TAMIL NADU AGRICULTURAL UNIVERSITY

PROCEEDINGS

9th Scientists Meet on Non Crop Specific Projects - 2021
(01.07.2021)

Lead Centre

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

Directorate of Research
Tamil Nadu Agricultural University
Coimbatore 641 003

2021

PROCEEDINGS

9th Scientists' Meet on "Non-Crop Specific Projects"
(01th July 2021)

The 9th Scientists' Meet on "Non-Crop Specific Projects" was conducted on **01.07.2021** at Anna Auditorium in which 75 scientists participated off-line and more than 250 scientists joined on-line encompassing Colleges, Research Stations and KVKs. **Dr. N. Kumar,** Vice Chancellor, TNAU, Coimbatore offered opening remarks to the event and highlighted the importance and accomplishments of new initiatives in TNAU such as Nanotechnology, Geoinformatics, Drone technology for smart delivery inputs, substantial reduction due to frequent lockdowns due to COVID 19. The Vice Chancellor indicated multi-disciplinary collaborative research programs is being undertaken at the Directorate of NRM with other Directorates and Disciplines that lead to the successful product development.

Dr. K.S. Subramanian, Director of Research flagged off issues such as commercialization of TNAU Nano-Products, TNAU's role in implementation of DBT Guidelines for the use of Nano-products in the country, Notification of IFFCO Nano Urea by GOI, conceptualization of e-Nose technology for on-site detection of soil, seed, plant and produce health status, 3D printing technology, digital farming using geoinformatics tools and techniques, oxygen park through bheema bamboo plantation and microbe-mediated water vapour condensation. He appreciated scientists for fund mobilization from various external funding agencies. **Dr. R. Santhi,** Director (DNRM) has presented the action taken report on the recommendations of the 8th Non-Crop Specific Project meet besides highlighting significant achievements made by the Directorate of Natural Resource Management.

The technical Directors and HODs reviewed 39 Externally Funded Projects, 39 URPs, 12 Action Plan projects and 11 core funded projects and the outcome was presented. The Prof. & Heads **Dr. A. Lakshmanan**, Dept. Nano Science & Technology, **Dr. S. Palanivelan**, Remote Sensing & GIS, **Dr. M. Maheswari**, Environmental Sciences, **Dr. M. Malarvizhi**, Soil Science & Agrl. Chemistry, **Dr. V. Gomathy,** Agricultural Microbiology, **Dr. SP. Ramanathan**, Agro Climatology Research Center, **Dr. CR. Chinnamuthu**, Agronomy and **Dr. N. Sathiah**, Agrl. Entomology presented the salient outcome from the research projects for adoption, OFT and Information and new OFT and action plans for 2021-2022.

Based on the discussion, the following recommendations and action plans pertaining to the Departments of Nano Science and Technology, Remote Sensing and GIS, Environmental Sciences, Soil Science and Agricultural Chemistry and Agricultural Microbiology are furnished under the following headings.

A.   Decisions made on Adoption / OFT/ Information
B.   Action plan 2020 – 21
C.   Research projects and remarks on the ongoing Research Projects
D.   General remarks
E.   Participants

A. Decisions made on Adoption / OFT / Information:

1. Department of Nano Science and Technology

For Adoption

1. Nano based smart delivery of agri-inputs to promote pulses productivity (DST Nano Mission Rs. 164 Lakhs)

1.1. Nano-fibre based Multi Nutrients Delivery to Achieve Balanced Nutrition for Greengram

Nano-fibre based nutrient delivery technology has been developed by combining multinutrients and biodegradable polymer (PVA) through electrospinning method. The high surface area of the e-spun nanofibre facilitates perfect encapsulation and even distribution of nutrients in the fibre matrix system. The uniform distribution of multinutrients in the nano-fibre matrix may help to achieve balanced delivery of nutrients upon seed treatment that improves the germination, crop growth and yield. The data revealed that the MNC loaded nano-fibre coated seeds recorded higher germination, seelding establishment, yield attributing biometric characters and yield (802 kg/ha) which was 29 per cent increased yield over untreated control (680 kg/ha) and relatively on par with recommended dose of fertilizer application (760kg/ha)

1.2. Encapsulation of seeds with nano-matrix fortified with bio-inoculants for improved plant and yield in pulses

Seed inoculation with microbial cells is one of the potential invigouration techniques for enhancing the germination, growth and yield of plants. Herein, an innovative localized delivery of beneficial microbial cells (*Rhizobium leguminosarum*) was approached by invigorating greengram seeds with electrospun polyvinyl alcohol (PVA), PVA and Sericin composite nanofibres. The bio-efficacy of Rhizobium *leguminosarum* immobilized nanofibre coated seeds was tested under *invitro* and *invivo* conditions. The results of pot culture study excelled the uncoated seeds in registering the germination, seedling growth and yield attributing biometric characters. The output of field trial conducted at ARS Bhavanisagar during summer season of 2020 revealed that bacterial cells infused nanofibre invigorated seeds along with recommended package of practices out- performed the untreated control in recording the field emergence, plant growth and yield.

1.3. Nanofibre Encapsulation of Tebuconazole Fungicide Molecule – A smart Delivery System for Management of Dry Root rot (Macrophomina phaseolina) in Blackgram

Pulse crops account 30 per cent yield losses per annum and within the pest complex, dry root rot disease caused by *Macrophomina phaseolina* reduce*s* 15-20 per cent yield loss in blackgram. Considering the practical difficulties of the existing technology, a viable and economically feasible e-spun nanofibre technology was developed for smart delivery of tebuconazole fungicide molecules. The tebuconazole concentration of 500 and 750 ppm was loaded into 10% PVA prepared by dissolving the fungicide in acetonitrile organic solvent. The encapsulation efficiency study resulted about 27% tebuconazole was successfully infused in PVA nanofibre. The release kinetics of tebuconazole infused in PVA nanofibres was sustained and as control release. The bio-efficacy test results of disc diffusion assay and poisoned food techniques demonstrated the effectiveness of tebuconazole loaded nanofibre invigorated seeds on dry root rot incidence as there were maximum inhibitory growth zone of dry root rot observed. The artificial inoculation study supported the previous techniques as plants inoculated with tebuconazole infused PVA nanofibres recorded minimum dry root rot incidence. Seed quality test result revealed positive response of nanofibre invigouration in recording germination, seedling growth, dry matter production and vigour index.

1.4. E-Spin Nanofibre as smart carriers for hormones (IAA and GA3) delivery in seed invigoration for enhancing germination and seedling vigor of groundnut blackgram

Germination and seedling establishment are the critical issues that decide the crop productivity particularly in pulses as more than 70% are cultivated as rainfed crops. Addressing these problems, nanofibre seed coating technology was developed to encapsulate and deliver the plant growth promoting hormones to improve germination and seedling growth of blackgram. Nanofibers were developed from biodegradable polymer polyvinyl alcohol (PVA). PVA at 10% has produced fiber with required size (111 nm to 176 nm). The nanofiber was infused with plant growth promoting hormones, Gibberellic acid (GA3) and indole acetic acid (IAA) and was characterized using SEM and UV–Vis spectroscopy. Topography of hormones-loaded electrospun fiber revealed that the diameter of the fiber was increased due to loading of hormones. GA3- loaded nanofibers had the diameter ranges from 131 to 296 nm, and IAA-loaded fibers had the diameter size ranges from 106 to 275 nm after loading. The UV–Vis spectra confirmed the hormonal loading in e-spun nanofiber. Hormones-infused PVA nanofibres were evaluated for its bio-efficacy on seed quality under in vitro condition, and the results revealed that IAA incorporated nano-fiber-coated seeds such as groundnut and black gram had registered higher germination at 88% and 86%, seedling vigor at 3458 and 3431, respectively. The nano-fibers-coated seeds were also tested under different PEG-induced moisture regimes. The data indicated that groundnut and black gram seeds

coated with IAA-infused nanofibers were found to be registered higher germination and seedling vigor under higher moisture stress.

1.5. Development of multi-nutri-capsules for balanced nutrition to improve pulses productivity

Multi-nutrient solution was prepared by mixing nitrogen (23.8%), phosphorous (22.0%), potassium (38.9%), calcium (13.2%), magnesim (15.6%), sulphur (21.3%), iron (1.0%), zinc (0.02%), copper (0.04%), boron (0.16%), manganese (0.17%) and molebdenum (0.01%) per litre. Natural and synthetic zeolites and multi nutrient solution was separately taken at the ratio of 1: 2.5 for making pellets using a pelletizer instrument. The nutrient loaded natural and synthetic zeolite was characterized and the results of , PSA, SEM and TEM with EDAX, UV-Vis and FTIR confirmed their size, shape and morphology. Further, the nutrient release pattern was studied for adopting distillation technique for nitrogen, venadomolybdate yellow colour method for phosphorus, flame photometer for potassium, murexide for calcium, eriochrome black T method for magnesium and AAS for micronutrients and all these nutrient content was analyzed in the collected sample from the percolation assembly. The results demonstrated that nutrients were released in a slow and sustained way than synthetic zeolite. Field study was carried out to find the effect of nutrient loaded natural and synthetic zeolite on morphological and yield parameters of pulse crop. The data on biometric observations explained that nutrients loaded natural and synthetic pellets were found to be on par with conventional fertilizer and performed better than absolute control.

1.6. Development of hydrogel to conserve moisture

Chitosan-graft-polyethylene glycol/oxalic acid/citric acid super absorbent polymer formulation was synthesized using ionic-linking method. Chitosan (3% w/v) was dissolved using glacial acetic acid (1.4% v/v) used magnetic stirred at 100 rpm for one hour to dissolve completely. The calculated quantity of polyethylene glycol/oxalic acid/citric acid were added to the chitosan solution, where aqueous phase of chitosan turns into gel phase. The gel was transferred to conventional laboratory oven for drying at 70ºC for 3 to 4 h. The product was stored at ambient temperature for further analysis and characterization and the results of SEM and TEM showed the perfect structure development of hydrogel. Further, the hydrogel was subjected to Equilibrium swelling, Water uptake under saline and varied pH conditions and Soil water retention studies. The results exhibited that the highest equilibrium content was observed in chitosan – graft – polyethylene glycol hydrogel (126 per cent), while it was followed by chitosan – graft – oxalic acid hydrogel (109 per cent). Water uptake of chitosan – graft – oxalic acid hydrogel absorbed 15.6 and 12.0 g g^{-1} of water @ 0.1 and 0.9 per cent saline solutions respectively, while the chitosan – graft – polyethylene glycol hydrogel recorded 12.4 and 10.2 g g^{-1} under salinity levels of 0.1 and 0.9 per cent respectively. The water uptake was poor in chitosan – graft – citric acid hydrogel at both salinity

levels. The results of soil water retention studied demonstrated that the chitosan – graft – oxalic acid hydrogel amended soil was higher (17.1 per cent) after 7 h of drying in oven at 70°C, while it was 11.4 % for soils amended with chitosan – graft – polyethylene glycol hydrogel. The highest water holding capacity in chitosan – graft – oxalic acid hydrogel after 7 h of drying may be an outcome of the higher stability of hydrogels and ionic strength of cross linker.

1.7. Nano-Silica formulation for the Mungbean Yellow Mosaic Virus (MYMV) transmission vector (Bemisia tabaci) control

Silica nanoparticles have increased advantages in protective delivery of biomolecules because of its high surface area, high thermal stability and biocompability. Azadirachtin – a phytochemical is a better alternative to chemical pesticides which controls *Bemisia tabaci* – the vector of *Mungbean Yellow Mosaic Virus* (MYMV) is highly sensitive to photo-bleaching and leach out. Hence, a controlled delivery system for the delivery of Azadirachtin was prepared using silica nanoparticles. Azadirachtin embedded silica nanoparticles had increased stability with zeta potential of -83.6mV and release profile of Azadirachtin from silica nanoparticles was concentration and time dependent that was very well explained using first order release kinetics and Higuchi model. It was in parallel with the results of molecular docking, that the Azadirachtin molecule loaded in silica nanoparticles were released in a sustained manner. The 500ppm of Azadirachtin loaded nanosilica showed cent per cent mortality against *Bemisia tabaci* – a vector of *Mungbean Yellow Mosaic Virus* (MYMV) within 5hr and with an extended duration of 15hr the lower concentrations such as 100ppm and 250ppm also showed cent per cent mortality.

2. **Development of Nano-fibre based Nutrient Delivery to Achieve Balanced Nutrition for Groundnut (NABARD Project)**

E-spun nano-fibre based smart and sustained nutrient delivery system has been developed for achieving balanced nutrition to improve productivity of groundnut. For developing nanofibre the synthetic biodegradable polymer Polyvinyl alcohol was used. The multinutrients such as nitrogen, potassium, Ca, Mg, Boron, Iron, Zn, Cu and Mo were successfully infused in 10% PVA nanofibre at the optimum concentration. The SEM (EDAX) , TEM, ICP and AAS studies confirmed the loading of multinutrients in biodegradable nanofibre. Multinutrients incorporated nafibrre were coated over the groundnut seeds of variety TMV-1, and the impact of nanofibre coated seeds was tested under *invivo* and *invitro* conditions. The output of potculture studies conducted at Department of Nano Science and Technology showed that the MNC incorporated nafibrre coated seeds outshined in registering germination percentage and other biometric observations. The field trials on crop response studies conducted at Coconut Research Station, Aliyar Nagar during 2019 and 2020 showed that the MNC loaded nano-fibre coated seeds recorded higher germination, seelding establishment, yield

attributing biometric characters and pod yield (1950kg/ha) which was 14.7 per cent increased yield over untreated control (1700kg/ha) and relatively on par with recommended dose of fertilizer application. The results from field obervation revealed that the nano-fibre released the balanced and sustained nutrients to the groundnut plants.

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

- **Moisture Sensor :** Plant moisture spectral absorption band for O-H (1465-1853 cm^{-1}) and H-O-H (2614-4000 cm^{-1}) were predicted using bench top ATR-FTIR spectrophotometer taking maize as model plant. A low cost portable moisture sensor was fabricated from commercially available open source components including microprocessor (NodeMCU: ESP8266-WiFi module (Dimension: 49×24.5×13 mm) with micro USB port for programming, debugging and power), infrared source and silicon photodiode, optical light emitting diode display (128x64 0.96 inch OLED display module with I^2C interface) and quarts cuvette (3.5 mL capacity, 10 mm diameter). The developed on-site detection kit were calibrated using conventional plant water measurement techniques like relative water content (RWC), fresh leaf weight, dry leaf weight and turgor leaf weight and calibration equations were developed. A novel carbon cloth (CC) - reduced graphene oxide (rGO) -copper/silver nano particle (Cu/AgNPS) and polyaniline (PANI) (CC/ rGO/ CuNPs /AgNPs /PANI) based electrical nano composite detectors were fabricated to measure plant electrical impedance.

- **Nitrogen sensor :** Maize gradient crop were raised for standardizing various nitrogen estimation methods like CHNS/O elemental analyser, chlorophyll content, spectro radiometer, kjeldhal nitrogen estimation at different growth stages of maize (Knee height, tasseling, silk and dough forming stage). Close correlation between spectral signature and N content has been established

4. **TNAU Rhizo Boost**

TNAU Rhizo boost is a fortified plant growth booster contains probiotic microbial consortium (*Azotobacter chroococcum*, *Bacillus subtilis* and B*acillus amyloliquefaciens*), mineral phosphate and hydrogel embedded in Nano bio polymer. **TNAU Rhizo Boost** creates an Effective Rhizosphere and aids in enhanced nutrient transformation and also confers disease resistance. The hydrogel helps in enhancing the use efficiency of water and creates a favourable micro climate in the rhizosphere for the enhanced activity of probiotic microbial communities and also aids in better root proliferation, plant growth and yield. **TNAU Rhizo Boost** can be better applied at the time of planting particularly for horticultural crops and tree seedlings @ 10 ml per sapling. For existing plantation or trees dilute 25 ml of Rhizoboost in one litre of water and apply around the root zone.

For field crops dilute 25 ml of Rhizoboost in one litre of water and apply around the root zone and foliar spray during important physiological stages.

The presence of the functional molecules such as Nano Chitosamine (5000 ppm), Humic (8000 ppm), Fulvic (4000ppm,) and Probiotics(2% W/V) have been confirmed by FTIR and SEM and EDAX. The population of the bacterial genera in the consortium and the compatability were also confirmed through accelerated aging studies. The cell load was also confirmed after impregnating in to nano bio polymer (N acetyl Glucosamine and Poly Vinyl Pyrrolidone) through metagenomics.The multiplication rate, nutrient transformation, variation in root exudate profile and carbon Sequestration potential due probiotic consortium was assessed in rice. The vigour index due to Rhizoboost application was assessed in vegetables, maize and found to be higher due to Rhizoboost inoculation. Novel compounds such as Milbemycins, Phorbol, Dicyclooctanopyridazineetc were identified in the root exudates due to probiotic inoculation using GCMS chromatography

5. <u>Technologies for adoption as special cases</u>

During the 9th Scientists' Meet on Non-Crop Specific Projects, it was observed that some of the products developed by Department of Nano Science and Technology found effective and tested in large scale and proved effective for minimizing the damages caused by the invasive pests and pathogens. The results have been presented in the non-crop specific projects meet, but was not presented in SWC. By considering the importance and need of such cutting-edge technology to be available to farmers in time, the Vice –Chancellor and Director of Research suggested to include the following three adoptions as a special case through "Fast Track" approval process.

5.1. Polymeric nano formulation for preventing fungal growth in coconut copra

Copra, the dried kernel is the chief commercial product from coconut. Milling copra is used to extract oil while edible grade of copra is consumed as a dry kernel. Naturally it contains 70% of moisture content and it is dried to about 7% for production of coconut oil. If the drying atmosphere is highly humid, there is an enough possibility of fungal infections over the products. The sulphur is added as preservative, which acts as anti-microbial agent for preventing fungal growth in the copra. Sulphur is a toxic food preservative and the sulphur fumigation over coconut affects human both externally and internally. The polymeric nano formulation contains chitosan nano spheres that effectively prevents fungal contamination in coconut copra. This chitosan nano formulation is ecofriendly and cost effective to various stakeholders and the cost of treating one ton of copra is around Rs.300.0

Technology: Treating coconut copra with 1% Poly D glucosamine nano formulation controls fungal growth effectively for 5 days

5.2. Nano bio formulation for the effective deodorization and decomposition of vegetable, food and slaughter house wastes

Vegetable, food and slaughter house wastes decomposition has associated problem of foul odour due to the release of volatiles including sulfides. The presence of proteins and sugars in the waste invites flies and maggot growth that make the composting process unlikable and difficult. The nano formulation contains bacterial consortium that is impregnated in ZIF-8 - Zeolitic imidazolate Framework. Besides Azadirachtin molecules are infused in the frame work for managing maggots during composting. This nano bio hybrid system can be effectively used to capture foul odour emanating during composting besides resulting in enriched bio manure.

Technology: MOF (ZIF-8 - Zeolitic imidazolate Framework) based nano bio formulation showed excellent volatile capturing efficiency and waste stabilization. This nano formulation can be used @ 1 litre/Kg of waste for effective composting of vegetable, food and slaughter house wastes.

5.3. Nano Biopesticide for the management of Tea Mosquito Bug and other pests

To manage the tea mosquito bug in tea plantations, Department of Nano Science and Technology, DNRM, TNAU developed a Nano biopesticide in which multi-functional phyto molecules have been impregnated in nano polymer matrix for enhancing the stability and release pattern and this formulation has been assessed for the field efficacy through multilocation and large-scale field trials in tea gardens at Valparai. The results revealed that in all the three locations, the % damage, number of TMB/bush and number of feeding punctures/bush were less in Nano bio-pesticide formulation than other treatments and control. An IPM strategy has been developed and Nano biopesticide is integrated in to the existing practices for effective control of TMB.

Technology: Application of Nano biopesticide @ 5 ml/litre controls the Tea mosquito bug effectively. Integrating nano biopesticide in the existing IPM protocol is a prudent strategy for the management of TMB and to avoid the problems associated with pest resistance and chemical residues in the tea leaves.

For OFT:

OFT 1: Assessing the field efficacy of chelated nano Zinc in Maize Treatments

1. $ZnSo_4$
2. Chelated Zinc
3. Chelated Nano Zinc

Crop : Maize
Centers and Scientists:

Coordinating Centre	**:**	Department of Nano Science & Technology, TNAU, Coimbatore
		Dr. C.Sharmila Rahale
		Assistant Professor (SS&AC)
Sub Centre	**:**	MRS, Vagarai
		Dr. M.Senthivelu
		Assistant Professor (Agronomy)

OFT 2 (Technology validation in coordination with industries): Infusing functional molecules in seeds through nano fibre technology

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

Centre and Scientists:

Centre	**:**	Department of Nano Science & Technology, TNAU, Coimbatore
		Scientists:
		Dr.K.Raja, Assistant Professor (SST), DNST, Coimbatore
		Dr. A. Lakshmanan, Professor & Head, DNST, TNAU, Coimbatore
		Dr.M. Senthilkumar, Assistant Professor, AC&RI, Eachankottai
		Dr.K.Sabarinathan, Assistant Professor, AC&RI, Killikulam

The technology will be validated in coordination with seed industries and others stakeholders

OFT 3: Efficacy studies of Nano formulation of annonaceous acetogenins from *Annona muricata* Linn

Treatment
Annonacin loaded PLGA nano formulation will be tested for its efficacy on HeLa cell lines and based on the results, clinical trials can be initiated as per ICMR guidelines

Centre and Scientists:

Centre   **:**   Department of Nano Science & Technology, TNAU, Coimbatore
                   Scientists
                   Dr.S.Haripriya, Assistant Professor (Horti)
                   DNST, TNAU, Coimbatore

OFT 4 Nano Surface disinfectant for inanimate objects Treatment

Benzalkonium chloride encapsulated in nano adsorbents will be tested for sustained release of the active ingredient and disinfection efficiency on inanimate objects Efficacy studies, docking studies will be completed in coordination with stakeholders for generating data necessary for product commercialization

Centre and Scientists:

Centre   **:**   Department of Nano Science & Technology, TNAU, Coimbatore
                   Scientist
                   Dr. A. Lakshmanan, Professor & Head, DNST, TNAU, Coimbatore

For Information:

1. Transforming coconut waste into High value Carbon Dots (C-Dots) and Development of Nano-based Technology for Disinfection of water.
- Hydrothermal carbonization method is found to be very effective in synthesizing C dots of size less than 10 nm compared to a non-aqueous method (muffle furnace assisted synthesis).

2. Rice Micro-biome studies to understand the connect between rhizosphere and atmosphere in response to changing climate. (BRIFS)
- Emission of CO_2 has positive correlation with increase in the soil temperature. Similarly there is a positive correlation between elevated temperature and methane flux from soil

3. Flexible and Adhesive surface Enhanced Raman Spectroscopy Based Nanostructures Device for Efficient Detection of Multicomponent Pesticide Residues in Fruits and Vegetables
- Detection of pesticide standardized with a detection limit of 25 ng/Cm^2 for thiram, 21 ng/cm^2 for chlorpyrifos and 18 ng/Cm^2 methyl parathion

4. Insights and Biosafety of IFFCO Nano fertilizer in Agricultural Production System (Phase 1 and Phase II)
- The growth dynamics of probiotic microbes (*Bacillus amyloliquefaciens, B.subtilis,* and *Azotobactorchroococcum*) were on par with control at recommended doze and up 3X for Nano N, CU and Zinc.

- Application of different levels of Nano N, Zn and Cu had significant influence on maize and Rice grain yield.

5. 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.
- Halloysite nanotube hydrogel (HNTH) has been synthesized and characterized using X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy TEM and the biosafety studies confirmed the absence of any toxic effects on beneficial microbes and earth worms.

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

7. NanoBeeLure – A novel nano based honeybee lure dispense mechanism to increase pollination in vegetable crops
- Developed chitosan based core lure compound utilizing 11 natural essential oils for slow and sustained release.
- The nano formulation is at a range of 100 to 130 nm with polydispersity index of 0.945.

8. Developing advanced formulation for botanical insecticide (Azadirachtin) using nanoporous biogenic silica from sugarcane bagasse for high bioefficacy.
- Silica Nanoparticle synthesis process from bagasse standardized and the release pattern studies confirmed the sustained release up to 96 hrs.

9. Nanoformulation of AnnonaceousAcetogenins from *Annona muricata* for better delivery
- Higher entrapment efficiency of 80% of annonacin has been achieved using the developed PLGA nano formulation.
- Controlled release of annonacin (pH 7.4) from annonacin loaded PLGA nano formulation has also been confirmed.

B. Action Plan (2021-2022)

NST – Action plan proposed during NCSM, 2021	

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 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 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) 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 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 OECD protocols and guidelines set by the Government of India	-	• The complete characterization insights and mechanisms involve in translocation and internalization can be determined for the IFFCO nano-fertilizers. • Uptake, utilization and nutrient balance can be assessed for the innovative nano-fertilizer formulations • Biosafety of nano fertilizer formulations can be evaluated 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 of Multicomponent 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 study on the morphological, structural, surface area for invention prepare sample. Fabricate and determine SERS Substrate To analysis and perform of SERS sensing substratefor pesticide residues in fruits and vegetables To investigate and analyze prepare SERS substrate for the selectivity, sensitivity, stability, molecular information, LOD, and reproducibility.	Dr. S. Thirumalairajan DBT-Ramalingaswami Re-entry Faculty Fellow,Depart of Nanoscience & 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 quality and achieve smooth surface morphology, controlled size.	To study the effect of reaction time, temperature and various pH on the controlled size of the different nanostructure samples and also to investigate the physico-chemical properties. Analyze the samples for XRD, TEM, SEM, XPS and surface area analysis.	Fabricate and determine SERS Substrate To analyze and perform of SERS substrate for 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.	Achieve the controlled size and various shape nanostructures modified SERS adhesive substrate will be prepared by the facile wet chemical method Analysis report on the morphology, structure, and surface area properties will be ready Further to demonstrate the SERS performance of the prepared substrate, the enhancement factor (EF) will be calculated Analysis report on the selectivity, sensitivity, molecular information, stability, low detection limits and reproducibility.

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 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 and prolonged delivery ➢ Characterizing the nano-formulation for enhanced stability and assessing bio-efficacy against CWSB under invitro and vivo conditions ➢ Confirming the bio safety of the nano formulation and up scaling the invention into commercial formulation in coordination with stakeholders to manage CWSB Project Duration : 2021-2022 (18 months)	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 and prolonged delivery	➢ Characterizing the nano-formulation for enhanced stability and assessing bio-efficacy against CWSB under invitro and vivo conditions ➢ Confirming the bio safety of the nano formulation and up scaling the invention into commercial formulation in coordination with stakeholders to manage CWSB	-	Ecofriendly bio nano formulation would be available for the management of Coffee White Stem borer

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 tuning the protocol for the synthesis of bio polymer as raw material for the production of various value added products • Value addition such as biodegradable Carry bags/ cling film / grow bags and other packing material • Linking science and industriers and creating a commercial link for the TOT. Project Duration : 2021-22	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 polymer as raw material for the production of various value added products	• Value addition such as biodegradable Carry bags/ cling film / grow bags and other 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 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 controlled release system for the staged delivery of growth stimulants and herbicides (NCL) • To characterize the controlled release formulation for efficient encapsulation of growth stimulant and herbicide (TNAU and NCL) • To test the efficacy of the nanocomposites based formulation both in 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 the controlled release formulation for efficient encapsulation of growth stimulant and herbicide (TNAU and NCL)	• To test the efficacy of the nano composites based formulation both in 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: Three year (2021 to 2024)	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 of novel nanoformulation 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	• Plant bioactive based nano product for enhanced immune boosting activity with sustained release of marker compounds from Ashawagandha and Kalmegh

C. Research Projects and remarks

Research Projects reviewed:

URP	Core Project	EFP	Private	Action Plan Projects	Total
3	1	13	-	-	**17**

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

S. No.	Project No. and Title	Scientists in-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 (Alagappauniv.), Dr. R. S. Viswanathan (Alagappa Univ.)	May, 2019 to May 2020 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	The project may be continued
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	The project may be continued

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 & Lead Principal 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	The project may be continued

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 August 2023 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 Coffee Board	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

| 14.	**ERDF Projects** Preservation of Neera through selective separation of fermentative microorganisms using Nano filtration technology	**Principal Investigator** Dr. A. Lakshmanan **Co-Principal Investigator:** Dr. C. Sharmila Rahale	August, 2018 – July 2021 TNAU ERDF	The project may be continued
University Research Projects				
15.	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.JayaSundara Sharmila, Asst. Prof. (Phy.)	September 2019 to August 2021	The project may be continued with set objectives
16.	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 2020 to August 2022	The project may be continued with set objectives
17.	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	The project may be continued with set objectives

2. Department of Remote Sensing and GIS

A. Decisions made on Adoption / OFT / Information:

Technology for adoption

1. Machine learning based Digital Soil Mapping technology

a. Methodology
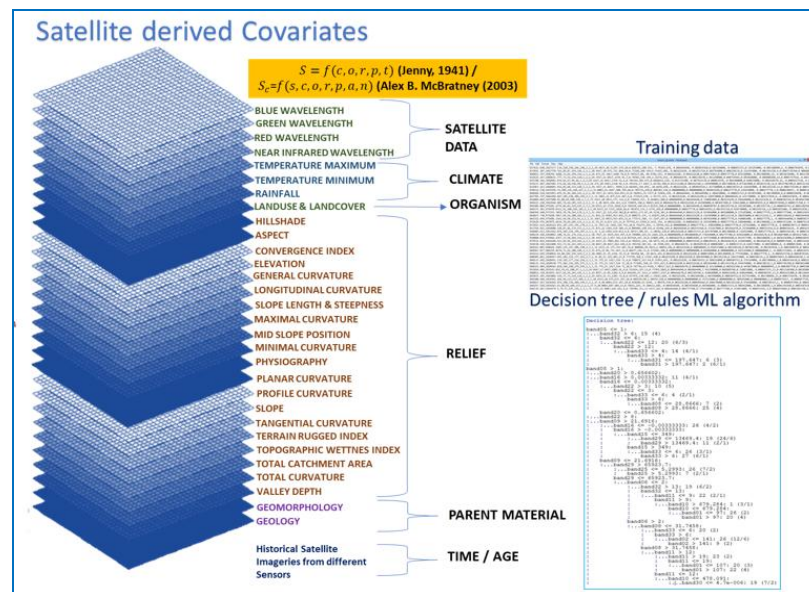
b. Anticipated outputs

- Satellite derived environmental covariates
- Digital database on soil profiles and properties
- Methodology for Digital Soil Mapping integrating Machine learning tools
- Digital soil class and soil properties maps at 30 m resolution

c. Demonstration and test verification

Methodology for Digital Soil Mapping was developed and test verified during 2018-19 to 2020-21 for Coimbatore and Tiruppur districts. Maps and statistics at 30 m resolution on Soil taxonomic classes and physico-chemical properties were generated and validated with actual soil profile observations from 512 points.

2. Mapping and Yield estimation in Maize and Groundnut

a. Methodology
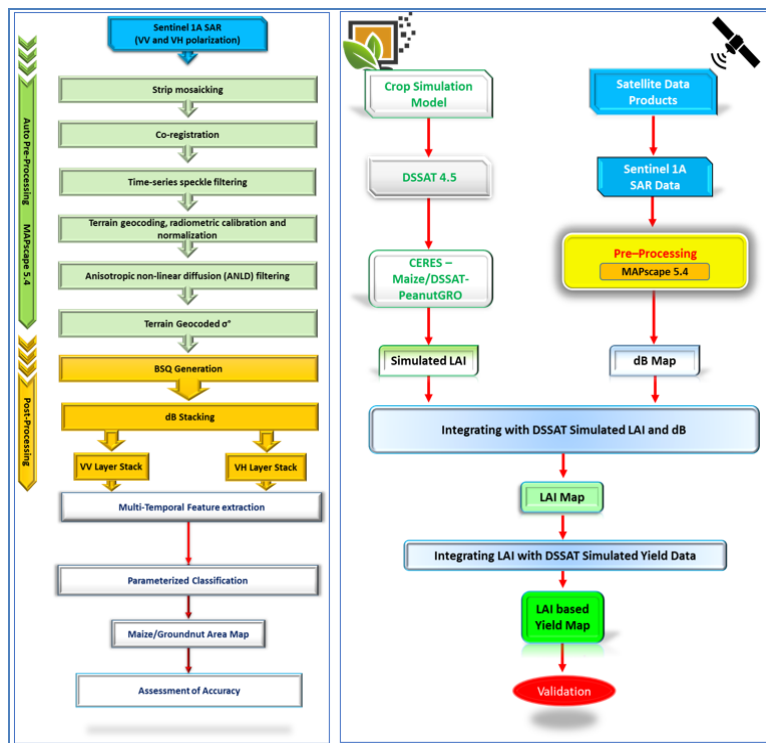
b. Anticipated outputs
- Spectral signature showing crop growth, condition and failure if any.
- Area map and statistics at district, block and village level
- Methodology for Spatial Yield estimation integrating DSSAT Crop growth model with remote sensing products for Maize and Groundnut

c. Demonstration and test verification
Methodology for mapping area and spatial yield estimation was developed and test verified from 2015-16 to 2020-21 for maize and groundnut. Maps and statistics at district, block and village level were generated and validated with DES statistics and ground truth verification and accuracy assessment from more than 900 points.

For Information

1. Rice area map, Seasonality and yield maps across 11,911 major rice growing villages of Tamil Nadu during samba (2020-21).
2. Maize and Cotton area maps and statistics pertaining to Perambalur, Ariyalur, Cuddalore and part of Tiruchirappalli districts were generated.
3. Maps and statistics for Drought Indices viz., NDVI, NDWI and MAI for Tamil Nadu during 2020-21 ensuring drought preparedness

4. Developed customized software tool Crop Analyst for crop mapping, sentinel data retrieval and flood inundated area mapping integrating open-source tools with python coding
5. Failed sowing / prevented sowing, crop failure and crop sown area check reports for Tirunelveli district for insurances under PMFBY pertaining to 2020-21
6. Mapping coconut plantations was done to detect the changes happening in GAJA cyclone affected areas and incidence of invasive pest and diseases
7. Generated digitized cadastral maps of 871 villages in Cuddalore, Perambalur and Ariyalur districts
8. TNAU soil Doc App –Updated Soil Constraints and its recommendation
9. Flood affected areas of Cuddalore and Ramnad districts were mapped using Sentinel 1A SAR data and damages due to unseasonal rainfall during January 2021 in Cauvery Delta Districts was assessed using drones.
10. Digitized maps of 4331 PWD tanks and Water spread in tanks and reservoirs of Tamil Nadu from August 2020 to January 2021.
11. Spatial estimation of Methane from Paddy fields in Cauvery Delta Zone
12. Standardization of drone based spraying techniques for foliar application of Nutrients, Organics and Plant Protection Chemicals

B. ACTION PLAN PROPOSED FOR 2021- 2022

Action Plan 1:

Title of the Action Plan	Geospatial Technologies for Digital Agriculture
Name of the Scientist in charge	**Department of RS&GIS:** Dr. S. Pazhanivelan, Prof. & Head; Dr. D. Muthumanickam, Prof.(SS&AC), Dr. R. Jagadeeswaran, Asso.Pro.(SS&AC) & Dr. R.Kumaraperumal, Asst.Prof. (SS&AC), **Department of SS&AC:** Dr. R. Santhi, Professor (SS&AC) & Director (NRM) and Dr. M. Gopalakrishnan, Asst.Prof.(SS&AC), Dr. K. Sivakumar, Asst.Prof.(SS&AC) **ARS, Bhavanisagar:** Dr. K.P. Raghunath, Asst.Prof.(SS&AC) Dr. M. Gopalakrishnan, Asst. Prof. (SS&AC) **ACRC:** Dr. V. Geethalakshmi, Director (CM), Dr. S.P. Ramanathan, Prof. & Head **Department of Agronomy:** Dr. P. Murali Arthanari, Associate Professor (AGR) **Department of Plant Pathology:** Dr. K. Prabakar, Director (CPPS), Dr. G. Karthikeyan, Prof. & Head **Department of Entomology:** Dr. N. Sathiah Prof. & Head, Dr. K. Senguttuvan, Asst. Professor (AEN)

Name of the Location/Centre	Dept. of Remote Sensing and GIS, DNRM, TNAU, Coimbatore	
Activity	**2021-22**	**Deliverables/ expected out come**
• Developing Tamil Nadu Spatial Agriculture Information Platform to provide insight on crop condition using Geo-spatial analytics • Digital farming with IoT and sensors • AI and image based stress detection • Creating TNAU survey database and image library with geospatial information using mobile app	1. Developing database on 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 2. Developing mobile application for AI based weed detection 3. Demonstration of digital tools (TN soils App) 4. Developing mobile application for ground truth and training dataset collection	• TN Agri 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

Action Plan 2:

Title of the Action Plan	**Deep learning based Digital Soil Mapping and quantification of soil nutrients**
Name of the Scientist in charge	**Department of RS&GIS:** Dr. R. Jagadeeswaran, Asso. Prof. (SS&AC) Dr. R. Kumaraperumal, Asst. Prof. (SS&AC) **Dept. of SS&AC** Dr. K. Sivakumar, Asst.Prof. (SS&AC) **AC&RI, Killikulam** Dr. B. Saliha, Assoc. Prof. (SS&AC)

Name of the Location/Centre	Dept. of Remote Sensing and GIS, DNRM, TNAU, Coimbatore	
Activity	**2021-22**	**Deliverables/ expected out come**
• Digital soil mapping of Tamil Nadu using deep learning tools • Quantification of soil nutrients using hyper spectral remote sensing • Digitization and generation of cadastral Maps and soil nutrient mapping	1. Developing Digital Soil Mapping methodology using innovative deep learning tools 2. Developing environmental covariates for Tamil nadu 3. Collection of Soil profile samples from major 50 soil series of Tamil Nadu for Quantification of soil nutrients using hyper spectral remote sensing 4. Digitization of cadastral maps of Ariyalur and Salem district	▪ Cadastral level soil nutrient map ▪ Block level soil available nutrient status ▪ Digital Soil Maps ▪ Spectral library on soil nutrients

Action Plan 3:

Title of the Action Plan	Mapping horticultural crops and plantations using object based classification	
Name of the Scientist in charge	**Department of RS&GIS:** Dr. S. Pazhanivelan, Prof. & Head (RS&GIS), Dr. R. Jagadeeswaran, Asso.Prof.(SS&AC) Dr. D. Vidhya, Asst. Professor (Hort.), HC&RI, Coimbatore Dr. S. Sri Vidhya, Asst. Professor (Hort.), RRS, Paiyur	
Name of the Location/Centre	Dept. of Remote Sensing and GIS, DNRM, TNAU, Coimbatore	
Activity	**2021-22**	**Deliverables/ expected out come**
• Mapping horticultural crops and plantations using object based classification	1. Methodology for mapping horticultural crops 2. Object based classification and mapping of mango and cashew plantations 3. Drone mapping of plantations	• Maps and statistics of mango and cashew plantations • Maps and statistics on tomato, onion and turmeric

Action Plan 4:

Title of the Action Plan	**Crop loss assessment, climate change and environmental monitoring using geospatial technologies**
Name of the Scientist in charge	**Department of RS&GIS:** Dr. S. Pazhanivelan, Prof. & Head (RS&GIS), Dr. D. Muthumanickam, Prof. (SS&AC) Dr. R. Kumaraperumal, Asst.Prof.(SS&AC), **ENS:** Dr. M. Maheshwari, Prof. & Head **ACRC:** Dr. S. P. Ramanathan, Prof. & Head **TRRI, Aduthurai:** Dr. C. Uma Maheswari, Assoc. Prof. (Agron.) **ORS, Tindivanam:** Dr. S. Thiruvarasan, Asst. Professor (Agron)
Name of the Location/Centre	Dept. of Remote Sensing and GIS, DNRM, TNAU, Coimbatore

Activity	2021-22	Deliverables/ expected out come
• 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 • Assessing Carbon sequestration using geospatial technologies for different land use system viz., Agriculture, horticulture and forestry	1. Developing methodology for crop loss assessment 2. Establishing Eddy flux tower and soil moisture probes 3. Validating spatial ET and soil moisture products	• 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. • Assessment of Carbon sequestration for Tamil Nadu

C. Research Projects and remarks

Research Projects reviewed:

URP	Core Project	EFP	Private	Action Plan Projects	Total
4	1	3	-	-	**8**

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

Sl.No	Project No. and Title	Project Leaders	Remarks
1.	**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. R. 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 Asst.Prof.(SSAC) & **Project Leaders:** Theme I: Dr. K. Sivakumar, Assistant Professor (SS&AC), Dept. of RS&GIS, DNRM, TNAU, Coimbatore.	• Studies on spray drift, blocking of nozzles and effect of hard water usage in PP chemicals has to be carried out. • Economics has to be worked out for the nutrient spraying study. • Drone-based PPFM spray and crop boostershas to be conducted as per the schedule. • Drone-based spraying of Panchagavya may be conducted in larger areas. • Under the theme of Drone based herbicide spraying, detailed output on residue analysis has to be included in the research highlights. Herbicide spraying on other crops has to be studied. • Engineering scientists involved in the drone research team has to conduct the spray dynamics study in collaboration

		Dr. M. Gopalakrishnan, Assistant Professor (SS&AC), Dept. of SS&AC, DNRM, TNAU, Coimbatore. Theme II: Dr. R. Anandham, Assistant Professor (AGM), Dept. of AGM, DNRM, TNAU, Coimbatore. Dr. V. Gomathi, Professor and Head, Dept. of AGM, DNRM, TNAU, Coimbatore. Dr. M . Senthilkumar, Associate Professor (AGM), Dept. of Crop Management, AC&RI, Eachangkottai, Thanjavur. Dr. J. Prabhaharan, Assistant Professor (SS&AC), Coastal Saline Research Centre, TNAU, Ramanathapuram. Theme III: Dr. V. Davamani, Assistant Professor (ENS), Dept. of Environmental Sciences, DNRM, TNAU, Coimbatore. Theme IV: Dr. V. Babu Rajendra Prasad, Assistant Professor (CRP),	with Dept. of RS&GIS.

		Dept. of Crop Physiology, DCM, TNAU, Coimbatore. Theme V: Dr. P. Murali Arthanari, Associate Professor (Agronomy) Dept. of Agronomy, DCM, TNAU, Coimbatore. Dr. C. Bharathi, Assistant Professor (SS&AC), Dept. of Agronomy, DCM, TNAU, Coimbatore.	
2.	**NRM/CBE/RSG/SAC/2020/001** Digital Soil Mapping using machine learning algorithms and expert system approach (October 2019 – March 2022)	Dr. R. Kumaraperumal, Asst Prof (SS&AC)	• The outputs of Digital Soil Mapping have to be presented in Research Highlights. • DSM has to be extended for Salem and Erode districts.
3.	**NRM/CBE/RSG/SAC/2020/002** Developing an Automated tool for extraction of crop condition from temporal Synthetic Aperture Radar (SAR) data (February 2020 - March 2021)	Dr. K.P. Ragunath, Asst. Professor (SS&AC)	• Compare the statistics on Rice area of Ramnad district during 2016-17 with 2019-20 with the newly developed crop condition automation tool. • Project is to be closed and completion report has to be submitted.
4.	**NRM/CBE/RSG/2019/001** Cadastral level soil Nutrient mapping in Madathukkulam block in Tiruppur District(Dec. 2019 to March 2021)	Dr. K. Sivakumar, Asst Prof (SS&AC)	• Nutrient mapping of Madathukulam block has to be completed as per work plan and presented in the Research Highlights. • The project may be closed and closing report may be submitted

5.	**NRM/CBE/SAC/RSG/2018/CP 135** Coconut area mapping and change detection in Coimbatore and Tiruppur districts of Tamil Nadu using Remote Sensing techniques (February 2019 to December 2020)	Dr. K. Sivakumar Asst. Prof. (SS&AC) Dr. R. Jagadeeswaran, Assoc. Prof. (SS&AC)	• Project may be closed and completion report has to be submitted.
6.	**TNIAMP– Phase I** 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	• Project may be continued as per the programme.
7.	**NRSC/NRM/CBE/RSG/2018/R 001** Developing a methodology and interface for spatial maize crop production estimation using Crop simulation model (November 2018 to October 2021)	PI: Dr. S. Pazhanivelan Professor and Head (RS&GIS) Co-PIs: Dr. K.P. Ragunath, Asst. Prof. (SS&AC), RS&GIS Dr. R. Kumaraperumal, Asst. Prof. (SS&AC), RS&GIS	• Project may be continued as per the programme.
8.	**SAC/NRM/CBE/RSG/2019/R0 06** SUFALAM- Use of Space Technology for Area Estimation of Rabi-Groundnut and Pilot Studies for Crop Insurance and Yield estimation in Tamil Nadu state(April 2019 to October 2021)	Dr. S. Pazhanivelan Professor and Head (RS&GIS)	• Project may be continued as per the programme.

3. Department of Environmental Sciences

A. Decisions made on Adoption / OFT / Information:

Technology for adoption

For textile and tannery effluent contaminated soil with high salt content (EC 4.0 dSm^{-1}) irrigated with high EC water (7.9 dSm^{-1}), application of recommended dose of N & K and 50% of P along with soil application of AM fungi @ 50 kg ha^{-1} and Composted Poultry manure @ 5 t ha^{-1}resulted in better growth and yield of Castor. Hence, for the sustainable management of textile and tannery effluent contaminated soil and water, castor priming with AM fungi is recommended.

For OFT

OFT 1: Impact of ambient tropospheric ozone and the effectiveness of anti-ozonant on rice cultivars (Year: 2021-2022)

Objective: To assess the efficiency of anti-ozonant on rice cultivars under high ambient tropospheric ozone regions

Location	:	Coimbatore (SIDCO, Kurichi) and Thiruvallur (Gummudipoondi)
Lead centre & Scientist In-charge	:	Department of Env. Sciences, TNAU, Coimbatore Dr. P. Dhevagi, Assoc. Professor (ENS) Dr. R. M. Jayabalakrishnan, Asst. Prof. (ENS)
Co-coordinating centres	:	Thiruvallur: KVK, Tirur

Treatments
Rice Varieties: Anna (R) 4 (Tolerant variety), TRY (R) 2 (Sensitive variety)
T$_1$: Anna (R) 4 (Control)
T$_2$: Anna (R) 4 + EDU 300 ppm
T$_3$: TRY (R) 2 (Control)
T$_4$: TRY (R) 2 + EDU 300 ppm

Spacing	:	15 x 10 cm
Season	:	Samba (Aug – Sep), Navarai (Dec – Jan)
Design	:	Randomized Block Design (RBD)
Duration	:	One Year (July 2021 to June 2022)
Observations to be recorded	:	Physiological parameters (Photosynthetic rate, stomatal conductance and chlorophyll content), Yield (Number of tillers, Number of productive tillers, 1000

grain weight, yield, BC ratio)

Outcome : The effectiveness of anti – ozonant could be determined for rice crop under high ambient tropospheric ozone regions

For Information

1. **Coconut shell-based filtration system for treating textile dye effluent**

   - Filtration system designed with $ZnCl_2$ impregnated activated carbon from coconut shell: Geotextile: Coir fibre (1:0.6:1) showed higher colour removal efficiency (99.89 %), reduction in TDS (62.84 %), BOD (82.15 %) and COD (91.24 %) in textile dye effluent.

2. **Natural adsorbents for mercury removal from aqueous solution**

   - From aqueous solution of 0.1 ppm mercury, among the natural adsorbents studied, rice husk biochar (RHBC) having the zeta potential of -25.6 mV recorded maximum Hg removal efficiency (82%) followed by coirpithbiochar (74%) and vermiculite (72%) within 6 hours of contact time.

3. **Microplastics in agricultural soil**

   - Samples were collected from different agricultural fields applied with sewage water sludge and plastic mulched fields for the assessment of microplastics. Microplastics extraction procedures were standardised and amongst various reagents used for the digestion to remove organic matter, 30% hydrogen peroxide exhibited highest removal (64%) compared to other reagents.
   - Similarly, in density separation, 5M NaCl was found to be highly effective in the extraction of microplastics

4. **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 soil application of ETP sludge vermicompost @ 5 t ha^{-1} in pearl millet (Co 10) has recorded 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 irrigated through surface irrigation (flood method) along with soil application of ETP sludge @ 5 t ha^{-1}.
   - Higher nutrient availability in soil was recorded under 50% STCR recommended NPK along with 50% Mixed Liquor Suspended Solids (MLSS) under paper board mill effluent irrigation.

- In paper mill effluent irrigated soil, the cultivation of *S. portulacastrum* at 5 X 5 spacing along with pressmud compost @ 5 t ha^{-1} + CSR BIO @ 5 t ha^{-1} for two sequence reduced the salt built-up up to 33.1 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).
- From the rhizosphere of halophytes grown in TNPL effluent irrigated soil with high EC, bacterial cultures were isolated and identified based on 16S rRNA sequencing. These cultures were screened for plant growth promoting activities and compatibility studies are under evaluation.

5. Recycling of treated sewage and septage for agriculture

- Continuous irrigation of treated sewage for two years increased the soil organic carbon by 11% (0.61 to 0.68%) besides improving the microbial population and enzyme activities.
- The quality of forage was found to be good recording 13.45, 22.35, 2.14 and 11.68 per cent crude protein, crude fibre, fat, ash with an oxalate content of 2.85 per cent which is below the permissible limit of 4 per cent.
- 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.
- In septage treated through reed bed *Colocasia sp.* and *Typha sp*. addition of EM culture @ 5 ml per litre + 4 hours aeration reduced the BOD by 70.82 %, COD by 75 % and coli form population by 84.29 %
- The dewatered sludge of septage composted with municipal solid waste and coirdust 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 in the permissible limits.

6. Hydrochar production from sewage sludge for environmental application

- Optimum condition for the production of hydrochar from sewage sludge is 200°C for 6 h reaction
- Hydrothermal carbonization increased the higher heating value (HHV) of the sewage sludge from 16.24 to 19.41 MJ kg^{-1} (19.52%)
- Thermogravimetric analysis exhibited through the proportion of 50% coal + 50% hydrochar exhibited HHV of 23.16 MJ kg^{-1} which confirms the efficacy of hydrochar as an energy alternative.

7. Impact of COVID 19 on river water quality

- The impact of COVID 19 lockdown on water quality of rivers *viz.*, Cauvery and Thamirabarani were evaluated and it was found that the river water quality was improved during COVID 19 lockdown compared to pre-COVID period.
- In river Cauvery, reduction in TDS by 35.6 % (410 to 264 mg L^{-1}), BOD by 61.1 % (35 to 13.6 mg L^{-1}), COD by 34.5% (410 to 264 mg L^{-1}) and Coliforms by 73.5% (900 to 240 MPN100^{-1} ml) was observed.
- In river Thamirabarani, TDS reduced by 55 % (280 to 126 mg L^{-1}), BOD by 86.9% (75 to 9.8 mg L^{-1}), COD by 88.2% (204 to 24 mg L^{-1}), and Coliforms by 43.75% (1600 to 900 MPN100^{-1}ml).
- Water quality in the pilgrimage places of Thamirabharani river recorded the highest population of total coliforms (1600 MPN100^{-1}ml) during Aadiamavasai and Mahalayaamavasai festival in 2019; whereas it showed reduction in population during 2020.

8. Black Carbon status over high altitude in Southern India

- Diurnal variations of aerosol Black Carbon (BC) revealed an evening peak (during 17:00 to 22:00 h) during Feb to May, which decreased gradually towards morning and the lowest value was recorded during the early morning hours (05:00 h). The overall annual mean BC concentration recorded at Ooty was 0.57 ± 0.22 µg m^{-3}. The Values of $α_{abs}$ ~ 1 in most cases, > 85% of the daily mean values remained < 1 indicating dominance of fossil fuel aerosols in modifying aerosol absorption properties at Ooty.
- Highest columnar Aerosol Optical Depth (AOD) was observed in summer and minimum value in autumn and the overall annual mean AOD at 500 nm for Ooty region is 0.35 and the angstrom exponent value ranged from 0.4 to 2.6 highlighting changing aerosol source type at high altitude Ooty region.

9. Atmospheric Trace Gases Chemistry Transport and Modelling (ATCTM)

- Diurnal cycle of ground-level ozone concentration showed higher values at night hours and lower values was observed at daytime. Other precursors such as NOx (NO and NO_2), SO_2 and CO showed day time peak. Furthermore, an inverse relationship was found between O_3 and its precursors.
- Annual variation of monthly mean ozone concentrations followed a systematic pattern with the lowest value in July – Sep (20.02±2.26 ppb) and highest during Feb – May (54.03±6.64 ppb).
- Seasonal mean values (ppb) of ozone were 54.43±7.49, 20.40±2.5, 29.43±6.8 and 43.03±5.39 for summer, monsoon, post monsoon and winter, respectively .
- Monthly maximum NOx value was observed during summer month of April (1.86 ppb), whereas minimum value was observed during monsoon month of August (0.19 ppb).

- Monthly maximum SO_2 was observed during summer months such as March and April (1.0 and 0.6ppb, respectively) and the minimum value of about 0.10ppb was observed during November.

10. Impact of Ozone Protectant on Rice and Blackgram under elevated Ozone condition

- Among the rice cultivars, Anna (R) 4 was found to be tolerant and TRY 2 was sensitive to elevated tropospheric ozone concentration of 100 ppb. In Black gram, VBN 8 was tolerant and VBN 3 was sensitive to 100 ppb of ozone.
- Application of Ethylene Diurea (EDU) @ 300 ppm during flowering stage (30 DAS) improved the plant traits of black gram at elevated ozone concentration of 100 ppb.
- In blackgram (*var* VBN 3.), application of EDU @ 300 ppm during ozone exposure period of 10 days(31 DAS to 40 DAS) improved the photosynthetic rate by 28.97% (O_3:11.21, O_3+EDU: 15.78 µmol CO_2 m^{-2} s^{-1}), stomatal conductance by 21.90 % (O_3:0.27, O_3+EDU:0.35 mol H_2O m^{-2} s^{-1}), chlorophyll content by 32.37 % (O_3:16.11, O_3+EDU:23.82), superoxide dismutase activity by 20.8 % (O_3:4.80, O_3+EDU:5.80 unit g^{-1}), peroxidase activity by 39.8 % (O_3:28.67, O_3+EDU:40.07 µMpurpurogallin formed min^{-1} mg^{-1}FW) and catalase activity by 5.45 % (O_3:0.37, O_3+EDU:0.39 mM H_2O_2 oxidized $min^{-1}g^{-1}$)
- In rice (*Var* TRY(R)2), application of EDU @ 300 ppm during ozone exposure period of 30 days (29 DAT to 59 DAT) improved the photosynthetic rate by 21.54% (O_3:14.60, O_3+EDU: 18.60 µmol CO_2 m^{-2} s^{-1}), stomatal conductance by 10.58 % (O_3:0.31, O_3+EDU:0.35 mol H_2O m^{-2} s^{-1}), chlorophyll content by 14.93 % (O_3:23.20, O_3+EDU:27.11), superoxide dismutase activity by 51.40 % (O_3:12.48, O_3+EDU:18.90 unit g^{-1}), peroxidase activity by 1.35 % (O_3:30.00, O_3+EDU:25.00 µMpurpurogallin formed min^{-1} mg^{-1}FW); while catalase activity was found to decline by 4.05% (O_3:0.25, O_3+EDU:0.26 mM H_2O_2 oxidized $min^{-1}g^{-1}$) respectively.

11. Nitrogen inhibitor on nitrous oxide emission reduction under intensive tomato cultivation

- STCR based application of N as neem coated urea reduced the N_2O emission (38%) as well as increased the yield of tomato by 14% under red sandy loam soil overSTCR based normal urea application along with 1% Potassium thiosulfate (KTS) as N_2 inhibitor.

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

- Field experiments conducted at TNAU, Coimbatore and KVK, Needamangalam showed that *in-situ* decomposition of rotavator thrashed rice stubbles with TNAU biomineralizer @ 2 kg/tonne of residue along with urea @ 25 kg significantly

decreased the C:N ratio from 55.71 to 53.28 and from 42.47 to 40.37 at TNAU, CBE and KVK, Needamangalam respectively. The reduction of CN ratio was 4.36% and 5.20% in TNAU, CBE and KVK, Needamangalam over control. Furthermore, the soil microbial population and soil enzyme activities were also found to be significantly increased .

13. *D*ecomposition of crop residues with TNAU biomineralizer

- Application of 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 agroresidues) 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.

14. Potential of oil palm (*Elaeisguineensis*) plantation on carbon sequestration

- Oil palm was found to sequester significant amount of carbon and the total CO_2 sequestered by oil palm of 15, 8, 4 years were 2802, 1663 and 1138 kg palm^{-1}, respectively.
- The highest biomass build up (1528 kg palm^{-1}) and CO_2 sequestration (400.6 t ha^{-1}) was observed under drip fertigation @ 1.2: 0.6: 1.2 Kg N, P, K palm^{-1}year^{-1} with soil application of composted oil palm residue @ 30 kg palm^{-1} year^{-1} in 15-year-old plantations

15. Screening trees for better noise reduction

- Noise reduction potential of 40 tree plantations were studied in Coimbatore, Mettupalayam, Karur and Tiruppur. Among the 40 tree species studied, tree species namely *Azardirachta indica*, *Thespesia populenea*, *Neolamarckia cadamba* and *Pithecellobium dulce* as High Density Plantation of 30m width reduced more than 20 dB noise level.
- The Air Pollution Tolerance Index (APTI) for Sacred fig (*Ficus religiosa*), False Ashoka Tree (*Polyalthia longifolia*), KodukkaiPuli (*Pithecellobium dulce*), Rain tree (*Samaneasaman*), Portia Tree (*Thespesia populnea*) were 49.16, 46.53, 19.17, 18.36 and 17.15, respectively.

B. ACTION PLAN PROPOSED FOR 2021- 2022

Action plan -1 New

Title of the action plan	Studies on antibiotics residue in soils and crops under intensive organic farming systems of Tamil Nadu		
Name of the scientists in charge	**Dr. V. Davamani,** Asst. Prof. (ENS), Dept. of ENS, DNRM, TNAU, Coimbatore. **Dr. A. Christopher Lourduraj,** Prof. (ENS), Directorate of Research, TNAU, Coimbatore. **Dr. S. Paul Sebastian,** Asst. Prof. (ENS), Dept. of DCM, AC&RI, Kudumiyanmalai		
Name of the Location / Centre	**Dept. of Environmental Sciences, DNRM, TNAU, Coimbatore**		
Activity	**2021-22**	**2022-23**	**Deliverables/Expected outcome**
To assess the dynamics of manure driven antibiotics in soil and its bioaccumulation in crops.	1. Collection and analysis of organic manures, soils & plant samples from intensive organic cultivation fields of Tomato in Coimbatore district and Paddy in Thanjavur district Tamil Nadu for **first season.** 2. Incubation study of soil spiked with antibiotics	Collection and analysis of organic manures, soils & plant samples from intensive organic cultivation fields of Tomato in Coimbatore district and Paddy in Thanjavur district Tamil Nadu for **second season.**	• The outcome of the project is to be principally used for application of organic manure on safe mode and judicious use of veterinary antibiotics in livestock. • It can be used additionally to evolve the long-term accumulation and translocation pattern of antibiotics.

Action plan -2 New

Title of the action plan	Development of effective microbial (EM) formulation and assessing its potential in waste treatment
Name of the **scientist** in charge	Scientists In-charge: Dr. P. Kalaiselvi, Assistant Professor (ENS) Dr. E. Parameswari, Assistant Professor (ENS) Dr. M. Maheswari, Professor & Head (ENS)

Name of the Location/ Centre	Department of Environmental Sciences, DNRM, TNAU		
Activity	**2021-22**	**2022-23**	**Deliverables/Expected outcome**
• Development of Effective Microbial formulation	• Isolation of microbial culturesfrom the organic substrates • Identification by metagenomic analysis • Compatibility studies • Preparation of EM formulation	• Standardizing the dosages of EM formulation for composting and wastewater treatment	• The EM formulation developed will be useful for sustainable eco-friendly waste management.

C. Research Projects and Remarks

(i) Theme Wise Research Projects

S. No.	Theme Area	Number of Projects			Projects recommended to be closed
		URP	EFP	Total	
1	Bioremediation of Polluted Environments	3	-	3	-
2	Wastewater Treatment and Recycling	5	5	10	1
3	Air pollution Monitoring and Mitigation	6	3	9	-
4	Integrated Solid Waste Management	1	5	6	1
5	Agro-ecology and Ecosystem Services	2	-	2	1
	Total	**17**	**13**	**30**	**3**

(ii). Remarks on the ongoing University Research projects/ Externally Funded Projects/ Core Projects

S. No.	Project No. and Title	Scientists in-charge	Duration	Remarks
ThemeArea1 –Bioremediation of Polluted Environments				
1.	NRM/CBE/ENS/2020/002: Recycling of sewage sludge for synthesis of functional nano materials and its environment applications	Dr.E. Parameswari Asst.Prof.(ENS)	March, 2020 - February, 2022	The project may be continued as per technical programme.
2.	NRM/CBE/ENS/2020/004: Assessment of Micro plastics in Agricultural Soils	Dr. P.Dhevagi, Assoc.Prof. (ENS)	April,2020 - July,2022	The project may be continued and extension proposal may be submitted

3.	NRM/TRY/ENS/FLO2020/001: Evaluation of flower in gannuals suitable for sodic soils	Dr.C.Prabakaran Asst.Prof.(ENS)	June,2020 - May,2023	A mid-term correction proposal including sodicity level maintenance in consultation with soil scientists at HC & RI (W) / ADAC 7 RI, Trichy for conducting trials with flowers and vegetable crops may be submitted to Director of Research through DNRM and the project may be continued
Theme Area 2 Waste water Treatment and Recycling				
4.	ITC/NRM/CBE/ENS/2014/R003 Studieson 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 (ENS) Dr.G.Balasubramanian Professor (ENS)	July,2020 - June,2023	The project may be continued as per technical programme
5.	SPBL/NRM/CBE / ENS /2014 / R005 Ecofriendly 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 impacton soil and ground water	Dr. M. Maheswari Prof.&Head(ENS) Dr.V.Davamani, Asst.Prof.(ENS)	April,2020 - March, 2021 (An Endowment Scheme)	Profile study may completed at the earliest and the project may be continued as per technical programme.
6.	TNPL/NRM/CBE/ENS/2015/R008 Evaluation of long term effect of using treated TNPL Unit I (Karur) effluent water for irrigation and remediation of effluent tirrigated soil habitat	Dr. M. Maheswari Prof. and Head (ENS) Dr.P.Thangavel Professor (ENS)	April,2018 - March,2021	The project may be continued as per technical programme

7.	TNPL/NRM/TRY/SAC/2015/R002 Environmental quality assessment in the use of paper board industry (TNPL Unit II) waste water foragro-for estry system	Dr.P. Balasubramaniam Professor and Head, Dept. of SS&AC,ADAC&RI, Trichy Dr. D. Jawahar, Professor(SS&AC), TNAU Dr.J. Ejilane, Asst. Prof (Micro) Dr.P.Janaki, Assoc.Prof. (SS&AC) Dr.S.PaulSebastian Asst.Prof. (ENS) ADAC&RI, Trichy	April,2019 - March,2022	The project may be continued as per the technical programme
8.	DST/NRM/ALR/ENS/2017/R005 Preparation and Development of Adsorbent carbon and nano cellulose fibrils from Cocusnucifera and its potential application in waste water treatment system	Dr.R.M.Jayabala krishnan Asst.Prof. (ENS)	May,2017-April,2021	Project may be closed and completion report may be submitted for approval.
9.	NRM/CBE/ ENS/2019/002 Rhizofiltration of micro pollutants usingvetiver	Dr. K Sara Parwin Banu, Professor (ENS)	Oct.2019 - Oct 2021	Vetiver Floating Wetlands Technology may be standardized and extension proposal may be submitted.
10.	NRM/CBE/ENS/2020/001 Impact of treated sewage irrigation on soil and fodder quality	Dr.M.Maheswari, Prof. & Head (ENS) Dr.S.D.Sivakumar	January, 2020 - Decem	The project may be continued as per programme.

			ber,2021	
		Assoc.Prof.(Agr.), Dept.of Forage Crops		
11.	NRM/CBE/ENS/2020/006 EvaluatingtheimpactofCOVID19onriverwaterquality	Dr.K.Suganya Asst.Prof. (ENS) Dr.P.T.Ramesh Assoc.Prof.(ENS)	June,2020– May,2021	Project may be continued and extension proposal may be submitted.
12.	NRM/CBE/ENS/2018/003 Evaluation of Natural adsorbents for removal of Mercury from waste water	Dr.K.Suganya Asst.Prof. (ENS)	June,2020– May,2022	Pore volume of the adsorbents may be ascertained and the project may be continued.
13.	NRM/TVM/ENS/2021/001 Synthesis of carbon nano sheet from groundnut shell as potential agent for sewage waste water treatment	Dr. P.C. Prabu Asst Prof (ENS) RRS, Paiyur Dr.K.Raja Asst. Prof. (SST) DNST,TNAU	October, 2020 - September,2023	The project may be continued as per programme.
Theme 3 Air Pollution Monitoring and Mitigation				
14.	ISRO/NRM/KKM/ENS/2012/D001 GoI-ISRO-ARFI-Establishment and maintenance of aerosol observatory at HRS, Ooty for assessing the Aerosol Radiative Forcing over India (ARFI)	Dr. M. Maheswari Prof.andHead(ENS) Dr.R.M.JayabalakrishnanAsst. Prof. (ENS) Dr. K. Boomiraj,Asst.Prof.(ENS) ODL,TNAU Assoc. Prof. & Head,HRS,Ooty.	April, 2018 toMarch 2021 (Continuation on yearly basis)	Maintenance of instruments and retrieving of data has to be continued. The project may be continued as per the technical programme

15.	ISRO/NRM/KKM/ENS/2014/D002: Establishment and Maintenance Of Environmental Observatory at Wood House, HRS, Ooty for Atmospheric Trace gases Chemistry Transport Modeling(ATCTM)	Dr.M.Maheswari, Prof and Head (ENS) Dr.P.Dhevagi, Assoc.Prof.(ENS) Assoc.Prof. & Head, HRS, Ooty	2008 to 2013 (Continuat ion on yearly basis)	OFT may be conducted to validate the impact of the ozone on rice under open condition
16.	DST/NRM/CBE/ENS/2018/R011 Assessment on the potential of oil palm (*Elaeisguineensis*)plantationsforcar bonsequestrationindifferentregions ofTamilNadu	Dr. V. Davamani, Asst.Prof.(ENS) Dr. E. Parameswari Asst.Prof.(ENS) Dr. M. Velmurugan, Asst.Prof.(Hort.), Dept.of Flori., TNAU	April,20 18- Septem ber, 2021	The project may be continued as per technical programme
17.	NRM/CBE/ENS/BGR/2019/001 Impact of Tropospheric Ozone on Blackgram	Dr.P.Dhevagi Assoc.Prof. (ENS)	October, 2019 - Sep.20 21	The project may be continued
18.	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.Jayabala krishnan Asst. Prof. (ENS) Dr.S.Karthikeyan Asst.Prof.(Hort.)	October 2020 - Septem ber, 2022	The project may be continued

#	Project	Investigators	Duration	Recommendation
19.	NRM/KKM/ENS/2020 /001 Impact evaluation of particulate matter deposits around Thoothukudi Thermal Power Plant (TTPP) on trees	Dr. P.T.RameshAssoc.Prof.(ENS) Dr. A. KavithaPushpam Asst.Prof. (BIC) AC&RI,Killkulam	September,2020 – August, 2022	Particulate matter deposition level on a whole tree may be assessed and the project may be continued
20.	NRM/MTP/ENS/2020/002: Assessingtheairpollutiontoleranceofvarioustreespeciesforurbanforestry and improved air quality	Dr.M.Prasanthrajan Assoc.Prof.(ENS)	October,2020 - September, 2023	Oxygen emitting tree species can be included in the study and the project may be continued
Theme Area 4 Integrated Solid Waste Management				
21.	NRM/CBE/ENS/2020/R012 Sustainable Management of Human Waste for Better Sanitation and Resource Utilization in Agriculture	Dr.M.Maheswari Prof. and Head(ENS) Dr.S.K.Raj Kishore, Asst.Prof (ENS), O/o The Dean (SPGS),TNAU	July,2020- September ,2021	The project may be continued
22.	NRM/CBE/ENS/2019/003 Development of elite microbial consortium for degradationof lingo cellulosic wastes	Dr. P. Kalaiselvi, Asst. Prof. (ENS) Dr.V. Davamani, Asst. Prof. (ENS) Dr.M.Maheswari Prof.&Head(ENS) Dr.M. Prasanthrajan Assoc.Prof. (ENS)	November,2019 – October ,2021	Project may be closed and completion report has to be submitted for approval

23.	NRM/CBE/ENS/2020/003 Assessing the *in situ*de composition potential of TNAU Biomineralizer on crop residues	Dr.P.Kalaiselvi, Asst. Prof. (ENS) Dr.V.Davamani, Asst.Prof. (ENS) Dr.M. Selvamurugan Asst.Prof. (ENS) KVK, Needamangalam	August,2 020 - July,20 21	Project may be continued and extension proposal may be submitted.
24.	NRM/VVR/ENS/2019/01 Study on assessing the effectiveness of native micro organism for quick decomposition off arm wastes	Dr.A.Krishnaveni Asst.Prof.(ENS)	June,20 19– May,20 21	Isolated cultures and results of the project may be shared to Dept. of ENS, TNAU for maintenance The project may be closed and completion report to be submitted.
25.	NRM/PKM/ENS/2020/001: Strategy to increase the organic carbon content and micronutrient status of soils of HC&RI, Periyakulam	Dr. J. Kannan, Prof & Head (NRM) HC&RI, Periyakulam	Octobe r,2020 - Septem ber,202 2	The title of the URP proposal may be changed as In-Situ degradation of horticultural wastes for improving organic carbon and micronutrient status of soils of HC&RI, Periyakulam and the revised proposal may be submitted to Director of Research through DNRM.
Theme Area 5 Agroecology and Ecosystem Services				
26.	NRM/CBE/ENS/2019/001: Screening trees for bio-silencing of Noise	Dr.M.P. Sugumaran Assoc.Prof. (ENS)	June,2 019– May,20 21	Project may be closed and completion report has to be submitted for approval
27.	NRM/CBE/ENS/2019/001: Ecological impact of Miyawaki plantations in TNAU Campus	Dr.M.P. Sugumaran Assoc.Prof.(ENS)	August, 2020– July, 2023	High Density Plantations at two different locations may be included to compare the efficiency with TNAU Miyawaki plantation.The project may be continued

4. Department of Soil Science and Agricultural Chemistry

A. Decisions made on Adoption / OFT / Information:

I. For Adoption

1. Amelioration of Fluoride in soils

On Farm trials were conducted in maize at three locations *viz.,*Pongalur, Vagarai and Pappireddipatti in soils with initial fluoride content of 1.85, 1.81 and 2.05 mg kg^{-1} respectively. The results revealed that aapplication of Gypsum @ 2.0 t ha^{-1} along with STCR based NPK recommendation lowered the fluoride content to 1.57, 1.52 and 1.62 mg kg^{-1} respectively. Besides, the increase in mean maize grain yield recorded over control (NPK alone) was 19.05 %.

2. Sensor based automated drip irrigation

Sensor basedautomated drip irrigation trials conducted in chillies at HC & RI, Periyakulam and AC & RI, Killikulam recorded 6.75 % and 5.42 % increase in dry pod yield over conventional drip irrigation.

II. For Information

1. Fertility status of the farm soils of TNAU were assessed in colleges *viz.*, AC&RI, Vazhavachanur, HC & RI, Periyakulam, AC&RI, Kudumiyanmalai and Research Stations *viz.,* ARS, Kovilpatti, ORS, Tindivanam, HRS, Ooty and KVK, Ponglaur.

   i) **AC&RI, Vazhavachanur :** The pH of the surface soils varied from 6.33 to 7.84; Organic carbon ranged from low to medium (0.8 to 7.0 g kg^{-1}); available nitrogen status is low (112 to 269 kg ha^{-1}); available phosphorus ranged from low to medium (6.0 to 21.0 kg ha^{-1}) and available potassium ranged from low to high (179to 392 kg ha^{-1}).

   ii) **HRS, Ooty :**Soil reaction (pH) was acidic with the pH values ranged from 4.3 to 6.2; EC ranged from 0.05 to 0.31 dS m^{-1}; available nitrogen status is medium to high (313 to 583kg ha^{-1}); available P (Bray) content ranged from low to high (22.4 to 224kg ha^{-1});available K content of the soil ranged from medium to high (154 to 841kg ha^{-1}).

   iii) **ARS, Kovilpatti :** In red soil farm, soil pH ranged from 7.41 to 7.88; EC ranged from 0.23 to 1.12 dS m^{-1}; available nitrogen was low, ranging from 119 to 158 kg ha^{-1}; available phosphorus was medium, ranged between

12.5 to 18.5 kg ha^{-1}; available potassium ranged from medium to high (255 to 478 kg ha^{-1}).

In black soil farm, the soil pH ranged from 7.78 to 8.46; EC ranged from 0.23 to 1.12 dS m^{-1}; available nitrogen was low, ranged from 103 to 163 kg ha^{-1}; available phosphorus ranged from low to medium (7.7 to 12.7 kg ha^{-1}). Low organic carbon status was recorded in both the farms.

iv) **HC & RI, Periyakulam:** The Spatial Variability maps of soil physico-chemical properties and available nutrient status of cultivated soils of Central and Eastern Farms of HC & RI, Periyakulam revealed that the soil is neutral to alkaline in reaction and non saline, slightly calcareous to non-calcareous in nature. Organic carbon status was under medium category; available nitrogen was found to be low; available phosphorus was medium to high; available potassium was high. Regarding micro nutrients, Zn was found to be deficient in both farms. Quality of irrigation water in all the farm bore wells was found to be safe for irrigation.

v) **ORS, Tindivanam:** The soil samples are categorized under sandy loam to sandy clay loam in texture with slightly alkaline pH. EC ranged from 0.02 to 3.0 dS m^{-1}. Among the major available nutrients, available N was found to be low, P was low to medium and K was medium to high in C Block. The irrigation water in all the farm bore well and open well was safe for irrigation.

vi) **KVK, Pongalur :**The soils are grouped under slightly alkaline and non-saline category. The organic carbon status is low to moderate. Regarding the available nutrient status, the soil was low in available nitrogen and available phosphorus and high in available potassium status.

vii) **AC&RI, Kudumiyanmalai :** The water quality analysis of four open wells and six bore wells, showed that the pH of the water samples are neutral; EC varied from 0.39 to 2.97 dS m^{-1}; TDS ranged from 252 to 1929 ppm. Among the anions chloride content was found to be high in all the samples followed by bi-carbonate content.

2. The studies on the management of soil constraints at AC&RI, Eachangkottai, Thanjavur showed that addition of FYM @12.5 t + Clay @50 t ha^{-1} + Coarse sand @50 t ha^{-1} registered significant influence on soil physical properties *viz.,* reduction in soil bulk density, improvement in pore space, infiltration rate and hydraulic conductivity and recorded enhanced rice grain yield by 25 per cent over control.

3. Water quality parameters were assessed in ground water samples representing the post monsoon period (Sep - Dec 2020) and pre - monsoon period (Jan – Feb 2021) in the villages of Anaimalai block, Pollachi (North) and Pollachi (South) blocks. Electrical conductivity revealed slight salinity in 21.1 % of the samples, high salinity in 15 % of the samples. Chloride injury was witnessed in 25.0 % of the samples and carbonate hazard in 20.0 % of the samples.

4. Assessment of groundwater quality in Tirunelveli district revealed that 57 per cent of groundwater were of good quality, 18% , marginally saline, 4% , saline, 11% marginally alkali, 8% , alkali, 1% , high-SAR saline and 1% , high alkali. High SAR saline in Radhapuram block (4%), saline in Palayamkottai (20%), marginal saline in Kadayanallur (60%), high alkali in Valliyur (11%), alkali in Palayamkottai and Keezhapavur (40%), marginally alkali in Kadayanallur (40%) were recorded. Among the different blocks of Tirunelveli district, Radhapuram (75%) and Valliyur (55.55%) recorded the highest level of possible seawater intrusion.

5. Soil fertility status of available P and K in the soils of Kanyakumari, Theni, Namakkal and Dindugal districts indicated low phosphorus status in 4.60 to 10.7% of the samples and low K status in 1.60 to 5.50% of the samples. Out of the four districts, low phosphorus status was observed in Namakkal district (10.7%). Also, few blocks such as Thiruvattar (8.4%) in Kanyakumari, Kambam (11.2%) and Andipatti (10.7%) blocks in Theni, Thirucherngode (31.4%) and Mallasamudarm (20.4%) blocks in Namakkal, Palani (9%) in Dindigul districts had considerably low phosphorus status which warrants soil test crop response based balanced fertilization.

6. An efficient, low-cost, easy to use electrochemical (EC) sensor kit was developed, and the results of soil pH and electrical conductivity were found equivalent in both methods (standard and sensor methods). The water-soluble nitrogen, phosphorus and potassium results showed moderate variation with high coefficient of variation.

B. ACTION PLAN PROPOSED FOR 2021- 2022

New Action Plans 2021 – 2022:			
Action plan 1	**Effect of Long term fertilization practices on dynamics of low dose herbicides in soil**		
Name of the Scientists and Centre	**2021-2022**	**2022 - 2023**	**Deliverables/Expected outcome**
Dr. P. Janaki, Asso. Professor (SS&AC) Dr. D. Jayanthi, Associate Professor (SS&AC) Dept. of SS&AC, TNAU, Coimbatore.	**Column study** • Leachate collection & analysis on 1, 3, 5, 7 and 14 days after herbicide application (DAHA) • Residue analysis in leachate and soil on 14 DAHA	**Sorption study** • Analysis of residue in equilibrium solution (after 8, 12 hrs and 24 hrs) for sorption • Calculation of sorbed quantity of herbicides and fitting data in kinetic equations	• Effect of long term fertilization practices on the movement of low dose herbicides in soil • Effect of long term fertilization practices on the sorption behaviour of low dose herbicides in soil
Action plan 2	**Demonstrations on Management of Sub-soil Hard Pan in soils of Coimbatore**		
Dr.N.Chandrasekaran, Professor (SS&AC) Dept. of SS&AC, TNAU, Coimbatore.	**Field Experiment Treatments** T_1 : Farmers practice (Disc plough and cultivator twice) T_2 : Chisel plough + STCR based fertilizer recommendation + FYM @ 12.5 t ha^{-1} Crops : Deep rooted crops (Red gram / Cotton / Castor)	**Observations / Analysis** • Soil physical parameters: Bulk Density, Particle Density, Porosity, Penetrometer reading, Hydraulic Conductivity and Infiltration rate. • Crop Parameters: Biometric observations, yield, nutrient content & uptake.	• Demonstration of management technologies for alleviating sub-soil hard pan • Evaluation on the impact of technological interventions on the improvement of soil properties.

Action plan 3	Identification and Mapping of Soil Constraints for sustained crop production in Red & Laterite Soils		
Dr.P.P.Mahendran, Prof.&Head, Dept. of Soil & Environment, AC&RI, Madurai. Dr.R.Jagadeeswaran, Asso.Prof. (SS&AC) Dept. of RS&GIS, CBE Dr.M.Vijayakumar Asst.Prof. (SS&AC) Dept. of DCM, AC&RI, Kudumiyanmalai	• Surface (0-20 cm) & Sub-surface soil sampling (20-50 cm) with Geo-coordinates • Soil Analysis: Texture, Density, Porosity, pH, EC, Organic Carbon, CEC	• Analysis of Exchangeable cations, P-fixation capacity and Nutrient indexing and mapping	• Identification of the surface and sub-surface soil constraints in major soil series of Red and Laterite soils of Pudukottai District • Mapping of soil constraints and assessing the potential of soils for crop production by employing FCC
Action plan 4	Development of Geospatial map for soil fertility and crop suitability analysis of RRS, Paiyur		
Dr.P.C.Prabu, Asst.Prof (ENS) RRS, Paiyur Dr.R.Kumaraperumal Asst.Prof (SS&AC) Dept. Of RS&GIS, TNAU, Coimbatore	• Generating base map of RRS, Paiyur • Collection of GPS aided surface and sub surface soil samples • Soil profile studies	• Surface and sub-surface soil sample analysis for Physical, chemical & biological properties • Preparing soil fertility and crop suitability map using GIS	• Assessment of the fertility status of the farm soils and quality of irrigation water • Developing soil resource database of RRS, Paiyur for proper appraisal of productivity potential and rational use.

C. Research Projects and remarks

(i). Research Projects reviewed:

URP	Core Project	EFP	AICRP	Action Plan Projects	Total
10	-	2	2	4	**18**

(ii). Remarks on the ongoing University Research projects/ Externally Funded Projects/ Core Projects

S. No.	Project No. and Title	Duration	Project leader(s) / Co-Project Leader(s)	Remarks
Action Plan Projects				
1.	Mapping ground water quality in Pollachi Taluk	2019-2021	Dr.C.Sudhalakshmi Assistant Professor (SS &AC), CRS, Aliyarnagar Dr.R.Kumaraperumal Assistant Professor (SS & AC), Dept. of RS & GIS, TNAU, Coimbatore.	• AICRP on Salt Affected Soils at Trichy may be contacted for the appropriate classification of water quality. • Water samples may be collected and analysed from the remaining block and water quality maps may be prepared.
2.	Soil resource inventory and Fertility mapping of farm soils of AC&RI, Vazhavachanur using GIS.	2019 -2022	Dr.V.Arunkumar, Assistant Professor (SS & AC) AC & RI, Vazhavachanur.	• Action plan may be proposed as University Research project and proposal may be submitted for obtaining project number. • Analysis of micro nutrients may be completed. • Soil fertility maps may be displayed in AC & RI, Vazhavachanur for the benefit of students and visiting farmers and also shared with extension functionaries.

3.	Fertility mapping of the farm soils of HRS, Ooty using GIS.	2020 - 2022	Dr.D.Selvi, Professor (SS&AC), Dept. of SS&AC. Dr.K.Sivakumar Assistant Professor (SS & AC) Dept. of RS & GIS TNAU, Coimbatore.	• Sample size may be increased to obtain representative data. • More no. of GPS points (geo co-ordinates) may be collected for preparation of thematic maps.
4.	Digitalization of soil fertility map of red and black soil farms of Agricultural Research Station – Kovilpatti	2020-2021	PI : Dr. K. Baskar Professor and Head cum Chief Scientist (AICRPDA) Co-PI : Dr.V.Sanjivkumar, Asst. Professor (SS&AC) Agricultural Research Station, Kovilpatti.	• The maps may be displayed in the Research Station and shared with extension functionaries (JDA/ADA) for the benefit of farmers.
URP				
5.	**NRM/PKM/SAC/2019/001** Developing Spatial Variability maps of soil physico-chemical properties and available nutrient status and assessment of irrigation water quality of Central and Eastern Farms of HC & RI, Periyakulam.	June 2019 to May 2021	Dr.K.M.Sellamuthu Assoc. Professor (SS&AC) Dept. of Natural Resource Management HC&RI, Periyakulam. Dr.R.Kumaraperuamal Asst. Professor (SS&AC) Dept. of RS&GIS, TNAU, CBE	• Soil fertility maps of Central Farm, Eastern Farm and Western Farm may be displayed in HC & RI, Periyakulam for the benefit of students and visiting farmers. • In addition, these maps may be shared with extension functionaries (JDA/ADA) for the benefit of farmers.

6.	**NRM/TVM/ENS/2020/001** Fertility mapping of the farm soils of Oilseeds Research Station of Tindivanam using GIS	January, 2020 to April, 2022	Dr. P .G. Lavanya Professor (SS&AC) ORS, Tindivanam Dr.R.Kumaraperumal Assistant Professor (SS&AC) Dept of RS &GIS,TNAU, CBE	• In addition to soil reaction and electrical conductivity, other soil fertility parameters may be analysed and soil fertility maps may be prepared.
7.	**NRM/MTP/SAC/2019/001** Status and dynamics of soil nutrients with organic manures in mulberry growing soil	March 2019 to February 22	Dr.R.Rajeswari Assistant Professor (SS&AC) Dept. of Sericulture FC&RI, Mettupalayam.	• Production of seri-composts by various methods *viz.,* through EM and earthworms shall be discussed and clarified with Professor and Head, Dept. of Environmental Sciences, TNAU, Coimbatore. • The expertise of Professor and Head, Dept. of SS&AC,TNAU,Coimbatore shall be utilized for recording mulberry leaf yield. • In continuation of this experiment at FC&RI, Mettupalayam, one more field trial may be initiated in the contact farmer's field *viz.,*silkworm rearing farm, Annur.
8.	**NRM/CBE/SAC/2020/01.** Mapping Spatial Variability of soil physico-chemical properties and available nutrient status and assessment of irrigation water quality of KVK farm, Pongalur.	April 2020 to March 2022	Dr.D.Jawahar, Professor (SS&AC), Dept. of SS&AC, TNAU, Coimbatore.	• Analysis of other soil fertility parameters may be completed and soil fertility maps may be prepared. • The project work may be completed on time as per technical programme.

9.	NRM/MDU/AGC/2018/R001 Development of Dry formulation from botanicals for insect Pest management.	Nov – 2017 to Oct - 2020	Dr. K. Senthil Assistant Professor (Agrl. Chemicals) Dept.of Soils and Environment, AC&RI, Madurai.	• Findings may be given for information. • On farm testing of the developed product may be proposed involving Agrl. Entomologist.
10	NRM /ECK/SSAC/2021/002 Management of Soil constraints at Agricultural College and Research Institute, Eachangkottai, Thanjavur	January 2021 - December 2024	Dr.S. Mohandas Professor(SS&AC)&Head, Dept. of Crop Management, AC&RI, Eachangkottai, Thanjavur.	• The Project is to be continued. • Since, this is the first year of experiment, two more field experiments may be conducted to get comparable results. • Cost of the treatments imposed may be considered while imposing the treatments.
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.	January, 2021 - December, 2023	Dr. P. Janaki Associate Professor (SS&AC) Dept. of SS&AC TNAU, Coimbatore	• The Project work to be continued and speeded up so as to bring salient outcome for CSM 2022.
12	NRM/KKM/SAC/2020/001 Exploring the non-conventional halophytes for reclamation of salt affected soils	December, 2019 - November, 2021	Dr.K.Manikandan Assistant Professor (SS&AC) Dept. of SS&AC AC&RI, Killikulam,Thoothukudi.	• The Project is to be continued as per technical programme. • Proposal may be submitted for the extension of project period upto March 2022.

13	**NRM/ KKM/ SAC/ 2021/ 001** Spatial and Temporal Mapping of Micronutrient status of Tamiraparani river basin	December 2020 to November 2022	Dr. D. Leninraja Asst. Professor (SS&AC) Dept. of SS&AC, AC&RI, Killikulam, Thoothukudi.	• Mapping of the micronutrient status of Tamiraparani river basin may be completed.
14	**NRM /ECK/SSAC/2021/00 1** Management Technologies for surface crusting in red soils of Thanjavur District	June 2021 – May 2024	Dr.A.Rathinasamy Professor (SS&AC) Dr.K.Venkatalakshmi Assistant Professor (Agronomy) AC&RI, Eachangkottai, Thanjavur.	• The Project is to be continued as per technical programme.
Externally funded Projects				
15	**NASF/ACRI/MDU/DS E/2020/R007** Development of electrochemical sensor tool for soil health analysis	Feb 2020 to January 2023	Dr. P. Kannan Assistant Professor (SS&AC) Dept. of Soils and Environment AC&RI, Madurai.	Water-soluble N, P, and K results showed moderate 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.
16	**ICAR/WTC/CBE/AGR /2016/R 009** Agri Consortia research platform on water - Groundwater contami-nation due to geogenic factors and industrial effluents and its impact on food chain.	2020 - 2021	Dr. M. Elayarajan Associate Professor (SS & AC), WTC, TNAU, Coimbatore.	• The findings of the project may be reported in annual report of the scheme.

AICRP Projects				
17	**AICRP/NRM/CBE/SAC/004** Assessing the soil available phosphorus and potassium status in selected districts of Tamil Nadu using GIS and GPS techniques.	2020 - 2021	Dr.T.Chitdeshwari Professor (SS&AC) Dr.D.Jegadeeswari Assoc. Professor (SS&AC) Dept. of SS&AC TNAU, Coimbatore.	• Findings may be given for information.
18	**AICRP/NRM/TRY/005** Survey and characterization of ground water of Coastal districts of Tamil Nadu for Irrigation.	2020 - 2021	Dr.P.Balasubramaniam, Professor and Head, Dept. of SS&AC ADAC&RI, Trichy.	• Findings may be given for information.

5. Department of Agricultural Microbiology

A. Decisions made on Adoption / OFT / Information:

For adoption

Large scale field demonstrations on rice conducted at ARS, Bhavanisagar, ORS, Tindivanam, TRRI, Aduthurai and AC&RI, Killikulam during 2020-21 with 100 % and 50 % recommended dose of zinc as ZnSO$_4$, revealed that inoculation of Zinc Solubilising Bacteria (ZnSB) along with 50% Zn as ZnSO$_4$ (12.5 kg ha^{-1}) recorded mean yield increase of 17% over control (no zinc)

For Information

- *Bacillus thuringiensis* BC (BN1) showed significant effect on inhibition of egg hatching of *M. incognita* (87.2%) and caused mortality of juveniles (82.0%) followed by *Azotobacter chroococcum* (BN3) which showed 81.0 and 72.0 per cent, respectively.
- Recombinant over-expressed yeast produced xylose reductase for the conversion of xylose into xylitol (0.03g.mL^{-1})using NADPH as a reductant, at pH 5.0 and temperature 30 ^{o}C.
- Thermophilic cellulase producing *Brevibacillus borstelensis* MC18 exhibited CMCase, FPase , Avicelase activities and were found to be thermostable retaining 60% of its activity at 80°C, and its enzyme recorded 65 % of saccharification efficiency of corn cob biomass
- Colour based probe was developed for soil health management and gel color change had positive correlation with soil biological quality index and actual measure of CO_2
- 42 (9 bacteria, 20 fungi, 13 actinobacteria) have been identified as lignocellulolytic bacteria out of 160 cultures.
- Supplementing poultry concentrate feed with 7.5% dried Azolla recorded a higher average body weight of 2.12 kg per Vencobb bird at 6th week compared to control (2.06 kg) with a Feed Conversion Ratio (FCR) of 1.73 in as against 1.86 in control birds, and also saving in concentrate feed (130 g kg -1 body weight).

B. ACTION PLAN PROPOSED FOR 2021- 2022

New Action Plans 2021 – 2022:			
Action plan 1	**Bio-capsule/Pellet formulation of NPK bio-inoculants and testing its bio-efficacy**		
Name of the Scientists and Centre	**2021-2022**	**2022 - 2023**	**Deliverables/Expected outcome**
Lead centre: Dr. B. Jeberlin Prabina, Associate Professor (Agrl. Microbiology), Dr. S.Suresh, Prof & Head, Dept. of SS&AC., AC&RI., Killikulam **Sub centre:** Dr. D. Balachandar, Professor, Dept. of Agrl. Microbiology, TNAU, Cbe, Dr.K.Kumutha, Prof & Head, Dept. of Agrl.Microbiology., AC&RI., Madurai	• To profile the Plant Growth Promotion (PGP) related metabolites of the potash releasers, *Rhizobiumpusense* and *Stenotrophomonasmaltophila* • To develop capsule/pellet formulation of the potash releasers with Azospirillum and phosphobacteria	• To test and validate the efficacy of the formulation with paddy brinjal, tomato and banana as test crops	• Developed a compressed formulation of NPK bio-inoculants with the added advantages of bearing higher cell load, longer shelf life, volume reduction with enhanced plant growth promotion

C. Research Projects and remarks

(i). Research Projects reviewed:

URP	Core Project	EFP	AICRP	Action Plan Projects	Total
6	1	6	1	2	**16**

(ii). Remarks on the ongoing University Research projects/ Externally Funded Projects/ Core Projects

S. No.	Title of the projects	Period	Name, designation & official address of the project leaders	Remarks
1.	Action Plan: Development of microbial formulation for effective management of root knot nematode, *M. incognita*	2019-2021	Dr.V.Gomathi Professor and Head Dr.A.Ramalakhmi Asst. Prof. (Agrl. Microbiology) Dr. P. Vetrivelkalai Asst. Prof. (Nematology)	• The findings may be given for information.
2.	NRM/CBE/AGM/2018/CP016: Enzymatic production of Xylitol from corn cob biomass: a cost economic approach for biorefinaries	2018-2021	Dr. U. Sivakumar, Professor (Agrl. Microbiology)	• Completion report maybe submitted at the earliest
3.	DBT/NRM/CBE/AGM/2017/R022: Novel Biocatalysts for Biomass Valorization: Functional analysis and Engineering of Glycosyl Hydrolases and Laccases from thermal springs and *Haloferaxvolcanii*.	2018-2021	PI: Dr.R.Priyadharshini Mentor: Prof.U.Sivakumar	• The project has to be closed and completion report to be submitted.

4.	SERB/NRM/AGM/CBE/2021/R026: Development of process for laccase production by *Hexagoniahirta* MSF2 using coconut industry wastes and recovery of biochemicals	2020-2023	Dr. U. Sivakumar, Professor (Agrl. Microbiology)	• The project may be continued as per programme.
5.	SERB/NRM/AGM/CBE/2021/R001: Nano-formulation of plant probiotic, *Bacillus altitudinis* FD8 and their metabolites for induced drought protection, plant defense and enhanced productivity in rice	2020-2023	Dr. U. Sivakumar, Professor (Agrl. Microbiology)	• The project may be continued as per programme.
6.	AICRP/NRM/CBE/AGM/001 All India Network Project on Soil Biodiversity and Biofertilizers	2016-21	Dr.D.Balachandar, Professor (Agrl. Micro.) Dr.M.Gnanachitra, Asso.Pro. (Agrl. Micro.)	• The colour based probe for soil health may be patented. • The project may be continued
7.	Bioversity/NRM/AGM/CBE/2019/R025: Enabling farmers to assess soil quality implications of agricultural options: farmer citizen science. (Bioversity, New Delhi)	Sep. 2019 to March 2021	Dr.D. Balachandar, Professor (Agrl. Micro.) Dr.M. Chitra, Associate Professor (Entomology)	• The project may be closed and completion report may be submitted at the earliest
8.	NRM/CBE/AGM/2017/ 001.Development of gamma mutants of oleaginous mixotrophic microalgae for higher lipid productivity	Jan. 2017 to 2021	Dr. T. Kalaiselvi, Professor (Agrl. Micro.)	• Project may be closed, and completion report may be submitted at the earliest
9.	DBT/AGM/KKM/SAC/2018/T002 "Raising the livelihood of women farmers in selected villages of Thoothukudi district through development of *Azolla* bio-village"	2018-2021	Dr.B.Jeberlin Prabina Associate Prof. (Agrl. Micro)	• The findings may be given for information.

10.	TNSCST Synthesis and tailoring of novel degradable plastics using blue green algal and tree oils for application in smart agriculture	Feb. 2020 to Jan. 2022	Dr.B.JeberlinPrabina Associate Prof. (Agrl. Micro)	• Green algae for degradable plastics may be included and the project may be continued
11.	NRM/TRY/AGM/2021/001 Screening of efficient bacterial strains for improving soil health of fallow land	Oct 2020 to Sep 2022	Dr. K.G.Anitha Asst. Prof. (Agrl. Micro) ADAC & RI, Trichy	• The project may be continued
12.	NRM/CBE/AGM/RIC/2021/001: Utilization of amylolytic characteristics of probiotic lactic acid bacteria in rice based food formulations	August 2020 to June 2023	Dr. K. Vijila, Professor (AGM) DNRM, TNAU, CBE	• The project may be continued
13.	NRM/MDU/AGM/2020/004 Development of novel bacterial strains for Nitrogen fixation and PO4 solubilization in sunflower	Sept 2020 to August 2023	Dr.N.Ramalingam, AC&RI, Madurai	• The project may be continued
14.	NRM/MDU/AGM/2020/001 Degradation of leaf litter by lignocellulolytic microbial consortia for production of quality compost	Sept 2019 to August 2021	Dr.R.Subhashini, AC&RI, Madurai	• The findings may be given for information
15.	NRM/MDU/AGM/2020/002 Development of thermotolerant Bacillus isolates for plant growth promotion	Sept2020 to August 2023	Dr.R.Umasankareswari, AC&RI, Madurai	• The project may be continued
16.	Demonstration of ZnSB in rice	2021	Dr. D. Balachander Prof. (Agrl. Microbiology) DNRM, TNAU, CBE	• Multilocation yield data may be compiled and submitted
17.	Phyllosphere yeast are to be evaluated under field conditions	2020-21	Dr. M.Gomathy Asst. Prof. (Agrl. Micro) Dept. of SS&AC, AC & RI, Killikulam	• Few more trials may be conducted for confirmation

6. Department of Agricultural Entomology

A. Decisions made on Adoption / OFT / Information:

For adoption

Pollination of moringa with *Apis cerana indica* for improved crop productivity

Placing four *Apis cerana indica* bee colonies per acre of moringa crop recorded 20.24 per cent increased fruit set with a yield increase of 11.40 per cent and the highest BC ratio of 1: 3.9 compared to open pollination

FOR On Farm Trial

OFT : 1 - Standardization of queen production in stingless bee, *Tetragonula laeviceps*

Treatments:
T1: Colony division using spare queen cells produced
T2: Colony division through emergency queen cells produced
T3: Control colonies (no. of swarm colonies produced)
Design: RBD; Replication: Seven
Duration: Two years (2021-2023)

Observations to be recorded:
1. No. of queen cells produced
2. No. of emergency queen cells
3. No. of gynes emerged
4. Queen status and colony establishment time intervals

Centres to be involved:

AC & RI, Coimbatore	:	Monitoring Scientist: Dr. M.R.Srinivasan, Professor (Entomology) Dr. P.A.Saravanan, Assistant Professor (Entomology)
AC&RI, Vazhavachanur	:	Dr. S. Douressamy, Professor (Entomology)
AC & RI, Killikulam	:	Dr. G.Preetha , Assistant Professor (Entomology)
ADAC&RI, Trichy	:	Dr. Sheeba Joyce Roseleen, Assistant Professor (Entomology)
CRS, Srivilliputhur (Madurai Dt.)	:	Dr. K. Suresh, Assistant Professor (Entomology)

OFT 2: Managed stingless bee pollination for enhancing mango productivity
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: *Tetragonula iridipennis*

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
- Quality parameters

Centres to be involved:

AC & RI, Coimbatore	:	**Theme Leader : Dr. G. Umapathy, Professor (Entomology)** Dr. P.A. Saravanan, Assistant Professor (Entomology)
AC & RI, Killikulam	:	Dr. G. Preetha, Assistant Professor (Entomology)
HC&RI, Periyakulam	:	Dr. P. Indiragandhi, Assistant Professor (Entomology)
KVK, Sandhiyur	:	Dr. S. SuganyaKanna, Assistant Professor (Entomology)

For Information

1. Neonicotinoid molecules *viz.,* imidacloprid, acetamiprid, thiacloprid, dinotefuran, thiamethoxam and clothianidin applied at 10% bloom of cotton crop, caused significant mortality to honey bees. Hence, spraying in cotton should be scheduled only during evening hours to minimize impact of neonicotinoids on pollinators

2. *Callosobruchus analis* and *C. phaseoli* were recorded for the first time from stored pulses in Coimbatore region.

B. Action Plan (2021-2022)

Theme Leader	Dr.P.A.Saravanan, Assistant Professor (Agrl. Entomology), AC&RI, Coimbatore		
Action Plan No. 1	Assessment of wood suitability for making the bee hives		
Action Plan	**Name of the scientist(s) and centre**	**Activities**	**Deliverables**
Assessing the suitability and performance of hives made from selected wood	<u>AC & RI, Killikulam</u> Dr.M.R.Srinivasan Professor and Head <u>TNAU, Coimbatore</u> Dr.P.A.Saravanan Asst. Prof. (Entomology)	Treatments: T1 - Teak T2 - Punnai T3 - Acacia T4 – Rubber T5 - Vagai T6 - Vengai T7 – Malaivembu Replications: 3 **Observations to be recorded** • Hives made from different wood material by FC&RI to be evaluated • Colony growth and performance of honeybees in each hive to be documented	Durable, cheaper wood material for hive making will be identified

Theme Leader	Dr.M.R.Srinivasan, Professor and Head (Entomology), AC&RI, Killikulam		
Action Plan No. 2	Evaluating drumstick as forage for Italian honey bee and its utilization in Pollination		
Action Plan	Name of the scientist(s) and centre	Activities	Deliverables
To estimate role of *A. mellifera* in pollination, and fruit yield of drumstick and to evaluate drumstick as a forage for Italian honey bee	AC&RI, Killikulam Dr.M.R.Srinivasan, Professor and Head TNAU, Coimbatore Dr.P.A.Saravanan, Assistant Professor (Entomology) AC&RI, Madurai Dr. J.Jeyaraj, Professor (Entomology) ADAC&RI, Trichy Dr. Sheeba Joyce Roseleen, Assistant Professor (Entomology)	TREATMENTS T1 – Three colonies/acre T2 – Two colonies/acre T3 – Control Replications: Seven Observations to be recorded • Pollination potential of *A. mellifera* in moringa • Colony growth parameters and honey production • Yield improvement in moringa	Establishing drumstick as bee pasturage for Italian honey bee & their role in pollination

C. Remarks on the Research Projects

1. AGRL. ENTOMOLOGY

S. No.	Project details	Remarks
URP		
1	**CPPS/TRY/ENT/2020/001.** Sustaining and multiplication of Italian bees *Apis mellifera* L. through suitable queen rearing, bee pasturage and supplementary feeding. Period: September 2020 to August 2023 **Dr. C. Gailce Leo Justin** Professor and Head Dept. of Plant Protection, ADAC&RI, Trichy	The Project may be continued
2	**CPPS/KKM/ENT/VEG/2020/001** Evaluating drumstick *Moringa oleifera* Lam as forage for Italian honey bee *Apis mellifera* L. and its utilization in Pollination **Period:** June 2020 to May 2022 **Dr.M.R.Srinivasan** Professor and Head Dept. of Agrl.Entomology,AC&RI, Killikulam	The Project may be continued
3	**CPPS/CBE/ENT/NCR/2018/001** Evaluation of stingless bees as potential pollinators of polyhouse greenhouse vegetables Period: April 2018-March 2021 **Dr. P.A.Saravanan**, Assistant Professor (Entomology)	The project may be closed and completion report should be submitted
4	**CPPS/CBE/RES/2018/001** Multiresidue analysis of diamide group insecticides in vegetable ecosystem and their risk assessment Period: January 2018 to December 2021 **Dr. M.Paramasivam** Assistant Professor (SS & AC)	The project may be continued.
5	**CPPS/CBE/ENT/RES/2018/001** Multiresidue method for the determination of neonicotinoid pesticide	The project may be closed and completion report should be

	residues in pollen, honey and bees using LC/MS/MS Period: July 2018-June 2020 **Dr.A.Suganthi** Assistant Professor (Entomology)	submitted.
6	**CPPS/CBE/ENT/2019/001** Diversity of *Callosobruchus* pic in Coimbatore district and its management Period: April 2019 -March 2022 Dr.R.Arul Prakash Assistant Professor (Agrl. Entomology)	The project may be continued.
7	**CPPS/CBE/PAT/SOR/2021/001** Development of actinobacteria consortia for the effective biological management of *Macrophomina phaseolina* (Tassi.) Goid. Period: April 2021 to March 2024 **Dr. K. Angappan** Professor(Plant Pathology)	The Project may be continued. The results may be presented in Pulses Scientist Meet
Core projects		
8.	**CPPS/TRY/ENT/RES/2018/CP027** Early detection of insecticide residues on crop samples at market/household level using the instant residue indicator drop (i-RID) in comparison with analytical procedures Period: September 2018 to August 2021 **Dr.P.Yasodha** Assistant Professor (Agrl. Entomology)	The project may be closed and completion report should be submitted.
AICRP projects		
9.	**AICRP/PPS/CBE/AEN/006** All India Coordinated Research Project on Honey bees and Pollinators Pe Period: 2020- 2021 **Dr. P.A.Saravanan**, Assistant Professor (Entomology)	The project may be continued.

7. Department of Agro Climate Research Centre

A. Decisions made on Adoption / OFT / Information:

For adoption

Theme 1: Weather forecasting and Agro advisory

- Studies undertaken to improve the medium range weather forecast of Tamil Nadu Agricultural University revealed that the WRF model v4.2.1 with WSM3 @ 3km resolution for TN had higher Forecast Accuracy Index (FAI) and higher Forecast Usability Percentage (FUP), hence that could be used in all the Agro Climate Zones (ACZ) of Tamil Nadu for developing village level forecast. The results of 17 locations in seven ACZ inferred that the FAI of MRWF was between 0.80 – 0.94 during CWP, 0.62 – 0.76 during HWP, 0.55 and 0.69 during SWM and between 0.62 to 0.74 during NEM. The FUP of MRWF was ranged between 59 – 84 during CWP, 39 – 70 during HWP, 46 - 83 during SWM and between 59 to 89 during NEM.

For Information

Theme 1: Weather forecast and Agro advisory

- URP on seasonal forecast inferred that the improved seasonal forecast of TNAU with IOD and ENSO values had performed better in NEM monsoon than SWM. In addition, among the four-machine learning algorithms viz., Decision Tree Regression, Gradient Boosting, Ada Boost and Random Forest Regression employed for the hindcast of monthly rainfall at Coimbatore, the Random Forest Regression performed better with R^2 value of 0.8.

- URP on Astrometeorology and wind speed found that the presence of Neptune and Mercury at 61 – 120 degree and 240 – 300degree azimuth to the observer location increased the wind speed. In addition the Active state of Mercury, Venus, Moon, Mars, Jupiter and Uranus and ruling state of Saturn have increased the wind speed of a location.

- IMD sponsored GKMS scheme observed that the Whatsapp group become effective mode of agromet advisory dissemination and the reach is higher than any other mode. The usefulness of agromet advisories is improved due to increased awareness among the farmers. Advisories are mostly preferred by the farmers for scheduling irrigation, harvest, planting and spraying operations

Theme 2: Basic and applied meteorology

- The annual rainfall variability studies undertaken at Kovilpatti in response to the Vice Chancellor's remarks indicated that there was an increase in frequency of deficit rainfall years than normal and excess rainfall year. The rainfall event with >50mm was increasing whereas the >100mm events at decreasing trend. Seasonal rainfall analysis indicated that there was decrease in rainfall quantity during CWP and HWP, increase in SWM and no markable trend during NEM.The Length of Growing Period (LGP) analysis of Kovilpatti indicated that there was delay in onset of monsoon from 38 (Sep. 17-23) to 41(Oct. 8-14) standard week and correspondingly the LGP was decreased from 14 to 11 weeks (98 to 77 days).The long period temperature analysis indicated that there was increase in both maximum and minimum temperature of annual, SWM, NEM and HWP period, whereas the CWP showed increasing trend in maximum temperature and no significant trend in minimum temperature. There was a slight increase in both minimum and maximum temperature during last decade in all seasons.

- IMD sponsored FASAL scheme findings revealed that the sowing window of rice crop in Cauvery Delta Zone as the 3rd week of June for ADT 53 during Kuruvai(4683 kg/ha) and 2nd week of September for ADT 54 during Thaladi season (4594 kg/ha) which recorded higher yields than other sowing windows.

- The studies undertaken to compare the remote sensed weather products and ground truth data inferred that the RS & GIS based LGP values were mostly underestimated than the LGP calculated from observed values from the standard observatories. On contrast, RS & GIS tools have overestimated the PET values compared to calculated from observed values. Hence, the weather related satellite products need to be validated for using in any scientific or developmental purpose/

- A Ph.D thesis research on the yield gap assessment in Cotton identified that the Vellore, Tiruvannamalai, Salem, Namakkal, Dharmapuri, Sivagangai, Thirunelveli, Theni, Dindigul, Thiruvarur, Karur, Perambalur, Ariyalur, Pudukkottai and Tiruppur districts are Most Efficient Cropping zone for Cotton Crop. Coimbatore comes under Yield Efficient Cropping zone because of less spread area but yield was good. The districts such as Thoothukudi, Virudhunagar and Madurai come under AECZ with High RYI and low RSI.

- Another M.Sc Thesis research on the impact of climate change in the small Onion crop inferred that the Coimbatore, Tiruppur, Dindigul and parts of Namakkal are best suited districts for onion cultivation. Best time of planting onion is 4thOctober and it is sufficient to apply the recommended dose of N (30 kg ha^{-1}) for increasing the productivity. In onion, critical stage for moisture stress is at bulb development and bulb initiation stages and yield is significantly affected if the crop was exposed to water stress at bulb initiation and bulb development stages. The projected

increase in minimum temperature by 2.18 °C and maximum temperature by 3.01 °C is expected to have the negative impact on onion yield in the mid-century. Additionally, projected decrease rainfall would amplify the negative impact by creating warm and dry climate in future.

Theme 3: Climate change and crop weather model

- URP on climate variability and millet study with elevated temperature (1.5^oC) and enhanced CO_2 (+50 to 150 ppm) inferred that the grain yield of Sorghum CO 30 was reduced to the tune 2.4 to 7.7 and the yield of K12 variety was reduced to the tune of2.12 to 6.4 per cent. The flowering stage of sorghum was more sensitive to elevated temperature followed by grain filling stage and vegetative stage was least sensitive compared other stages. Among the varieties studied, the K 12 was found to be better than CO 30 in near future.

- The IMD sponsored FASAL scheme noted that addition of bright sunshine hours and actual evapotranspiration in statistical yield forecasting model had improved the accuracy of the crop yield forecast by 3 to 4 per cent.

- DST sponsored BRIFS scheme resulted that the Groundnut yield was reduced by 14, 30, 47, 62 and 73 per cent with $1^{\circ}C$, $2^{\circ}C$, $3^{\circ}C$, $4^{\circ}C$ and $5^{\circ}C$ rise in temperature respectively. Moisture stress exacerbated the groundnut productivity in coupled with elevated temperature under all the CO_2 levels. CO_2 fertilization tended to have the beneficial effect on WUE and there was an increase in WUE by 6.9, 11.5, 16.4, 20.9 and 24.5 per cent under ambient temperature with the 450, 500, 550, 600 and 650 ppm CO_2 concentrations respectively. NUE reduced between 13.5 and78.8 percent for the increase in temperature from 1^oC to 5^oC. The NUE was increased by 6.2, 10.0, 12.3, 16.1 and 19.4 per cent with the CO_2 enrichment to 450, 500, 550, 600 and 650 ppm under ambient temperature.

- Differential gene expression analyses in DST sponsored BRIFS scheme revealed that the variety N22 exhibits innate higher expression levels of genes conferring thermotolerance than the susceptible varieties. Studies on genes which have higher levels of gene expression could provide cues to breeding rice varieties with improved thermotolerance. Cyanobacteria and Azolla systems have been identified as attractive candidates in carbon sequestration as they are fast growing and easier to manipulate in paddy fields. Apart from carbon sequestration, these diazotrophs can also help in soil fertility enhancement through nitrogen fixation.

- DST sponsored BRIFS scheme on the efficacy of insecticidal spray under elevated Temperature inferred that the temperature above threshold is detrimental to insect development. Hence, the time of insecticide applications could be planned based on the thermal accumulation (degree days) of the insects, which will improve the efficiency and also reduces the spray cost.

- National Academy of Sciences, USA sponsored Climate change adaptation pathway study in Bhavani Basin projected an increase in average annual rainfall. Looking at the monthly projections, September month, coinciding with the South-west monsoon, is projected to be the wettest month. The post-monsoon showers of January and February month are projected to decrease. Spatial distribution of future rainfall shows the south-western part to be drier than the other regions. Maximum increase in Tmax is projected for February month and for Tmin in the month of December, indicating that the increase in winter temperatures is more than that of the summer months. Increase in temperature is also projected for the monsoon months.

- An M.Sc. thesis research on Elevated temperature of + 2 $^\circ$C and organic amendment in black gram revealed that use of organic amendments and foliar spray could protect the plants by mitigating the deleterious effect of high temperature stress and promote the plant growth and yield. The appropriate stress mitigation module will be basal application of vermicompost followed by foliar spray of PPFM in blackgram against elevated temperature conditions predicted in future.

- The M.Sc. thesis research on climate change and Green gram yield indicated that the productivity of Greengram was found to have a beneficial stimulus moderately with the enriched CO_2, irrespective of the varieties. Among the varieties studied, the yield response of VBN 4 greengram would perform better than CO 8 and ADT 3 in near future. The green gram cultivars CO 8, VBN 4 and ADT 3 showed negative yield response under current and future climate while advancing one week prior to normal sowing and vice versa trend was observed when one week delayed from normal sowing. Selecting a suitable sowing window would be the better adaptation strategy to mitigate the climate variability effect on productivity of green gram in the near future period.

B. 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	-	5 + 9	-	-	1	**19**
2. Basic and applied meteorology	2	-	-	1	-	3	**6**
3. Climate change & Crop models	2	-	4	-	-	3	**9**
Total	**8**	**-**	**18**	**1**	**-**	**7**	**34**

Crop wise Research Projects

Crop	URP	AICRP	GOI	GoTN	Private	Students' Research	Total
Rice	1		2*			2	**5**
Millets	2		1*				**3**
Pulses	1					3	**4**
Oil seeds	-		1*				**1**
Cotton	-					1	**1**
Non crop**	4		14	1	0	1	**20**
Total	**8**		**18***	**1**	**0**	**7**	**34**

* Multi crop projects; ** Weather forecasting and agro advisory services

1. 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 Dr. K.P. Ragunath Asst. Prof. (SAC), RS & GIS	Jun. 2019 – May 2021. **To be Concluded**
2.	**DCM/CBE/AMT/2019/001** Developing hybrid weather forecast by integrating the numerical and astrometeorological forecast	Dr. Ga. Dheebakaran Asst. Prof (Agronomy), ACRC Dr. SP. Ramanathan, Prof. and Head, ACRC	Jun. 2019 – May 2022 **To be Continued.**
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 Dr. V. Geethalakshmi, Director, Crop Management	Jun. 2019 – May 2022 **To be Continued.**
4.	**DCM/CBE/AMT/2021/001** Evaluation of Automated Agro advisory Services for enhancing farmers Adoption	Dr. S. Kokilavani Asst. Prof (Agrl. Met.), ACRC Dr. SP. Ramanathan, Prof. and Head, ACRC	Jan 2021- Dec. 2022 **To be Continued.**

II	Theme 2: Basic and applied meteorology		
5.	**DCM/CBE/AMT/RIC/2019/001** Climate Smart Organic Farming in Rice	Dr. SP. Ramanathan, P&H, ACRC Dr. E. Somasundaram, P&H, SOA Dr. K. Ganesan, Asst. Prof, SOA Dr. S. Kokilavani, Asst. Prof, ACRC Dr. C. Uma Maheswari, Assoc. Prof, TRRI, Aduthurai Dr. M. Raju, Assoc. Prof, TRRI Dr. E. Subramanian, Asst. Prof, AC&RI, Madurai. Dr. P. Kannan, Asst. Prof, AC&RI, Madurai Dr. V. Muralidharan, Prof., RRS, Tirur Dr. S.R. Shreerangaswami, Asst. Prof, RRS, Ambasamudram. Dr. K.G. Sabarinathan, Asst. Prof, RRS, Ambasamudram.	2019 – 2021 Report presented in Rice CSM. **To be Concluded**
6.	**Action Plan** Studies on microclimate modification in Groundnut + Redgram intercropping system.	Dr. SP. Ramanathan, P&H, ACRC Dr. N.K. Sathyamoorthy, ACRC Dr. N. Sathiskumar, ARS, BSR Dr. Sudhalakshmi, CRS, Aliyar	2019 – 2021 Report presented in Oil seed CSM. **To be Concluded**

III	Theme 3: Climate change and crop weather model		
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,	Jun. 2019 – May 20212 **To be Continued.**
8.	**DCM/CBE/AGR/2021/001** Evaluation of oxygen and other gases production in Beema Bamboo Plantation.	Dr. N. Maragatham, Professor (Agronomy), ACRC, TNAU, Dr. SP. Ramanathan, Professor and Head, ACRC, TNAU, Dr. M. Maheswari, Professor and Head, ENS, TNAU	Jan. 2021 – Dec. 2023 **To be Continued.**

2. 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 –Gramin Krishi Mausam Sewa (GKMS) - Experimental Agro-Met Advisory Services (AAS), Aduthurai.	Dr. K. Sathiya Bama Assoc. Prof. (SS&AC) Dr. M. Raju, Assoc. Prof. (Agronomy) TRRI, Aduthurai	Apr. 2014 - Mar. 2022 **To be continued**
2.	**IMD/DCM/CBE/ACR/2014/R006** GOI – IMD – Agmet –Gramin Krishi Mausam Sewa (GKMS) at Agro Meteorological Field Units (AMFU), Coimbatore	Dr. SP. Ramanathan Prof. and Head Dr. Ga. Dheebakaran Asst. Prof. (Agronomy) ACRC, TNAU, CBE -3	Apr. 2014 - Mar. 2022 **To be continued**
3.	**IMD/DCM/KPT/AGR/1995/R004** GOI – IMD - Agromet – Gramin Krishi Mausam Sewa (GKMS) – Agrometeorology Field Unit (AMFU) for Agrometeorological Advisory Services (GKMS – Gramin Krishi Mausam Sewa) under IMD, GOI at ARS, Kovilpatti.	Dr. E. Murugan Prof. and Head Dr. B. Arthirani Asst. Prof. (Agrl. Met) ARS, Kovilpatti	Apr. 2014 - Mar. 2022 **To be continued**
4.	**GOI/DCM/OTY/ACRC/2016/R003** Agrometeorology Field Unit (AMFU) for Agrometeorological Advisory Services under IMD, GOI at HRS, Ooty	Dr.D.Keisar Lourdusamy Assoc. Prof. and Head Dr. P. Balasubramanian, Teaching Asst. (Agron)	Mar. 2014 - Mar. 2022 **To be continued**
5.	**GOI/DCM/PPI/ACRC/2016/R001** Agro meteorology Field Unit (AMFU) for Agro meteorological Advisory Services (GKMS – Gramin Krishi Mausam Sewa) under IMD, GOI at HRS, Pechiparai.	Dr. A. Jaya Jasmine Prof. and Head Dr. S.T. Bini Sundar Assistant Professor (Horticulture)	Mar. 2014 - Mar. 2022 **To be continued**
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. P. Arunkumar SMS (Agrometeorology)	2019 – 2024 **To be continued**
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**

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. C. Sivakumar, Programme coordinator, Mr. B. Balamurali. SMS (Agrometeorology)	2019 – 2024 **To be continued**
9.	Setting up District Agro Met Units (DAMUs) at KVKs for Weather Based Agro Advisory Services under ICAR-IMD Collaboration – KVK, Pudukkottai District	Dr. G. Prabu kumar Prog. Coordinator (i/c)	2019 – 2024 **To be continued**
10.	Setting up District Agro Met Units (DAMUs) at KVKs for Weather Based Agro Advisory Services under ICAR-IMD Collaboration – KVK, Ramanathapuram District	Dr. T. Ragavan Programme Coordinator Dr. M. Vengateswari SMS (Agrometeorology)	2019 – 2024 **To be continued**
11.	Setting up District Agro Met Units (DAMUs) at KVKs for Weather Based Agro Advisory Services under ICAR-IMD Collaboration – KVK, Sandhiyur, Salem	Dr. M. Vijayakumar Programme Coordinator Dr. M.Malarkodi Scheme In-charge	2019 – 2024 **To be continued**
12.	Setting up District Agro Met Units (DAMUs) at KVKs for Weather Based Agro Advisory Services under ICAR-IMD Collaboration – Sirugamani, Tiruchirappalli	Dr. N. Tamilselvan, Programme Coordinator Dr. Noorjehan A.K.A Hanif, Asst. Prof. (AEX)	2019 – 2024 **To be continued**
13.	Setting up District Agro Met Units (DAMUs) at KVKs for Weather Based Agro Advisory Services under ICAR-IMD Collaboration – Virinjipuram, Vellore	Dr. S. Nanthakumar Programme Coordinator Ms. K. Rathika, SMS (Agrometeorology)	2019 – 2024 **To be continued**
14.	Setting up District Agro Met Units (DAMUs) at KVKs for Weather Based Agro Advisory Services under ICAR-IMD Collaboration – KVK, Tiruvallur, Tirur	Dr. P. Santhi, Programme Coordinator	2019 – 2024 **To be continued**
II	**Theme 2: Basic and Applied meteorology**		
15.	**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. 2022 **To be continued**

III	**Theme 3: Climate change & crop modeling**		
16.	**IMD/DCM/ADT/AGR/2011/R001** Forecasting Agricultural output using Space, Agrometerology and Land based observations (FASAL) to Agro Advisory	Dr. M. Raju, Assoc. Prof. (Agronomy) Dr. K. Sathiya Bama, Assoc. Prof. (SS&AC)	Jan. 2011 Mar. 2022 **To be continued**

	Services for Cauvery Delta Zone – a linked project of AMFU for AAS (GKMS) under IMD at TRRI, Aduthurai.	TRRI, Aduthurai		
17.	**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 Director, DCM Dr. Ga. Dheebakaran Asst. Prof. (Agronomy), ACRC, TNAU, Coimbatore	Jan. 2011 Mar. 2022 **To be continued**
18.	**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 Director, DCM Dr. Ga. Dheebakaran Asst. Prof. (Agronomy), Dr. S. Kokilavani, Asst. Prof. (Agrl. Met), ACRC,	Nov. 2018 -Mar. 2022 **To be continued**
19.	**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 Director, DCM, TNAU, Dr. R. Gowtham, Research Assoc. ACRC Dr. A. Senthil, Assoc. Prof., CRP Dr. M. Rajavel, Asst. Professor, WTC Dr. V. Karthick, Asst. Professor, AEC	Jan .2020 – Jun. 2021 **To be continued**

FUTURE RESEARCH PLAN – 2021-2023

S.No	Project Title	Project Teams
	Theme 1 – Weather forecasting and agro advisory services	
1.	**Developing Forewarning model for pest and disease of Major Crops (Continued)** Pest and disease are the major biological threat to crop production. Weather is the major factor for the epidemic and outbreak of pest and disease incidence. Recent past, due to changing climate and shift in cropping pattern, minor pest and disease become major and causes severe damages. Based on the weather – pest – host interaction studies, outbreak could be predicted in advance and necessary preparedness may be ensured. In this context, development of forewarning model for rice and groundnutwill be continued for another two years.	1. Agro Climate Research Centre, DCM, TNAU 2. Dept. of Agrl. Entomology 3.Dept. of Plant Pathology, CPPS, 4.Dept.of Physical Sciences, TNAU, Coimbatore

2.	**Refining the agromet advisories in AAS (Continued)** ACRChas developed theAutomated Agro Advisory Services (AAS) software for dissemination of weather based agro advisory for 108 crops under 54 weather scenarios and 6 crop stages which reach directly to the farmers' through mobile. It is planned to add perennial crops, livestock and additional weather scenarios in the existing app. The soil characteristics will also be added as an additional module for improving the holistic agro advisory to the farmers.	1. Agro Climate Research Centre, TNAU 2. Dept. of Agrl. Entomology 3.Dept. of Plant Pathology, CPPS,

8. Dept. of Agronomy (AICRP-IFS) and Dept. of SOA

A. Decisions made on Adoption / OFT / Information:

For adoption

Title: Integrated Organic Farming System (IOFS) model for garden land ecosystem
Centre: Department of Sustainable Organic Agriculture, DCM, TNAU, Coimbat

• The IOFS model comprising of crop, livestock, fodder, perennial horticultural plantations, composting units, agro forestry, pest repellent cafeteria and bee keeping is the most suitable and efficient farming system model providing net income of Rs.83,390 per annum with BCR of 2.17 generating an average of 566 man days per year. The same model at farmers field with higher efficiency will generate an income of Rs.1,14,842 per annum with BCR of 3.21.

• 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 IOFS model is recommended for adoption to sustain food and nutritional security and to conserve the resource base through efficient recycling of residues and wastes within the system.

For Information

1. Sustainable Resource Management for Climate Smart IFS
   at TNAU, Coimbatore

In an experiment conducted at TNAU, Coimbatore, Integrated Farming System model involving components *viz.,* Crop - Horticulture - Dairy - Goat - Poultry - Kitchen garden - Boundary planting - Vermicompost - Value addition in an area of 1.0 ha recorded an overall gross return of Rs. 5,88,638/- , net return of Rs. 3,23,329 B:C ratio of 1.82. Cropping system contributed 52.0 % to the total net returns followed by goat (11.0 %) and the rest by other components. Employment generation from the IFS model was 446 man days. By residue recycling the total quantity of nutrient addition achieved was 156 kg N, 56.8 kg P and 68.7 kg K/ha.

2. Sustainable Resource Management for Climate Smart IFS
   at 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 Rs.232258/year. The maximum net return of Rs.79382/- was obtained from the dairy unit. This was followed by cropping component with a net return of Rs. 71351/- and fishery unit with a net return of Rs.32650/- from 0.8 ha. A major share of 34.2% was contributed by dairy unit to the net income followed by cropping system (30.7%) and fishery unit (14.1%). Through the recycling, 248.7 kg N, 84 kg P and 190 kg K was recycled within the IFS model. 406 Man days was generated from the IFS model. 30% of inputs generated from the IFS model was recycled within the system.

II List of Research Projects during 2021 - 2022

	Centre	URP	AICRP	EFP	Total
AICRP-IFS	Department of Agronomy, TNAU, Coimbatore	-	**3**	-	**3**
	ARS, Thanjavur	-	**1**	-	**1**
	ARS, Bhavanisagar	-	**3**	-	**3**
	TCRS, Yethapur	-	**3**	-	**3**

Ongoing URPs /AICRPs / Externally Funded Projects

Sl. No.	Project No. and Title	Remarks
	AICRP-IFS, Dept. of Agronomy	
1.	**AICRP/DCM - CBE - AGR/001** Sustainable resource management for climate smart IFS (June 2017- May 2022) Dr.K.R.Latha Professor (Agronomy) & Chief Agronomist (AICRP-IFS), TNAU, Coimbatore	• The project may be continued Given for information
2.	**AICRP/DCM - CBE – AGR/001** Expt. 1 a. - Identification of cropping system module for different farming system modules (June 2017- May 2022) Dr.S.P.**S**angeetha, Assistant Professor (Agronomy), TNAU, Coimbatore	• The project may be continued
3.	**AICRP/DCM - CBE – AGR/001** Carbon crediting and GHG emission in IFS model (June 2017- May 2022) Dr.A.Renukadevi, Assistant Professor (SS & AC), 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. S. Porpavai, Professor (Agronomy) and Head, 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 (Agronomy), ARS, Bhavanisagar	. • The project may be continued
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), ARS, Bhavanisagar	• The project may be continued

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), ARS, Bhavanisagar	• The project may be continued
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. R. Nageswari, Asst. Professor (Agronomy), TCRS, Yethapur	• The project may be continued
9.	**AICRP/DCM - CBE − AGR/001** OFR 2: Diversification of existing farming systems under marginal household conditions. (April 2017 to March 2022) Dr. R. Nageswari, Asst. Professor (Agronomy), TCRS, Yethapur	• The project may be continued
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. R. Nageswari, Asst. Professor (Agronomy), TCRS, Yethapur	• The project may be continued

III Action Plan

URP No: DCM/CBE/AGR/2020/001
Action plan 1: 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 T1: Control	**Department of Agronomy, TNAU, Coimbatore** Dr.K.R.Latha Professor (Agronomy) &	The project may be closed **For information** • Agricultural and horticultural based Integrated Organic Farming System experiment was experimented in an area of 0.6

T2: Field Crops (Green manure- Rice-Blackgram)+ fish + Japanese quail T3: Vegetable crops (Tomato-Green manure- Pumpkin) + fish + duck T4: Leaf Banana + fish + Desi chicken Kitchen garden: Amaranthus, Coriander, Fenugreek, Mint, Gourds, Radish, Palak Border Planting: Papaya, Moringa	Chief Agronomist (AICRP - IFS), TNAU, Coimbatore Dr.T.Saraswathi Professor (Horticulture) TNAU, Coimbatore	ha in the wetland ecosystem during June 2019 - May 2021. • During first year, compared to conventional cropping and agricultural (rice) based Integrated Organic Farming System, vegetable based Integrated Organic Farming System recorded higher net returns (Rs. 2,51,557), B:C ratio (2.01), employment generation (144 man days) • During second year, banana based IOFS recorded higher system productivity (25,385 kg), net return (Rs. 3,60,239), B:C ratio (2.84) and employment generation (153 man days)

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
To study the GHG emission from crop component in IFS model **Treatments** **A. Cropping Systems** 1. Cowpea (G) - Ragi - G.Manure 2. Maize - Sunflower - G.Manure 3. Prosomillet - Chillies - G.Manure 4. Pearlmillet - Cotton - G.Manure 5. Perennial fodder grass and *Desmanthus* **B. Sample Collection** Seasons- (*kharif, rabi* and summer)	**Centre** : Dept. of Agronomy Scientists Involved Dr.A.Renukadevi Asst. Prof. (SS&AC) Dr.S. Kokilavani Asst. Prof. Agrl. Meterology Dr.S.P.Sangeetha Asst. Prof. (Agron) TNAU, Coimbatore	May be converted as University Research Project and to be continued

General Remarks

Directorate of NRM

- Phytomolecules extracted from *Eucalyptus globulus, Eucalyptus grandis* and *Alnus sp* shall be explored for developing nano-bio herbicide formulation and subsequent field testing at the earliest.

- The Nano Revive (antitraspirant nano formulation) can be further validated in large scale demonstrations in farmers' fields.

- The Nano formulation to manage fungal contamination in coconut cobra can be promoted as technology at the earliest for the benefit of copra units.

- The nano formulation for effective composting and deodorizing of vegetable, food and slaughter house wastes shall be promoted as technology at the earliest.

- The nano biopesticide technology can be displayed in the annual meeting/conference of UPASI.

- TNAU Soil doc mobile application link has to be shared with the Department officials through DoA and TNAU scientists for larger adoption.

- Methodology has to be developed to assess the spread of major 5 to 6 varieties of Rice using Remote sensing and GIS technology.

- Digital maps and cadastral level natural resource and disaster information developed for Cuddalore district has to be presented to the District administration.

- Remote Sensing based information generated on water resources, especially tanks in Tamilnadu has to be reported to the State Government.

- Demonstration of Drone spraying has to be taken up in association with JDA's by fixing hiring charges.

- Effort should be made to standardize herbicide spray protocols using Drone.

- Feasibility of Drone spraying in Tea plantations and onion fields should be assessed.

- Advanced pilot training for Agricultural Drone applications to be organized through ABD for Agriculture and Non farm graduates.

- In case of *in situ* composting using biominearliser, the plot size of the treatments may be increased in the subsequent field experiments.

- Different species of Ficus and *Terminalia katappa* may be focused for noise reduction studies.

- The results of studies on assessing the status of major rivers of Tamil Nadu before and after COVID 19 may be published.

- Organic carbon content in the HRS, Ooty farm soil may be rechecked.

- Soil fertility maps prepared shall be displayed in the entrance of colleges/Research stations/KVKs for the benefit of students and visiting farmers.

- The results/outcome of the projects of their region may be published in Tamil, also in journals like Valarum Velanmai to create awareness among the farmers.

- Soil Physics Unit of Department of SS&AC,TNAU, Coimbatore may be strengthened by using FMC funds.

- The findings of Phyllosphere yeast project may be evaluated under different locations of Tamil Nadu

- Indian bee colonies should be maintained and multiplied in TNAU main campus and at AC&RI, Madurai

- Indian bee colonies should be strengthened at CRS, Aliyarnagar

- Long term weather analysis of ARS, Kovilpatti may be published as research paper in good impact factor journal

- Verification of satellite-based evapotranspiration products with ground truth observation may be continued as student's thesis research.

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