil. The hydroxylated resin exhibited a blue shift when compared with the corresponding parent oil which is attributed to the substitution of hydroxyl group at the unsaturated moiety.
- Multifarious PGP *Rhizobium pusense* KRBKKM1 & *Stenotrophomonas maltophila* KRBKKM2 that possess nitrogen fixing potential; P &K solubilization; siderophore production; Volatile Organic Compounds – Pentadecene, Tridecene [plant growth]; Heptadecene [antimicrobial]; Methoxy phenol [plant-microbe symbiosis] have been identified from banana rhizosphere.

B. Action Plan - 2022-23

Assessing the performance of Quantitative Color-based Probe in Farmers' fields for monitoring the soil biological health

Rationale

Soil health measures the capacity of soil to function as vital living system and the soil health was influenced by several crop management strategies. There is no simple on-field tool available to measure the soil health or biological activities. A color-changing gel has been developed at Department of Agricultural Microbiology to measure the respiration rate of the soil, thereby understanding the overall-biological activities and in turn the biological quality of soil. The present action plan will allow to develop a low-cost farmer-oriented probe to assess the soil's health, which will help the farmer to monitor his soil's health without much scientific skill and equipment.

Objective

To evaluate the efficiency of Color-based probe for measuring the soil health in farmer's fields

Work plan

The soil samples from farmers' field will be collected across Tamil Nadu. The soil biological quality index (SBQI) of each sample will be assessed. The respiration rate by alkali-trap method will be quantified for each soil. Then, the gel-based color probe will be used to measure the respiration and the score value will be compared with actual CO_2 release and SBQI. The relatedness of color-based gel with SBQI and crop yields will be assessed.

Centres

Microbiology, Coimbatore; Microbiology, Madurai; AC & RI, Killikulam; TRRI, Aduthurai; ORS, Tindivanam; AC & RI, Vazhavachanur; RRS, Tirur; ARS, Viruthachalam.

The Microbiologists in association with Soil Scientists of each centre will perform the investigation.

Scientist in-charge: Dr. D. Balachandar, Professor (Ag Micro)

Outcome

A farmer-usable simple kit will be designed to pursue soil respiration for soil health assessment

C. Project wise remarks

S. No.	Title of the Project	Name, designation & official address of the project leaders	Period	Remarks
Action Plan				
1.	Bio-capsule/Pellet formulation of NPK bio-inoculants and testing its bio-efficacy	Dr. B. Jeberlin Prabina Assoc. Professor	2021-2024	The project may be

		Dept. of SS&AC., Killikulam		continued
UNIVERSITY RESEARCH PROJECTS				
2.	NRM/CBE/AGM/RIC/2021/001 Utilization of amylolytic characteristics of probiotic lactic acid bacteria in rice based food formulations	Dr.K.Vijila, Professor, Department of Agrl. Microbiology, TNAU, Coimbatore	Aug. 2020 to June 2023	The project may be continued
3.	NRM/MDU/AGM/2020/001 Degradation of leaf litter by lignocellulolytic microbial consortia for production of quality compost	Dr. R. Subhashini, Associate Professor Dr. R. Jayashree, Asst. Professor Dept. of Agricultural Microbiology AC & RI, Madurai	Sept 2019 – Aug 2021	The project has to be closed
4.	NRM/MDU/AGM/2020/002 Development of thermotolerant *Bacillus* isolates for plant growth promotion	Dr.R. Uma Sankareswari Asst. Professor Department of Agricultural Microbiology, AC & RI, Madurai	URP; Sep 2020 to August, 2023	The project may be continued
5.	NRM/MDU/AGM/2020/004 Development of novel bacterial strains for Nitrogen fixation and PO_4solubilization in sunflower	Dr.N. Ramalingam, Professor Department of Agricultural Microbiology, AC & RI, Madurai	URP; September 2020-August 2023	The project may be continued
6.	NRM/TRY/AGM/2020/001 Influence of AM fungal association on growth and root biomass production of Ashwagandha (*Withania somnifera* L.) in sodic soil	Dr. L. Srimathi Priya, Asst. Professor Horticultural College & Research Institute for Women, TRICHY	URP; September 2020 – August 2023	The project may be continued
7.	NRM/ TRY/ AGM/ 2021/001 Screening of efficient bacterial strains for improving soil health of fallow land	Dr. K.G. Anitha Asst. Professor Anbil Dharmalingam Agricultural College & Research Institute, Navalur Kuttapattu, Trichy- 27	URP; Oct, 2020 – Sep, 2022	The project may be continued
8.	URP/2022-00039/NRM/AGM/NON/001. Exploring antimicrobial secondary metaboliotes from agriculturally important microbes as next generation weedicide.	Dr.V.Gomathi Professor Department of Agricultural Microbiology TNAU, Coimbatore	URP; March, 2022 to Feb, 2024	The project may be continued

AICRIP				
9.	AICRP/NRM/CBE/AGM/001 All India Network Project on Soil Biodiversity and Biofertilizers	Dr. D. Balachandar, Professor Dr. M. Gnanachitra, Professor Department of Agricultural Microbiology TNAU, Coimbatore	ICAR-AICRIP-2016-21	The project may be continued
EXTERNALLY FUNDED PROJECTS				
10.	Bioversity/NRM/AGM/CBE/2019/R025 Enabling farmers to assess soil quality implications of agricultural options: farmer citizen science. (Bioversity, New Delhi)	Dr.D. Balachandar, Professor Dr.M. Gnanachitra, Associate Professor Department of Agricultural Microbiology TNAU, Coimbatore	Biovarsity; Sep, 2019 to March, 2021	The project May be closed
11.	SERB/NRM/AGM/CBE/2021/R026 Development of process for laccase production by *Hexagoniahirta* MSF2 using coconut industry wastes and recovery of biochemical (E28AFM)	Dr. U. Sivakumar Professor Department of Agricultural Microbiology, TNAU, Coimbatore	SERB; 30.12.2020 – 29.11.2023	The project may be continued
12	ICAR/NRM/CBE/AGM/202/R002. Bioproccessing of Natural Fibres and Agro residues for Production of Oligo-saccharides and Starch	Dr. U. Sivakumar Professor Department of Agricultural Microbiology TNAU, Coimbatore	2021-2024	The project may be continued
13	SERB/NRM/AGM/CBE/2021/R001: Nano-formulated plant probiotic *Bacillus altitudinis* FD48 and their metabolites for induced drought protection, plant defense and enhanced productivity in Rice.	Dr. U. Sivakumar Professor Department of Agricultural Microbiology TNAU, Coimbatore	2020-2023	The project may be continued
14	DBT/AGM/KKM/SAC/2018/RO11: The Spatio temporal documentation of the phyllosphere microorganisms in different agricultural ecosystems through foldscope	Dr. M. Gomathy, Asst. Professor Dept. of SS&AC., Killikulam	2018-2022	
15	TNSCST/ACRI/KKM/SAC/2020/R006 Synthesis and tailoring of novel degradable plastics using blue-green algal and tree oils for application in smart agriculture	Dr. B. Jeberlin Prabina Assoc. Professor	2020-2023	The project may be continued

16.	SADP/MDU/AGM/2021/R001 Establishment of biovillage for production and utilization of bioinnoculant in chellampatti block of Madurai District -Front line demonstration for *Azolla* Front line demonstration for VAM	Dr. M. Jeya Bharathi Asst. Professor Dept. of Agrl. Microbiology AC & RI, Madurai	2020 -21	The project May be closed
17.	TNSCST/HCRI/TRY/HOR/2021/R002 : Investigation on the effect of AM fungi and PGPR against panama wilt in banana caused by *Fusarium oxysporum* f. sp*. cubense*"	Dr. L. Srimathi Priya, Asst. Professor HC&RI(W), Trichy	April 2021 – March 2023	The project may be continued
STUDENT'S THESIS				
18.	Developing microbial holobiont of rice to enhance drought tolerance and nutrient acquisition (DST-Inspire 2018)	Ms.Nunna Sai Aparna Devi, 2018801102, Dr.D. Balachandar Department of Agricultural Microbiology, TNAU, Coimbatore	TNAU	

WATER TECHNOLOGY CENTRE

1. Technologies for adoption/OFT

1. Adoption

1. Sediment Filtering System for Groundwater Recharge through Bore wells

TNAU Water Technology Centre has developed a three layer sediment filtering system for ground water recharge through borewells devoid of clogging problem. The first layer consists of crushed granite stones of 12 mm to 24 mm size horizontally for a distance of 50 cm and the second layer comprises crushed granite stones of 8 mm to 12 mm vertically down for a depth of 120 cm. The filtered water is collected in a sump around the bore well. The third layer of filtering is done either passing the water through a polyurethane foam layer of sixty ppi(number of pores per inch) with 3.75 cm thickness placed around the casing pipe or through a siphon filter which is placed above ground. Both options can also be used simultaneously. For a filtration efficiency of 90 %, the filtration rate of siphon filter was optimized as 1400 litres per hour per square metre of filter area.

3. Sprinkler irrigation for tube rose

Sprinkler irrigation with 400 mini sprinklers for 1 ha with the spacing of 15 feet was found to cover and sprinkle the required water (1,80,000 lit/ha/day) for crop growth. This technology resulted in 40% enhanced flower productivity (73kg/ha/day) and water saving(1,20,000 lit/ha/day) inturn increased net income of farmers.

S. No	Particulars	Drip irrigation	Sprinkler irrigation
1.	Water usage	3,00,000 lit /ha/ day	1,80,000 lit/ha/day
2.	Flower productivity	52 kg/ha/day	73 kg / ha/ day
3.	Flower weight	1.17 g/ flower	1.33 g/flower
4.	Flower length	6 cm	7 cm
5.	Number of flowers per kg	850	750
6.	Market price	Rs.20 /kg	Rs.25 /kg
7.	Disease	Root rot	Below ETL
8.	Pest	Mealy bug, mites	Below ETL
9.	Yield	18980 kg/year	26645 kg/year

2. On Farm Trial: Nil

3. Research Projects and remarks

3.1 Research Projects

Crop	Centre	URP	Action plan	Core project	AICRP	EFP	Total
Rice	AC&RI,Madurai	-	-	-	2	**-**	**2**
Maize	WTC-Coimbatore & AC&RI,Madurai	-	-	-	2	**-**	**2**
Banana	ARS, Bhavanisagar	-	-	-	1	**-**	**1**
Brinjal and Chilli	AC&RI,Madurai	-	-	-	1	**-**	**1**
Others	WTC-Coimbatore	-	-	-	2	**-**	**2**
	ARS, Bhavanisagar	-	-	-	1	**-**	**1**
Total					**9**	**0**	**9**

3.2 Remarks on the ongoing university research projects /AICRP/ Externally funded projects

S. No.	Project No. & Title	Remarks
All India Coordinated Research Project (AICRP) on Irrigation Water Management - Coimbatore		
1.	Identification of Potential Groundwater Recharge Zones in various River basins of Tamil Nadu(2020-2023) Dr.V.Raviumar, Professor(SWCE)	Project may be continued
2.	Automated drip irrigation scheduling for Maize(2020-2023) Dr.A.Valliammai, Associate Professor(SWCE)	Project may be continued
3.	Design of sediment filtration for groundwater recharge through bore wells(2021-2024) Dr.V.Raviumar, Professor (SWCE)	Project may be continued
ARS, Bhavanisagar		
1.	Application of Soil and Water Assessment Tool (SWAT) model for estimation of surface water resources and temporal water demand for sustainable water management in selected watershed of Bhavani river basin (September, 2018 to August, 2023)	Proposal for extension of the project is submitted Project may be continued
2.	Estimation of crop coefficient for Banana for drip irrigation in Western Zone of Tamil Nadu (October 2020 to September, 2023)	Project may be continued
AC&RI,Madurai		
1.	Drip fertigation studies in Brinjal and Chilli (2021-2022) Dr. T. Sampathkumar, Asst. Prof. (Agronomy) Dr.Bhakiyathu saliha, Assoc. Prof. (SS&AC)	Project may be closed
2.	Assessment of the yield advantage, water requirement and water use efficiency under different methods of irrigation in rice (2019 to	Project may be closed

	2021) Dr. T. Sampathkumar, Asst. Prof. (Agronomy) Dr.Bhakiyathu saliha, Assoc. Prof. (SS&AC)	
3.	Deficit Irrigation for rice follow crop with higher productivity and profitability for Periyar Vaigai command area (2021-2023) Dr. T. Sampathkumar, Asst. Prof. (Agronomy) Dr.Bhakiyathu saliha, Assoc. Prof. (SS&AC)	Project may be continued
4.	Précising irrigation scheduling through leaf water potential in drip irrigated Maize (2021-2023) Dr. T. Sampathkumar, Asst. Prof. (Agronomy) Dr.Bhakiyathu saliha, Assoc. Prof. (SS&AC)	Project may be continued

4. Action Plan proposed for 2022-2024

Action Plan 1:
Standardization of automated irrigation to increase water productivity in major irrigated crops

Rationale

- Conventional method of irrigation results in heavy water loss due to seepage and deep percolation in the irrigation channel.
- In order to minimise water loss and enhancing water productivity, automatic irrigation planning process in the farm plan is needed.
- Automatic irrigation is the use of a device to operate irrigation structures so as to the change of flow of water from bays can occur in the absence of the irrigator
- Precise quantities of water matching crop water requirement will further optimise the utilisation of water resources and increase the productivity

Objectives

- To estimate water requirement precisely by integrating evaporative demand and soil moisture condition.
- To design effective irrigation schedule for major irrigated crops
- To validate and propose effective sensors and water controllers for different farm situations.
- To develop Standard Operating Procedures for automated micro irrigation for major irrigated crops

Duration: 2 Years (2022-2024)

Centre and Scientists involved

WTC, Coimbatore
Dr.V.Ravikumar, Professor (SWCE)
Dr.M. Raju, Professor (Agronomy)
Dr.S.Selvakumar, Associate Professor (SWCE)
Dr.A.P.Sivamurugan, Associate Professor (Agronomy)
Dr.K.P.Ragunath, Associate Professor (SS&AC)

ARS, Bhavanisagar
Dr.N.Sakthivel, Professor and Head
Dr.V.Vakeeshwaran, Associate Professor (SST)

AC&RI, Madurai
Dr.Veeraputhiran, Associate Professor (Agronomy)
Dr.Bhakiyathu saliha, Professor (SS&AC)

Action Plan 2:
Working out the water productivity in different sub basins and developing policy document on crop planning, crop intensification and alternate livelihood

Rationale

- Water productivity varies from region to region and from field to field, depending on many factors viz., crop patterns, climate patterns etc.
- The loss of water and improper utilization of available water in the sub basins tanks are to be rectified
- Proper sharing of water for crop intensification and diversification has to be achieved to optimise water use.
- Water productivity in the sub basin level or tank level needs to be analysed through a holistic modelling framework by deploying spatial analytical tools.

Objectives

- To estimate water productivity at sub basin level for create historic data base on cropping intensity and identifying potential areas for crop intensification and diversification to increase water productivity and profitability.
- To develop frame work for advising suitable integrated farming system models for alternate livehood under normal and water stress conditions

Duration: 2 Years (2022-2024)

Centre and Scientists involved

WTC, Coimbatore
Dr.V.Ravikumar, Professor (SWCE)
Dr.M. Raju, Professor (Agronomy)
Dr.S.Selvakumar, Associate Professor (SWCE)
Dr.A.P.Sivamurugan, Associate Professor (Agronomy)
Dr.K.P.Ragunath, Associate Professor (SS&AC)

Action Plan 3:
Assessing methane emission by using satellite measurements and micro-meteorological observation
Rationale

- Methane emission from rice ecosystem accounts 1.5 percent of total global greenhouse gas emissions
- Flooding a rice field cuts off the oxygen supply from the atmosphere to the soil, results in anaerobic fermentation of soil organic matter.
- Spatial estimation of methane emission through integration of remote sensing and field measurements helps in developing climate resilient agricultural systems.
- Proposed an ICT tool utilizing GIS platform: designed, developed and deployed to acquire data through remote sensing satellites viz., sentinel IA, sentinel 5P, GOSAT satellite sensors and other global open source data sets.
- At field level, Eddy covariance flux towers will be installed in two locations to quantify methane emission and its contribution to atmospheric flux.

Objectives

- To create inventory on GHG including CH4 for TNIAMP sub basins integrating remote sensing, DNDC and FAO EXACT model
- To assess the impact of TNIAMP crop management practices in reducing methane emission using remote sensing technique.
- To estimate of methane at field and spatial scale using portable gas analyzer and Eddy Flux tower
- To demonstrate agronomic practices for reducing GHG emission in the sub basins.

Duration: 2 Years (2022-2024)

Centre and Scientists involved

WTC, Coimbatore
Dr.M. Raju, Professor (Agronomy)
Dr.A.P. Sivamurugan, Associate Professor (Agronomy)
Dr.K.P.Ragunath, Associate Professor (SS&AC)

Agricultural Meteorology

A. Decisions made on Adoption / OFT / Information:

A1. For Adoption

Theme 1: Weather forecasting and Agro advisory

Weather based response farming promises sustainable productivity and net return by lowering input loss risk and increasing input use efficiency. The response farming is highly dependent on the accurate weather information in advance, at least for a week, which is highly dynamic, depending on geographical location, topography, and green fractions and other factors. Further improvement of the TNAU's block level Medium Range Weather Forecast (TNAU - MRWF), the TNAU sponsored University Research Project (URP, 2019 - 22) has downscaled the forecast by spatially to the village level @ 3km resolution) and temporally to hourly for catering the local circulations and hour of happenings. The TNAU Village Level MRWF has been verified across all the seven Agro Climate Zones of Tamil Nadu during 2020 – 2021 and the Forecast Usability Percentage was ranged between 60 - 80 during CWP, 40 - 60 during HWP, 50 - 70 during SWM and between 70 and 90 during NEM. During 2020 -21, a separate web application to host "TNAU - Village Level Forecast" has been developed http://aas.tnau.ac.in/vlf/ with map view and table view. Weather forecast for next six days to 18,585 revenue villages of Tamil Nadu is being uploaded by 10 AM of everyday. In the Map view, the web application provides "popup" of current hour forecast of nearby village. The detailed table view provides hourly and daily forecast for next six days to the selected revenue villages in Tamil Nadu. The **TNAU – Village Level Forecast website** http://aas.tnau.ac.in/vlf/**is ready for launch and adoption**.

A2. OFT - Nil

A3. For Information

Theme 1: Weather forecast and Agro advisory

- URP on seasonal forecast inferred that in Climate Predictability Tool (CPT), the SST was found to be the best predictor with better goodness of index value in predicting SWM & NEM, 2021 than other predictors viz., MSLP, Nino-regions, U & V component and Geo potential height. Among the four-machine learning algorithm viz., Decision Tree Regression, Gradient Boosting, Ada Boost and Random Forest Regression employed for the hindcast of monthly rainfall at Kovilpatti, the Random Forest Regression performed better with R^2 value of 0.8.
- URP on Astromet forecast for rainfall had given a conclusion that the negative state of the Sun, active status of the Saturn, Uranus, Venus and Moon were influenced positively on the rainfall quantity received in an hour. In case of wind events, the windy planet Mercury and the Neptune at active state, the Sun, Saturn and Neptune at Rule state, Venus and Uranus at negative state, Jupiter at highly active state had significant influence on the increased wind speed.

- IMD sponsored GKMS scheme is being operated at 5 AMFU centres and 9 DAMU centres of Tamil Nadu Agricultural University. The number of farmers registered for SMS advisories in Tamil Nadu had increased from 8.65 to 9.36 per cent (12.95 lakhs) during 2021-22, in addition to village level Whatsapp group. Agromet advisories are mostly preferred by the farmers to schedule irrigation, harvest, planting and spraying operations. Even with the IMD's lower weather forecast accuracy varied from 25 – 75 per cent, the Agro Advisory Service provided by TNAU scientists have given added benefit to the farmers from Rs. 2500 – 50000 per ha and reduce risk of complete loss,

Theme 2: Basic and applied meteorology

- Under NADP scheme, revival of 240 AWS has been completed so far. It is estimated that all the 285 AWS be functional before the end of October 2022. In addition, discussion with CRA is in progress for the taken over of physical stock of AWS, installing balance 100 AWS and AMC for all the 385 AWS.
- M.Sc. Thesis research on the Radiation Use Efficiency (RUE) under different intercropping ratio of Sorghum and Cow pea inferred that the intercropped Sorghum was found to have higher RUE than the sole Sorghum. Among the ratio of sole crop and intercrop, higher RUE was noticed in 2:1 pattern than 2:2 pattern. The higher plant density under 2:2 pattern could be attributed to the competition for resources which caused the biological stress,reduction in dry matter accumulation and ultimately affected the radiation use efficiency in 2:2 pattern.
- M.Sc. Thesis research in vegetable crops with different colours of polythene mulches inferred that the black mulch performed better than other four mulches viz., yellow, white, silver and red colours in Cucumber, whereas the white performed better in Tomato. Among the irrigation levels, 50 per cent irrigation had greater WUE but showed delay in flowering and small fruit sizes when compared to 100% irrigation and 75 % irrigation.

Theme 3: Climate change and crop weather model

- An URP on pearl millet under elevated temperature and enhanced CO_2 during the near, mid and end century (**T1**: Tmax+1^{o}C & 50ppm, Tmin +1.5^{o}C & 50ppm ; **T2**: Tmax+2^{o}C & 100ppm, Tmin +2.5^{o}C & 100ppm +2^{o}C & 100ppm; **sT3**: Tmax+3^{o}C & 150 ppm, Tmin +3.5^{o}C & 150ppm +2^{o}C & 100ppm;, 2, 2.5 and 3^{o}C) inferred that the grain yield of Pearl Millet CO 10 was reduced by 10-15, 15-24 and 25–35 per cent during *kharif,* whereas the yield reduction was lesser during rabi viz., 5-8, 10-15, and 20–25 per cent, respectively for the near, mid and end century. The higher negative deviation as well as fluctuations over temporal scale was observed in grain yield compared fodder yield.
- DST sponsored externally funded project "Co-Adapt" to enhance the adaptive capacity and agricultural productivity through ICT tools indicated that there would be yield reduction up to -21, -15, and -15 per cent in rainfed Groundnut of ParambikulamAliyar Project (PAP) basin during the near, mid and end century

period, respectively. The decline in groundnut yield is mainly due to rising nighttime temperature.

- The IMD sponsored FASAL scheme inferred that the statistical model 'Bayesian' consistently outperformed in block level rice yield prediction during both the kharif and rabi seasons as well as at the Flowering (F2) and Preharvest stage (F3). The SMLR model ranks second, while the LASSO and ENET models were the worst. In another FASAL study, farmers' practices were used instead of general recommended practices in crop simulation model-based rice yield prediction, and all districts with an acceptable variance of 10 per cent or less performed better, with the exception of Dharmapuri, where the difference between actual and forecast yield was over 18%.
- In DST – BRIFS scheme, the projection of future climate showed an increase in temperature and rainfall over the Cauvery delta and southern agro-climatic zones with varying magnitude, resulted in negative impact on rice productivity in these regions.
- In another study under the DST sponsored BRIFS scheme investigated the impact of organic inputs on Cow Pea under elevated temperature stress and reported that the heat stress (+2^{o}C from ambient level) impaired the growth characteristics and yield attributes. The physiological parameters *viz.,* photosynthetic rate and stomatal conductance were decreased while transpiration rate and leaf temperature were found to be at an increasing rate. The protein per centage was found to be significantly reduced when the cowpea crop exposed to heat stress. It was concluded fromt he study that soil application of Vermicompost and Panchagavya foliar spray (3%) reduced the negative effects of elevated temperature by increasing proline and peroxidase accumulation and by improving membrane stability.
- DST - Australia India Strategic Research Fund, India sponsored scheme on "Enhancing climate change adaptation processes" had surveyed in mango growing areas and found that the farmers felt drought year by every three years, whereas the flood year by every five years. About 23 per cent farmers alone have the capacity to resilience against weather vagaries. The coffee growers, opined that the drought is major issue for their area and have not faced flood issues during recent past. Rainfall forecast information during south west and northeast monsoon are more useful for the coffee growers as it is preferred by 69 and 82 per cent of growers respectively.
- National Academy of Sciences, Washington DC, USA sponsored Collaborative Adaptation Pathways for Water Management in Agriculture in Bhavani River Basin project inferred that the agricultural system is more sensitive to climate variability than climate change. There would be a high risk of supply-demand ratio to climate stressors, whereas low risk on paddy yield to change in climate stressors. The project outcome pointed that there would be a Robust adaptation plans needed to tackle the changes in climate stressors.
- A M/s. Coramandal International ltd, Chennai project on Neem and weather parameter interactions has developed a yield prediction model for neem and found

a negative yield response to maximum temperature during vegetative, flowering and fruiting stages. Relative humidity, minimum temperature and rainfall showed negative response to yield at all stages. The negative response of yield to rainfall was higher in flowering and fruiting stages when compared to pre-flowering stage. The influence of weather parameters was higher in flowering and fruiting stage when compared to other pre-flowering stage.

- Ph.D. thesis research on elevated night temperature at different stage of green gram and black gram recorded that the Greengram was very sensitive to high night temperature stress than blackgram. The flowering and pod filling stage of both the black and green gram are most sensitive stages t elevated night temperatures. Green gram is more sensitive to elevated night temperature and CO2 stress during 36 to 42 DAS whereas the black gram is sensitive during 43-49 DAS.
- In a Ph.D. thesis research work, the SRI method of rice cultivation with new functions for cono weeding and altering soil properties have been successfully incorporated in DSSAT model.

Theme 4: Weather based pest and disease forewarning model

- Ph.D thesis research work found that the incidence and development of rice leaf blast are mainly influenced by minimum temperature, grass minimum temperature, morning dew point temperature, afternoon dew point temperature, afternoon relative humidity and rainfall like drizzling for more than two days with lower temperature leads to an outbreak of leaf blast. Among all these weather parameters minimum temperature has significant relation.

B. Action Plan– 2022 – 2025

S. No.	Project Title	Project Teams
	Theme 3 – Climate Change and Crop Weather Model	
1.	**Assessing the climate change impact and adaptation strategies for sustaining the sorghum production in different most efficient cropping zones of Tamil Nadu** Physiology-based crop simulation models have become a key tool in extrapolating the impact of climate change from limited experimental evidence to broader climatic zones, soil types, crop management regimens, crops and climate change scenarios. This includes the use of modelling to optimize management practices, assist in breeding programs, develop new crop rotations and maximize the value of seasonal climate forecasts. In order to meet the increasing demand for assessment of climate change impact, crop models need to be further improved and tested with climate change scenarios involving various changes in ambient temperature and CO2 concentration. Current knowledge gaps include limited understanding and modelling of the interactive impact of climate factors, the impact of extreme events occurring at different crop stages, sink-source	Dr. S. Kokilavani Asst. Prof. (Agmet) Dr. K. Boomiraj Asst. Prof. (ENS) Dr. Ga. Dheebakaran Asst. Prof. (Agronomy)

	relationships, and changes in yield quality of crops under future climates. There are limited studies to assess the probable impact of climate change on Sorghum under elevated temperature and CO_2.	

S. No	Project Title	Project Teams
	Theme 2 – Basic and Applied Agrometeorology	
1.	**Assessing the crop responses to temporal variability in drought and developing management protocols through agronomical, breeding, molecular and genomics approaches** Crop response to the individual weather parameter is highly differ from combinations of multiple weather parameters. Furthermore variation is added by the magnitude of each weather parameter in that combination. The crop response to the summer (bright sunshine, hot and dry air) is highly different from the monsoon (cloudy, warm and moist air) and winter (clear sky, cool and dry air). The drought during these period may add another variable 'soil moisture' in the above combination, that brings much more complication in the morphological, physiological, biochemical and molecular response of crops. Plants have evolved a variety of complicated resistance and adaptation mechanisms, including physiological and biochemical responses, to cope with water scarcity, which vary by species. A clear understanding of crop responses to varied magnitude of weather combinations during different seasons of a year may provide opportunities to choose right management technologies from the row of agronomical, biochemical, breeding, molecular and genomics (omics technology) strategies. **(Planned for external funding)**	Dr. Ga. Dheebakaran Asst. Prof. (Agronomy) Dr. M. Raveendran, Prof. (Bio Tech.) & Director of Research, TNAU Dr. A. Senthil Professor & Head, Crop Physiology

C. Research Projects and Remarks

THEME WISE RESEARCH PROJECTS

Theme	URP	Externally funded Projects				Students' Research	Total
		AICRP	GOI	GoTN	Private		
1. Weather forecasting and Agro Advisory	4	-	15	-	-	1	**20**
2. Basic and applied meteorology	1	-	-	1	-	5	**7**
3. Climate change & Crop models	2	-	5	-	1	5	**13**
4. Pest & Disease Forewarning						1	**1**
Total	**7**	**-**	**20**	**1**	**1**	**12**	**41**

CROP WISE RESEARCH PROJECTS

Crop	URP	AICRP	GOI	GoTN	Private	Students' Research	Total
Rice	1		2			4	**7**
Millets	1		1*			2	**3**
Pulses	0					2	**2**
Oil seeds	-		1*			1	**1**
Vegetables	-					1	**1**
Non crop	5		18	1	1	2	**27**
Total	**7**		**20***	**1**	**1**	**12**	**41**

* Multi crop projects added in rice

UNIVERSITY RESEARCH PROJECTS

S. No.	Project Title	Project Leader(s)	Period & Remarks
I	**Theme 1: Weather forecasting and Agro Advisory**		
1.	**DCM/CBE/AMT/2019 /002** Developing TNAU's village level medium range forecast with higher accuracy.	Dr. Ga. Dheebakaran Asst. Prof (Agronomy), ACRC, TNAU, CBE Dr. K.P. Ragunath Asst. Prof. (SAC), RS & GIS	Jun. 2019 – May 2021 Project completed. Outcome is already approved for adoption in 9th NCSM. The Upgradation of now casting and TNAU Village level forecast web page are recommended for adoption.
2.	**DCM/CBE/AMT/2019 /001** Developing hybrid weather forecast by integrating the numerical and astrometeorological forecast	Dr. Ga. Dheebakaran Asst. Prof (Agronomy), ACRC, TNAU, CBE Dr. SP. Ramanathan, Prof. and Head, ACRC	Jun. 2019 – May 2022 **To be continued.** Information may be given. Extension proposal up to Mar. 2023 may be submitted as astromet rules for temp., RH and BSS are in progress.
3.	**DCM/CBE/AMT/RIC/ 2020/002** Enhancing the predictability of location specific seasonal rainfall for Tamil Nadu.	Dr. S. Kokilavani Asst. Prof (Agrl. Met.), ACRC, TNAU, CBE Dr. V. Geethalakshmi, Prof. (Agronomy) & Vice Chancellor	Jun. 2019 –May 2022 **To be concluded as per schedule and completion report may be submitted.** Information may be given. Submit completion report.
4.	**DCM/CBE/AMT/2021/ 001** Evaluation of Automated Agro advisory Services for enhancing farmers Adoption	Dr. S. Kokilavani Asst. Prof (Agrl. Met.), Dr. SP. Ramanathan, Prof. and Head, ACRC	Jan 2021- Dec. 2022 **To be continued.** Information may be given.
II	**Theme 2: Basic and applied meteorology**		
5.	**DCM/CBE/AGR/RIC/ 2021/002**	Dr. N. Maragatham, Prof. (Agronomy) &	Nov. 2021 - Oct. 2023 New project.

	Influence of lunar phases at flowering stage on the productivity and quality of rice varieties	Director (DSW) Dr. Ga. Dheebakaran, Asst. Prof. (Agronomy) ACRC, TNAU, CBE	**To be Continued.**
III	**Theme 3: Climate change and crop weather model**		
6.	**DCM/CBE/AGR/2021 / 001** Evaluation of oxygen and other gases production in Beema Bamboo Plantation.	Dr. N. Maragatham, Professor (Agronomy) & Director (DSW) Dr. SP. Ramanathan, Prof. and Head, ACRC, TNAU Dr. M. Maheswari, Professor and Head, ENS, TNAU	Jan. 2021 – Dec. 2023 **To be Continued.**
7.	**DCM/CBE/AMT/MLT/ 2019/001** Studies on the climate variability of millets through crop simulation model	Dr. N. K. Sathyamoorthy Assoc. Prof. (Agronomy), ACRC, TNAU, Coimbatore	JUN. 2019 – MAY 2022 **To be Continued.** Information may be given. Extension proposal up to Mar. 2023 may be submitted.

EXTERNALLY FUNDED PROJECTS

S. No.	Project Title	Project Leader(s)	Period & Status
I	**Theme 1: Weather forecasting and agro advisory services**		
1.	**NCMRWF/DCM/ADT/ AGR/2013/ R003** GOI – IMD – Agromet – GraminKrishiMausamSewa (GKMS) - Experimental Agro-Met Advisory Services (AAS), Aduthurai.	Dr. K. SathiyaBama Assoc. Prof. (SS&AC) Dr. M. Raju, Assoc. Prof. (Agronomy) TRRI, Aduthurai	Apr. 2014 - Mar. 2023 **To be continued.** Partial budgeting method of economic analysis may be adopted. Uniform verification method as that of Coimbatore – AMFU may be followed.
2.	**IMD/DCM/CBE/ACR/ 2014/R006** GOI – IMD – Agmet – GraminKrishiMausamSewa (GKMS) at Agro Meteorological Field Units (AMFU), Coimbatore	Dr. SP. Ramanathan Prof. and Head, ACRC Dr. Ga. Dheebakaran Asst. Prof. (Agronomy) ACRC, TNAU, CBE	Apr. 2014 - Mar. 2023 **To be continued** Low usability level of IMD's Weather forecast may be reported to IMD. Collectively give one or two information from all GKMS & DAMU centers.
3.	**IMD/DCM/KPT/AGR/ 1995/R004** Agrometeorology Field Unit (AMFU) for Agrometeorological Advisory Services (GKMS –	Dr. K. Baskar Professor and Head Dr. B. Arthirani Asst. Prof. (Agrl. Met) ARS, Kovilpatti	Apr. 2014 - Mar. 2023 **To be continued.** Partial budgeting method of economic analysis may be adopted. Uniform verification method as that of Coimbatore

	GraminKrishiMausamSewa) under IMD, GOI at ARS, Kovilpatti.		– AMFU may be followed.
4.	**GOI/DCM/OTY/ACRC/2016/R003** Agrometeorology Field Unit (AMFU) for Agrometeorological Advisory Services under IMD, GOI at HRS, Ooty	Dr. D. KeisarLourdusamy Assoc. Prof. & Head Dr. P. Balasubramanian, Teaching Asst. (Agronomy)	Mar. 2014 - Mar. 2023 **To be continued.** Partial budgeting method of economic analysis may be adopted. Uniform verification method as that of Coimbatore – AMFU may be followed.
5.	**GOI/DCM/PPI/ACRC/ 2016/R001** Agro meteorology Field Unit (AMFU) for Agro meteorological Advisory Services (GKMS – GraminKrishiMausamSewa) under IMD, GOI at HRS, Pechiparai.	Dr. A. Jaya Jasmine Prof. and Head Dr. K.R. Manikandan SRF (Entomology)	Mar. 2014 - Mar. 2023 **To be continued.** Partial budgeting method of economic analysis may be adopted. Uniform verification method as that of Coimbatore – AMFU may be followed.
6.	Setting up District Agro Met Units (DAMUs) at KVKs for Weather Based Agro Advisory Services under ICAR-IMD Collaboration – KVK, Aruppukottai, Virudhunagar District	Dr. G. Srinivasan Prog. Coordinator Dr. N.S. Sudarmanian SMS (Agrometeorology)	2019 – 2024 **To be continued** Partial budgeting method of economic analysis may be adopted. Follow Uniform verification method as that of Coimbatore – AMFU.
7.	Setting up District Agro Met Units (DAMUs) at KVKs for Weather Based Agro Advisory Services under ICAR-IMD Collaboration – KVK, Vriddhachalam, Cuddalore District	Dr. N. Sriram Programme Coordinator Ms. C. Arulmathi SMS (Agrometeorology)	2019 – 2024 **To be continued** Partial budgeting method of economic analysis may be adopted. Follow Uniform verification method as that of Coimbatore – AMFU.
8.	Setting up District Agro Met Units (DAMUs) at KVKs for Weather Based Agro Advisory Services under ICAR-IMD Collaboration – KVK, Papparapatti, Dharmapuri District	Dr. M. Vijayakumar, Programme coordinator Mr. P. Arunkumar. SMS (Agrometeorology)	2019 – 2024 **To be continued** Partial budgeting method of economic analysis may be adopted. Follow Uniform verification method as that of Coimbatore – AMFU.
9.	Setting up District Agro Met Units (DAMUs) at KVKs for Weather Based Agro Advisory Services under ICAR-IMD Collaboration – KVK, Pudukkottai District	Dr. V.M. InduMathi Programme Coordinator Mr. B. Balamurali SMS (Agrometeorology)	2019 – 2024 **To be continued** Partial budgeting method of economic analysis may be adopted. Follow Uniform verification method as that of Coimbatore – AMFU.
10.	Setting up District Agro Met	Dr. T. Ragavan	2019 – 2024

	Units (DAMUs) at KVKs for Weather Based Agro Advisory Services under ICAR-IMD Collaboration – KVK, Ramanathapuram District	Programme Coordinator Dr. M. Vengateswari SMS (Agrometeorology)	**To be continued** Partial budgeting method of economic analysis may be adopted. Follow Uniform verification method as that of Coimbatore – AMFU.
11.	Setting up District Agro Met Units (DAMUs) at KVKs for Weather Based Agro Advisory Services under ICAR-IMD Collaboration – KVK, Sandhiyur, Salem District	Dr. R.Jegathambal Programme Coordinator Dr. C. Pradipa SMS (Agrometeorology)	2019 – 2024 **To be continued** Partial budgeting method of economic analysis may be adopted. Follow Uniform verification method as that of Coimbatore – AMFU.
12.	Setting up District Agro Met Units (DAMUs) at KVKs for Weather Based Agro Advisory Services under ICAR-IMD Collaboration – Sirugamani, Tiruchirappalli District	Dr. N. Tamilselvan, Programme Coordinator Dr. V. Guhan SMS (Agrometeorology)	2019 – 2024 **To be continued** Partial budgeting method of economic analysis may be adopted. Follow Uniform verification method as that of Coimbatore – AMFU.
13.	Setting up District Agro Met Units (DAMUs) at KVKs for Weather Based Agro Advisory Services under ICAR-IMD Collaboration – Virinjipuram, Vellore District	Dr. S. Nanthakumar Programme Coordinator Ms. K. Rathika, SMS (Agrometeorology)	2019 – 2024 **To be continued** Partial budgeting method of economic analysis may be adopted. Follow Uniform verification method as that of Coimbatore – AMFU.
14.	Setting up District Agro Met Units (DAMUs) at KVKs for Weather Based Agro Advisory Services under ICAR-IMD Collaboration – KVK, Tiruvallur, Tirur District	Dr. P. Santhi, Programme Coordinator Dr. S. Arul Prasd SMS (Agrometeorology)	2019 – 2024 **To be continued** Partial budgeting method of economic analysis may be adopted. Follow Uniform verification method as that of Coimbatore – AMFU.
15.	**DST/DCM/CBE/2019/ R010** Enhancing climate change adaptive capacity and agriculture productivity in ParambikulamAliyar (PAP) basin areas through ICTs and other technological interventions	Dr. P. Dhanya Women Scientist, ACRC Dr. V. Geethalakshmi Professor (Agronomy) & Vice Chancellor, TNAU	Oct 2019 to Sep 2022 **To be concluded as per schedule and completion report may be submitted.** Information may be given.

II	**Theme 2: Basic and Applied meteorology**		
16.	**NADP/DCM/CBE/ACR/2020/D007** Revival of Automatic Weather Station in 285 blocks and relocation of 100 Nos. of Automatic Weather Stations in Tamil Nadu.	Dr. SP. Ramanathan Dr. N. Maragatham Dr. N.K. Sathyamoorthy Dr. Ga. Dheebakaran Dr. S. Kokilavani ACRC, TNAU, CBE	Nov. 2020 Mar. 2023 **To be continued.** Information may be given.
III	**Theme 3: Climate Change & Crop Modeling**		
17.	**IMD/DCM/ADT/AGR/2011/R001** Forecasting Agricultural output using Space, Agrometerology and Land based observations (FASAL) to Agro Advisory Services for Cauvery Delta Zone TRRI, Aduthurai.	Dr. M. Raju, Assoc. Prof. (Agronomy) Dr. K. SathiyaBama, Assoc. Prof. (SS&AC) TRRI, Aduthurai	Jan. 2011 Mar. 2025 **To be continued** Both statistical and crop simulation models has to be adopted for yield prediction. Bayesian model may be used for statistical forecast. Test with different weather combinations.
18.	**IMD/DCM/CBE/ACR/2010/R001** Yield forecasting for rice, maize and Groundnut in Western zone of Tamil Nadu using space, Agrometeorology and land based observation (FASAL)	Dr. V. Geethalakshmi Professor (Agronomy) & Vice Chancellor, TNAU Dr. Ga. Dheebakaran Asst. Prof. (Agronomy), ACRC, TNAU, Coimbatore	Jan. 2011 Mar. 2025 **To be continued.** Information may be given.
19.	**DST/DCM/CBE/AGR/2018/R003** DST - CCP- SPLICE (BRIFS) - Building Resilience to Climate Change and Improving Food Security through Climate Smart Solutions (E28ADP)	Dr. V. Geethalakshmi Professor (Agronomy) & Vice Chancellor, TNAU Dr. Ga. Dheebakaran Asst. Prof. (Agronomy), Dr. S. Kokilavani, Asst. Prof. (Agrl. Met), ACRC, TNAU	Nov. 2018 -Sep. 2022 **To be concluded as per schedule and completion report may be submitted.** Information may be given.
20.	**DST/DCM/CBE/FARM/2021/R001** Enhancing Climate Change Adaptation Processes for Farmers and Agribusiness	Dr. V. Geethalakshmi, Professor (Agronomy) & Vice Chancellor, TNAU Dr. R. Gowtham Research Associate and Dr. A. Senthil Professor, CRP, TNAU	Apr 2021 to Mar, 2024 **To be continued.** Information may be given.

21.	**NAS/DCM/CBE/2020/R011** Collaborative Adaptation Pathways for Water Management in Agriculture in Bhavani River Basin, India (co-Adapt) (F38 IH)	Dr. V. Geethalakshmi Professor (Agronomy) & Vice Chancellor, TNAU Dr. R. Gowtham, Research Assoc. ACRC Dr. A. Senthil, Prof. & Head, CRP Dr. M. Rajavel, Asst. Prof. (CRP), PRO Dr. V. Karthick, Asst. Professor, AEC	Jan .2020 – May. 2022 **To be concluded as per schedule and completion report may be submitted.** Information may be given.
22.	CIL/DCM/CBE/DCM/2019/R 008 Neem (*Azadirachta indica*) seed yield prediction exploring weather and physiological interaction (F37AIV)	Dr. V. Geethalakshmi Professor (Agronomy) & Vice Chancellor, TNAU Dr. A. Senthil, Assoc. Prof., CRP Dr. M. Rajavel, Asst. Professor, PRO	July 2019– Jun. 2022 **To be concluded as per schedule and completion report may be submitted.** Information may be given.

Department of Agronomy (AICRP-IFS)

A1. Decisions made on Adoption

Title: Sustainable Resource Management for Climate Smart IFS (IFS model for irrigated upland of western zone of Tamil Nadu - 1.0 ha)

Centre: Department of Agronomy, AICRP-IFS, DCM, TNAU, Coimbatore

- Integrated farming system model (1.0 ha) for western zone of Tamil Nadu comprising cropping systems, horticulture, dairy, goatary, poultry along with supplementary enterprises like border planting, vermicomposting and kitchen garden is the most suitable and efficient farming system model providing net profit of ₹ 3,14,339 with a total cost of ₹ 3,96,536 and B:C ratio of 1.83. Employment generation was 501 man days.
- Improved IFS model results in significantly higher production (105%), profit (186%), employment (160%), water productivity (219 %) as compared to existing farming system besides meeting the family nutrition.
- The nutritional requirement of the system was self-sustained through resource recycling which curtails the cost of cultivation and increases profit margins and employment.
- Hence, the proposed IFS model is recommended for adoption to obtain income enhancement, employment generation, resource recycling and higher water productivity for 1.0 ha of irrigated upland areas of Western zone of Tamil Nadu.

A2. OFT – Nil

A3. Salient findings for Information

a. Sustainable Resource Management for Climate Smart IFS

Centre: ARS, Thanjavur

In an experiment conducted at ARS, Thanjavur, Integrated Farming System model involving components *viz.,* Crop + Horticulture + Dairy + Fishery + Poultry + Vermicompost in an area of 0.8 ha recorded a total net return of ₹1,74,000/year. Employment generation from the IFS model was 388 man days. By residue recycling the total quantity of nutrient addition achieved was 240 kg N, 29 kg P and 145 kg K/ha.

b. Identification of cropping systems module for different farming systems (1a)

Centre: Department of Agronomy, AICRP-IFS, DCM, TNAU, Coimbatore

Family Nutrition

Proso millet - cowpea - sunflower cropping system was recorded higher food grain production of 1966 kg millets, 975 kg of pulses and1394 kg of oilseeds which was fulfills the food grain demand of 5 family members.

Income enhancement

Maize - chillies – radish cropping system was recorded higher net return (₹3,94,810/ha), B:C ratio (3.38) and water productivity (30.06 kg/ha.mm).

Livestock nutrition

Perennial fodder system bajra Napier grass + *desmanthus* (4:2) was obtained higher green fodder production to meet the fodder requirement of 2 milch cow+2 calf.

Soil fertility

Maize - bengal gram - cowpea (grain) cropping system was recorded higher available soil N of 243 kg ha^{-1}, available P of 21.0 kg ha^{-1} and available K of 613 kg ha^{-1}.

B. Action Plan

Action plan 1: DCM/CBE/AGR/2020/001 Agricultural and horticultural crops based integrated organic farming system model for small and marginal farmers of Tamil Nadu

Activity	Name of the scientist and centre	Remarks
To identify the best integrated organic farming system model for Tamil Nadu Treatments T_1: Control T_2: Field Crops (Green manure- Rice-Blackgram)+ fish + Japanese quail T_3: Vegetable crops (Tomato-Green manure- Pumpkin) + fish + duck T_4: Leaf Banana + fish + Desi chicken Kitchen garden: Amaranthus, Coriander, Fenugreek, Mint, Gourds, Radish, Palak Border Planting: Papaya, Moringa	Dr.K.R.Latha Chief Agronomist AICRP - IFS, TNAU, Coimbatore Dr.T.Saraswathi Professor (Horticulture) TNAU, Coimbatore	Completion report submitted and approved on 21.06.2022

Action Plan 2. Validation of GHG emission in IFS model for Crop Component from real time field data

Activity	Name of the scientist and centre	Remarks
Prediction and validation of carbon footprint in components of IFS model **Treatments** **A. Cropping Systems** 1. Maize-bengalgram-cowpea 2. Maize-chillies-radish 3. Prosomillet – cowpea-sunflower 4. Perennial fodder grass	**Centre** : Dept. of Agronomy Dr.P.C.Prabu Associate Professor (ENS) Dr.S.P.Sangeetha Asst. Prof. (Agron.) TNAU, Coimbatore	• The project has been numbered as DCM/CBE/AGR/NON/2022/001 (April 2022 to June 2024) • The Project may be continued

(BN grass) and *Desmanthus* **B. Sample Collection** Seasons- (*kharif, rabi* and summer)		

C. List of Research Projects during 2022 - 2023

	Centre	URP	AICRP	EFP	Total
AICRP-IFS	Department of Agronomy, TNAU, Coimbatore	1	3	-	4
	ARS, Thanjavur	-	1	-	1
	MRS, Vagarai	-	3	-	3
	TCRS, Yethapur	-	1	-	1

Ongoing URPs /AICRPs / Externally Funded Projects

AICRP-IFS, Dept. of Agronomy		
S. No.	**Project No. and Title**	**Remarks**
1.	**AICRP/DCM/CBE/AGR/IFS/2020/001** Sustainable resource management for climate smart IFS (June 2017- May 2022) Dr.P.M.Shanmugam Professor (Agronomy) &Chief Agronomist (AICRP-IFS), TNAU, Coimbatore	• The project may be continued Given for adoption
2.	**AICRP/DCM/CBE/AGR/IFS/2020/002** Expt. 1 a. - Identification of cropping system module for different farming system modules (June 2017- May 2022) Dr.S.P.Sangeetha, Assistant Professor (Agronomy), TNAU, Coimbatore	• The project may be continued Given for information
3.	**AICRP/DCM - CBE – AGR/001** Carbon crediting and GHG emission in IFS model (June 2017- May 2022) Dr.P.C.Prabu, Associate Professor (ENS), TNAU, Coimbatore	• The project may be continued
4.	**AICRP/DCM - CBE - AGR/001** Sustainable Resource Management for Climate Smart IFS (June 2017- May 2022) Dr. T.Parthipan,Asst.Professor (Agronomy) , ARS, Thanjavur	• The project may be continued
5.	**AICRP/DCM - CBE – AGR/001** OFR Experiment I- On-Farm crop response to plant nutrients in pre-dominant cropping systems and their impact on crop-livestock-human continuum (April 2017 to March 2022) Dr.N.Satheeskumar, Asst. Professor	. • The Project may be continued • The OFR centre was shifted from ARS, Bhavanisagar to MRS, Vagarai during April 2022

	(Agronomy), MRS, Vagarai	
6.	**AICRP/DCM - CBE – AGR/001** OFR Experiment II-Diversification of Existing Farming Systems under Marginal household conditions (April 2017 to March 2022) Dr.N.Satheeskumar**,** Asst. Professor (Agronomy), MRS, Vagarai	• The Project may be continued • The OFR centre was shifted from ARS, Bhavanisagar to MRS, Vagarai during April 2022
7.	**AICRP/DCM - CBE - AGR/001** OFR Experiment III- On-farm evaluation of farming system modules for improving profitability and livelihood of small and marginal farmers (April 2017 to March 2022) Dr.N.Satheeskumar**,** Asst. Professor (Agronomy), MRS, Vagarai	• The Project may be continued • The OFR centre was shifted from ARS, Bhavanisagar to MRS, Vagarai during April 2022
8.	**AICRP/DCM - CBE - AGR/001** OFR 1: On Farm crop response to plant nutrients in pre-dominant cropping systems and their impact on crop - livestock - human continuum (April 2017 to March 2022) Dr. S.K.Natarajan, Associate Professor (Agronomy),TCRS, Yethapur	• The new project "Pilot study on Model value chain development for integrated farming system" was approved by IIFSR. Modipuram for 2022 to 2026 at TCRS, Yethapur
9.	**AICRP/DCM - CBE – AGR/001** OFR 2: Diversification of existing farming systems under marginal household conditions (April 2017 to March 2022) Dr. S.K.Natarajan, Associate Professor (Agronomy),TCRS, Yethapur	
10.	**AICRP/DCM - CBE – AGR/001** OFR 3: On-farm evaluation of farming system modules for improving profitability and livelihood of small and marginal farmers (April 2017 to March 2022) Dr. S.K.Natarajan, Associate Professor (Agronomy),TCRS, Yethapur	

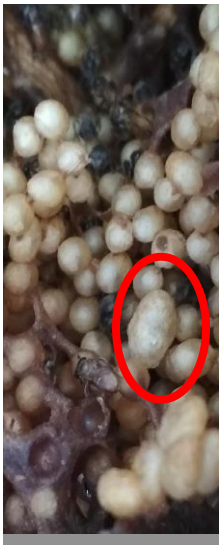
Centre for Plant Protection Studies

A1. Adoption – Nil

A2. For On Farm Testing

OFT 1.Standardization of queen production in stingless bee, *Tetragonula* sp. (OFT to be continued for confirmatory results)

Trt. Treatment details
T1 Colony division using spare queen cells produced
T2 Colony division through emergency queen cells produced
T3 Control colonies (no. of swarm colonies produced)



Methodology
Design: RBD, Replication: 4 Nos.
Observations:
No. of queen cells produced,
No. of emergency queen cells,
Queen status, colony strength, honey yield
Centres
AC & RI, Coimbatore: Dr.M.R.Srinivasan, Prof. (Entomology)
AC & RI, Madurai : Dr. J. Jayaraj. Prof. (Entomology)
TCRS, Yethapur : Dr. P.A.Saravanan. Assoc. Prof. (Entomology)
CRS, Aliyanagar : Dr. Arul Prakash, Asst. Prof. (Entomology)

OFT 2: Evaluating drumstick as forage for Italian honey bee and its utilization in Pollination
(Based on the results of the URP)

Treatments
T1 – Three colonies/ acre
T2 – Two colonies/ acre
T3 – Control
Observations
Pollinator count
Yield and parameters
Colony growth parameters
Centres
AC & RI, Coimbatore: Dr.M.R.Srinivasan, Prof. (Entomology)
AC & RI, Madurai : Dr. J. Jayaraj. Prof. (Entomology)
HC & RI, Periyakulam Dr. SuganyaKanna Assoc. Prof. (Entomology)
HC & RI, Trichy : Dr. Sheeba Joyce Roseleen, Assoc. Professor (Entomology)

OFT 3 : Managed stingless bee pollination for enhancing mango productivity (OFT to be continued for confirmatory results)

Treatments proposed:

T_1 Four bee colonies /acre
T_2 Six bee colonies /acre
T_3 Eight bee colonies /acre
T_4 Control (no managed bee colonies)

Design: RBD; Replications: Five
Stingless species: *Tetragonulairidipennis*
Season: Regular bearing season

Observations to be recorded:

- Peak foraging activity, No. of fruits/panicle, Individual fruit weight and grade, Bee visitation rate, Fruit yield /tree

Centres to be involved:

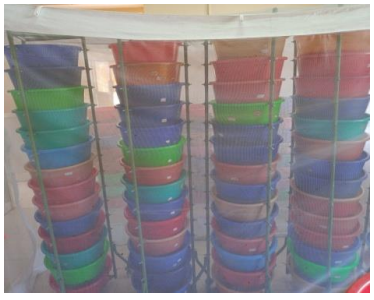
AC & RI, Coimbatore	**:**	Dr. M.R. Srinivasan, Prof. (Entomology)
AC & RI, Madurai	**:**	Dr. J. Jayaraj, Professor (Entomology)
HC&RI, Periyakulam	**:**	Dr. S. SuganyaKanna, Assoc. Prof. (Entomology)
TCRS, Yethapur	**:**	Dr. P.A. Saravanan, Assoc. Professor (Entomology)

OFT - 4. Validation of an ergonomic technique for collection of Corcyra moths in mass rearing

Activities:

T1: Plastic trays rearing method (Conventional method)
Rice moth will be reared in 15 plastic trays in cumbu medium
T2: Stack rearing method (Ergonomic technique)
Rice moth will be reared in 15 plastic trays in cumbu medium stacked in a tripod stand and covered with a net

Observations
Numbers of moth emerged (males and females)
Time taken for collection of moths on daily basis
Quantity of eggs obtained on daily basis for 30days
TNAU, CBE : Dr. S. Jeyarajan Nelson, Professor (Entomology)
AC&RI, MDU : Dr.J.Jayaraj, Professor (Entomology)
AC&RI, Trichy: Dr.A. Kalyanasundaram, Professor (Entomology)
AC&RI, KKM : Dr.L.Allwin, Assoc. Professor (Entomology)



ERGONOMIC METHOD

A3. For Information

1. Seven species of hymenopteran and four species of dipteran pollinators / flower visitors were recorded in bitter gourd ecosystem under open cultivation.
2. A bee strength of Six brood frames + 5 super frames was found to be suitable for mass queen rearing of *Apis ceranaindica*
3. Wax moth *Galleria mellonella* was more common in June-Aug in *Apis ceranaindica* apiaries in all the locations surveyed namely Coimbatore, Erode and Kanyakumari districts.
4. Electron microscopic studies of pollen of cucurbitaceous vegetables revealed unique shape of surface characteristics and their sizes ranged from 55 to 122 micrometers in diameter.
5. Treatment with formic acid 60% (20ml/hive) provided best control of the honey bee mites namely *Varroa destructor* and *Tropilaelapsmer cedesae* affecting *Apis mellifera*
6. Keeping eight stingless beehives per acre can help to retain more fruits per panicle through cross-pollination and aid in increase of mango fruit yield by 27.4 per cent.

Action Plan–1. Assessment of wood and hive type suitability for *Apisceranaindica*

Treatments

T1- TNAU Ac22 type *Melia dubia* (Malaivembu) hive
T2- TNAU Ac22 type *Albizia lebbek* (Vagai) hive
T3- BIS A type *Albizia lebbek* (Vagai) hive
T4 - Marthandam type *Albizia lebbek* (Vagai) hive

Design: RBD; Replications: Five

Observations to be recorded:

Colony growth parameters namely brood area, honey store area and pollen store area on comb, bee population in terms of framestrength, hive and brood temperature

Centres to be involved:

AC & RI, Coimbatore	**:**	Dr. M.R. Srinivasan, Prof. (Entomology)
CRS, Aliyanagar	:	Dr. Arul Prakash, Asst. Prof. (Entomology)

C. Remarks on the URPs/ Externally funded projects

S. No.	Project Number and Title	Name and Designation of the project leader	Duration	Remarks
	University Research Projects			
1	**CPPS/KKM/ENT/VEG/ 2020/001** Evaluating drumstick *Moringaoleifera* Lam as forage for Italian honey bee *Apismellifera*L. and its utilization in Pollination	Dr. M.R.Srinivasan, Professor, Dept. of Agrl. Entomology TNAU, Coimbatore	June 2020 to May 2022	May be concluded and completion report may be submitted. OFT may be proposed based on results.
2	**CPPS/CBE/ENT/2019/001** Diversity of *Callosobruchus* Pic in Coimbatore district and its management	Dr. R. Arulprakash Assistant Professor (Agrl. Entomology) Dept. of Agricultural Entomology, TNAU, Coimbatore	April 2019 - September 2022	May be concluded and completion report may be submitted
3	**CPPS/CBE/ENT/2021/007** Establishment of a repository for key insect pests *viz.,* mealybug species of cassava and brinjal fruit and shoot borer.	Dr. K. Premalatha Asst. Professor (Agrl. Entomology)	Jan 2021 – Dec 2022	May be continued
4	**CPPS/SGM/ENT/ URP 2021-00147** Establishment of a repository for key insect pests	Dr. V. Baskaran Assistant Professor (Entomology)	December 2020 – December 2022	May be continued
	AICRP			
1.	All India Coordinated Research Project (AICRP) on Honey bees and Pollinators	Dr.M.R.Srinivasan, Professor (Entomology)	2021-22	May be continued
	Externally funded projects			
1.	Insecticide risk profiling for honeybees (Indian bees) in focal crops of Tamil Nadu and residue mitigation studies funded by National Bee Board (Budget 18.6 lakhs)	Dr.A.Suganthi, Asst. Professor, Dept of Agrl. Entomology, CBE	2021-23	May be continued
2.	Developing suitable hive type for rearing *Apis mellifera* and *A. cerana*	Dr.M.R.Srinivasan, Professor (Entomology)	2021-23	May be continued

D. REMARKS:

a. General recommendations

- All the scientists were sensitized and encouraged to publish in Journal of NAAS score > 6
- All the scientists were sensitized to attract external funding support

b. Directorate of NRM

- Efforts may be taken to commercialize the Nano products
- SoPs for drone spray of Agricultural inputs may be developed in major crops
- Application of water soluble fertilizers through drone spray may be optimized
- Efforts may be taken to evaluate the efficacy of PPFM in drought mitigation
- The causes of pollution of major rivers of Tamil Nadu (post COVID 19) may be studied.
- Efforts may be taken to optimize the *Vetiver* float technology for the treatment of polluted lake water.
- Biomass accumulation and soil's salt removal capacity of *Sesuvium portulacastrum* may be studied.
- Research on analysing the herbicidal properties of *Eucalyptus* leaves may be intensified
- Presence of micro plastics in sewage irrigated soils may be analyzed.
- Basic research on soil mapping may be completed within at the earliest.
- Effective stress alleviating molecules from the microbial strains may be isolated for commercialization and may be registered with CIB
- Efforts may be taken to register the drought mitigating microbe, *B. altitudinus* (FD48).
- More scientific data may be generated on the effectiveness of Nano-revive in mitigating the abiotic stress by involving Crop Physiologists
- The pathogenic strains available with Dr. S. Nakkeeran, Dean AC&RI, Kudumiyanmalai may be obtained for investigating the biocontrol potential of AM fungi and PGPR against panama wilt in banana caused by *Fusarium oxysporum* f. sp*. cubense*
- Research outcomes on the effect of Phyllospheric yeast and its effect on rice growth and yield may be discussed separately.
- Action plans on SS&AC may be focused on emerging issues
- status report on the effect of Orthosalicilic acid and Humic acid in agriculture may be prepared

c. Water Technology Centre

- Water requirement for major crops under different irrigation methods may be worked out and cpmpared
- A comprehensive model for automated irrigation may be developed for major crops
- Drone spraying of herbicides, crop boosters and pesticides may be evaluated in greengram and blackgram

d. ACRC

- Efforts may be taken to critically analyse the extreme weather events occurred so as to predict and to offer suitable advisory
- In medium range forecast, the forecast output of different agencies and models may be compared and verified.
- The prediction accuracy of South West Monsoon may be increased by exploring different models.
- Village level weather forecasting may be popularized so as to reach more farmers
- Crop Physiologists may be involved to study the effect of elevated temperature on the yield and quality of major crops
- Scientific validation on the accumulation of proline upon application of *panchakavya* may be carried out

e. Agronomy

- All the evaluated IFS models may be popularized
- GHG emission in IFS model (crop component) is to be studied

f. Agricultural Entomology

- Capacity building of farmers on beekeeping may be strengthened through trainings.
- The research work on various honey bee species may be compiled.

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