ICAR-National Agricultural Higher Education Project

Project Report (Up to December 31, 2023)

Component 1b: Centre for Advanced Agricultural Science and Technology (CAAST)

Name of AU: Mahatma Phule Krishi Vidyapeeth, Rahuri

Project Title: Centre for Advanced Agricultural Science and Technology for Climate Smart Agriculture and Water Management (CAAST-CSAWM)

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Executive Summary:

Name of the AU	: Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar Maharashtra
Project Title	: Centre for Advanced Agricultural Science and Technology for Climate Smart Agriculture and Water Management (CAAST-CSAWM)

Executive Summary:

The major challenges before the agriculture sectors are: sustainably increasing the productivity and profitability, enhancing the input use efficiency, reducing the greenhouse gas emissions, achieving social and gender equity, and attracting the human resources for agriculture. In order to address these challenges in the context of changing climate, deteriorating and diminishing natural resources; and the increasing food demands of the consistently growing population, the project entitled "Centre for Advanced Agricultural Science and Technology for Climate Smart Agriculture and Water Management (CAAST-CSAWM)" was implemented at MPKV, Rahuri from 2018 to 2023. The main objectives of the project were capacity building, development of new course curricula, development of the digital technologies; and upscaling of the developed technologies and entrepreneurships development in context of the climate smart agriculture and water management with the interventions of the digital technologies.

1. **Capacity development:** The focus of this centre has been capacity building of students, faculty and farmers for the development and adoption of climate smart agriculture and precision water management technologies. The CAAST-CSAWM started this activity with organization of on campus trainings, certificate courses, seminars, workshops, symposia. However, the lockdown in India started from the last week of March 2020 due to Covid 19 situation. The CAAST-CSAWM immediately shifted to online mode of learning by developing its own online learning model and methodology for organizing multisession online training programmes. Based on the specific thematic areas, this centre organized 469 national and international capacity building programmes through offline (256) and online (212) modes and developed the capacity of 82,520 participants comprising students, faculty, industry, NGO, and farmers.

   There is provision in the project for international level training (ILT) to the faculties and students of MPKV Rahuri. For this CAAST-CSAWM developed and implemented the novel and output-oriented concept of providing international level training to the Post Graduate Students, scientists and faculties of MPKV wherein the participants (students, scientists and faculties) were offered basic two week pre-training followed by the ILT for one month (at Geo-Informatics Centre, Asian Institute of Technology, Bangkok, Thailand; the University of Wisconsin, Madison, USA; and University of Tsukuba, Ibaraki, Japan, University Putra Malaysia, Hue Universuty & Can Tho University, Vietnam) followed by two weeks hands-on training at University for the completion of projects and research papers. Total of 97 students; and 31 faculties and scientists were offered the ILT in this mode. In addition,02University Officers visited USA and 10 officers visited AIT, Thailand for networking and studying best practices in those Universities. The students completed 20 individual projects and published 20 research papers based on their learning during the International Training**.**
2. **Development of academic programmes:** Considering the need of human resources in the domain of climate smart agriculture and water management, the CAAST-CSAWM project developed one year post graduate diploma in Climate Smart Agriculture and Water Management (CSAWM) which consists of 4 modules of 13 weeks duration each. It is for practitioners in climate smart agriculture and water management and is in sync with National Education Policy 2020. Post Doctorate programme in CSAWM was also developed, but could not be started due to non availability of fellowship to the researchers. However, efforts are being taken to start the industry sponsored fellowships for the programme. New audit courses on climate smart agriculture and water management have been introduced in the existing course curriculum of PG and PhD programmes.
3. **Development of Infrastructure:** The Center for Advanced Agricultural Science and Technology for Climate-Smart Agriculture & Water Management (CAAST-CSAWM) has established various laboratories and research units equipped with the state-of-art equipment/instrument facilities.

These include Drone laboratory equipped with 36 drones for agriculture spraying, photography, and mapping, training grade drones for students and 3D printing facility, Hyperspectral Imaging laboratory equipped with hyperspectral and multispectral imaging sensors, thermal sensor, 3D LiDAR sensor, spectroradiometer, hexacopter drone for hyperspectral imaging and data analysis facility, RS and GIS Laboratory focused on Remote Sensing (RS) and Geographic Information System (GIS) technologies, supporting spatial analysis and mapping for agriculture, IoT Application Laboratory for the development and testing of Internet of Things (IoT) applications and sensors for precision agriculture, Robotics Laboratory for the research and development of agricultural robotics application such as spraying robo, harvesting robo, and E-entra facility for students to understand the robotics application in agriculture and Abiotic stress management facility with rainout shelter, Temperature and CO_2 control glass house, CO_2 ring, etc. A 12 ha specialized research block is developed focusing on climate-smart agricultural practices, testing of IoT systems, demonstration of digital agricultural technologies, precision agriculture technologies, etc and to conduct and support the PG and Ph. D. student research projects. The IoT park is developed under this project to demonstrate and showcase the IoT-enabled systems for climate smart agriculture water management, allowing students, farmers, faculties/scientists, industry peoples and other stakeholders to witness and understand the practical applications of these innovative technologies. These laboratories and other research facilities are extensively used by the post graduate (M. Tech., M. Sc.) and Ph. D. students for their research. During the last four years 47 post graduate and Ph. D. students used these laboratories and climate smart research block for their research. The MPKV became the first Agricultural university to start DGCA approved Remote Pilot Training Organization (RPTO) and trained 150+ drone pilots. Thus, CAAST-CSAWM has successfully developed a dynamic and technologically advanced infrastructure for research and development in climate-smart agricultural water management. As a result of networking of and technology development in the CAAST-CSAWM, the project could bring several externally funded projects worth Rs 890 lakh and started two revenue generation activities viz. RPTO and Revolving funds to sustain the infrastructure developed under CAAST-CSAWM and to continue the research on climate smart agriculture in future. Center of Excellence for Digital Agricultutre (COEDA) has been set up and all these projects are brought underthe umbrella of COEDA. The office infrastructure developed provides environment for interdisciplinary research and administrative activities

4. **Development of tools and technologies:** The state-of-the-art laboratories and other research facilities created under CAAST-CSAWM helped the project to develop innovative digital technologies for agriculture. As a result of this, CAAST-CSAWM developed 18 IoT and sensor-based technologies including AutoPIS, SmartPIS, PISMISS, Smart AWS; 3 robotic machines and technologies including Phule Robo for orchard spraying, Robotic prototype for fruit harvester and Slurry applicator, 1 precision planter, 1 variable rate fertilizer applicator, 40 mobile and web-based applications; project obtained 21 copyrights and could publish one patent.

5. **Up-scaling, entrepreneurship development and networking:**

a. Up-scaling:

The concept of a climate-smart village has been extended to a climate smart digital agriculture village under CAAST, thereby developing the framework for promoting entrepreneurship opportunities to rural youth. The CAAST-CSAWM project adopted eleven villages in the university vicinity, a village Buchkewadi, in Pune district, is being developed in association with NABARD and Lupin Foundation; 07 villages from Akole block are developed in association with NABARD and BAIF, and one village, Baburdi Ghumat in Ahmednagar district is being developed in association with SEVA NGO, Ahmednagar and Alumni Association, Dr. ASCAET, MPKV, Rahuri and Kasare village in association with Social Centre Ahmednagar, and Shetphale in Sangli district. The project continuously organized different extension activities for disseminating and adopting climate-smart digital agriculture technologies such as exposure visits, group discussions, meetings, training programmes, workshops, demonstrations, expert advisory services, and diagnostic field visits to these villages. All these institutions are networked into collaboration for the development of CSDAV. The center has developed Village level crop contingency plan for 7 villages of akole block and installed various digital technologies in adopted villages.

b. Employability and Entrepreneurship development:

The project has been sonsistently organizing training programs to increase the employability and develop entrreprenurship attitude among the students. A 5 weeks online training programme on competitive examinations and test series for JRF/SRF, NET, ARS, PhD entrance and a four-day national training programme on national and international agricultural higher educational opportunities, was organized. As a result of these training programmes, 92 Students qualified for the JRF/SRF/NET examinations, and 125 got admissions for the PhD programmes in different Agricultural Universities.

The center organized 15 standalone certificate courses (3 weeks each) and two modules (consisting of 3 certificate courses each) and completed 15 certificate courses, and two-week lecture series on agriprenuership and placement opportunities in agriculture and allied sectors. CAAST-CSAWM is supporting 12 young farmers from adopted villages by providing them with training to become drone pilots. The vision of CAAST-CSAWM is to empower the young farmers which will be leaders in using precise and advanced farming methods with drones, making their villages' agriculture more sustainable and attractive. Few students have started the startups after attending CAAST trainings and few have become successful drone entreprenurs after getting trained in the MPKV RPTO.

c. Networking

Networking of MPKV with external institutions/industries has increased significantly, and many institutions/industries are coming forward to collaborate with MPKV on different projects. The center has signed 10 MoUs for research and education collaboration with various International and National organizations such as Washington State University, Pullman, USA, Asian Institute of Technology, Bangkok, Thailand, Centre for Ganga River Basin Management & Studies, IIT Kanpur, IoTechWorld Avigation Pvt. Ltd., Haryana, Einnovation Pvt. Ltd. Pune, ESDS, Nasik, ASAP Agritech LLP Nashik, BAIF, Nashik and Yorient Technologies Pvt. Ltd., Pune. These collaborations are helping both the institutions in achieving their objectives.

Introduction:

Background:

India ranks second worldwide in farm output, but has very low agricultural productivity. Currently in spite of the great efforts put forth for improving the productivity of rice and wheat, India ranks 13 and 14 respectively in the world. Productivity of other crops is still much lower. If we enhance our productivity, we can produce more, save land and water resources and improve the soil health by appropriate use of chemicals. As an example, we could produce 2.5 times what we currently do, if we were to produce wheat at the rate at which New Zealand does. Similarly, if we produce rice at Chinese levels, we could halve the amount of land devoted to rice cultivation making available the land for other purposes. Thus, productivity needs to be increased to enable the farmers get more remuneration with less resources i.e land, water, labour, fertilizers, chemicals. On 28th February, 2016 while talking at the Farmers' rally in Uttar Pradesh, the Prime Minister stated that it is his dream to see farmers double their income by 2022 when India completes 75 years of its independence. Thus, the goal of the Agriculture University scientists/teachers need to be to produce the technology and competent human resources for enabling the farmers to adopt the technology for doubling the farm income in the realm of climate change and climate variability. Precise use and application of inputs considering the principles of climate smart agriculture can provide a way to do it. Precision agriculture is the technique of the site-specific management of crops taking in to account in-field variability by using GIS, GPS and Remote Sensing technologies to produce and manage climate, soil and crop variability in order to optimize the use of water, fertilizers and chemicals in agriculture.

There is growing concerns about climate change and variability and their adverse impact on different sectors of development including agriculture and water. Hence while enhancing the productivity of agriculture and efficiency of water use, it is necessary that increase in agricultural productivity, water use efficiency and farm income is on sustainable basis and without having an adverse impact on the environment. At the same time, it is necessary to reduce the exposure of farmers to short-term risks, while also strengthening their resilience to adapt to longer-term stresses; and whenever possible, help farmers to reduce greenhouse gas emissions. Climate smart agriculture offers solution to this. FAO defined climate smart agriculture as "agriculture that sustainably increases productivity, enhances resilience (adaptation), reduces/removes greenhouse gas emissions (mitigation) wherever possible, and enhances achievement of national food security and development goals"

The current perception of scientists, extension workers and farmers respectively for developing, disseminating and adopting the generic practices need to be changed if the limited available natural resources such as land and water need to be utilized efficiently and optimally and the inputs such as fertilizers and chemicals are to be used efficiently so as to make farming more remunerative, environmentally friendly and less polluted. Hence the focus needs to be changed from generic to specific, meaning specific to crop, soil, weather, different systems and finally to farm. The IT technologies coupled with remote sensing, including satellite, GIS, GPS, SDSS enable to connect the aspects of precision agriculture, water management, climate smart agriculture; facilitate the intricacies associated with offering solutions to providing farm specific precision technologies in real time considering the climate variability and climate change; and provide the means for dissemination and adoption. Currently globally the agriculture and water management are moving towards precision, climate smart, specific and in real time; and many multinationals are showing interest in India. Few Indian companies have also started the thought process. Under such circumstances it is necessary to develop the human resources in India by equipping them with the technologies and tools that suit to Indian agriculture and water sectors. Thus, there is a need of both developing the technologies and human resources. Hence, in the proposed project, it is envisaged to develop the tools and technologies; and build the capacity amongst the existing human resources, develop the capable human resources and technologies to adopt and implement these technologies.

Considering this, the project proposal on the "Centre for Advanced Agricultural Science & Technology (CAAST) for Climate Smart Agriculture & Water Management (CSAWM)" was submitted to the NAHEP for approval. The project was approved in the first call and started implementation in 2018. It is implemented through the National Agricultural Higher Education Project (NAHEP), a flagship project of the Indian Council of Agricultural Research (ICAR) New Delhi vide F.No. NAHEP/CAAST/2018-19/4 dated 13.06.2018 and UR No. MTG-3 (690)/203/2018 dated 19.11.2018. The themeatic areas of CAAST-CSAWM are climate

smart agriculture and water management, Geo-informatics (RS/GIS), UAVs (Drone), Robotics, IoT, and precision agriculture

Project Title: Centre for Advanced Agricultural Science & Technology (CAAST) for Climate Smart Agriculture and Water Management (CSAWM)

Objectives:

The project objectives are,

1. To develop the capacity amongst the faculties and scientists for the development and adoption of the precise Climate Smart Agriculture and Water Management technologies.
2. To start the one year Post Graduate Diploma in "Climate Smart Agriculture and Water Management" for developing the human resources enabling them to start entrepreneurship and employable in public sectors and private industries, strengthen the current M.Sc., M.Tech. and Ph.D. programme (for their research projects); and make provision for the perspective beginner/middle level faculties/researchers for Post Doctorate studies in precision water management, precise climate smart agriculture and Geo-informatics.
3. To develop an integrated system including RS/GIS and GPS tools, modelling and SDSS tools using unmanned aerial system (UAS aka. drone) and sensor-based technologies; and mobile applications and their applications for climate smart and precision agriculture and water management.
4. To conduct end-to-end capacity building through on-the-job training and case study-based learning; enhance the employment and placement rate; and business and entrepreneurship opportunities.

Intended benefits:

1. Establishment of state-of-the-art laboratories in the university having advanced instruments
2. Trained human resources i.e. students, faculty, farmers, practitioners for climate smart agriculture, precision agriculture & digital agriculture
3. Technologies for climate smart agriculture with interventions of digital technology.
4. Introduction of audit courses on climate smart and precision agriculture in the existing course curricula in the university
5. Starting of Post Graduate Diploma in Climate Smart Agriculture & Water Management (CSAWM)
6. Starting the post doctorate programme in CSAWM
7. Use of AI & ML in agriculture
8. Increased networking and collaboration of the university with national and international institutes of repute for education and research
9. Increased industry funding for research in the university
10. Increased role of alumni in the development of the university

1. Key activities carried out under the project during the entire period

1.1. Interventions carried out by AU which helped to improved research effectiveness

Key interventions	Remarks/Photographs

A. Establishment/Strengthening of Research Infrastructure

New state of the art laboratories has been developed through NAHEP funds which have helped in initiating research on digital technologies in agriculture. Few existing infrastructures like irrigation park and protected cultivation structures have been strengthened through NAHEP funds. Many Masters and PhD students are using these facilities for their research

i) Hyperspectral Imaging Laboratory at CAAST-CSAWM:

Hyperspectral imaging is a cutting-edge spectroscopy based remote sensing technique. In agriculture, Hyperspectral imaging enables remote sensing to address a much broader range of farming challenges and applications. It benefits precision agriculture, climate smart agriculture, and water management.

The major objective of the Hyperspectral Imaging Laboratory is to promote cutting-edge research in hyperspectral and multispectral imaging technologies applied to agriculture. This includes developing innovative methodologies for crop monitoring, disease detection, and precision agriculture. The laboratory serves as a capacity-building centre for research and educational activities, offering specialized courses and training programs in hyperspectral imaging for PG and Ph.D. students and faculties/scientists from different disciplines of agricultural research and education. The goal is to equip students with the knowledge and skills needed to address the evolving challenges in the agricultural sector. The laboratory facilitates the development of innovative solutions and technologies applicable to the agriculture. It supports students in translating their research into practical applications and encourages the establishment of entrepreneurship.

This state-of-the-art facility available in the hyperspectral imaging laboratory which are dedicated to research, teaching, and capacity building with a focus on integrating agricultural education with employment for postgraduate (PG) and Ph.D. students are;

Cutting-edge Instruments/Equipment: The Hyperspectral Imaging Laboratory is equipped with the latest drone mounted and had held hyperspectral and multispectral imaging sensors, spectroradiometers, other sensors and devices allowing researchers and students to capture

detailed spectral information of crops, soil, and water across a wide range of wavelengths.

The infrastructure facilities developed as the Hyperspectral Imaging Laboratory are extensively used by the 47 PG and Ph. D. Students from different agriculture and agricultural engineering disciplines for their research.

Continuous Capacity Building: Regular workshops, seminars, and training programs are organized to keep students and researchers abreast of the latest advancements in hyperspectral imaging and related fields through this interdisciplinary advanced canter for innovative research, teaching, extension, and capacity building in hyperspectral imaging.

Initiatives on Integrated Use of hyperspectral imaging, multispectral imaging and AI Technologies in Agriculture:

1. Hyperspectral Imaging for Stress Detection:
2. Hyperspectral Imaging for genotyping of different crops
3. Multispectral Imaging for crop monitoring
4. Drone Technology for Precision Agriculture:
5. AI and ML for Data Analysis:
6. Irrigation Water Management:
7. Development of AI and ML assisted Decision Support System

Overall, the establishment of the Hyperspectral Imaging Laboratory at CAAST-CSAWM marks a significant milestone in advancing agricultural research and education. By integrating hyperspectral imaging technologies, the laboratory can make substantial contributions to the development of sustainable and technologically advanced agriculture.

ii) Digital Lysimeter Complex:

The CAAST-CSAWM at MPKV, Rahuri, has initiated pioneering efforts in the realm of agricultural research with the development of Lysimeter complex. The complex comprises 16 Lysimeters with varying dimensions. The diverse dimensions are strategically designed to accommodate crops with different root zone depths and canopy sizes, facilitating comprehensive studies. Within this Lysimeter complex, different research experiments are being undertaken to determine localized crop coefficients for crops common in the region. Additionally, five Portable Micro Lysimeters are installed in the Climate Smart Research Block for the purpose of determining crop coefficients for vegetable crops such as Coriander, Fenugreek, Spinach, etc. Along with the development of local crop coefficients for different crops, studies are being conducted to establish correlation between local crop coefficients and NDVI. Five postgraduate students have conducted their academic research projects using the facility and many more will be working in future. The locally developed crop coefficients from studies in the Lysimeter Complex are more precise for estimating crop and irrigation water requirements, contributing to precision water management practices. The students are more skilled thereby increasing their employability in irrigation sector.

iii) Unmanned Aerial Vehicle (UAV) Lab:

Unmanned Aerial Vehicle (UAV)/ Drone is one of the formidable technologies that have found potential application in agriculture. Drones have two major applications in agriculture i.e. i) inputs application and ii) resource mapping. The inputs such as nutrients, fertilizers, chemicals (insect & pest) spray and the seeding/broadcasting of granular fertilizer using drones. In order to create awareness among students/faculties/farmers CAAST-CSAWM, MPKV Rahuri has developed drone laboratory for education and research with different types of drones as given below:

- Spreading and spraying UAV (hexacopter; 10 Litre)- 3
- Spraying UAV (Quadcopter, 10 litre)- 1
- Spraying UAV (Quadcopter 5 Litre)- 2
- Petrol Engine Operated spraying UAV (12 Litre)-1
- Fixed wing UAV (VTOL)-1
- UAV with RGB camera-1
- First person view UAV-1
- Training grade UAVs-2
- Drone training kits-22
- 3 D printing facility-1

With CAAST's UAV lab facilities PG students are taking their research on spraying drone for optimizing operating parameters, standard operating procedure (SOPs) for different crops and various formulations. This is enriching their research experiences and increasing their employability and entrepreneur skills.

iv) Remote Pilot Training Organization:

Drone technology is increasingly available for use in various sectors of agriculture. Government of India has recently announced national policy on use of drones and promoted the use of drones in agriculture. In order to increase use of drones in agriculture skilled manpower is required. Remote Pilot Certificate (RPC) Training is now mandatory to fly ANY DRONE above the weight of 250 gms in India.

MPKV, Rahuri is India's first Agricultural University to establish Directorate General of Civil Aviation (DGCA) approved Remote Pilot Training Organization (RPTO) under UAS Rules 2021. RPTO conducts the RPC training as per the requirement of the DGCA and issues license of 10 years validity. In addition to DCAG syllabus, we provide the additional agricultural spraying drone training emphasizing on operating parameters and crop specific SOPs.

Our RPTO mission is to provide the entrepreneurship opportunities to rural youths by giving remote pilot training and enhancing the use of drones in agriculture for input application and resource mapping. RPC training will generate skilled manpower required for agricultural drone, so as to take this cutting-edge technology to each and every farmer.

Our RPTO trained more than 150 pilots having diverse participation i.e. students, farmers, scientists, government officers, industry persons. One of our students, Rishikesh Tarange a 25-year young boy from Mada, Solapur is doing a custom hiring service for spraying drone and earning Rs 1.25 lakh per month. He is flying the drone almost on all field crops including Sugarcane, Soybean, Pigeon Pea and Maize. It shows the demand for drone spraying on field crops and business opportunity for rural youths. Pune based alumnus Er Yogesh Jadhav has a surveying and mapping firm. His annual revenue shoot up from 70 lakh to 7 crore in a single year after completion of drone pilot training from MPKV RPTO.

v) Robotic laboratory:

Robots can be used in agriculture to carry out repetitive tasks. The general applications of robots in agriculture are harvesting of fruits, weed control, pruning, seeding, spraying etc. In order to create awareness among students/faculties/farmers CAAST-CSAWM has developed robotics laboratory for education and research with different types robotic kits with e-YANTRA facility as given below:

- Arduino robotic kit CTC 101-1
- Line following Robotic kit-1
- Lego educational robotic kits-3
- Programmable robotic kit-1
- Humanoid robot-1
- Advanced electro-hydraulic Trainer-1
- Advanced electro-pneumatic Trainer -1
- Different types of servos, stepper motors, grippers, actuators
- Automation studio software-1
- Fire Bird V robotic research Platform-4
- Spark V robotic research platform-3

Robotics lab has created awareness among students for taking research on agricultural robots to reduce drudgery in agricultural operation. Robotic lab is helping M. Tech/Ph.D students of agricultural engineering conducting the research on robotics thereby increasing their employability in the industry.

vi) IoT Laboratory:

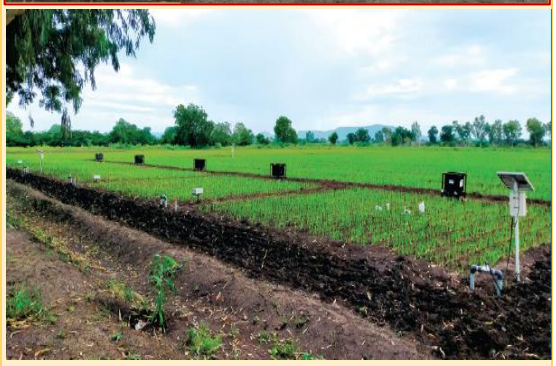
IoT is the network of smart devices, sensor and actuators that interconnects with each other and provides the decision on time. Recognizing the importance of IoT, sensors and precision agriculture technologies in climate smart agriculture and water management, CAAST-CSAWM developed the concept of real-time management of the inputs by using different gadgets and sensors for making the farming attractive. Based on these concepts, the CAAST-CSAWM developed following sensors and IoT based technologies.

1. FDR-capacitance and capacitance-based soil moisture sensor

2. Weighing type digital lysimeter
3. IoT enabled tensiometer
4. IoT enabled smart weather stations of different types (Type 1 to 6)
5. IoT enabled Phule Irrigation Scheduler (PIS) based irrigation scheduling for single plot crop (AutoPIS)
6. IoT enabled PIS based irrigation scheduling system for multiplot crops (SmartPIS)
7. IoT enabled soil moisture sensor-based irrigation scheduling system (PSMISS)
8. IoT enabled siphon system for irrigation from farm ponds
9. Anti-theft system for agricultural pumps
10. Automatic double ring infiltrometer
11. IoT enabled trench water level recorder
12. IoT enabled pan evaporimeter (Ultrasonic sensor based and load cell based)

Through this intervention, PG students and researchers have gained access to cutting-edge tools and technology that facilitate data collection, analysis and experimentation across various agricultural disciplines. With CAAST's IoT solutions, students are empowered to conduct experiments, gather real-time data, and derive meaningful insights, thereby elevating their research experiences and increasing their employability and entrepreneur skills.

vii) Climate Smart Agriculture Research cum Demonstration Block (CSARDB): CAAST-CSAWM has developed 12 ha climate smart agriculture research cum demonstration block (CSARDB) at the central campus of MPKV, Rahuri. Various IoT and precision agriculture technologies have been demonstrated on this block. The technologies demonstrated are Protected cultivation structures, precision machinery, Auto Phule Irrigation System, Smart Phule Irrigation System, Phule soil moisture base irrigation scheduling, Smart weather stations, Portable lysimeters, Manna Irrigations system (Donated by M/s. Revulis Irrigation ltd.), Drone Spraying, IoT enabled syphons (SiPond) system for farm pond. This block is playing an important role in the capacity building of the students as around 20-25 PG and Ph.D. students from different departments of the university have taken the benefits of various technologies of this block in their research and are trained in various new and advanced technologies in agriculture. The CSARDB is one of the most visited sites by farmers in the university.



Field demonstration of IoT enabled Automatic Pump Controller for multiple plot (SmartPIS) system for students and farmers

viii) Abiotic Stress Complex

Abiotic stress complex has been developed through NAHEP funds which is helping the students to take up research in the context of climate change. Research on the effect of increased ambient temperature and increased level of CO_2 concentration in the air on the performance of various crop genotypes is conducted by PhD students in this complex. It is therefore helping to shift the focus of students' research towards climate change and making them expert in this field. This will improve their employability in the domain of Climate resilient agriculture.

B. Capacity Building Programme:

i) International Level Training (ILT)

There was a provision in the project for international level training (ILT) to the faculties and students of MPKV Rahuri. The MPKV CAAST succefully organized ILT at Geo-Informatics Centre, Asian Institute of Technology, Bangkok, Thailand; the University of Wisconsin, Madison, USA; and University of Tsukuba, Ibaraki, Japan, University Putra Malaysia, Hue Universuty & Can Tho University, Vietnam and sent 97 students and 31 faculties and scientists for ILT in these countries. In addition,02University Officers visited USA and 10 officers visited AIT, Thailand for networking and studying best practices in those Universities.

International exposure: Visit of university officers and one month training of faculties at AIT, Bangkok, Thailand (2023)

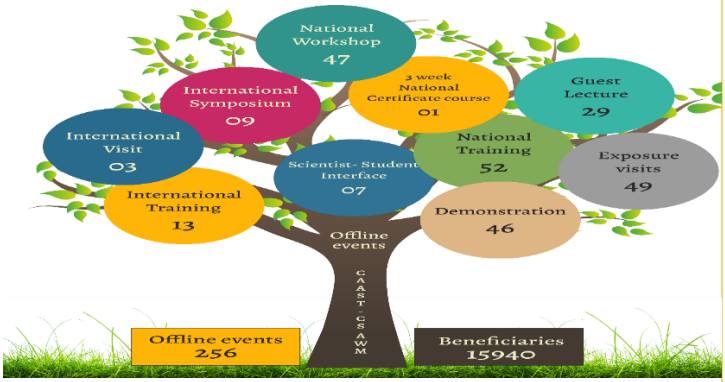
The international level training helped students and faculty to take up advance research using digital technologies in agriculture. Forty-Seven (47) Masters/PhD students on the campus who have undertaken ILT are using the advanced laboratories facilities developed under NAHEP CAAST. Six (6) faculty have brought externally funded projects after completion of ILT. The students completed 20 individual projects and published 20 research papers based on their learning during the International Training.

ii) Capacity building programmes organized by CAAST-CSAWM:

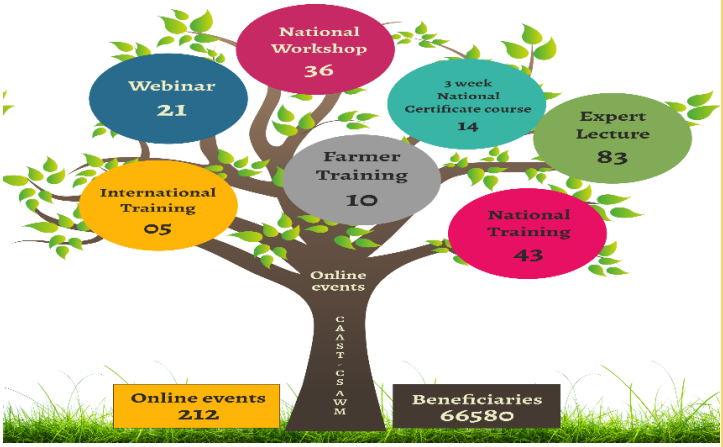
The focus of this centre has been to build the capacity of students, faculty and farmers for the development and adoption of climate smart agriculture and precision water management technologies. Based on the specific thematic areas, this centre organized 468 national and international capacity building programmes through offline and online modes and developed the capacity of 82520 participants comprising faculties, students and farmers.

On campus mode

This centre organized 256 on-campus programmes including international training (13), Short visits (03), Symposia (09), Student-Industry interface/workshops (07), National training (52), National workshops (47), Guest lectures (29), Exposure visits (49) and Demonstrations (46) in MPKV Rahuri providing training to 15940 beneficiaries (4172 faculties, 9069 students and 2699 farmers

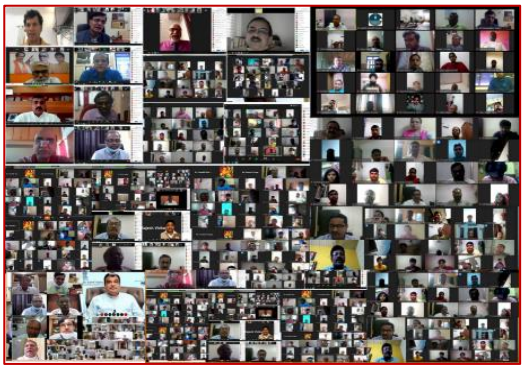


Online mode:



Since then, CAAST-CSAWM organized online international (05) and national trainings (43), three-week national certificate courses (14), workshops (36), farmers trainings (13) consisting of 1125 technical sessions of 1.5-2.0 hr durations benefiting 66580(29891 students and 2769faculties; and 8998 farmers) participants. In addition to this, CAAST-CSAWM organized 21 webinars by inviting experts from the different disciplines of climate-smart agriculture and water management. This centre also organized 86 online expert lectures.

This capacity development program at such a massive scale involved almost all students and faculty of the university which trained them on advanced technologies for agriculture. This defintelt motivated them to take up research on climate smart agriculture, precision agriculture using digtal technologies.



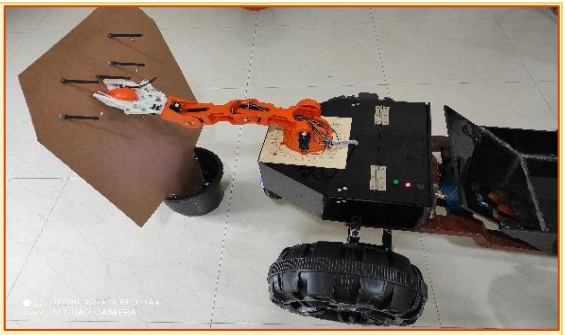
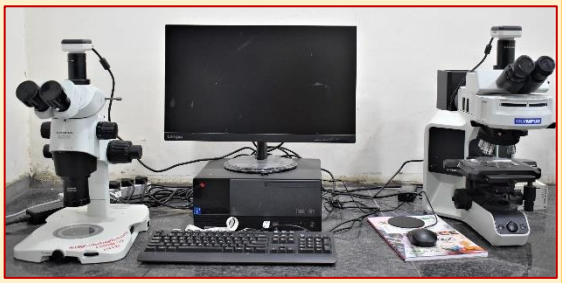
Glimpses of capacity building programmes organized by CAAST-CSAWM, through online mode

1.2. How the facilitative units helped to enhance learning outcomes

Facilitative Units:

Facilitative unit	*Activity/ achievement*	*Remarks/Photographs*
1. Unmanned Aerial Vehicle (UAV)/ Drone laboratory • Spraying UAV (Quadcopter; 5, 10 Litre) • Petrol Engine Operated spraying UAV (12 Litre) • Spreading and spraying UAV (hexacopter; 10 Litre) • Fixed wing UAV(VTOL) • UAV with RGB camera • First person view UAV • Training grade UAVs • Drone training kits • 3 D printing facility	**Capacity building:** • Audit course on fundamentals of drones for agriculture:1 • Certificate course: 1 • One week training: 2 • One day workshop:8 • Demonstrations: 13 **Research:** • Developed the SOPs for spraying drone • Developed SOPs for spraying of chemicals **Student Projects:** 4 **Impact:** • Dr. S. D. Gorantiwar, PI, CAAST-CSAWM, member three national level committee on drones. • Dr. S. M. Nalawade, Head, Dept of FMPE, is the member of Food and Agriculture department committee (FAD-11) of Bureau of Indian Standards and sub-committee for development ofIndian standard for agricultural spraying drone **Collaborative projects:** • "Standardizing Drone Spraying Protocols" with Fowler Westrup (India) Private Ltd, Malur, Karnataka.	   

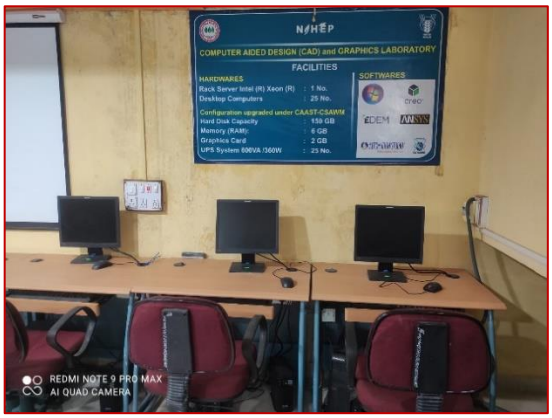
	RPTO: • Established DGCA approved RPTO • Trained > 150 participants	
2. Hyper-spectral imaging laboratory • UAV/drone (DJI Matrice 600 Pro) based Hyperspectral Imaging Camera (Pika-L 400-1000nm and Pika NIR320 - 900-1700nm) • Spectroradiometer (SVC HR-1024i) • Outdoor Hyperspectral Imaging System with Pika-L 400-1000nm and Pika NIR320 - 900-1700nm • Thermal Sensor • Hyperspectral Imaging Camera, (HSC-2) • Portable NDVI meter • Digital Plant Canopy Imager • Handheld GPS • 3D-LIDAR Sensor • Intergraph (ERDAS) Imagine software - 2018, Arc GIS software 10.7	• Developed spectral signatures for different crops using spectroradiometers under different water stress conditions • Developed yield estimation model for sugarcane and soybean using hyperspectral imaging • Conducted research on genotyping of different wheat cultivars under heat stress conditions using hyperspectral imaging • 47 MSc, M.Tech and Ph. D students from different disciplines are using these facilities for their research	 
3. Robotics lab	• Established E-Yantra laboratory sponsored by IIT, Bombay • Research conducted by 3 M. Tech and Ph. D student of Agricultural Engineering • Developed remotely operated spraying robot (Phule Robo) • Developed lab model of AI based robotic harvester • Development of variable rate fertilizer application system	

• Arduino robotic kit CTC 101 • Line following Robotic kit • Lego educational robotic kits • Fire Bird V and Spark-V robotic research Platform • Programmable robotic kit • Humanoid robot • Advanced electro-hydraulic Trainer • Advanced electro-pneumatic Trainer • Different types of servos, stepper motors, grippers, actuators etc. • Automation studio software	• Development of site-specific slurry application **Patent:** • Published one patent on "Sensor module for orchard plant detection" **Publications**: • Research Paper: 2	 
4. IoT & Sensors laboratory • Capacitance-based soil moisture sensor • IoT enabled FDR-capacitance based soil moisture sensor • IoT enabled multidepth capacitance-based soil moisture sensor • IoT enabled resistance based soil moisture sensor • Weighing type digital lysimeter (Laboratory model) • IoT enabled tensiometer • Time Domain Reflectometry (TDR) moisture sensor • Frequency Domain Reflectometry (FDR) moisture sensor • Diffuse Reflectance Spectrophotometry (DRS) moisture sensor	• Developed IoT Park • Developed Climate Smart Agriculture Block **Technologies Released-** • Web and Mobile-Based Applications for Real Time Estimation of Location-Specific Evapotranspiration "Spatial ETr" • Map-based Web and Mobile Applications for the Estimation of Location Specific Real Time Irrigation Water Requirement • Mobile and web-based applications for automatic weather stations • IoT enabled location specific-real time irrigation scheduling system for single crop based on PIS: AutoPIS • IoT enabled location specific- real time irrigation scheduling system for multiple crop based on PIS: SmartPIS	  

• Soil SPEC tensiometer system	• Mobile and web-based applications for display of soil type in USDA textural triangle • IoT enabled “Anti-Theft” system for agricultural pumps • Automatic double ring infiltrometer • Web and mobile applications for deciding the fertilizer quantities based on Soil Test Crop Response (STCR) equation, Recommended Dose of Fertilizer (RDF) and As per Soil Test (AST) • Mobile applications on "Crop Production Technologies, Management Practices and Value Addition for 22 Agronomical Crops (Cereals, Pulses, Oilseeds, Spices and Cash Crops)" **Copyrights: 21**	
5. IoT park: • IoT enabled Automatic Weather Stations of different types: Smart Weather Stations (SWS type 1 to 6) • Phule Automatic double ring infiltrometer • IoT enabled double-ring infiltrometer • IoT enabled pan evaporimeter based on the principle of load cells • IoT enabled pan evaporimeter based on the principle of ultrasonic pressure sensor • Anti-Theft system for agricultural pumps • IoT enabled trench water level recorder	• For Dissemination and demonstration of various climate smart technologies to the scientists, students, farmers and visitors from different fields. • **No. of Visitors :** Faculty- 763 Students- 1123 Farmers- 456	 

		
6. Climate smart agriculture research cum demonstration (CSARDB) block: • IoT enabled Automatic Weather Station (SWS type 5) • AWS star topology system for estimating rainfall variability • IoT enabled PIS based irrigation scheduling system for single crop (AutoPIS) • IoT enabled PIS based irrigation scheduling system for multiplot crops (SmartPIS) • IoT enabled soil moisture sensor based irrigation scheduling system (PSMISS) • HDPE lined farm pond • IoT enabled siphon system for farm ponds • Weighing Type Digital Lysimeters • Naturally ventilated Polyhouse • Cable and Post shadenet house • Shadenet house	• Implementation and utilization of developed technologies for Climate Smart Agriculture • Research conducted by 29 M.Sc., M.Tech and Ph.D. Students on Precision water management, Application, IoT Technologies, Protected Cultivation (polyhouse and Shadenet house) Drone application for spraying etc.	 

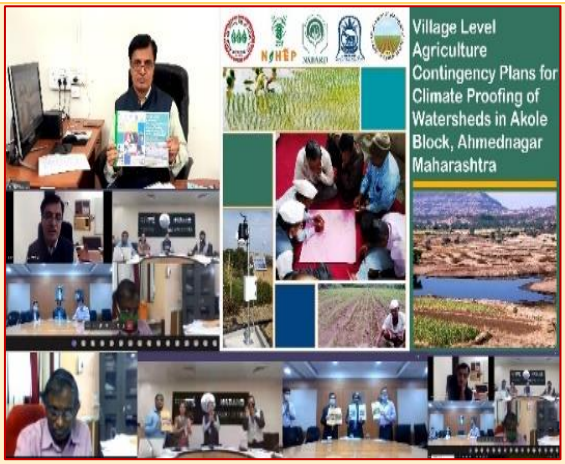
7. Abiotic stress research unit: • Polycarbonate House Dimensions: 4 m X 8 m (Two chambers, carbon dioxide and temperature controllers) • Rainout Shelter Dimensions: 10 m X 30 m (150 sq meter working shelter area) • Carbon Dioxide Application Rig Dimensions: 8 m diameter ring with ambient portal	• Conducted research on elevated Co2 and temperature levels on wheat and soybean crops • Conducted research on identification of abiotic stress • Evaluation of different wheat genotypes for heat stress	 
8. Remote Pilot Training Organization (RPTO): • Drone/UAV laboratory • Drone maintenance assembling and dismantling laboratory • Flight simulation system • Digital/Smart class room • Flying station • Library • DGCA approved small category drones with UIN	• Successfully completed 19 batches of Remote Pilot Certificate (RPC) training • Issued RPC to 163 trainees • **Collaboration:** ◦ Syngenta foundation of India ◦ SARTHI, Pune	  
9. Virtual Classroom: • Interactive Board • Audio-Visual System • Internet facility • Multimedia Projector	• Used for trainings to faculties, scientist, students and farmers on climate smart agriculture and water management • Used for classroom training of RPC • Used for conducting UG, PG and Ph.D classes	

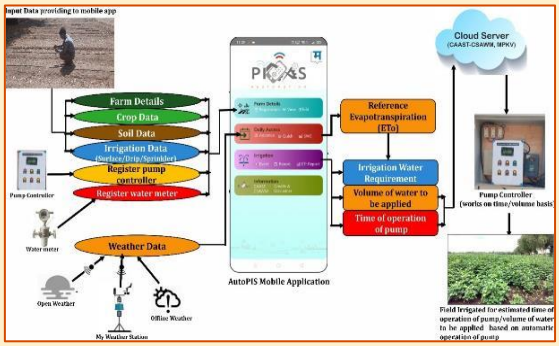
10. CAD/CAM Laboratory: • ANSYS Academic Research Mechanical & CFD- 25 bundle • CREO 5.0 University plus Academic Lab Pack-50 users bundle • Discrete element model (DEM) • *Auto-Cad*	• The UG, PG and PhD students of Agricultural Engineering are using this facility for designing and simulation of agricultural machines. • Four PhD and Six M.Tech students have designed their project prototypes. • The designing and virtual testing of institutional research project prototypes. • Teaching of CAD courses like computer aided system design, Tractor and farm machinery design, Computer Aided Design of Machinery to the UG and PG students.	 
11. Atomic Absorption Spectrophotometer	• The UG, PG and PhD students are using this facility for research purpose. • Soil, plant and compost samples received from farmers and industrialists are analysed for various parameters like micronutrients. • Analysis: Micronutrients from soil, plant, compost and heavy metals from city compost. About 1512 soil samples, 880 plant samples and 341 compost samples (total 2733 samples analysed)	

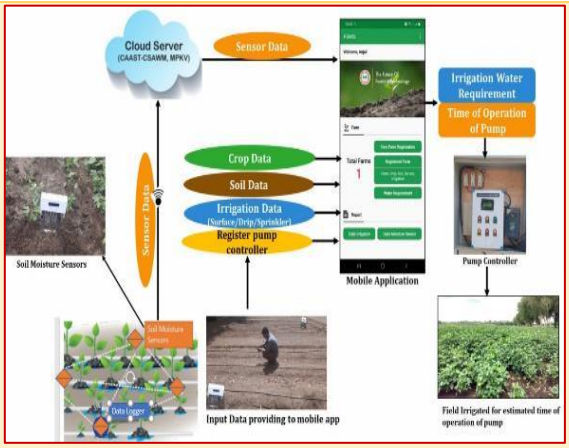
12. CNC laser cutting machine	• Conducted practical of PG students for laser cutting of wooden and acrylic sheets. • Cutting of different shapes of wooden and acrylic sheet.	

1.3 Out-of-box initiatives undertaken by the AU

Out-of-box initiative	Activity/achievement	Remarks/Photographs
1. CAAST-CSAWM Online Learning Model	i. The **Coronavirus pandemic and the resulting lockdown** forced the immediate closure of schools, colleges, and offices across India (since the second week of March, 2020). ii. To overcome the challenge posed by Covid Pandemic the CAAST-CSAWM immediately switched over to online learning mode and **developed an online learning model** for students and faculties of MPKV as well as other universities across India. This was an out of box in the sense that when the entire population in country was locked in their residences, we took it as challenge and developed an online learning model consisting of well-defined procedure which is shown in the picture. iii. As a result of this initiative we could develop the **capacity of 66580** students, faculties, practitioners, farmers etc by **organising online events** comprising **1253 technical sessions**. iv. Invited over **521+ experts/ resource persons** including progressive farmers, scientists, faculties, and industry personals for technical sessions. v. Saved money and tonnes of carbon footprint (estimates in progress) by eliminating the road/train/air travel of resource persons and participants; common food arrangements thus increased safety to the environment.	 *The face-to- face learning results in about **130 kg CO2** and the online learning results in about **2 kg CO2** per student per 100 study hours. (Caird et al., 2015)* *Since April 2020,* *527 technical sessions of 1.5 hr each* *43000 beneficiaries* CAAST-CSAWM Online learning module ***680 tCO2 emission*** If Offline (face to face) learning ***44189 tCO2 emission***

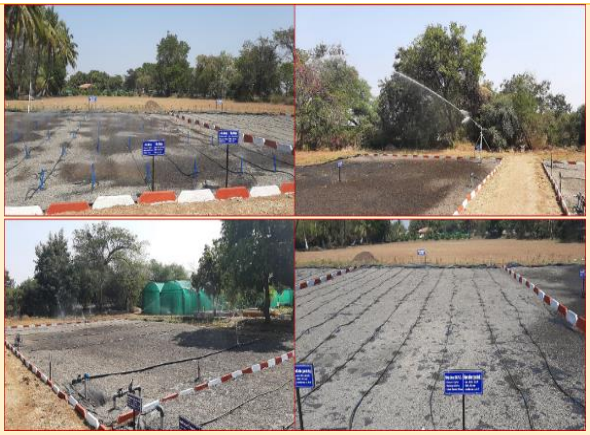
2. International Level Training (Sandwich program)	At CAAST-CSAWM, we developed a sandwish program for International Level Training (ILT) in which one moth Pre-training on advance technologies in agriculture was given to the students/faculty at MPKV. It was followed by one-month ILT at university/ institution abroad. The participants were again given 15 days training after return from ILT which involved project work with some case study involving the knowledge gained by the participants at institutions abroad. This type of unique program increased the effectiveness of ILT and students published 20 research papers and faculty brought externally funded projects in the university.	 
3. Village level Contingency Crop Plan (VLCCP)	The District Agriculture Contingency Plans (DACPs) were developed by the ICAR-Central Research Institute for Dryland Agriculture (CRIDA), Hyderabad, in association with other partners for 614 districts in India, to provide the technological interventions to manage various weather aberrations and extreme climatic conditions. But we realized the need to down-scale these plans to the village level for the implementation in real-time and also for the climate-proofing of watersheds. CAAST-CSAWM, MPKV, Rahuri developed the linkages with all active partners, including CRIDA, BAIF, NABARD, State Dept. of Agriculture, KVK, and the farmers in the villages; started the process of down-scaling the plans to the village level. Finally, came out with the publication in English and Marathi languages that includes the procedure developed and adopted to down-scale the DACPs to village level	  **Steps followed during development of VLCCP for Akole block**

	crop contingent plans for seven villages in Akole Taluka. The implementation plan was finalized by the convergence of CAAST and the active partners mentioned above after several brainstorming sessions, workshops, visits, and consultations. The students and faculties of MPKV also participated in these seesions.	
4. Development of Digital Agriculture Technologies		
i) IoT enabled Automatic Pump Controller for multiplot crops (SmartPIS):	Internet of Things (IoT) enabled Phule Irrigation Scheduler based Automatic Pump Controller (SmartPIS) mobile application used for estimation of water requirement of different crops, time of operation considering different water application methods i. e. drip, sprinkler and surface irrigation and to operate the motor for calculated time of operation for multiple plots in a single field or farm. The developed application works on Android 5.1 onward based mobile phone and tablet, user friendly and available with English and Marathi language support.	
ii) IoT enabled siphon system for farm ponds	Farm (Storage) ponds are very common in Maharashtra. However, there is no mechanism for taking out measured quantity of water which is required by crops. Our technology enables to start the siphon system installed on the storage pond remotely and automatically using continuous water level sensor and solenoid valve and takes out pre decided quantity of water from the pond. Components: • IoT enabled continuous water level sensor: for monitoring water level in farm pond • IoT enabled solenoid valve: for delivering water to the	 **IoT enabled continuous water level sensor**

	field from farm pond with zero energy for desired depth (start and stop) • Cloud server: for fetching the requisite data from and providing to other components • Connectivity options such as WiFi/GPRS module Waterproof enclosures with solar panel arrangement	 **IoT enabled solenoid**
iii) IoT enabled soil moisture sensor-based irrigation scheduling system (PSMISS)	Phule Soil Moisture Irrigation Scheduling System (PSMISS) is the IoT enabled soil moisture sensor-based (single and multi-depth sensor) irrigation scheduling system. The IoT enabled soil moisture sensors (single and multi-depth sensor) are integrated with PSMISS mobile application. The action regarding whether to irrigate or when to irrigate is decided based on defined depletion criteria for a specified crop and specified irrigation method. The water to be applied at the time of irrigation is decided based on the moisture to be added in the soil root zone to take the moisture content in the soil from the actual observed level to the field capacity or other desired level, and according to system/pump discharge; the time of application for irrigation is estimated	
iv) Phule Robo for spraying	Light weight track type Phule Robo is designed for spraying orchard and vegetable crops, particularly in muddy conditions where the tractor is stuck in the field. It has battery-operated motors that reduce its weight, and the tracks that increase traction. It is remotely operated track type vehicle. It is being converted into autonomous robot. Recently this invention was presented in the Agri India Hackathon 2020 and won Rs 1 lack prize.	

5. MPKV-CLIMEX 2022	The CAAST-CSAWM and Alumni Associations of MPKV jointly organized three-day event MPKV Alumni Carnival of Leaders of Industry and Entrepreneurs Meet & Exhibition (CLIMEX) from 20-22 December 2022 that comprised of following six events i. *Education fair* ii. *Job fair* iii. *Technical sessions* iv. *Exhibition,* v. *Mega Alumni Meet* vi. *Felicitation of University Idols* The entrepreneur alumni wholeheartedly participated in the event and displayed their product and services in the exhibition. The expert speeches of these alumni were very motivating for the students on the campus. More than 100 students got job through the campus interview during the job fair. The event was totally sponsored by the entrepreneur alumni and we could save Rs 40 lakh from the event. The money is distributed to four colleges for starting the entrepreneurship cells at these colleges	  
6. International Conclave on Futuristic Farming (ICFF-2023)	The ICAR-NAHEP, CAAST-CSAWM project organized an International Conclave on Futuristic Farming. The conclave was held in Pune on 20-21 December, 2023. The conclave, featuring one international conference and five international symposia served as a platform for collaboration, innovation, and knowledge exchange in the field of advanced agricultural technologies. This conclave brought together experts, researchers, and innovators from international and national institutes, organizations, industries, and entrepreneurs who are working at the forefront	 

	of agricultural innovations and technology applications. The symposiums covered a spectrum of cutting-edge topics, bringing together around 350 delegates from national and international institutes, industry leaders, entrepreneurs, and students along with the notable presence of delegates from USA, UK, Japan, Thailand, and Vietnam.	
7. Capacity Building Programme on "Solar Powered Irrigation System" at BISA Jabalpur (MP)	MPKV has collaboration with GIZ for education and research. GIZ also collaborated with CAAST-CSAWM for designing courses on natural resources management. GIZ funded MPKV students and faculty for a 3-day capacity building programme on "Solar Power Irrigation System" during July-September, 2022 at BISA, Jabalpur. 100 participants (junior level faculties, students, staff of CAAST related project, KVK SMSs and progressive farmers) The training programme included fundamentals of Solar Power, different components of Solar Power Irrigation System, Government Schemes for solar power irrigation system, installation and maintenance of Solar Power Irrigation System etc.	Capacity Building Programme on "Solar Powered Irrigation System" at BISA Jabalpur (MP)  Batch-I 26-28July 2022 No. of Particpants=27 Students:11 Faculty:13 Farmers:03 Batch-II 2-4August, 2022 No. of Particpants=33 Students:10 Faculty:10 Farmers:13 Batch-III 6-8 September,2022 No. of Particpants=40 Students:15 Faculty:10 Farmers:15  

8. Climate Smart Digital Agricultural Village (CSDAV)	The concept of Climate Smart Village (CSV) developed by Food and Agriculture Organization (FAO) has been extended to **Climate Smart Digital Agricultural Village (CSDAV)** to include the use of digital agriculture techniques for precision, real time, and automatic operations of various agricultural systems 1. The adoption of CSDAV leads toward increase in productivity, net return and input use efficiency, reduced emission, increased resilience, increased gender and social inclusion; and make farming automatic and attractive. 2. The digital technologies that can be used in CSDAV are sensors, mobile and web-based applications, Internet of Things (IoT), UAV (drones)/UGV, robotics, precision machineries, artificial intelligence (AI) and machine learning (ML) and geo-informatics (Remote sensing, GIS and GPS).	   **Activities initiated in the Buckewadi village**
9. Irrigation Park	The Irrigation Park was developed by CAAST-CSAWM with the funds of NAHEP at Interfaculty Department of Irrigation Water Management MPKV, Rahuri to demonstrate all irrigation systems under one roof for training purpose. One of the activities of the CAAST-CSAWM project is the up-gradation of demonstration unit for training to staff and students on climate smart agriculture. The Irrigation Park is having Overhead sprinklers, Rain gun, Inline drippers, online drippers, Micro-sprinklers, Micro-jets, Landscape (garden) sprinklers and Anti-leak foggers. This facility is up-graded and became demonstration unit to the staff, students of Master and Doctoral programme and also farmers.	 

	During last three years around 30 thousand farmers, 2 thousand trainers/students and seven hundred officials and academicians visited the irrigation park.	

1.4 Collaborations with industry and other HEIs for bringing relevancy

Collaborations	*Activity/achievement/purpose*	*Remarks/Photographs*
1. BAIF, Nashik	MoU between CAAST-CSAWM, MPKV Rahuri and BAIF Development Research Foundation, Pune is signed on 18th October 2021 and the major objectives of this MoU are, • To build the capacity of the field experts and farmers of cluster of seven villages of Akole block, Ahmednagar; and to downscale the district contingency crop plan to village/ farm level. • To implement the developed village level contingency crop plan in the cluster of selected seven villages. • In this collaboration MPKV is providing the technical support to build the capacity of the field experts and farmers for downscaling of district contingency crop plan to village/ farm level. Whereas, BAIF is sharing the field level information for downscaling of district contingency crop plan and demonstrating and organize trainings on climate smart technologies at Akole block.	• CAAST-CSAWM has initiated the downscaling of district contingency crop to village level. • Accordingly, a document of Village level contingency crop plan (VLCCP), and a mobile and web-based applications were published.
2. Centre for Ganga River Basin Management & Studies, IIT Kanpur	MoU between CAAST-CSAWM, MPKV Rahuri and IIT Kanpur is signed to collaborate on development of sustainable agricultural practices and advanced agricultural infrastructure in India using state of the art technologies from around the world, and make that infrastructure, technology, knowledge with established market linkages available to Indian farmers in addition to providing capacity building for sustainability. The MoU is signed on 1st July 2022 and the major objectives of this MoU are, • To develop "Centre of Excellence (CoE)" for indoor farming and "Knowledge Training Centre (KTC)". • To establish a commercial farm on 10 acres land at College of Agriculture, Pune as a model farm that can be then replicated across the country.	• Identified the location to established model farm. • Activities are in progress as per the objectives of collaboration

	• To develop a set of sustainable agricultural practices and an economic framework. • To develop capacity for Agri producers.	
3. Washington State University (WSU) , Pullman, USA	Agreement between CAAST-CSAWM, MPKV Rahuri and Washington State University, Pullman, USA is signed on 27th January 2020 for the capacity building of faculties of MPKV Rahuri. The major objectives of this agreement are, • Short term visits/ trainings of MPKV faculties and scientists on "climate smart precision agriculture and water management" at WSU, Pullman. • Joint research work in climate smart precision agriculture and water management technologies	• One CAAST-CSAWM faculty member of this University has been offered the Post Doctorate Research Fellowship in WSU, Pullman, USA. He successfully completed the assignment. • Two University officers visited WSU, Pullman, USA, during March 6-16, 2020, to study the state of art facilities of drones, hyperspectral remote sensing, robotics; and discussing formalization of the collaborative research and post-doctoral research programmes.
4. Asian Institute of Technology, Bangkok, Thailand	Agreement between CAAST-CSAWM, MPKV Rahuri and Asian Institute of Technology, Bangkok, Thailand is signed on 1st November 2019 for the capacity building of faculties, scientists and post graduate students of MPKV Rahuri. The major objectives of this agreement are, • One-month duration trainings of MPKV faculties and PG students at AIT, Bangkok. • Joint research work in drone, its applications in agriculture and Google Earth Engine technologies.	• Following are the trainings and short visit to AIT, Bangkok, Thailand as a result of Collaboration • 59 PG Students completed one-month international level training on "Drones and Its Application and Google Earth Engine" at Geoinformatics Centre, • 10 University officers visited Asian Institute of Technology (AIT), Bangkok, Thailand as a part of exposure visits and explore the collaboration opportunities • 9 faculties of the MPKV completed one-month international level training on "Drones and Its Application and Google Ear th Engine" at Geoinformatics Centre • 2 Faculty completed short training of two weeks
5. Einnovation Pvt. Ltd. Pune	MoU between CAAST-CSAWM, MPKV Rahuri and Einnovation Pvt. Ltd. Pune is signed to collaborate on development of capacity of farmers on climate smart digital agricultural technologies. For this purpose, Buchkewadi village, Tah Junnar, Dist. Pune (MH) is selected for disseminating the IoT and sensor-based technologies developed	• Activities planned as per the objectives of the collaboration. • Draft framework prepared for Decision Support System for pest and disease

	under CAAST-CSAWM, MPKV Rahuri. The MoU is signed on 9th June 2022 and the major objectives of this MoU are, • To implement the climate smart digital agricultural technologies at village level. • To install IoT enabled soil moisture sensors-based irrigation system. • To provide guidance to farmers about IoT enabled soil moisture sensors-based irrigation system. To conduct capacity building programs on adoption of climate smart digital agricultural technologies.	management and nutrient management.
6. ESDS Pvt. Ltd., Nashik	MoU between CAAST-CSAWM, MPKV Rahuri and ESDS Pvt. Ltd., Nashik is signed for the development of Decision Support System (DSS) for pest and disease management for different crops. The objectives of the collaboration are, • To develop Decision Support System for pest and disease management and nutrient management in Crops. • To develop an advisory support system for farmers and other stakeholders. • To develop crops knowledge portal for farmers, farmer producer organizations, exporters and private organizations.	• Activities planned as per the objectives of the collaboration.
7. Yorient Technologies Pvt. Ltd., Pune	MoU between CAAST-CSAWM, MPKV Rahuri and Yorient Technologies Pvt. Ltd., Pune is signed for joint collaboration on "AI, drones and robotics technologies for Precision, Climate Smart Agriculture and Water Management." The MoU is signed on 1st January 2022 and the major objectives of this MoU are, • The students research programs on subjects related to ICT and AI technologies for precision and climate smart agriculture and water management. • Setting up Precision Agriculture, UAS (Unmanned Aerial Systems) Design Centre and Laboratory including UAS equipment, sensors and Electronic / Sensor /instrumentation Testing Facility • Start short term academic programs.	• Activities planned as per the objectives of the collaboration.
8. ASAP Agritech LLP Nashik	MoU between CAAST-CSAWM, MPKV Rahuri and ASAP Agritech LLP Nashik is signed for collaborative on development and testing of Agricultural Ground Vehicle (AGV) and Unmanned Aerial Vehicle (UAVs) for input application in agriculture	• Activities planned as per the objectives of the collaboration.

	and development of systems for various applications in climate smart and precision agriculture; machine validations of chemicals. The MoU is signed on 30th December 2020 and the major objectives of this MoU are, • To finalize the standard practices and algorithms for spraying on specific crop with specific spraying equipment. • To develop spraying mechanics with the new edge technologies like drones for Arial Spraying. • To evaluate the accuracy and results of the spraying mechanics integrated with Drone.	
9. IoTechWorld Avigation Pvt. Ltd., Haryana	MoU between CAAST-CSAWM, MPKV Rahuri and IoTechWorld Avigation Pvt. Ltd., Haryana is signed to work collectively in science and technology and promote the use of drones in agriculture. It aims at setting up Remote Pilot Training Organization (RPTO) for agri drones and to develop Standard Operating Procedures (SOPs) for crop spraying using Drones.	• Activities planned as per the objectives of the collaboration.

2. Achievements made through CAAST under NAHEP

2.1. Output-outcome monitoring

S. N.	Particulars	Apr'2018 to Dec'2023	
		Target	Achievement
1.	% increase in number of technologies commercialized	-	24.07
2.	% increase in faculty research effectiveness	20	31.08
3.	Number of direct beneficiaries of the project	1500	82520
4.	Number of female beneficiaries	1000	22928
5.	% increase in JRF / SRF / ARS	-	36.91
6.	% increase in number of students who were admitted in foreign universities	-	3
7.	% increase in PG student placements	-	15.37
8.	Number of industry- sponsored projects and positions in cutting-edge areas of agri-science	30	47
9.	Number of faculty training programmes (national) undertaken by AU	25	72
10.	Number of faculty training programmes (international) undertaken by AU	15	31
11.	Number of student training programmes (national) undertaken by AU	50	207
12.	Number of student training programmes (international) undertaken by AU	20	97

Observation

Key initiatives which helped in the overall output/outcome impact of the project

1.**Capacity building programs:**
The CAAST-CSAWM organized one of the biggest capacity building programs in the country in the project duration by conducting 256 on campus and 212 online events benefitting 82520. This helped students and faculty and made them more focused on education and research. The exponential increase in the number of faculty and students training program is the result of this initiative. This further helped in increase in JRF/SRF selection of students.

2.**International Training Program (Sandwich Model):**
At CAAST-CSAWM, we developed a sandwish model for International Level Training (ILT) in which one moth Pre-training on advance technologies in agriculture was given to the students/faculty at MPKV. It was followed by one-month ILT at university/ institution abroad. The participants were again given 15 days training after return from ILT which involved project work with some case study involving the knowledge gained by the participants at institutions abroad. This increased the number of technologies commercialized and increased the faculty research effectiveness and industry sponsored projects. The increase in number of faculty and students international training programs and increase in number of students admitted in forein universities is attributed to this key initiative.

3.MPKV CLIMEX 2022

The CAAST-CSAWM and Alumni Associations of MPKV jointly organized three-day event MPKV Alumni Carnival of Leaders of Industry and Entrepreneurs Meet & Exhibition (CLIMEX) from 2022 December 2022 that comprised six events -Education fair, Job fair, technical sessions, Exhibition, Mega Alumni Meet and Felicitation of successful entrepreneur alumni. The entrepreneur alumni wholeheartedly participated in the event and displayed their product and services in the exhibition. The expert speeches of these alumni were very motivating for the students on the campus. More than 100 students got job through the campus interview during the job fair. The event was totally sponsored by the entrepreneur alumni and we could save Rs 40 lakh from the event. The money is distributed to four colleges for starting the entrepreneurship cells at these colleges. Percent increase in PG students' placement and number of technologies commercialized is attributed to this ket initaive of MPKV CLIMEX 2022

2.2Knowledge Management Collaterals

I. Knowledge Collaterals	Apr'2018 to Dec'2023
1. Publications	16
2. Research Articles	35
3. Annual Reports	5
4. Books	20
5. Success Stories	6 (Unpublished)
6. Newsletter	69
7. Magazines	-
8. Blogs	10
<Please provide the details of the Knowledge Management Collaterals with detailed list of authors, title, publication period, URL links etc., in Annexure-A	

II. Mobile and Web Applications	Apr'2018 to Dec'2023
1. Mobile Applications Developed	40
2. Web Applications Developed	08
<Please provide the details of the applications (along with URL links) with List of documents, authors, publication period in Annexure-B	

III. Number of IPR (Intellectual Property Rights) Registered/Obtained	Apr'2018 to Dec'2023
1. Copyrights	21
2. Patents	01 (Published)
3. Others (Technology recommendations through University Mechanism)	27
<Please provide the details of the Knowledge Management Collaterals with List of documents, authors, publication period in Annexure-C	

IV. Dissemination and Outreach	Apr'2018 to Dec'2023
1. No. of Posts on Social Media	**1. Facebook: 1850 Posts** **2. Twitter: 994 Tweets** **3. Instagram: 710 Posts** **4. LinkedIn: 13466 Posts** **5. You Tube Live Channel: 315**
2. No. of Posts on Newspaper	**389**
3. No. of Posts on Magazines	**10**
4. No. of Unique Promotional or Outreach Collaterals	**357**

2.3 Capacity building programs to improve the research effectiveness

1. International trainings for students and faculties

Subject areas	*Host institutes, period of training*	*Output of the training*
Students		
Drones and It's applications, Google Earth Engine	Geoinformatics Centre, Asian Institute of Technology, Bangkok, Thailand 1 Month **(11 November to 10 December, 2019)**	i. Use of Drone and Remote sensing technology and Google earth engine (GEE) for research. ii. Increase in student research effectiveness and published 20 research and 40 practioners papers based on their learning during the international level training. iii. Established collaboration with Asian Institute of Technology, Bangkok, Thailand for research and academic purpose.
Application of Google Earth Engine, IoT and Drones for Precision Agriculture	Geoinformatics Centre, Asian Institute of Technology, Bangkok, Thailand 1 Month (**16 October to 15 November 2023)**	
Climate Smart Agriculture and Water Management	University Putra Malaysia, Selangor, Malaysia 1 Month **(06 November to 05 December, 2023)**	
Advanced technologies for the smart agriculture	Geoinformatics Centre, Asian Institute of Technology, Bangkok, Thailand 1 Month **(23 November to 22 December, 2023)**	
Smart Agriculture Programme	Can Tho University, Vietnam 1 Month **(4-30 December 2023)**	
Faculty		
Drones and It's applications Google Earth Engine	Geoinformatics Centre, Asian Institute of Technology, Bangkok, Thailand **1 Month (11 November –10 December, 2019)**	i. Prepared compendium of the digital technologies based on their leanings during the international training ii. Established collaboration of faculty with Asian Institute of Technology, Bangkok, Thailand, University of Wisconsin, Madison, USA; and University of Tsukuba, Ibaraki, Japan) for research and academic purpose iii. Faculty develipoed technoloiges (IoT enabled desi cow dairy farm, Phule Smart Amrutkal and Phule Spray Indicator mobile and web application iv. Faculty got approval for 06 projects to update/ upgrade, upscale and extend the developed
Applications of Google Earth Engine, IoT, and Drones for Precision Agriculture	Geoinformatics Centre, Asian Institute of Technology, Bangkok, Thailand **1 Month (30 January to 01 March, 2023)**	
Advanced Technologies for Climate Smart Agriculture	Geoinformatics Centre, Asian Institute of Technology, Bangkok, Thailand **1 Month (20 January to 19 February, 2023)**	
Smart Sensing System in Horticultural crop production System	University of Tsukuba, Japan **1 Month (20 January to 19 February, 2023)**	
The development of computer simulation model for the land applications of agricultural machinery	University of Wisconsin, River Falls, USA 1 Month **(16 January to 15 February, 2023)**	
Advanced Technologies for Climate Smart Agriculture	Geoinformatics Centre, Asian Institute of Technology, Bangkok, Thailand 1 Month **(23 November to 22 December, 2023)**	

Applications of Google Earth Engine, IoT, and Drones for Precision Agriculture	Geoinformatics Centre, Asian Institute of Technology, Bangkok, Thailand 15 days **(06-20 February, 2023)**	climate smart and digital technologies
Intelligent Technologies for Modern Agriculture	HUE University of Agriculture and Forestry (HUAF), Vietnam 15 days **(26 November to 11 December, 2023)**	
Advanced technologies for climate smart agriculture	Geoinformatics Centre, Asian Institute of Technology, Bangkok, Thailand 15 days **(01-15 December, 2023)**	
Short Visit for networking	Washington State University Pullman, USA One week **(March 6-14, 2020)**	
Short Visit for networking	Geoinformatics Centre, Asian Institute of Technology, Bangkok, Thailand One week **(06-12 February, 2023)**	
Short Visit for networking	Geoinformatics Centre, Asian Institute of Technology, Bangkok, Thailand One week **(02-10 December, 2023)**	
<Please provide the list of beneficiaries along with training details in **Annexure-D**		

2. National trainings for students and faculties:

Subject areas	***Period of training, total beneficiaries***	***Output of the training***
Students		
Robotics, Drones and IoTs, Remote sensing and Geoinformatics CSA Precision agricultural machineries Precision Irrigation Management and Protected Cultivation Climate smart agriculture CSA Natural Resource Management Communication, Personality, Soft Skills, Entrepreneurship Development Skills, and Marketing	Five-week, Three-Week, Two-Week, One-week, Four days, Three days, Two days One -day **Total beneficiaries: 21,349**	i. Students learned about the integration of different components of the drone and applications of robotics in precision agriculture ii. ii.67.34% of the students were made aware of the various ICAR level competitive examinations (JRF, SRF, ARS-NET and ASRB) iii. ii.27 % of students qualified for the JRF and SRF examinations iv. Generated interest among 79.12 % students about international exams like TOFEL, GRE etc. v. 86.47% of the Ph.D. students succeeded in receiving different state and national level fellowships vi. Students enhanced their professional efficiency, effective writing, and communication skills
Faculty :		

Robotics, Drones and IoTs, Remote sensing and Geoinformatics	Five-week, Three-Week, Two-Week, One-week, Four days, Three days, Two days One -day **Total beneficiaries: 25,524**	i. Faculty acquired skills in different innovative climate smart agriculture technologies. ii. Faculty improved their teaching and research abilities as reflected in their students' dissertations and motivation to write research papers through the new skills acquired.
CSA Precision agricultural machineries		
Precision Irrigation Management and Protected Cultivation		
Climate smart agriculture		
CSA Natural Resource Management		
Communication, Personality, Soft Skills, Entrepreneurship Development Skills, and Marketing		
Organic Farming & Honey Bee Keeping		
The list of trainings in Annexure: E		

Input and activity monitoring

	Capital	Revenue
Total funds sanctioned during 2018-2023 by PIU (INR Lakhs)	70244000	172066000
Total funds received till December 31, 2023 (Cumulative) (INR Lakhs)	70244000	172066000
Total expenditure up to December 31, 2023 (INR Lakhs)	70059739	168638524

Input / Activity indicator	Sub- head / category	Apr'2018 to Dec'2023 Expenditure / input in INR lakhs		Activity elaboration
		Utilization	Planned	
Goods and equipment	Equipment, Plant & Machinery	275.03	277.50	Equipment and machinery, namely Unmanned Aerial Vehicles (drones) with application and sensors, servo motors, stepper motors, electrostatic sprayer, linear actuators and grippers, PLC and OPC, telemetry and RTK systems, agricultural tractor and robotic harvesting machine were purchased from the grants of Equipment, Plant and Machinery.
	Office equipment	7.53	8.28	Refrigerators, LCD projectors and multifunction machines, license copies of operating systems and Microsoft Office were purchased from the grants of office equipment

Input / Activity indicator	Sub- head / category	Apr'2018 to Dec'2023 Expenditure / input in INR lakhs		Activity elaboration
		Utilization	Planned	
	Laboratory equipment	279.21	277.50	Automatic weather station (AWS), sensors for light detection, temperature, radiation measurement, sensors for water level monitoring, sensors for measurement of CO2, NH3, O2, ethylene were purchased. Further, protected cultivation structures viz., polyhouse, flat top shade net house and cable and post shade net house were erected from the grants of laboratory equipment
	Furniture & fixtures	16.56	16.67	Storewel Plains, student benches, storage racks and waiting chairs were purchased from the grants of furniture and fixtures
	Computers and Peripherals	18.76	19.05	Laptop and Desktop computers were purchased to establish student's laboratory as well as completion of day-to-day activities of the project
	Books and Journals	16.56	16.56	Online journals were subscribed. Further, books from different disciplines pertaining to thematic areas of the project, including reference books, were purchased
Civil works	Minor repair and renovation work	86.95	86.98	Works of renovation of seminar hall, staircase and flooring with electricity and UPS backup were completed
Human capacity building	National level training	--	--	**NA**
	International level training	74.94	112.13	31 faculty successfully completed the International level training in **USA, Japan, Thailand and Vietnam** for 1-month and 15 days duration
	Short visit/ seminars	19.14	42.42	University officials (12) visited **WSU, USA and AIT, Bankok** on a short visit to develop networking and collaboration between universities.
	Meetings and workshops	68.06	58.70	The amount was utilized to meet the expenditure during state and national meetings and workshops

Input / Activity indicator	Sub- head / category	Apr'2018 to Dec'2023 Expenditure / input in INR lakhs		Activity elaboration
		Utilization	Planned	
Consultancy	National level consultancies	22.17	86.98	Seven individual consultants were hired from October 2020 to March 2021. The expenditure incurred for the remuneration to consultants
Recurrent cost / Miscellaneous	Travel	16.06	38.00	The expenditure was incurred on domestic travel for project work and exposure visits for students, staff meetings for collaboration with national partners etc
	Contractual services	698.98	664.40	Salary of contractual staff, skilled workers, and office and field assistants was incurred from this head
	Operational costs	736.42	656.74	Expenditure on recurring contingent charges for management and operating laboratories, farm inputs etc., was done through this head. Expenditure for contingencies required for innovative research projects, including the purchase of different components and spare parts for these projects, was incurred, International Level Training of students
	Institutional charges	50.63	61.29	Expenditure incurred on payment of auditor's fees, electricity bills and development of farm improvement activities through the University
Total		**2386.98**	**2423.10**	

Observation

The CAAST-CSAWM started in 2018 and the total grants released till March 2023 were Rs 1990.10 lakh. Many state of the art laboratories and climate smart research block were developed, organization of international training for students and faculty and on campus and online capacity building programmes were organized, digital technology development. Out of Rs 1990.10 lakh Rs 1966.50 were utilized during the period thus achieving the financial target by 98.81% which matched with the technical progress.

The project got extension for a period from April 2023 to December 2023 with additional grants of Rs 433.00 lakh. These grants were utilized for technology development and international training of students and faculty. Out of the grants received, Rs 420.58 lakh were utilized during the period thus meeting the financial target by 97.13%.

Total grants received from 2018 to 2023 were Rs 2423.10 lakh. Out of this Rs 2386.98 lakh were utilized on the project activities thus meeting the overall financial target by 98.50%.

2.4 NAHEP outreach and other unique initiatives undertaken

a) Case studies/success stories developed under NAHEP

Illustrative: Success story

1. Success story: Rahul Rasal

Rahul Rasal is a progressive farmer and agricultural entrepreneur in the true sense. 42 years old Rahul started farming when he was in the 10th grade in 1997, with only 2 acres of land. Today he owns 40 acres of land and has high-value crops – vegetables and fruits that provide year-round income. Rahul's village, Nighoj, receives only about 330 mm of annual rainfall, which is barely enough for the Kharif season (June to September). Fortunately, he has access to water from a Kukadi Left Bank Canal, a minor irrigation canal). It provides irrigation in two to three rotations in the Rabi (October-March) and summer (March to June) seasons. To use this canal water for year-round water supply to crops, he pumps the water from the canal to the polythene-lined farm (storage) pond of about eight crore liter capacity from which irrigates the crop by taking water from the pond by gravity.

He has a weather station measuring actual rainfall and providing 5-day advance forecasts with an accuracy of around 95%. The evapotranspiration gauge provides the potential ET and other weather parameters- temperature, wind, humidity, etc. that are required for estimating the crop water requirement. He provides advisory to his fellow farmers based on the weather. Around 1,000 farmers receive weather forecasts from his weather station.



Rahul uses hi-tech irrigation- drip (Surface and subsurface) and sprinklers- to irrigate the crops using the farm pond water. Surface and subsurface drip lines irrigate his five acres of grapes, drip lines to five acres of Pomegranate and three acres of papaya. He practices intercropping vegetables in papaya and guava plantations with vegetables like brinjal, okra, chilli and capsicum. He uses sprinklers for 20 acres of big onion farm. His annual income from this agricultural farm enterprises is Rs. 3 to 4 crores.Rahul has mini cattle shed with ten cows. The biogas facility operated with cow dung provides bio gas and good quality slurry for orchards. He uses organic fertilizer to enrich his soil and chemical fertilizer to meet the nutrient requirements of the crops.


With all his knowledge and experience, he educates other farmers through radio talks and training. Rahul has many awards tohis credit. Rahul has travelled to many countries, including Israel, Peru, Brazil, and Chilli, to learn new techniques to improve his agriculture.

2. Success Story: Yogesh Jadhav:

Yogesh Jadhav is an Agricultural Engineer by profession and alumnus of MPKV. He has his own Engineering and Surveying firm in Pune. He was using traditional survey methods before getting drone pilot licence. He realized the importance of drone and applied for drone pilot training at MPKV, RPTO in the very first batch. After completing drone pilot training in December 2022, he started using drone for surveying and mapping. Recently he surveyed the Rammam River bordering Sikkim, West Bengal and Nepal for supporting the early warning system for landslides detection in the region and he has mastery in coal mines survey with drone. Till last year his business turnover was around Rs 60-70 lakh with traditional survey methods. This year his turnover rose to Rs 6 crores. OMG!! 10 times increase in the business due to drones in a single year. He always acknowledges CAAST, MPKV for giving him opportunity to learn drone flying. Not only his drone but Er Yogesh is also flying high as a trained drone pilot.

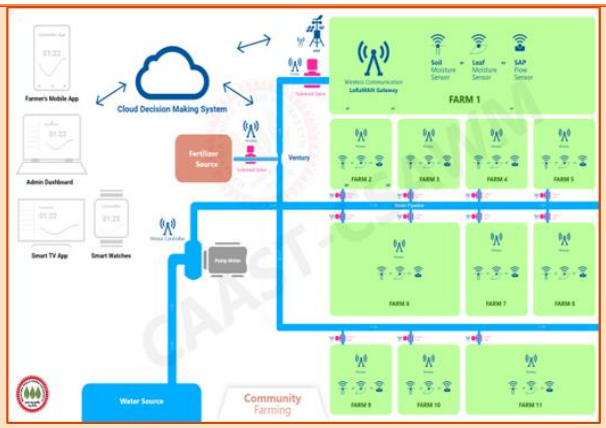
3. Success Story: Externally Funded Projects

The CAAST-CSAWM (Centre for Advanced in Agriculture Science and Technology - Climate-Smart Agriculture and Water Management) project has emerged as a center of excellence, for use of cutting-edge technologies for climate-smart agriculture and irrigation water management. The project has pioneered the use of drone and robotics technologies for precision agriculture. Drones equipped with spraying attachments advanced have enabled efficient applications of nutrients, pesticides, and insecticides for different crops. Drones equipped with advanced sensors have enabled efficient monitoring of crop health, pest infestations, and soil conditions, contributing to precision farming practices. The incorporation of robotics has automated tasks of spraying in the orchid plantation. The establishment of a dedicated laboratory for hyperspectral and multispectral imaging has allowed PG and Ph.D. students as well as researcher staff/faculties to use these cutting-edge technologies for the planning and execution of their research projects related to biotic and abiotic stress management, crop health monitoring, etc. The implementation of IoT applications in irrigation water management has become the prime area for climate-smart irrigation water management. Soil moisture sensors and actuators used in IoT-enabled irrigation management systems monitor soil moisture levels, weather conditions, and estimate the accurate water requirement for different crops in real-time, and actuate the irrigation pump for specific periods for precise application of water to crops. The IoT-based irrigation system ensures optimal water distribution, minimizing wastage and maximizing crop productivity. The establishment of a climate-smart research block has facilitated extensive research studies on climate-smart agriculture. The development of specialized laboratories, including the Drone laboratory, Robotics Laboratory, Hyperspectral Imaging Laboratory, and IoT Laboratory, has provided students and researchers with state-of-the-art facilities. These laboratories serve as canters for innovation, experimentation, and the development of climate-smart agricultural technologies in the university that bridge the gap between traditional agriculture and climate-smart agriculture. The IoT park developed under this project has

become the hot spot for visitors to understand the IoT technologies used for precision agriculture water management and precision agriculture. Thus, integration of drones and robotics, hyperspectral imaging, multispectral imaging, and IoT applications in climate-smart agriculture water management has not only transformed research methodologies but has also fetched significant grants from different project agencies.

The success of the CAAST-CSAWM project has attracted total external funding of Rs. 920.96 lakhs. This substantial financial support in terms of externally funded projects reflects the credibility, impact, and potential of the CAAST-CSAWM project. The funds will further strengthen research initiatives, expand technological capabilities, and drive the project's mission toward greater heights. The externally funded projects functioning under the umbrella of CAAST-CSAWM are;

Sr. No.	Externally Funded Project	Funding Agency	Funding (Rs in lakhs)
1	IoT Enabled Sensor Based Smart Irrigation Management System (Smart Irrigation Project).	ICAR-IIWM, Bhubaneswar	86.80
2	Automated Canal Irrigation System for Efficient and Smart Irrigation Water Management" (Canal Automation Project).	ICAR-IIWM, Bhubaneswar	40.74
3	Determination of crop coefficients for major crops by lysimetric studies	PoCRA, Govt. of MS Mumbai	31.43
4	Rastriya Krishi Vikas Yojana Project on "Solar Powered Central Pivot Irrigation System for Climate Smart Agriculture" (RKVY-SPCPIS).	RKVY, Govt. of MS, Mumbai	256.19
5	Development of Methodology for irrigation water management for sugarcane crop using ground/ drone/ satellite based spectral data.	RGSTC, Govt. of MS, Mumbai	5.00
6	Demonstration, training and evaluation of MPKV developed IoT based irrigation management technologies.	RGSTC, Govt. of MS, Mumbai	5.00
7	Standardizing Drone spraying protocols for various inputs in selected field crops (Soybean, Pigeonpea, Chickpea, Wheat and Sugarcane).	M/s Fowler Westrup Pvt. Ltd., Karnataka, India	19.80
8	Establishment of Centre of Excellence on Digital Technologies for Smart and Precision Agriculture	Govt. of MS, Mumbai	476.00
	Total, Lakh Rs		**920.96**



Agri. Consortia Research Project (CRP) on Water (Sensor based Smart Irrigation)

Agri. Consortia Research Project (CRP) on Water (Canal Automation)

4. Success Story: MPKV Alumni Carnival of Leaders of Industry and Entrepreneurs Meet & Exhibition (CLIMEX):

Moving towards integration of the University, Alumni, Farmers, and Industries for making the New Education Policy applicable in Agriculture Education System: An initiative under ICAR-NAHEP**.**

Mahatma Phule Krishi Vidyapeeth (MPKV), Rahuri completed more than 50 years. Since its establishment, the University has produced more than 1 lakh degree and diploma holders in various disciplines. These students are contributing in the development of the state and the nation in various roles. Many alumni of the University have turned into successful entrepreneurs. They provide various innovative inputs, services to the farmers and job opportunities to others, which are directly contributing to the dream of our Prime Minster. MPKV is proud of their contribution to the society in general and farmers' welfare. Further, Indian Council of Agricultural Research (ICAR) through its flagship project, “National Agricultural Higher Education Project (NAHEP)” is continuously making the efforts to attract the talents to the agricultural education system.

MPKV therefore organized three-day event MPKV Alumni Carnival of Leaders of Industry and Entrepreneurs Meet & Exhibition (CLIMEX) from 20-22 December 2022 that comprised of following six events

1. Education fair: The main objective of the fair was to realize the regional community about agriculture education system in all respect and attract the maximum students to agriculture sector. More than 30 colleges offering degree programs in various trades of agriculture including Agricultural Science, Engineering, Biotechnology, Business Management, Horticulture, Food Science and Technology; and 18 Departments offering Masters and Doctoral degree programs in various disciplines participated and explained the importance, scope and entrepreneurship opportunities of the various trades; and strength and special features of their colleges and departments such as experiential learning,

2. Job fair: The purpose of the job fair was to bring the industries in search of good talent and students and alumni in search of good jobs on one platform, provide them opportunities to interact with each other

and infrastructure to conduct the recruitment process; and finally enable the industries to recruit our students and alumni in reputed industries. More than 1000 students and alumni and 30 industries registered for the Job Fair. Around 500 candidates were interviewed in a single day, 85 shortlisted and 11 students got their offer letters on the spot with the highest package of 5.50 lakh.

3. Technical Sessions: CLIMEX 2022 hosted eight technical sessions, each of the technical session consisting of sharing of experts' experiences (experts mainly from the MPKV alumni), panel discussion (panel consisting of the members from various stakeholders' groups such as industries, entrepreneurs, farmers, government officials, students, consumers) and open discussion. The main purpose of these technical sessions was to investigate the need-based farming aspects that will support the Governments in policy making. Many entrepreneurs and industry leaders also presented entrepreneurship skills to the students during eight technical sessions

4. Exhibition: The MPKV alumni entrepreneurs and industry leaders exhibited their products for three days in 120 stalls and explained what they achieved during their career after graduation. It received a huge response and thousands of farmers and students visited the exhibition. The current students and perspective students (more than 10000) could know what agriculture graduates can do and how they have become successful entreprenursin their life and intern were motivated to become entrepreneurs and job providers.

5. Mega Alumni meet: Alumni meet of all MPKV alumni was arranged during the event. Many alumni interacted with the university students on the campus. Students on roll in the University also realized the vast scope of agriculture education in the market straight from their seniors. During the alumni meet, it was decided to strengthen the alumni associations of constituent colleges and enhance their involvement in the development of the university. One alumnus announced a huge scholarship scheme for the students while the other came up with the scheme of providing seed capital to the startups in Agricultural Mechanization.

6. University Idols: Every month university declares two MPKV idols-One a successful alumnus as an agricultural entrepreneur and the other a successful farmer who adopts MPKV technologies. On this occasion, the special session was organized to recognize the University Alumni and the Farmers by felicitating them as MPKV Idols for their contribution for the entrepreneurship development. They also interacted with the current and the perspective students. The contributions of the MPKV idols are also displayed on flex boards in each college and the University research stations.

Hon Vice Chancellor, MPKV, Dr P G. Patil announced starting of entrepreneurship cells at Pune, Dhule, Kolhapur and Rahuri during CLIMEX-2022.

The event was organized on the platform of ICAR-NAHEP under the CAAST-Climate Smart Agriculture and Water Management and Alumni Associations of MPKV. It was first of its kind of events in the history of MPKV which was entirely sponsored by Alumni entrepreneurs and industry leaders and guided by the ICAR-NAHEP.

5. Success Story ICFF- International Conclave on Futuristic Farming: Sparking the Digital Revolution in Agriculture

The ICAR-NAHEP, CAAST-CSAWM project organized an International Conclave on Futuristic Farming. The conclave was held in Pune on 20-21 December, 2023. The conclave, featuring one international conference and five international symposia served as a platform for collaboration, innovation, and knowledge exchange in the field of advanced agricultural technologies. This conclave brought together experts, researchers, and innovators from international and national institutes, organizations, industries and entrepreneurs who are working at the forefront of agricultural innovations and technology applications. The symposiums covered a spectrum of cutting-edge topics, bringing together around 350

delegates from national and international institutes, industry leaders, entrepreneurs, and students along with the notable presence of delegates from USA, UK, Japan, Thailand and Vietnam.

The success story of international conclave on, "Futuristic Farming" began with the eight keynote speakers during inaugural and plenary sessions from domain experts on agriculture and technology, who set the tone for the event, six concurrent symposiums on cutting-edge technological applications with four technical sessions each including total 96 expert lecturer's, research and industry presentations, insightful panel discussions, and technology demonstrations and 39 theme based poster presentations.

This international conclave featured one international conference and five concurrent symposia, each focusing on the key aspect of futuristic farming:

i. Drones for agriculture
ii. AI and hyperspectral imaging
iii. Robotics in agriculture
iv. IoT for agriculture
v. Indoor farming
vi. Advanced agricultural technologies

I. Drones for Agriculture: The Drones for agriculture Symposium unveiled cutting-edge technologies that utilized unmanned aerial vehicles for precision agriculture. From crop monitoring to pest control, participants were introduced to real-world applications that promised to enhance efficiency and reduce environmental impact. The symposium became a platform for experts to exchange ideas and discuss the potential of drone technology in transforming traditional farming methods. Total sixteen (16) presentations were conducted during the technical sessions on following themes;

- Drone based data collection systems including sensors and cameras
- Drone based input delivery systems-chemicals, nutrients and seeds
- Advancement in drone technologies and their futuristic applications
- Challenges and opportunities and policy measures for use of drones in agriculture

2. AI and Hyperspectral Imaging: The Hyperspectral Imaging Symposium explored the potential of advanced imaging techniques in agriculture. Researchers and companies showcased how hyperspectral imaging could provide invaluable insights into crop health, soil conditions, and overall farm management. Experts presented breakthroughs in using AI to analyze hyperspectral data, offering insights into crop health, disease detection, and resource optimization. The symposium sparked discussions on development of AI and hyperspectral imaging based total solutions for the specific needs of different crops and regions. Total thirteen (13) presentations were conducted during the technical sessions on following themes;

- Spectral imaging applications for biotic and abiotic stress management
- AI applications for agriculture
- Computer vision and instrumentation for AI and spectral imaging
- Integration of AI and spectral imaging with other digital technologies.

iii. Indoor Farming: Indoor Farming emerged as a focal point in conclave, where attendees were introduced to innovative approaches to growing crops in controlled environments exploring sustainable solutions to traditional farming challenges in context of climate change scenarios. From vertical farming to hydroponics to aeroponics, participants discussed how indoor farming could address challenges such as land scarcity, climate variability, and input resource optimization. The symposium generated the conversations on the integration of these technologies and precision agriculture practices to enhance the production and productivity ensuring sustainable food production. Total seventeen (17) presentations were conducted during the technical sessions on following themes;

- Hydroponics
- Aeroponics
- Vertical farming
- Other soilless cultivation practices

iv. Robotics in Agriculture: The Robotics Symposium showcased robotic applications in agriculture, from autonomous tractors to robotic harvesters (harvesting and post harvesting). Experts demonstrated how these machines could handle labor-intensive tasks, increase precision in planting and harvesting operations, and ultimately optimize the entire farming process. Experts also emphasized on integration between climate change, resource depletion, global food security, and technological adoption while designing Robot using AI, and computer vision technologies for applications in agriculture. Attendees could witness the live demonstrations of latest robotic technologies applications in agriculture operations. Total seventeen (17) presentations were conducted during the technical sessions on following themes;

- AI, ML and computer vision for agriculture robotics
- Robotics applications for farming operations (pre-harvesting)
- Challenges and opportunities and policy measures for the deployment of robots
- Robotics applications for farming operations (harvesting and post harvesting)

v. IoT for Agriculture: In the IoT Applications for agriculture Symposium, the focus was on the IoT enables devices and systems to create a smart farming system. Participants explored the potential of IoT

in monitoring and controlling various aspects of agriculture, such as irrigation, fertigation, and weather conditions. The experts demonstrated IoT enabled technologies trough exhibits and presentations and suggested the adoptive measures for wide adoption of IoT enabled and sensor-based systems/tools for real time and precision operations and management of the agricultural systems. The symposium encouraged collaborations between IT companies and agricultural experts to develop integrated IoT enabled solutions for the precision and smart agriculture. Total nineteen (19) presentations were conducted during the technical sessions on following themes;

- Sensors for IoT enabled systems
- IoT-Irrigation management systems
- IoT-Pest and disease management system
- IoT- Livestock and other management systems

vi. Advanced Agricultural Technologies: The "Advanced Agricultural Technologies" conference emerged as comprehensive overview of advanced technologies in agriculture covering climate smart and resilient technologies, Gio-informatics in agriculture, precision agricultural technologies and adoption of digital technologies in agriculture. This conference provided an opportunity to present the reflections of ICAR-NAHEP project in different parts of the country through the NAHEP CAAST projects and IDP projects through the presentations by Vice-Chancellors/PI's/Co-PI's of the respective projects. Experts discussed the synergy of various technologies and their collective potential to address agricultural challenges in different technical sessions. Total seventeen (17) presentations were conducted during the technical sessions on following themes;

- Climate smart and resilient and conservation technologies
- Geo-informatics, real time digital and precision technologies
- Intelligent technologies
- Other advanced agricultural technologies

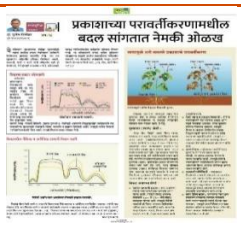
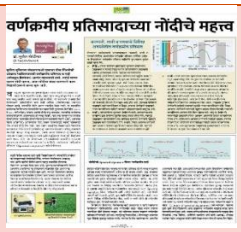
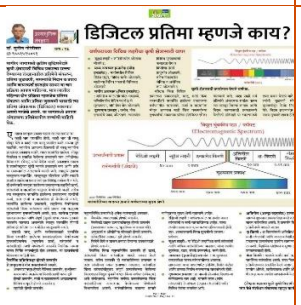
Overall the International Conclave on, "Futuristic Farming" with 6 concurrent international events on cutting-age technologies successfully sown the seeds of more technologically advanced, and sustainable agricultural future. It served as platform for collaboration, innovation, and knowledge exchange in the

field of advanced agricultural technologies. It also encouraged the inter institutional, institute-industry and public-private collaboration and innovation for betterment of farming community. Many industries and institutes came forward to collaborate with MPKV on advanced technologies for agriculture especially Artificial Intelligence

b) Knowledge management and outreach initiatives (development of collaterals, newsletter, social media outreach activities, creation of a website, experiential learning workshop, exposure visits)

Sl. No	Category of the collateral	Brief summary	Snapshot/cover page	Weblink (if any)
A. Articles				
	1.	भविष्यातील शेतीकडे जाताना **Futuristic farming** refers to the application of cutting-edge technologies and innovative practices in agriculture to enhance efficiency, productivity, profitability and sustainability.		https://www.epaper-hub.com/india/agrowon-epaper-
	2.	शाश्वत शेतीसाठी आधुनिक तंत्रज्ञानाचे महत्त्व: Applying technology and technical innovations in agriculture have significantly increased efficiency and output		https://www.epaper-hub.com/india/agrowon-epaper-
	3.	झाडावरील फळे काढणारा स्वायत्त यंत्रमानव Light weight track type Phule Robo is designed for spraying orchard and vegetable crops, particularly in muddy conditions where the tractor is stuck in the field. It has battery-operated motors that reduce its weight, and the tracks that increase traction.		https://www.epaper-hub.com/india/agrowon-epaper-

	4.	आकाशातून माहिती गोळा करण्याची उपयुक्तI Satellites can capture image of fields, which can be used to monitor crop health overtime. This information can help farmers identify potential such as nutrient deficiencies and to take corrective action		https://www.epaper-hub.com/india/agrowon-epaper-
	5.	तण काढणारा यंत्रमानव Weeding robots offer exceptional precision in weed detection and removal through machine learning and advanced vision systems.		https://www.epaper-hub.com/india/agrowon-epaper-
	6.	फवारणी करणाऱ्या यंत्र मानवा मागील तंत्रज्ञान Robotics and automatic spraying technologies like variable rate sprayers, UAV sprayers, and electrostatic sprayers are growing to Increase the utilization rate of pesticides, reduce pesticide residues, real-time, cost-saving, high compatibility of plant protection products application		https://www.epaper-hub.com/india/agrowon-epaper-
	7.	यंत्रमानव शेतीमध्ये स्वायत्तपणे कसे कार्य करतो? Mobile and articulated robots can be paired for tasks such as weed control. They can autonomously navigate through fields and identify and remove weeds without the need for human labor.		https://www.epaper-hub.com/india/agrowon-epaper-
	8.	स्वायत्त यंत्रमानव कृषी क्रांतीच्या दिशेने एक पाऊल Farmers can use these robots for tasks such as soil analysis, planting, and even harvesting in some cases.		https://www.epaper-hub.com/india/agrowon-epaper-

	9.	प्रकाशाच्या परावर्तीकरणामधील बदल सांगतात नेमकी ओळख Artificial Intelligence Technology: Due to the specific properties of different surfaces, the light falling on it is reflected to different extents in different ranges. The spectral response of these surfaces is different. The spectral signature of vegetation, water and soil is distinct, unique and unique		https://www.epaper-hub.com/india/agrowon-epaper-
	10.	वर्णक्रमीय प्रतिसादाच्या नोंदीचे महत्त्व Spectral signature is very important to identify a crop condition in artificial intelligence technology. Measure and record them. The work of collecting such records is currently going on in the university.		https://www.epaper-hub.com/india/agrowon-epaper-
	11.	संवेदक डोळ्यांपेक्षा अधिक चांगले का? Artificial Sensor Technology: Different artificial sensors (sensors) can capture light rays of different wavelengths and more than our eyes. As this information is provided in numerical form, it can also be instantly analyzed by artificial intelligence. How an object appears to us or a sensor is more beneficial than observing with our eyes		https://www.epaper-hub.com/india/agrowon-epaper-
	12.	डिजिटल प्रतिमा म्हणजे काय Application areas of Digital Image processing in agricultural field: Nutrient inadequacies identification and plant content, Grading quality of fruits, sorting fruits and inspection, Object tracking, realm and crop estimation, Crop Management		https://www.epaper-hub.com/india/agrowon-epaper-

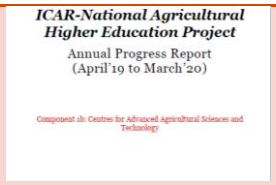
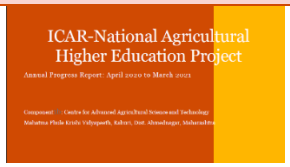
	13	रोग ,किड ओळखण्यासाठी ॲप एआय डिस्क Mobile Application based on Artificial Intelligence. It works to diagnose crop pests and diseases and suggest measures to control them		https://www.epaper-hub.com/india/agrowon-epaper-
	14	अशी असेल भविष्यातील शेती International Conclave on, "Futuristic Farming" with 6 concurrent international events on cutting-age technologies viz. Drones for agriculture, AI and Hyperspectral Imaging, Indoor Farming, Robotics in agriculture, IoT for agriculture, Indoor farming and Advanced agricultural technologies successfully sown the seeds of more technologically advanced, and sustainable agricultural future. It served as platform for collaboration, innovation, and knowledge exchange in the field of advanced agricultural technologies		https://www.epaper-hub.com/india/agrowon-epaper-
	15	ड्रोन द्वारे फवारणीची मार्गदर्शक तत्वे SOP for spraying using drone: Type certified droneRPC training use of CIB recommended chemical		https://www.epaper-hub.com/india/agrowon-epaper-
	16	शेतीमध्ये ड्रोन वापरातील आव्हाने Challenges for use of drones in agriculture •Battery life •Small size land, trees, high tension line •High initial investment •Trained pilot		https://www.epaper-hub.com/india/agrowon-epaper-

	17	ड्रोन चे विविध घटक आणि त्यांचे कार्य Drone components and its functions: Propeller, BLDC motor, ESC, controller, receiver, transmitter, landing gear, battery etc.		https://www.epaper-hub.com/india/agrowon-epaper-
	18	ड्रोन परवाना वापरासाठी करा नोंदणी Remote pilot certificate (RPC) training Eligibility: •10th pass •Age:18-65 •Passport/driving license/ ration card •Medical certificate		https://www.epaper-hub.com/india/agrowon-epaper-
	19	फवारणीसाठी ड्रोन चा वापर करताना **Use of spraying drone**: GPS calibration, pre-chekcs, flight planning, setting up of operating parameter (Height: 1.5-2.5 m, speed: 3-6 m/s)		https://www.epaper-hub.com/india/agrowon-epaper-
	20	मल्टी रोटर ड्रोन चा शेतीसाठी वापर करताना Use of multirotor drone in agriculture Quad copter, hexacopter, octocopter Easy to control		https://www.epaper-hub.com/india/agrowon-epaper-
	21	कृषी क्षेत्र डिजिटल तंत्रज्ञानाच्या दिशेने Digital technologies provide new opportunities to farmers, supply chain actors, including consumers, and policy makers to improve the productivity, sustainability, and resilience of food systems.		https://www.epaper-hub.com/india/agrowon-epaper-

News				
	1	International conclave on Futuristic Farming		
	2	International Symposium on Strategizing Education and innovations in Robotics, Drones and IoTs for Climate Smart Agriculture		
	3	International Scientist-Students Interface on Drones Robotics AI& FM at Rahuri		
	5	International workshop on Course Curricula Development for Post Graduate Diploma in CSA		
	5	International training programme Advanced technologies for climate smart agriculture		
	6	Workshop on Meet of Emerging Entrepreneurship (MEE)		
	7	MPKV, CLIMEX-2022		

	8	Brainstorming workshop on IoT-enabled Livestock Management Advances and Adoption in Indian Situation		
	9	Role of Journalism and Media in promoting the		
	10	Exposer visit of students and faculty to Sahyadri farm Nashik		
	11	Workshop on Cropping Pattern		
	12	Demonstration on Drone spraying		
	14	Agrovision Exhibition - 2021 at Nagpur		
	15	Climate Smart Digital Agriculture Village Baburdi-Ghumut		

	16	Exposure Visit of students and faculty to Rawalgaon		
	17	Exposure Visit of faculty to Nighoj at Parner		
	18	Three days pre -training programme on Fundamentals of geo-informatics for climate smart and Precision Agriculture		
	19	Visit of **Shri Manoj Ahuja**, Secretary, Department of Agriculture and Farmers Welfare (DA&FW), Government of India to CAAST-CSAWM, MPKV, Project		
	20	Visit of Indian Institute of Technology Bombay students to CAST-CSAWM, MPKV, Rahuri		
B. Reports				
1.	**Annual Report 2018-19**	Annual progress report, 2018-19 of CAAST-CSAWM, MPKV, Rahuri was submitted to NAHEP, New Delhi and included achievements of project.		https://www.mpkv-caast.ac.in/progressreport/annualprogressreportof2019/details

2.	**Annual Report 2019-20**	Annual progress report, 2019-2020 of CAAST-CSAWM, MPKV, Rahuri was submitted to NAHEP, New Delhi and included achievements of project		https://www.mpkv-caast.ac.in/progressreport/annualprogressreportof2020/details
3.	**Annual Report 2020-21**	Annual progress report, 200-21 of CAAST-CSAWM, MPKV, Rahuri was submitted to NAHEP, New Delhi and included achievements of project		https://www.mpkv-caast.ac.in/progressreport/annualprogressreportof2021/details
4.	**Status Report**	Status Report of CAAST-CSAWM, MPKV, Rahuri submitted NAHEP New Delhi in 2021-2022 which highlights last three the status of progress of CAASTproject.		https://www.mpkv-caast.ac.in/progressreport/annualprogressreportof2022/details
C	**Newsletter**			
1.	January 2019	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		https://mpkv.ac.in/Uploads/Comunication/MPKV%20Happenings%20January%202019_23_07_19_05_55_56_621.pdf
2.	**February 2019**	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		https://mpkv.ac.in/Uploads/Comunication/MPKV%20Happenings%20February%202019_23_07_19_05_56_56_837.pdf

3.	March 2019	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		https://mpkv.ac.in/Uploads/Comunication/MPKV%20Happenings%20March%202019_08_08_19_09_43_24_566.pdf
4.	April 2019	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		https://mpkv.ac.in/Uploads/Comunication/MPKV%20Happenings-%20April%202019_15_08_19_07_30_45_093.pdf
5.	May 2019	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		https://mpkv.ac.in/Uploads/Comunication/MPKV%20Happenings-May%202019_15_08_19_07_31_38_647.pdf
6.	June 2019	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		https://mpkv.ac.in/Uploads/Comunication/MPKV%20Happenings%20June%202019_28_08_19_10_30_40_202.pdf

7.	July 2019	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		https://mpkv.ac.in/Uploads/Comunication/MPKV%20Happenings%20July%202019_28_08_19_10_32_26_669.pdf
8.	August 2019	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		https://mpkv.ac.in/Uploads/Comunication/MPKV%20Happenings%20August%202019_01_10_19_09_17_18_417.pdf
9.	September 2019	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		https://mpkv.ac.in/Uploads/Comunication/MPKV%20Happenings%20September%20-%202019_20200216104058.pdf
10.	October 2019	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		https://mpkv.ac.in/Uploads/Comunication/MPKV%20Happenings%20October%20%20%202019_20200216104646.pdf

11.	November 2019	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		https://mpkv.ac.in/Uploads/Comunication/MPKV%20Happenings%20November%20%202019_20200216104733.pdf
12.	**December 2019**	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		https://mpkv.ac.in/Uploads/Comunication/MPKV%20Happenings%20December%20%202019_20200216104821.pdf
13.	**January 2020**	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		https://mpkv.ac.in/Uploads/Comunication/MPKV%20Happenings%20January%20%202020_20200327114544.pdf
14.	**February 2020**	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		https://mpkv.ac.in/Uploads/Comunication/MPKV%20Happenings%20%20February%20%202020_20200508033146.pdf

15.	**March 2020**	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		https://mpkv.ac.in/Uploads/Comunication/MPKV%20Happenings%20%20%20March%202020_20200615010440.pdf
16.	April, 2020	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		http://mpkv.ac.in/Uploads/Comunication/MPKV%20Happenings%20April%202020_20200706034710.pdf
17.	May 2020	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		http://mpkv.ac.in/Uploads/Comunication/MPKV%20Happenings%20%20May%202020_20200819044313.pdf
18.	June 2020	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		http://mpkv.ac.in/Uploads/Comunication/MPKV%20Happenings%20June%202020_20200911065633.pdf

19.	July 2020	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		http://mpkv.ac.in/Uploads/Comunication/MPKV%20Happenings%20July%202020_20201001030130.pdf
20.	August 2020	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		http://mpkv.ac.in/Uploads/Comunication/MPKV%20Happenings%20August%202020_20201026060323.pdf
21.	September 2020	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		http://mpkv.ac.in/Uploads/Comunication/MPKV%20Happenings%20%20September%202020_20201229092225.pdf
22.	October 2020	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audienceto the wider audience		http://mpkv.ac.in/Uploads/Comunication/MPKV%20Happenings%20%20October%202020_20210105110217.pdf

23.	November 2020	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		http://mpkv.ac.in/Uploads/Comunication/MPKV%20Happenings%20%20November%202020_20210112093121.pdf
24.	December 2020	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		http://mpkv.ac.in/Uploads/Comunication/MPKV%20Happenings%20%20%20December%202020_20210121033705.pdf
25.	January 2021	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		http://mpkv.ac.in/Uploads/Comunication/MPKV%20Happenings%20January%202021_20210331034515.pdf
	E-News			
26.	January 2021	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		https://mpkv.ac.in/Extension/ExtensionPublication

27.	February 2021	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		https://mpkv.ac.in/Extension/ExtensionPublication
28	March 2021	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		https://mpkv.ac.in/Extension/ExtensionPublication
29	April 2021	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		https://mpkv.ac.in/Extension/ExtensionPublication
30	May 2021	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		https://mpkv.ac.in/Extension/ExtensionPublication

31	June 2021	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		https://mpkv.ac.in/Extension/ExtensionPublication
32	July 2021	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		https://mpkv.ac.in/Extension/ExtensionPublication
33	August 2021	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		https://mpkv.ac.in/Extension/ExtensionPublication
34	September 2021	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		https://mpkv.ac.in/Extension/ExtensionPublication

35	October 2021	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		https://mpkv.ac.in/Extension/ExtensionPublication
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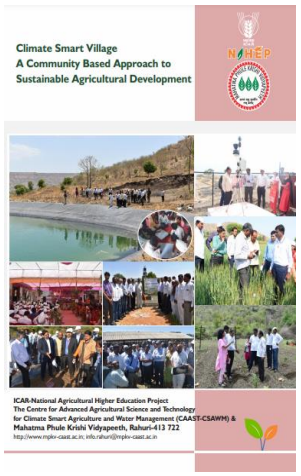
38	January 2022	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		https://mpkv.ac.in/Extension/ExtensionPublication

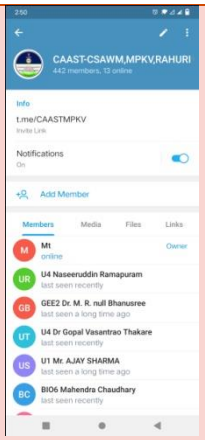
39	February 2022	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		https://mpkv.ac.in/Extension/ExtensionPublication
40	March 2022	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		https://mpkv.ac.in/Extension/ExtensionPublication
41	April 2022	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		https://mpkv.ac.in/Extension/ExtensionPublication
42	May 2022	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		https://mpkv.ac.in/Extension/ExtensionPublication

43	June 2022	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		https://mpkv.ac.in/Extension/ExtensionPublication
44	July 2022	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		https://mpkv.ac.in/Extension/ExtensionPublication
45	August 2022	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		https://mpkv.ac.in/Extension/ExtensionPublication
46	September 2022	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		https://mpkv.ac.in/Extension/ExtensionPublication

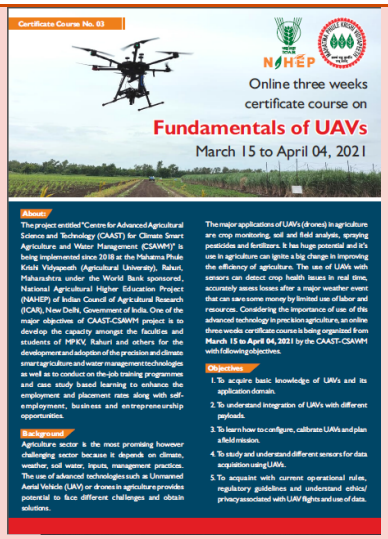
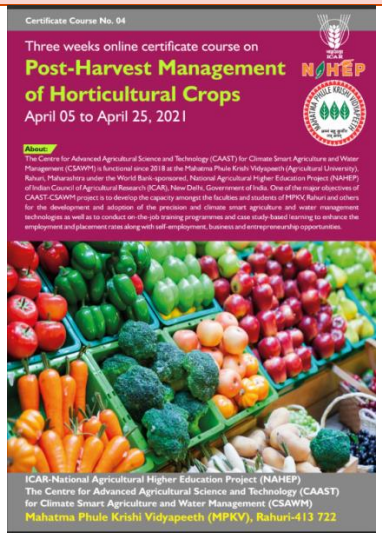
47	October 2022	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		https://mpkv.ac.in/Extension/ExtensionPublication
48	November 2022	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		https://mpkv.ac.in/Extension/ExtensionPublication
49	December 2022	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		https://mpkv.ac.in/Extension/ExtensionPublication
50	January 2023	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		https://mpkv.ac.in/Extension/ExtensionPublication

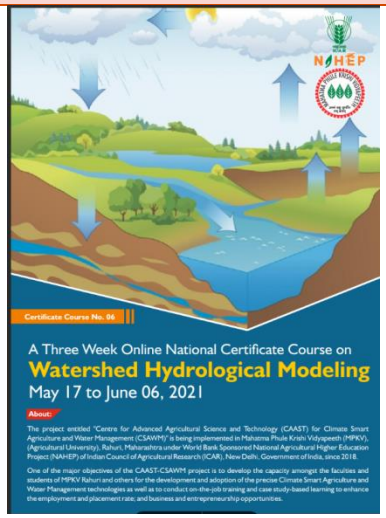
51	February 2023	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		https://mpkv.ac.in/Extension/ExtensionPublication
52	March 2023	MPKV, Rahuri publishes a monthly newsletter entitled "MPKV Happenings" in print form and also on its website. CAAST-CSAWM provides inputs to this newsletter. The CAAST-CSAWM uses this platform to disseminate its activities to the wider audience		https://mpkv.ac.in/Extension/ExtensionPublication
2.	**Climate Smart Village**	The CAAST-CSAWM project has adopted nine villages in the University's jurisdiction to disseminate specific climate smart technologies. Buchkewadi, a village in Junnar tahsil of Pune district, is being developed in association with NABARD and Lupin Ltd., Mumbai, 07 villages from Akole tahsil are being developed in association with NABARD and BAIF, Pune and one village Baburdi Ghumat, Tah Nagar, Dist. Ahmednagar is being developed in association with SEVA NGO, Ahmednagar, and the Alumni, Association, Dr. ASCAET, MPKV, Rahuri. The CAAST-CSAWM has been continuously organizing different extension activities at these villages		http://www.mpkv-caast.ac.in/page/progressreport/progressreports

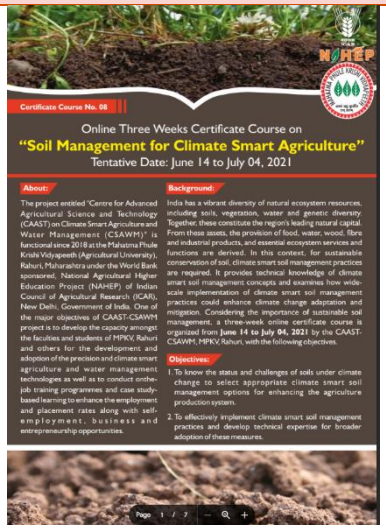
		for the dissemination and adoption of technologies related to the climate smart agricultural and water management such as exposure visits, group discussions & meetings, training programmes, workshops, demonstrations, expert advisory services, diagnostic field visits; and advising the concern agencies on adoption and dissemination of climate smart technologies in these villages.		
D. Social media outreach				
1	YouTube Channel	Total Subscribers: 5230		https://www.youtube.com/channel/UCes_cc0eScXBcf12pOx7C_A
2	LinkedIn	Total Subscribers: 13466		https://www.linkedin.com/company/ccsawm
3	Facebook	Total Subscribers: 1850		https://www.facebook.com/ccsawm
4	Twitter	Total Subscribers: 994		https://mobile.twitter.com/CCsawm
5	Instagram	Total Subscribers: 710		http://instagram.com/ccsawm?utm_source=qr

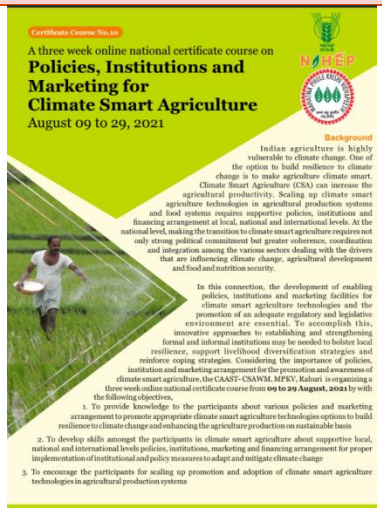
6	Telegram Channel	Total Subscribers: 456		https://t.me/CAASTMPKV
E. Website				
1	Website of the project and web-based content management system	1. Information about the project objectives, events organized, library, innovations, training program, procurement and recruitment advertisement. 2. The registration portal for training programs and webinar 3. The registration portal for the certificate course		http://www.mpkv-caast.ac.in/
F.	**Experiential learning workshop/certificate courses**			
1.	Online Three Weeks Certificate Course on Climate Smart Organic Farming	Organic agriculture is an integrated production management system that promotes and enhances agro-ecosystem health, including biodiversity, biological cycle and soil biological activity.. Three		http://www.mpkv-caast.ac.in/page/certificatecourses

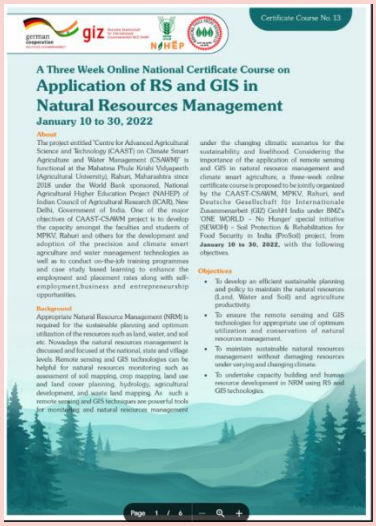
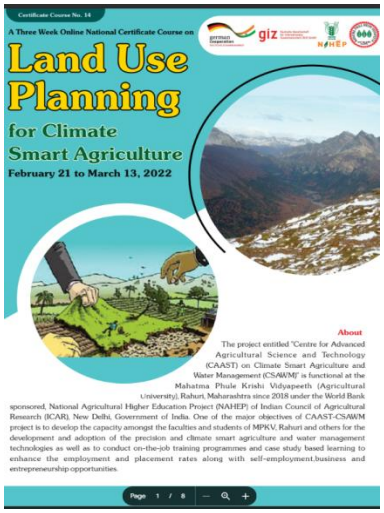
		weeks online certificate course organized from February 15 to March 07, 2021, by the CAAST-CSAWM and Organic Farming Research and Training Centre, MPKV, Rahuri		
2.	Online Three Weeks Certificate Course on Basic Geo-Informatics for Climate Smart	Geoinformatics is an emerging field, and there is great demand for geoinformatics professionals due to its application potential in several fields such as agriculture, rural and urban planning, environmental monitoring, natural resources management, natural hazards and disasters management etc. of spatial information. Online three weeks certificate course on basic geo-informatics for climate smart agriculture organized from February 22 to March 14, 2021		http://www.mpkv-caast.ac.in/page/certificatecourses

3.	Online three weeks certificate course on "Fundamentals of UAVs."	The agriculture sector is the most promising. However, it is a challenging sector because it depends on the climate, weather, soil water, inputs, and management practices. Advanced technologies such as Unmanned Aerial Vehicle (UAV) or drones in agriculture provide the potential to face different challenges and obtain solutions. The online three-week certificate course on the fundamentals of UAVs was organized from March 15 to April 04, 2021		http://www.mpkv-caast.ac.in/page/certificatecourses
4.	Online Three Weeks Certificate Course on Post-Harvest Management	A three-weeks online certificate course is organized from April 05 to April 25, 2021, by the CAAST-CSAWM, MPKV, Rahuri		https://drive.google.com/file/d/1PwE7hhRUXZmcepFC7LPpoNaYuEMdStYi/view

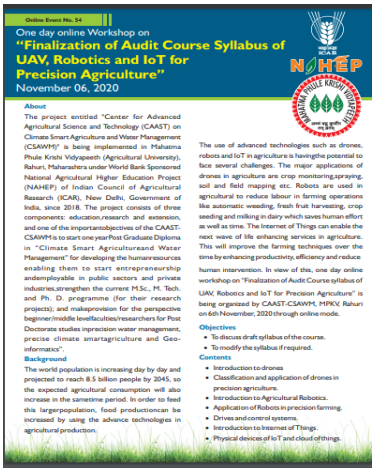
5.	Online Three Weeks Certificate Course on IT Applications in Precision Irrigation	The Mahatma Phule Krishi Vidyapeeth (MPKV), Rahuri has been contributing a lot in precision irrigation water management including development of mobile and web-based applications, IoT and Sensor-based applications. Realizing the need and relevance of IT applications in precision irrigation management, the CAAST-CSAWM, MPKV, Rahuri is organizing a three-week online national certificate course on "IT applications in Precision Irrigation Scheduling" from April 26 to May 17, 2021, for students, faculties, scientists and researchers.		https://drive.google.com/file/d/1LRCfUAt9jTuNO8FR7Ouf1tFbvxVvMKjb/view
6.	Online Three Weeks Certificate Course on Watershed Hydrological Models	CAAST-CSAWM, MPKV, Rahuri is organized three weeks online certificate course on “Watershed Hydrological Modeling” from May 17 to June 06, 2021. This certificate course will help young professionals hydrologist/ academicians/ scientist to gain in depth knowledge of watershed		https://drive.google.com/file/d/1Em968UvhrzFOdfZom5SPC8NFrXjVhvlL/view

		hydrologic modeling. They will also get trained in HEC-HMS and SWAT modeling.		
7.	Online Three Weeks Certificate Course on Google Earth Engine with python for Climate Smart Agriculture	Considering the importance of Google Earth Engine with Python on Climate smart agriculture and water management the three week online national certificate course is being organized from June 07- 27, 2021 by the CAAST-CSAWM.		https://drive.google.com/file/d/1ydz3HowON4MCDCyJ-E1uInjrohbRDRMK/view
8.	Online Three Weeks Certificate Course on Soil Management for Climate Smart Agriculture	Considering the importance of sustainable soil management, a three-week online certificate course is organized from June 14 to July 04, 2021 by the CAAST- CSAWM, MPKV, Rahuri, with the following objectives.		https://drive.google.com/file/d/1nPAZfiZBYabeV1EZJWTyuZf2W7F7-Q_g/view
9.	Online Three Weeks Certificate Course on Weather Based Agromet Advisory Services through ICT	CAAST-CSAWM, MPKV, Rahuri in collaboration with Deutsche Gesellscha für Internationale Zusammenarbeit (GIZ) GmbH India under BMZ's 'ONE WORLD – No Hunger' special initiative (SEWOH) - Soil		https://drive.google.com/file/d/16twEPmV64mR-n-Zc9dhpWzqq_lcKomgq/view

		Protection & Rehabilitation for Food Security in India (ProSoil) project, is organising a three-week national online certificate course from 02-22 August, 2021.		
10.	Online Three Weeks Certificate Course on Policies, Institutions and Marketing for Climate Smart Agriculture	Considering the importance of policies, institution and marketing arrangement for the promotion and awareness of climate smart agriculture, the CAAST- CSAWM, MPKV, Rahuri is organized a three week online national certificate course from 09 to 29 August, 2021.		https://drive.google.com/file/d/1tT8LCiMH5cpZELiMrhu-qNnGVsHusXr2/view
11.	Three Weeks Certificate Course on Tally	Tally software is used for storing all the transactions of each account in detail. Tally has made calculations simple. It has become part of all transactions related to account and finance.		https://drive.google.com/file/d/1uV8nrKjLqRQAdGzyo2kzqQHS5-hIJ-yp/view

12.	Online Three Weeks Certificate Course on Integrated Farming System for Sustainable Agriculture	A three-week online certifi cate course is proposed to organized from January 03 to 23, 2022, by the CAAST-CSAWM, MPKV, Rahuri, AICRP-Integrated Farming System, MPKV, Rahuri and ICAR-Indian Institute of Farming System Research Modipuram, UP, India.		https://drive.google.com/file/d/1cy0PO58dvDSavhwH4DYtdazSkT7Dokk-/view
13.	Online Three Weeks Certificate Course on Application of RS and GIS in Natural Resource Management	CAAST-CSAWM, MPKV, Rahuri, and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH India under BMZ's 'ONE WORLD – No Hunger' special initiative (SEWOH) - Soil Protection & Rehabilitation for Food Security in India (ProSoil) project, from January 10 to 30, 2022, with the following		https://drive.google.com/file/d/1bsXFEEd-ybhu8st5-G7IrjXzf1ICujpg/view
14.	Online Three Weeks Certificate Course on Land Use Planning for Climate Smart Agriculture	The CAAST-CSAWM, MPKV, Rahuri, and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH India under BMZ's 'ONE WORLD – No Hunger' special initiative (SEWOH) - Soil Protection & Rehabilitation for Food Security in India (ProSoil)		https://drive.google.com/file/d/1IriBgFJp-qObj722DMzWBtg5qv8CnomD/view

		project, from February 21 to March 13, 2022.		
15.	i. Online Three Weeks Certificate Course on Climate Smart Watershed Management ii. One Month Training program on Hydrological Modeling in Context of Climate Smart Watershed Management iii. One Week National Online workshop on Hydrological Modeling using Soil and Water Assessment Tool (SWAT)	1. One month national online training programme (specially designed for implant training) on "Hydrological Modeling in context of Climate Smart Watershed Management" from 01 to 28 June,2022 2. Three-week national online certificate course on "Climate Smart Watershed Management" from 01 to 21 June,2022and 3. One-week national online workshop on "Hydrological Modeling using Soil and Water Assessment Tool (SWAT)" from 22 to 28 June,2022		https://drive.google.com/file/d/1b68Ld53iipFZFUp7XouWo5GNsnORLMMG/view
16.	Brainstorming Workshop on Drought Early Warning System	CAAST-CSAWM, MPKV, Rahuri organized a brainstorming workshop and an expert panel discussion on Wednesday, 13 January 2021.		https://mpkv.ac.in/Uploads/Comunication/MPKV%20Happenings%20January%202021_20210331034515.pdf http://www.mpkv-caast.ac.in/page/training/trainingprograms

17.	One day online Workshop on "Finalization of Audit Course Syllabus of Precision Agricultural Machinery	One day online Workshop on "Finalization of Audit Course Syllabus of Precision Agricultural Machinery organized on 4th November, 2020.		http://www.mpkv-caast.ac.in/page/training/trainingprograms
18.	One day online Workshop on Finalization of Audit Course Syllabus of UAV, Robotics and IoT for Precision Agriculture	One day online Workshop on "Finalization of Audit Course Syllabus of UAV, Robotics and IoT for Precision Agriculture" organized on November 06, 2020		http://www.mpkv-caast.ac.in/page/training/trainingprograms
19.	Introductory workshop on Jagriti Yatra March 10, 2021 at 1100 hrs.	Jagriti Yatra is a 15 days long, national train journey that covers 8000 kilometers across the length and breadth of th th India. Every year, from December 24 to January 8 it takes 500 highly motivated youngsters (with some participation of international students), selected from thousands of applicants, to meet inspiring role models of India. The aim is building India		http://www.mpkv-caast.ac.in/page/training/trainingprograms

		through Enterprise with India's youth by exposing them to individuals and institutions that are developing unique solutions to India's challenge. Through this national event Jagriti Yatra has begun to inspire youth to lead and create enterprise solutions. Introductory workshop on Jagriti Yatra organized on March 10, 2021		
G.	**Exposure visits**			
1.	Exposure visit to Buchkewadi village, Tah. Junnar. Dist. Pune	Organized a scientific visit to Climate Smart Buchkewadi village, Tal. Junnar, Dist Pune on December 5, 2020. Vice-Chancellor Dr. Ashok Dhawan, Dr. A. L. Pharande, Dr. G. R. Chintala, Chairman, NABARD, visited the IoT project, demonstration plot, biofertilizer unit and the farm pond		http://www.mpkv-caast.ac.in/
4.	Exposure visit to Sahyadri farm Nashik	Visited Sayhadri Farms, Nashik a success story of FPO run by Vilas Shinde, alumnus of MPKV, Rahuri, No of Students 50		

5.	Exposure Visit to Rawalgaon	Visited successful Pomogranate and Drumstick Farmers in Rawalgaon. Students studied the best management practices adopted by the farmers, No of students 35		
6.	Exposure Visit to Pimpalgaon, Nashik	Visited one of the best grape nurseries at Pimpalgaon near Nashik. No of students 40		

C) Unique initiatives undertaken

(organizing trainings through online, conducting online examinations, administering attendance, developing of web applications, e-learning modules etc.)

1.Digital infrastructure

(organizing trainings through online, conducting online examinations, administering attendance, developing of web applications, e-learning modules etc

a. Virtual Classroom at MPKV, Rahuri

A virtual classroom has been established in the University as part of the network of virtual classrooms to strengthen agricultural education through ICT interventions under NAHEP Component 2 ICAR. In India, there were 18 institutoins where this facility was created under NAHEP Component -2, ICAR New Delhi. Through virtual classrooms, students benefit from lectures delivered through video capture. These classrooms are connected to a centralized Virtual Classroom software deployed at KrishiMegh at ICAR-IASRI. Through virtual classrooms, students benefit from lectures delivered through video capture.

Furthermore, virtual classrooms will be part of the 'blended learning' method that combines online and in-person teaching/learning. Supporting virtual classrooms will include a centralized video library of lectures that will take learning "to the anytime & anywhere". The virtual classroom is not just limited to hardware setup; it comes with a bundled multi-utility Agri-DIKSHA portal and a desktop application that can be installed on any platform. Using the Agri-DIKSHA portal, students can access any subject/topic lecture on mobile/laptop/desktop. To date, MPKV, Rahuri delivered more than hundred lectures by using Panopto software, which can be accessed by many students of India using the Agri-DIKSHA portal.

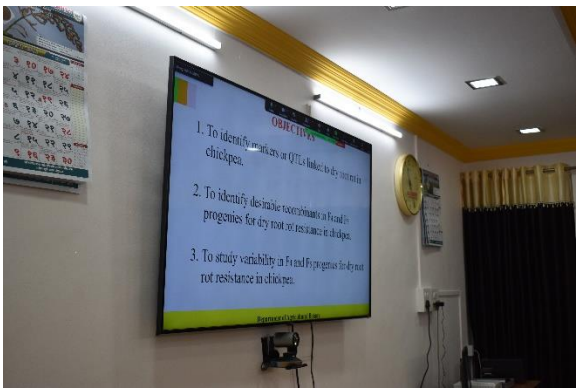
b. Digital Library

In this pandemic situation, the university library provides the online platform (Database): Digital Library through remote access to students and faculty.

- Jgate plus (CeRA)- Online Journal database
- Indianjournal.com- Journal related to agricultural science.
- E-books of 5 different publishers- CABI, CR C-Net base, Astral-International, NIPA International Art and Science Publisher.
- Krishikosh: An Institutional Repository Description-With the help of Krishikosh, we provide quality literature, including Theses, Journals, Articles, renowned books, reports etc., through online mode.
- Indiaagristat.com- This database provides online statistical information related to agriculture and allied sciences with 50 years of statistical information.
- JRF/SRF Database- We provide an online database called NIPA GENX dataset to prepare JRF/SRF following the ICAR Mandate. This database including more than 2 lakh online questions and test series related to the agriculture discipline.

c. Digital/Smart Classrooms:

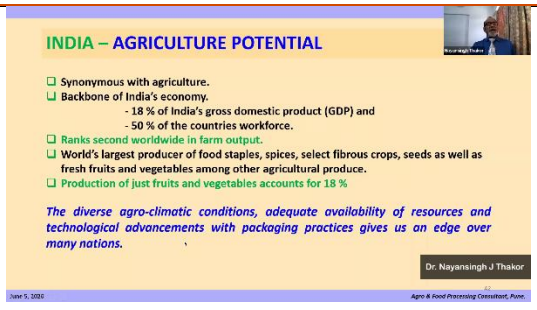
The digital/smart classroom of 25 capacity is developed under the CAAST-CSAWM project. This classroom has interactive whiteboards, smart projectors, desktop computer/laptop computer, and audio-visual equipment. The educational software and applications are provided to enhance teaching and learning experiences. The classroom is provided with High-speed internet connectivity through Wi-Fi for seamless access to online resources and collaborative tools.

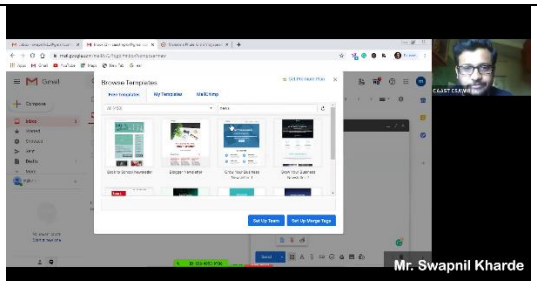


c) Platform of unique repository videos:

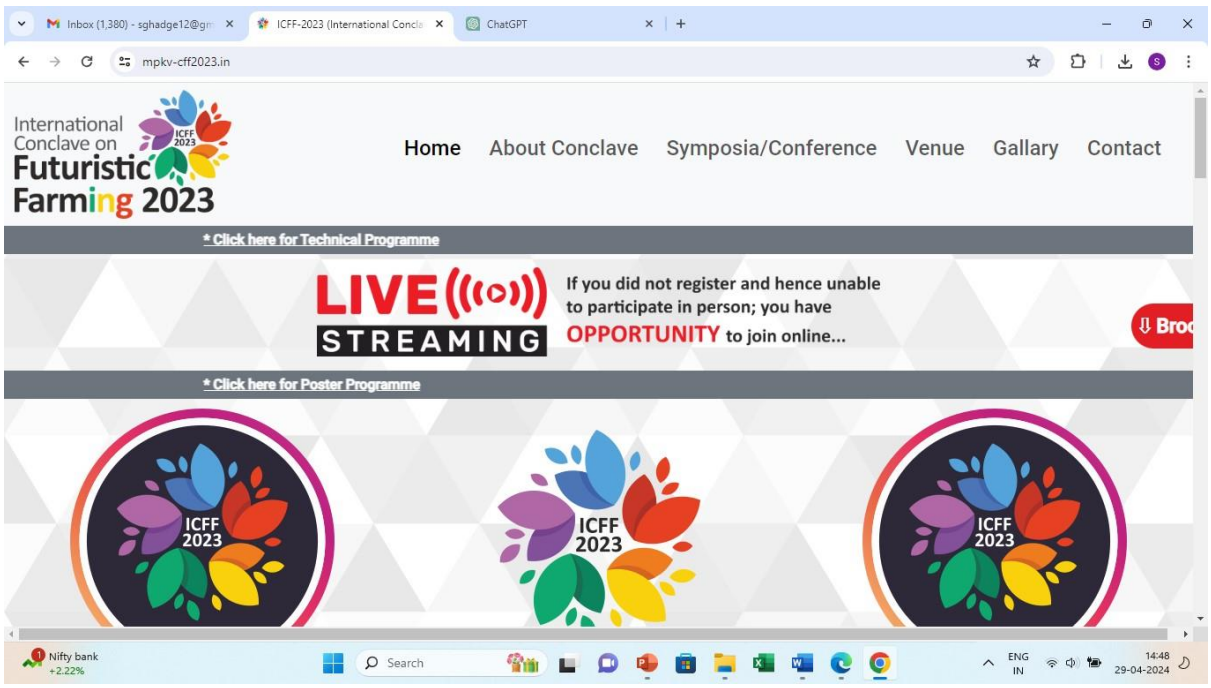
i. Video Library of different capacity building programmes:

The library of recorded videos of 700 lectures delivered by experts during one week, two week and three-week certificate courses organized on the different themes Robotics, Drones and IoTs, Remote sensing and Geoinformatics, CSA Precision agricultural machineries ,Precision Irrigation Management and Protected Cultivation ,Climate smart agriculture ,CSA Natural Resource Management ,Communication, Personality, Soft Skills, Entrepreneurship Development Skills, and Marketing and Organic Farming & Honey Bee Keeping of CAAST-CSAWM Project, were developed





ii.Developed website and youtube chanel for International Conclave on Futuristic Farming (ICFF-2023): to provide a centralized platform that effectively communicates the purpose, scope, and value of the event to its target audience and lays a crucial role in facilitating knowledge sharing, collaboration, and innovation within the futuristic farming community, ultimately contributing to the advancement of sustainable agriculture on a global scale.



2. Digital initiatives:

(Organizing trainings through online, conducting online examinations, administering attendance, developing of web applications, e-learning modules etc.)

SN	Category of the collateral	Digital initiative	Practice before the introduction of the initiative	Practice after the introduction of the initiative
A. Online Training Programmes				
The lockdown in India started from the last week of March 2020 due to Covid 19 pandemic. However, the CAAST-CSAWM immediately shifted to the online mode of learning. During the last week of March 2020,				

the CAAST-CSAWM developed the online learning model and methodology for organizing multisession online training programmes. Accordingly, it declared the first online national training programme in India in the first week of April 2020. Since then, CAAST-CSAWM has organized 05 International, 43 national training programmes, 26 workshops, 21webinars, 80 experts lectures, 07 demonstrations, 06 exposure visits consisting of 527 technical sessions of 1.5-2.0 durations benefiting 20747 students and faculties of MPKV and 21047 students and faculties from other agricultural universities and 4340 farmers from Maharashtra state.				
1.	**Online International Training Programmes**	1. Conservation Agriculture based Crop Management Technologies in Climate Smart Agriculture 2. Perspectives of Present and Future Weed Research under Climate Smart Agriculture 3. High-tech Agricultural Future Technology for Urban farming 4. Agriculture 4.0: Precision and Automated Ag Technologies 5. Water Resources Modeling	1. Participants need to present physically to attend the training programmes 2. Experts/ resource persons need to travel for delivering the lectures. 3. Less participation of participants from remote places and other states.	1. Explored the different online platforms 2. Developed the CAAST-CSAWM online learning module 3. Participations from across the country and globally. 4. The online training programmes were implemented without a single paper being used and printed, no paper/plastic banners, posters etc. 5. Saved money (on account of travel, lodging and boarding and different arrangements that are required to be made for the on-campus training) 6. Saved precious time of the human resources for travelling, unnecessary staying that would now be used for more constructive tasks.
2.	**Online National Training Programmes**	1. Fundamentals of Digital Marketing: I 2. Digital Farming in Context of Precision Water Management 3. Personality Development and Effective Communication, Skills and Stress Management 4. Fuzzy logic and its applications for Climate Smart Agriculture 5. Fundamentals of Digital Marketing 6. E-Resources of Libraries and Publication Ethics 7. Protected Cultivation Technologies for Climate Smart Agriculture 8. Effective Utilization of New Age e-Resources Technologies in Agriculture 9. Fundamentals of Drone Technology for Precision Agriculture		

		10. Aeroponics and Hydroponics Technologies for Precision Agriculture 11. Introduction to MATLAB and its Applications in Climate Smart Agriculture 12. Advanced Agrometeorological Techniques for Climate Smart Agriculture 13. Fundamentals of Pressurized Irrigation Methods 14. Introduction to Python Programming and its Applications in Climate Smart Agriculture 15. Smart Handling and Processing Systems of Horticultural Produce 16. Carbon Sequestration 17. Machine Learning and its Applications in Climate Smart Agriculture 18. Use of Media for Transfer of Agriculture Technology 19. Fundamentals of Robotics for Precision Agriculture 20. Advances in Smart Food Processing and Technologies 21. Soil and Water Conservation Interventions for Climate Smart Watershed 22. Advanced Agro-meteorological Techniques for Climate Smart Agriculture 23. Competitive Examination AIEEA(PG)JRF, AICE-JRF/SRF (Ph.D) and ICAR 24. Soft Skills to Enhance Professional Efficiency and Effectiveness 25. Agricultural Drainage for		

		Waterlogged and Salt Affected Soils 26. Writing Research papers for high impact factor journals and Effective proposals 27. Crop weather modelling tools for climate smart Agriculture 28. Adaptive measures for efficient utilization of irrigation water on the farm 29. National and International Agricultural Higher Education Opportunities 30. Emerging Urban Farming Technologies for Vegetable Production 31. Intellectual Property Rights and patents in Agriculture 32. Open Source Resources and Copyright Issues 33. Hands-on Training programme on the operation of UAVs for precision agriculture.		
B. Web applications				
1.	Development of mobile and web application	Smart weather mobile application and admin dashboard	The weather data recorded by the different Automatic Weather Stations are not directly available to the user, and it was sent to the cloud server. Every time the user needs to visit the location of AWS to check the particular weather data.	The Automatic Weather Station is now integrated with the developed Smart weather android mobile application and web dashboard. The real-time and derived weather data are now available on the developed applications that guide the end-user or farmer in planning different farming operations, such as irrigation, fertigation, spraying, sowing, harvesting, etc.

2.	Development of mobile and web application	VLCCP mobile and web application	The contingency crop plans were available at the district level. These plans were available on the CRIDA website in pdf format as well as a booklet in English. As a result, end-users and farmers are rarely able to use it.	CAAST-CSAWM has downscaled the district level contingent crop plan (DCCP) to the village level. The process document is published in the form of a book in Marathi and English language. Also, this document's mobile and web-based applications have been developed to make it readily available to all stakeholders and to access from anywhere.
3.	Development of Web-Based and Android mobile applications	"Phule Soil Textural Triangle" android mobile, and a Web-based application has been developed to represent large sample size in the texural triangle itself thus making it easy to know thee soil type of the location	In many reports and research papers of NRM, mentioning %sand, silt & clay is required. When the sample size is small,these can be mentioned in tabular format. But when the sample size is more (say in thousand) then it can not be mentioned in tabular format.	With the newly developed application, %sand, silt & clay for large sample size can be reprsesented in the textural trainagle itself facilitating the immediate information on soil type.
4.	Android application with web application	Teacher Evaluation System (TES)	• There was not any facility to capture the performance evaluation of the faculty or teacher by students. • The attendance system for the student was traditional. i.e. paper roll call was being maintained. • The teacher's performance by the student could not be assessed as it was time-consuming in the absence of a suitable App.	• TES (Teacher evaluation system) - An Android application with a Web-based Admin panel for Students' Attendance and teachers' performance evaluation is developed. • The database of all the subjects for B.Sc. (Agriculture), M.Sc (Agriculture), Ph.D. (Agriculture), B.Tech (Agriculture Engineering), M.Tech (Agriculture Engineering) and PhD (Agriculture Engineering) has been added to the system. • The developed mobile application has the following features; Web-based App to Add

				Colleges, Teacher data, Subjects, Student's data, Students' lecture wise attendance, Faculty's lecture-wise performance evaluation by students, Report Generation (classes conducted, Timelines and Weighted performance) • CAAST-CSAWM, MPKV, Rahuri registered for the copyright of this mobile application. A One-day workshop on the TES (Teacher evaluation system) was conducted, and this application was handed over to the University.
5.	Spatial ETr mobile and web application	Development of Web and Mobile-Based Applications for Real-Time Estimation of Location-Specific Evapotranspiration (Spatial ETr)	• The Evapotranspiration estimated from evaporimeters and lysimeters (direct methods) and empirical and semi-empirical models (indirect methods). • Traditional methods like PAN evaporimeter were used to estimate the ETr and to plan for irrigation.	• The Spatial ETr web and Android-based application is developed to estimate the location-specific Evapotranspiration • It uses the Spatial Google map on background and code based on the Penman-Monteith model algorithm to estimate reference evapotranspiration in mm/day. • This application is user friendly and easy to use, giving farmers and technicians the ability to evaluate daily Evapotranspiration useful for many water management tasks in agriculture using an Android mobile device or any web browser. • Users can search the desired location by entering the name in the search box or drag and tap on the Google map to estimate the Evapotranspiration in mm per day.

3. Potential impact of the intervention:

Observation

1. Capacity Building Programmes

Capacity building programme was one of the biggest activities of the CAAST-CSAWM. It involved organization of on campus and online 468 programmes comprising from one day to three weeks trainings, workshops, symposia, exposure visits.

Input: Capacity Building Programmes
Output: 82520 participants benefitted
Outcome: Greater awareness about Climate Smart Agriculture & Water Management among students, faculty, farmers and entrepreneurs
Impact: Students and faculty started doing research on climate smart agriculture & Water Management which will be continued in future. The CAAST-CSAWM for the first time introduced the subject of Digital Agriculture in the University Research Mechanism

2. State of the Art Laboratories

The CAAST-CSAWM developed state of the art laboratories which include Drone lab, Robotics lab, Hyperspectral Imaging lab, IoT lab and Climate Smart Research Block. These laboratories and research block are being extensively being used by PhD students for their research**.**

Input State of the Art Laboratories
Output: More than 25 PhD students used these facilities for their research
Outcome: Increased awareness among students and faculty about the facilities available in the CAAST for advanced research
Impact: The newly started Digital Agriculture subject in the Research Mechanism of the University will become more strong in future

3. Development of Innovative Technologies

The CAAST-CSAWM developed many IoT based technologies and mobile applications to empower the farmers and make their farms smart. These technologies are in the process of commercialization.

Input: Innovative Technology Development
Output: Developed 20 IoT based technologies and 40 mobile & 8 web applications
Outcome: The developed technologies will be in the market soon and will empower the farmers to use their resources more efficiently.
Impact: The developed technologies have the potential to increase the input use efficiency on the farm and make farming attractive.

4. Online learning model

The CAAST-CSAWM unit was the only active unit in the university during the first and second Covid pandemic. During these two pandemics the project organized 212 online programmes benefitting 66580 participants. This turned out to be a trend setter activity in the University and since then many meetings, viva voce exams, expert lectures are being organized online in the University.

Input: Online learning model
Output: Organized 212 online capacity building programmes benefitting 66580 participants

Outcome: Increased awareness, knowledge, skills among the trainees on various aspects of climate smart agriculture & water management
Impact: Left ever lasting impact in the University as University as adopted the online mode for many meetings, exams and expert lectures saving time, energy, money and reducing pollution many folds.

5. International exposure (Sandwich Model)

The CAAST-CSAWM project deputed 97 students, 31 faculty for international training & 12 University Officers for short visit to USA, Japan, Thailand, Malaysia, Vietnam. This is the first time that students and faculty in such a big number had international exposure in the University.

Input : International exposure

Output: 97 students, 31 faculty & 12 university officers had international exposure for international training and short visit abroad

Outcome: Many faculty and almost all students had international exposure for the first time. As a result, their perception has changed and many have started innovative research after completion of the training. A few students published research papers in journals with more than 7 NAAS rating. Dr Somnath Mane, Assistant Professor of Animal Husbandry & Dairy Science didn't have any knowledge of IoT, Drones, Robotics and Sensors. But after completion of one month training at AIT, Bangkok, Dr Mane developed IoT enabled Desi Cow Dairy Farm in the University. It has become the place of attraction for visitors.

Impact: These international trainings have imbibed a culture of use of digital technologies in various sectors of agriculture**.**

4. Challenges faced and lessons learned while implementing the project at AU

Challenges	
1	In the beginning, there were no particular and specific guidelines as to how to proceed with the NAHEP objectives and objectives of the project; and hence there were confusion and delays. Though at later stage regular workshops were conducted by NAHEP to address the difficulties encountered.
2	The guidelines regarding EAP, ESP and indicators should have been made available in the beginning. As those were released at middle of the project duration, many a times difficulties were encountered in completing the proformas to be submitted on these aspects. However, we regularly consult the PIU unit to overcome the problems faced regarding these issues. Further many a times, it was not clear whether these issues were to be addressed at University level and CAAST project level.
3	The issues regarding indicators are mostly at University level and PIs of the project many a times find difficulties to gather the information at University level. Though at MPKV, Rahuri; internal awareness programmes were organized to sensitize all on the philosophy of the project and problems were subsequently overcome, but it is also necessary at PIU level to keep Deans/Director of Instructions in loop for this purpose.
4	Climate smart and precision farming technologies were not easily grasped and accepted by practitioners and farmers and hence needed to be properly develop and disseminate in a meaningful form. However, through several capacity development programmes, this challenge is slowly overcome.
5	Networking with different organizations (Govt./ Private / NGOs) was one challenge as every organization has its own objectives and vision. However, due to excellent performance of the CAAST-CSAWM project, many institutions came forward to collaborate with the university for education and research.
6	The delegation of powers; procurement and financial rules and regulations are different than the university; and hence initially there were certain hurdles but later slowly smoothened out.

7	We were not familiar with the procurement procedure through STEP. The procurement was delayed initially due to delayed activation of STEP for NAHEP
8	Permissions from State Government for International visits/training. Though the DDG (Education) and National Director, NAHEP had written to the Chief Secretary of States, it was mandatory to the faculty of MPKV to seek the permission of state government for international travel which took lot of time.
9	Covid 19 pandemic seriously affected the normal functioning of the project. But it was partly overcome by switching over to the online model of learning.
Lessons learned	
1	Full powers to the PI and full involvement of the PI in the project were key parameters in the success of the project
2	Continuous focus and involvement in the project activities is a must to keep the timeline of activities
3	Interdisciplinary team of experts is more productive to meet the objectives of the project
4	By output oriented hard work, one must develop the brand of the project. CAAST-CSAWM has become a brand in the University which will leave its impact in the long run.
5	Linkages with National and International institutes of repute is highly essential for completion of the project objectives and long term benefits for education and research in the AU
6	Working in a project of such a scale, a candidate must be able to work under continuous pressure
7	Synergy between Project Leader and University Administration is a must which was very good for MPKV CAAST
8	National and international exposure to the faculty and students widens their horizons and helps them in improving education and research

5. Sustainability Plan

5.1 Sustainability plan of the AU

- *Does the AU have any sustainability plan for to make AU future ready and globally recognized? (Yes / No)* ***Yes***
- *If yes, details thereof?*

1.	**Centre of Excellence for Digital Agriculture (COEDA):** The MPKV, Rahuri established the "Centre of Excellence for Digital Agriculture" to continue to perform various tasks related to digital agriculture under one umbrella; and to generate the resources required to extend the Digital Agriculture initiatives further. Externally funded projects worth Rs 920.96 have been brought in the COEDA as result of NAHEP project. Moreover, revenue generating activities like Revolving Fund and Remote Pilot Training Organization (RPTO) have been started to generate the funds on continuous basis.
2.	**Externally funded Research Projects:** Presently following projects submitted under CAAST-CSAWM to continue, update/upgrade, upscale and extend the developed climate smart and digital technologies are being implemented in the MPKV. 1. Solar Power Central Pivot Irrigation System for Climate Smart Agriculture (RKVY- Rs 256 lakh) 2. IoT Enabled Sensor Based Smart Irrigation Management System (ICAR- Rs 86.80 lakh) 3. Automated Canal Irrigation System for Efficient and Smart Irrigation Water Management (ICAR- Rs 40.74 lakh) 4. Centre of Excellence for Digital Technologies for Smart & Precision Agriculture (GoM- Rs 476 lakh) 5. Dissemination, training and evaluation of MPKV (RKVY and CAAST) developed IoT based irrigation management technologies (RGSTC- Rs 5 lakh) 6. Development of methodology for real time irrigation management for Sugarcane using ground/drone/satellite based spectral data (RGSTC- Rs 5.5 lakh) 7. Standardizing Drone spraying protocols for various inputs in selected field crops viz. Soybean, Pigeonpea, Chickpea, Wheat and Sugarcane (M/s. Fowler Westrup (India)- Rs 19.80 lakh) New externally funded projects will be coming as a result of research facilities and trained manpower created under NAHEP project.

3.1. Sustainability plan for improving internal revenue generation through facilities and infrastructure created under the project

1	Remote Pilot Training Organization (RPTO): (Rs 40 lakh revenue generated during the last one and half years)
2	Established Revolving Fund for Climate Smart Research Block (Rs 30 lakh revenue generated from sale of farm produce since the last four years)
3	Established Revolving Fund for capacity building, training and demonstration
4	Commercialization of the developed technologies

6. Contribution of each individual in project

6.1 Name of Vice Chancellors(s) during project duration and contributions each PI, Co-PI and team along with their photographs

Name	Gender	Designation in AU and contact details (email, mobile)	Role in project (PI/ Co-PI/ RA/ SRF etc.)	Major contribution/ output	Photographs
Dr. P. G. Patil	Male	Vice Chancellor vcmpkv@gmail.com	Vice Chancellor	Provided below	
Major contribution/ output: Motivating and guiding CAAST team and appreciating its efforts at all levels, extending full support to all CAAST activities and CAAST team, and planning the visit of VVIPs to CAAST project					
Dr K. P. Viswanatha	Male	Vice Chancellor vcmpkv@gmail.com	Vice Chancellor	Provided below	
Major contribution/ output: Good support and involvement in the initial phase of the project.					
Dr. S. D. Gorantiwar	Male	Director of Research and Head, Department of Agril. Engineering, 9881595081 pi.caast.csawm@gmail.com	Principal Investigator	Provided below	
Major contribution/ output: As PI of the project performed for project planning and management, guided the Co-PI &DDO, Procurement officer, GRO, EAP, ESP on their respective portfolio, encouraged and coordinate 22 research associates for fulfilling the objectives of the project with timeline, developed international and national level linkages with institutes and industries for the collaborations on digital technologies, international level training of students and faculties and short visits of university officers. Conceived and designed postgraduate diploma in Climate Smart agriculture & Water Management and Certificate Courses with different themes, established UAV, Robotics, hyperspectral, IoT laboratory and IoT park. Led one of the biggest capacity development programmes in the university with organization of 468 events through both on campus and online mode. Guided development of 12 ha Climate Smart Research Block with advanced digital technologies where more than 40 PhD/Masters students have been working for their research. Guided the team for the establishment of the DGC approved RPTO (first AU in India), organization of mega events such as AI International Symposium, CLIMEX, ICFF. Brought externally funded projects from different national and international agencies worth Rs 900 lakh grants.				

Established Centre of Excellence for Digital Agriculture as a sustainability plan to utilize the facilities created under NAHEP. Major role in Project outputs: 18 Digital Technologies, 21 Copy rights, 1Patent, 20 Books, Climate Smart Digital Agril Village, 27 Technology Recommendations					
Dr. M. G. Shinde	Male	Professor of Soil and Water Conservation Engineering 9403605979 mgshinde1811@gmail.com	Co-Principal Investigator & Drawing and Disbursing Officer (DDO) & Grievance Redress Officer (GRO)	Below	
Major contribution/ output: As Drawing and Disbursing Officer for the project handled the accounts and audit of the project; as Co-PI of the project responsible for overall project management along with PI; as GRO handled the grievance redressal of the project; helped PI in handling international level training of students and faculty and short visit of University Officers; helped in the development of digital technologies in the project. Conceived, initiated and organized with PI MPKV- CLIMEX 2022 on the platform of NAHEP through the funds of MPKV Alumni; helped in the development of digital agricultural villages; handled the EAP component of the project; actively involved in all the capacity building programmes and exposure visits of the project.					
Dr. A. A. Atre	Male	Professor of SWCE 9860593836 atreatul@gmail.com,	Procurement Officer	Below	
Major contribution/ output: Worked as Procurement office for CAAST-CSAWM project and was involved in preparing the procurement plan in consultation with other members and Principal Investigator; responsible for maintaining the information update on STEP portal of world bank; kept liason with NAHEP- PIU regarding completion of procurement procedure, Involved in the internal and external audit, documentation of procured material, as member, involved in development of courses pertaining to watershed development and management and soil and water conservation, organized different capacity building programmes as secretary, joint organizing secretary; as member was involved in development of technologies and copyright.					
Dr. S. A. Kadam	Male	Associate Professor of IDE, Dept. of Agril. Engineering, MPKV, Rahuri sunil21075@gmail.com 9403608302	Team Member	Below	
Major contribution/ output: Worked as Team Member and handled the responsibilities of IT officer and RS and GIS protocol. Involved in development of PG diploma courses, IoT technologies for irrigation water management, mobile and web-based applications. Involved in establishment of Hyperspectral Imaging Laboratory, RS and GIS Facilities, IoT laboratory, IoT park and climate smart research block.					

Assisted procurement team. involved in the organization of capacity building programs; involved in the development of the technology recommendations related to digital agriculture (sensors, IoT, mobile and web-based applications, drone applications) at state level and assisted for preparation of the copyrights for the different mobile and web-based applications; coordinated research projects on Climate Smart Research Block for PG and Ph. D. students on hyperspectral and multispectral imaging applications in agriculture and other technologies; Assisted important activities such as International Level Training, the administrative and account related tasks of project whenever required and as entrusted by the PI and Co-PI.					
Dr. S. M. Nalawade	Male	Associate Professor and I/c Head, Department of Farm Machinery and Power, 9422382049 hod.mpkv@gov.in	CAAST-CSAWM Team Member	Below	
Major contribution/ output: Helped in the development of research laboratory for Agricultural Drones, and robotics, establishment of DGCA approved Remote Pilot Training organization, first in agriculture universities of India, associated in the development of course curricula for the courses on precision agricultural machineries, drones and robotics in agriculture for the postgraduate diploma and certificate course programme, involved in procurement of the precision agricultural machineries, drones, robots and electronics components for development different technologies, helped in the organization of capacity building programs, involved in technology development : Phule robo for agricultural spraying (winner of Agri India Hackathon 2021), Site specific slurry applicator for orchard crops, Sensor based variable rate fertilizer applicator, electronic controlled tractor operated automatic vegetable transplanter, fruit harvesting robot proof of concept 1 Patent published and 2 copy rights.					
Dr. P. L. Kulwal	Male	Professor of Agril. Biotechnology, 9404113740 pawankulwal@gmail.com	Environmental sustainability (ES) Officer,	Below	
Major contribution/ output: Worked as Nodal Officer on Environment Safeguards, involved in implementation of ESS guidelines, played key role in establishment of Abiotic Stress experimentation facility, involved in procurement of the computer and other digital infrastructure for the project, actively involved in developing library for the project, involved in the organization of capacity building programs; developed two courses for PG Diploma, developed Mobile based "Phule Pest and Disease Management App" for undertaking control measure against pest and diseases, received Copyright for the app, utilized Climate Smart Research Block of the Project for undertaking plant phenotyping in robust way.					
Dr. V. P. Kad	Male	Associate Professor of Agril. Process Engineering, 7588024697	Account and Finance Officer (AFO),	Below	

Major contribution/ output: Worked as Account and Finance Officer (AFO) and helped in the organization of capacity building programs during the project period.					
Dr. B. K. Gavit	Male	Associate Professor of SWCE, 9421700302 bhaugavit@gmail.com	IT Officer, CAAST-CSAWM	Below	
Major contribution/ output: Worked Team Member and IT Officer in CAAST Project; helped in the organization of capacity building programs during the project period.					
Dr. U. S. Surve	Male	Professor of Agronomy, 9822606511 drulhas11@gmail.com	Farm In-charge, CAAST-CSAWM	Below	
Major contribution/ output: As Farm In-charge, associated in development and management of 12 ha Climate Smart Research Block, management of cultivation in shadenet, poly house; helped in the organization of capacity building programs during the project period; helped in development of five courses for PG Diploma, involvement in the development of Mobile Apps for 22 crops in English and Marathi languages and copyrights for the app; conducted experiments for developing climate smart practices for Sugarcane and Turmeric, involved in the conduct of experiments for developing SOP for drone spraying; involved in the purchase of precision machineries for climate smart block; demonstration on Ultra High- density planting in Mango.					
Dr. N. K. Bhute	Male	Assistant Professor of Agril. Entomology, 7588082033 nandu.bhute@gmail.com	CAAST-CSAWM Team Member	Below	
Major contribution/ output: Worked on the project "Standardization of dose of insecticide for drone spraying in cotton" and conducting different trials of insecticides for the standardization of dose through drone application					
Dr. S. N. Ghadge	Female	8275441210 sghadge12@gmail.com	Research Associate (Extension Education & Communication)	Below	
Major contribution/ output: Involved in the organization of capacity building programmes for students, faculty and farmers; associated in the development of course curricula and pedagogy for the courses on social science for climate smart agriculture; involved in pre and post training evaluation proforma for feedback of participants, publications (research article, bulletins, and books) and publicity					

of CAAST activities; involvement in adopted Climate Smart Digital Agricultural Villages; involvement in capacity building programs; preparation of weekly and quarterly and assisted in preparation of annual reports, newsletters and preparation of annual meeting presentations; documentation and provide M&E-related inputs for PMTS; reporting of Equity action Plan (EAP) and Grievance Redressal and exhibited the drones and robotic technologies in the different national and state level agricultural exhibitions					
Dr. V. S. Malunjkar	Male	9595193388 ss.malunjkar@gmail.com	Research Associate (Soil & Water Conservation Engineering)	Below	
Major contribution/ output: Associated in the development of course curricula and pedagogy for the courses on sustainable soil management and climate smart watershed management for the postgraduate diploma and certificate course programmes; associated in the design, development and validation of IoT and sensor-based technologies for climate smart and sustainable agriculture; involved in the organization of trainings, workshops, certificate courses and field visits, downscaling and development of village level contingency crop plan, installation and monitoring of developed technologies at farmers' field; associated in the development of several mobile and web applications; involved in collaborations with partnering organization (MoUs), submission of IPR applications, annual report writing, research papers, books and bulletin publications, design and preparation of annual meeting presentations and conceptual frameworks. Liaison & coordination with government line departments and state Agriculture Universities.					
Dr. G. B. Bhanage	Male	8855094029 gbhanage1588@gmail.com	Research Associate (Farm Machinery & Power Engineering)	Below	
Major contribution/output: Associated in the development of course curricula for the courses on precision agricultural machineries, drones and robotics in agriculture; involved in establishment of education and research labs of unmanned aerial vehicle (UAV) / drone and robotics for precision agriculture, associated in development of Phule-SANMAN and Phule-SAM mobile application, associated in the development of remotely operated robotic sprayer (Phule-Robo), site specific slurry applicator for orchard crop, associated in development of SOP for input application using agricultural spraying drone, associated in STEP procurement activities of different precision agricultural machineries, drones and robots as per the procurement plan involved; associated in organization of Remote Pilot Certificate (RPC) training through RPTO, involved in various capacity development programmes, exhibited the drones and robotic technologies in the different national and state level exhibitions and involved in completing STEP activities of civil works as per guidelines.					
Er. M. A. Tamboli	Male	9860646586 mohasin.ayub@gmail.com	Research Associate (Computer Application)	Below	
Major contribution/ output: Involved in the setup and maintaining of an IT infrastructure, inhouse windows servers, website of project and other web-based and mobile applications; involved in the development of web based and android mobile based applications, setting up the official social media					

accounts for the project on Facebook, LinkedIn, Twitter, Instagram and Telegram. Associated in keeping all the social media accounts up to date with proper content, setting up and managing the YouTube Live and Facebook Live channels of the project for broadcasting the information and sessions, management of the Video conferencing unit of the project including the hardware and software. Associated in design and development of forms and Apps for baseline survey; associated in conducting the online training on Python programming, Linux operating system and its applications in climate smart agriculture; helped in handling several online trainings and certificate courses in the project.					
Dr. P. B. Jadhav	Male	9665919071 jadhavpradnya12@gmail.com	Research Associate (Irrigation and Drainage Engineering)	Below	
Major contribution/ output: Involved in the research activities of irrigation water management-development of Precision Irrigation Systems, IoT enabled instruments development, testing and validation, procurement required for development of above-mentioned research activities, helped in the organization of capacity buildings programmes and exhibited the IoT and sensor technologies in the different national and state level agricultural exhibitions; involvement in the documentation of International Level Training of students.					
Er. Tejashree Navale	Female	9404810341 Tejashree.nawale33@gmail.com	Research Associate (E&TC)	Below	
Major contribution/ output: Involvement in the research activities related to Electronics and Telecommunication, development of precision irrigation Systems, IoT enabled instruments development, testing and validation, procurement required for development of above-mentioned research activities					
Dr. A. S. Bade	Male	9420009118 anandbade11@gmail.com	Research Associate (PlantProtection)	Below	
Major contribution/ output: Involved in portfolio of International Level Training for students, faculties/scientists and university officers which included all paper work for proposals to NAHEP, budget, air ticket booking, visa documentation and permissions, etc.; assisted in organization of symposia and conferences.					
Ms. Kavita Rajput	Female	9096970296 rajput.kavi13@rediffmail.com	Research Associate (Agronomy)	Below	
Major contribution/ output: Involved in handling agronomical aspect of different research trials at CAAST field, involved in the organization of Pre-training of undergoing ILT student and faculty and worked as coordinator for "International symposium on IoTs (Internet of Things) for Agriculture"					

Dr. Lavudi Bheemlal Thulasiram	Male	09110335575 tulasiherty@gmail.com	Research Associate (Horticulture)	Below	
Involved in handling of horticultural research activities at CAAST field, procurement of different inputs required for conducting horticultural, research, helped in editing online lecture videos and worked as coordinator for international symposium on “AI and Hyperspectral imaging for agriculture”					
Er. Y. S. Dighe	Male	9960330468 yogeshin2009@gmail.com	Research Associate (Mechanical Engineering)		
Major contribution/ output: Associated in the development of course curricula for the courses on precision agricultural machineries, drones and robotics in agriculture; helped for the establishment of labs of drone and robotics for precision agriculture; assisted in development of Phule-SANMAN and Phule-SAM mobile applications and development of remotely operated robotic sprayer (Phule-Robo), site specific slurry applicator for orchard crop; involved in the organization of trainings, workshops, certificate courses and demonstrations of precision agricultural machinery, drones and robots.					
Dr. K. S. Borse	Male	9423940673 kalpeshborse22@gmail.com	Research Associate (Water Resource Engineering)	Below	
Major contribution/ output: Associated in the development of course curricula and pedagogy for the courses on water resources development, involved in the organization of trainings, workshops, certificate courses related to water resources development and management; involved in the portfolio of international level training of students and faculties of MPKV Rahuri; associated in the development of Phule textural triangle mobile and web applications; Liaison & coordination with government line departments and State Agriculture Universities.					
Dr. S. G. Kanade	Male	9970717888 snehalgkanade@gmail.com	Research Associate (Agro meteorology)	Below	
Major contribution/ output: Associated in the development of course curricula and pedagogy for the courses on Agrometeorology; assisted in the design, development and validation of IoT enabled smart weather stations; involved in the organization of trainings, workshops, certificate courses and field visits; assisted in downscaling and development of village level contingency crop plan, installation and monitoring of developed technologies at farmers’ field; assisted in the development of phule smart weather and VLCCP mobile and CAAST admin dashboard web applications; Liaison & coordination with experts and faculties from State Agriculture Universities.					

Dr. N. B. Kondvilkar	Female	9075306900 nilamkondvilkar@gmail.com	Research Associate (Soil Science & Agril. Chemistry)	Below	
Major contribution/ output: Assisted in development of web and android 'Phule Smart Fertilizer Calculator' applications; involved Soil health card distribution to farmers of Baburdi-ghumat and Buchkewadi villages; involved Environmental Sustainability Plan (ESP) related activities, and awareness programs; assisted Nodal Officer (ESP) in submission of award proposal for Green and Clean Campus Award-2021 and 2022; assisted in organization and co-ordination of Trainings/ Certificate Course/workshops/seminars, 1 recommendation and 1copy right.					
Dr.S.P. Badole	Male	9604777460 shrikantbadole358@gmail.com	Research Associate (Soil Science)	Below	
Major contribution/ output: Involved in the research work on "Evaluation of carbon stocks on varying irrigation and residue management practices in potential sugarcane-based cropping system"					
Dr. S. D. Thorat	Male	8806727662 sunilthoratagronomist@gmail.com	Research Associate (Agronomy)	Below	
Major contribution/ output: Assisted in development of "Climate smart research block" and helped in farm management activity, assisted in conduct of the expt. for "Climate Resilient Resource Conservation Technologies for Sustainable Production of Sugarcane"; involved in the organization of trainings, workshops, certificate courses related to Natural Resource Management; contributed in development of mobile application on "Crop production Technologies, Management Practices and Value addition for 22 Agronomical crop					
Dr. P. B. Kale	Male	9421592799 kalepbbtl@gmail.com	Research Associate (Biotechnology)	Below	
Major contribution/ output: Assisted in the procurement process through STEP; assisted in installation of abiotic stress experimentation facility; assisted in development of the mobile application Phule Pest and Disease Management; involved in capacity development activities.					

6.2Details of visits of PIU-NAHEP officials at your AU along with photographs

Sr. No.	Name of Officer from PIU-NAHEP	Visit of Date	Photographs
1	**Mr. Edward W. Bresnyan,** Senior, Agriculture Economist, World Bank .	23 January, 2019	
2.	**Mr. David Nielson**, Lead Agricultural Services Specialist, World Bank	23 January, 2019	
3.	**Mr. Mansur Ahmed**, Economist at the Agriculture Global Practice, World Bank	23 January, 2019	
4.	**Dr. Himanshu Pathak,** Secretary (DARE) & Director General (ICAR) Assistant Director General (International Relations) Indian Council of Agricultural Research, Department of Agricultural Research and Education Krishi Bhavan, New Delhi	23 August, 2023	

4	**Dr. R.C. Agrawal** Deputy Director General (Agriculture Education) and National Director, NAHEP, Indian Council of Agricultural Research, New Delhi, India.	17 October, 2021	
5	**Dr. R.C. Agrawal** Deputy Director General (Agriculture Education) and National Director, NAHEP, Indian Council of Agricultural Research, New Delhi, India.	20 December, 2022	
6	**Dr. R.C. Agrawal** Deputy Director General (Agriculture Education) and National Director, NAHEP, Indian Council of Agricultural Research, New Delhi, India	24 January, 2024	
7	**Dr.P.K.Ghosh,** National Coordinator, NAHEP-ICAR C-42, IARI, Pusa New Delhi-12	25-27 July, 2019	

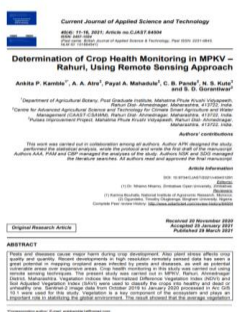
8	**Dr Prabhat Kumar** National Coordinator, NAHEP-ICAR C-42, IARI, Pusa New Delhi-12	25-27 July, 2019	
9	**Dr.Prabhat Kumar,** National Coordinator (M&E), NAHEP, ICAR, New DelhWorld Bank Team	23 January, 2019	
10	**Dr Prabhat Kumar** National Coordinator, NAHEP-ICAR C-42, IARI, Pusa New Delhi-12	17 October, 2021	
11	**Dr Anuradha Agrawal** National Coordinator | CAAST & Component 2 | ICAR-NAHEP, , New Delhi, India.	21 December,2022	

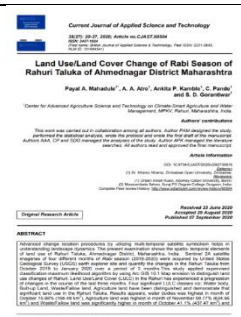
12	**Dr Anuradha Agrawal** National Coordinator | CAAST & Component 2 | ICAR-NAHEP, , New Delhi, India.	20-21 December, 2023	 
13	**Indira Prakash** Environmental Safeguard Specialist - National Agricultural Higher Education Project (*NAHEP*)-ICAR, New Delhi.	5-6 March,2021	
14	**Ranjit Kumar Sahoo** Social Safeguard Specialist National Agricultural Higher Education Project (*NAHEP*)-ICAR, New Delhi.	5-6 March,2021	

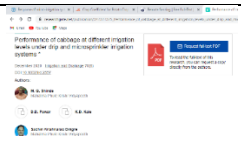
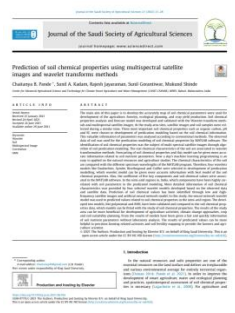
Annexure -A

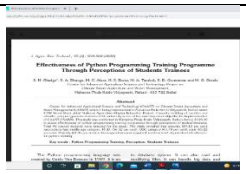
2.2 Knowledge Management Collaterals

Research Articles:

Sl. No	Category of the collateral	Brief summary	Snapshot/ cover page	Weblink (if any)
A. Articles				
1	Article (research-based)	**Title:** Determination of Crop Health Monitoring in MPKV Rahuri, Using Remote Sensing Approach **Authors:** Ankita P. Kamble, A. A. Atre, Payal A. Mahadule, C. B. Pande, N. S. Kute and S. D. Gorantiwar **Journal Name:** Current Journal of Applied Science and Technology		https://www.journalcjast.com/index.php/CJAST/article/view/31291/58714 (doi.org/10.9734/cjast/2021/v40i431291)
2	Article (research based)	**Title:** Application of NDVI in Vegetation Monitoring using Sentinel- 2 Data for Shrirampur Region of Maharashtra **Authors:** Ubale Sonali Jakku Prasanna, A. A. Atre, C. Pande and S. D. Gorantiwar **Journal Name**: International Journal of Current Microbiology and Applied Sciences (IJCMAS)		https://www.ijcmas.com/abstractview.php?ID=20943&vol=10-1-2021&SNo=98 (doi.org/10.20546/ijcmas.2021.1001.098)
3	Article (research-based)	**Title:** Change Analysis of Grape Area for Mavadi Village of Nashik Region Using Satellite Data **Authors:** V. S. Ghule, S. A. Ranpise, S. P. Shinde, C. B. Pande and A. A. Atre **Journal Name:** Multilogic In Science Journal		https://ycjournal.net/Multilogicinscience/ResearchPapers.aspx
4	Article (research-based)	**Title:** Identification of Cropping Pattern in Khadambe bk. Using Sentinel- 2 Images and Arc GIS Software **Authors:** KA Chavan, P. S. Bodake, C. B. Pande, A. A. Atre, S. D. Gorantiwar and A. D. Rau **Journal Name:** International Journal of Current Microbiology and Applied Sciences		https://www.ijcmas.com/abstractview.php?ID=19159&vol=9-9-2020&SNo=141 doi.org/10.20546/ijcmas.2020.909.141

5	Article (research-based)	**Title:** Land Use/Land Cover Change of Rabi Season of Rahuri Taluka of Ahmednagar District Maharashtra **Authors**: Payal A. Mahadule, A. A. Atre, Ankita P. Kamble, C. Pande and S. D. Gorantiwar **Journal Name:** Current Journal of Applied Science and Technology		https://journalcjast.com/index.php/CJAST/article/view/30916 doi.org/10.9734/cjast/2020/v39i2730916
6	Article (research-based)	**Title:** Surface water dynamics analysis based on sentinel imagery and Google Earth Engine Platform: a case study of Jayakwadi dam **Authors:** Vidya. U. Kandekar, Chaitanya. B. Pande, Jayaraman Rajesh, A. A. Atre, S. D. Gorantiwar, S. A. Kadam and Bhau Gavit **Journal Name:** Sustainable Water Resources Management		https://link.springer.com/article/10.1007/s40899-021-00527-7 doi.org/10.1007/s40899-021-00527-7
7	Article (research-based)	**Title:** Training Need of MPKV Ph.D. Students towards Application of Drone Technology in Agriculture **Authors:** M. S. Anarase, G. K. Sasane, S. A. Dhenge, S. D. Gorantiwar, P. A. Ghadage and R. B. Kalamkar **Journal Name:** International Journal of Current Microbiology and Applied Sciences		https://www.ijcmas.com/9-92020/M.%20S.%20Anarase,%20et%20al.pdf doi.org/10.20546/ijcmas.2020.909.427
8	Article (research-based)	**Title:** Drone and its Applications in Agriculture **Authors:** R. B. Kalamkar, M. C. Ahire, P. A. Ghadge, S. A. Dhenge and M. S. Anarase **Journal Name:** International Journal of Current Microbiology and Applied Sciences		https://www.ijcmas.com/9-62020/R.%20B.%20Kalamkar,%20et%20al.pdf doi.org/10.20546/ijcmas.2020.906.363
9	Article (research-based)	**Title:** Water use efficiency in pomegranate" in Global Hi-Tech Horticulture **Authors:** Meshram D.T., S. D. Gorantiwar, U.R. Sangale and Nagraj Bake. 2018. published by ASTRAL.		https://epubs.icar.org.in/index.php/IJAgS/article/view/55942
10	Article (research-based)	**Title:** Association mapping in plants in the post-GWAS genomics era.		doi.org/10.1016/bs.adgen.

		Authors: PK Gupta, PL Kulwal, V Jaiswal (2019) **Journal:** Advances in Genetics 2018.12.001 pp 1-62		
11	Article (research-based)	**Title:** Response of micro-irrigation systems on growth, yield and WUE of Pomegranate (Punica granatum L.) in semi-arid regions of India. **Authors:** D.T. Meshram, S. D. Gorantiwar, N.V. Singh, K.D. Babu. **Journal:** Scientia Horticulture, 246: 686-692. (NAAS rating: 7.96)		https://www.cabdirect.org/cabdirect/abstract/20193071548
12	Article (research-based)	**Title:** Crop Coefficient for Potato Crop Evapotranspiration Estimation by Field Water Balance Method in Semi-Arid Region, Maharashtra, India. **Authors:** S. A. Kadam, S. D. Gorantiwar, N. P. Mandre and D. P. Tale. **Journal:** Potato Research, Journal of the European Association for Potato Research. Potato Res. (NAAS rating 6.86)		https://pubag.nal.usda.gov/catalog/7481660 DOI 10.1007/s11540-020-09484-8
13	Article (research-based)	**Title:** Performance of cabbage at different irrigation levels under drip and micro sprinkler irrigation systems **Authors:** M. G. Shinde, D. D. Pawar, K. D. Kale and S. K. Dingre **Journal:** Irrigation and Drainage		https://doi.org/10.1002/ird.2557
14	Article (research-based)	**Title:** Suitability of Earth Engine Evaporation Flux (EEFlux) Estimation of Evapotranspiration in Rainfed Crops. **Authors:** Sunil A. Kadam, Claudio O. Stockle, Mingliang Liu, Zhongming Gao and Eric S. Russell. **Journal:** Remote Sensing. 2021, 13, 3884. (NAAS rating 10.51)		https://www.mdpi.com/2072-4292/13/19/3884 https://doi.org/10.3390/rs13193884
15	Article (research-based)	**Title:** Prediction of soil chemical properties using multispectral satellite images and wavelet transforms methods. **Authors:** Chaitanya B. Pande, Sunil A. Kadam, Rajesh Jayaraman, Sunil Gorantiwar and Mukund Shinde.		https://doi.org/10.1016/j.jssas.2021.06.016

		Journal: *Journal of the Saudi Society of Agricultural Sciences,* 1658-077 (Impact factor 7.2)		
16	Article (research-based)	Title: Exploration of groundwater potential zones using analytical hierarchical process (AHP) approach in the Godavari river basin of Maharashtra in India Authors: J. Rajesh, Chaitanya B. Pande, Sunil A. Kadam, Sunil D. Gorantiwar and Mukund G. Shinde Journal: Applied Water Science, Springer publication, 11(12), pp.1-11. (Impact Factor 3.87)		https://doi.org/10.1007/s13201-021-01518-x. (Impact Factor 3.87)
17	Article (research-based)	**Title:** Gender Attitude towards Environmental Protection: A Comparative Survey During COVID-19 Lockdown Situation **Authors: S**. A. Dhenge, S. N. Ghadge, M. C. Ahire, S.D. Gorantiwar and M.G. Shinde **Journal:** Environment, Development and Sustainability **Impact Factor-2.191 and NAAS Rating- 9.36**		https://link.springer.com/article/10.1007/s10668-021-02015-6
18	Article (research-based)	Title: Effectiveness of Python programming training programme through perceptions of students trainees		
19	Article (research-based)	**Title:** Characterization of basaltic rock aquifer parameters using hydraulic parameters, Theis's method and aquifer test software in the hard rock area of Buchkewadi watershed, Maharashtra, India **Authors:** S. P. Shinde, V. N. Barai, Nadhir Al-Ansari, B. K. Gavit, S. A. Kadam, A. A. Atre, R. D. Bansod and Ahmed Elbeltagi **Journal:** Applied Water Science, springer journal 2022		https://www.researchgate.net/publication/362412977 https://doi.org/10.1007/s13201-022-01731-2
20	Article (research-based)	**Title:** A review on water resource planning and management with special reference to groundwater using remote sensing and GIS techniques **Authors:** S. P. Shinde, V. N. Barai, R. D. Bansod, A. A. Atre, B. K. Gavit and S. A. Kadam		https://DOI.ORG/10.23910/2/2022.0516b

		Journal: International Journal of Economic Plants		
21	Article (research-based)	**Title: C**orrelating the feld water balance derived crop coefcient (Kc) and canopy refectance-based NDVI for irrigated sugarcane **Authors:** S. K. Dingare, S. D. Gorantiwar and S. A. Kadam **Journal:** Precision Agriculture		https://doi.org/10.1007/s11119-020-09774-8
22	Article (research-based)	**Title:** Variable rate fertilizer application technology for nutrient management: A review **Authors:** Pawase P.P., Nalawade S.M., Bhanage G.B., Walunj A.A., Kadam P.B., Durgude A.G. and Patil M.R.		https://www.ijabe.org/index.php/ijabe/article/view/7671 DOI: 10.25165/j.ijabe.20231604.7671
23	Article (research-based)	**Title:** Comprehensive study of on-the-go sensing and variable rate application of liquid nitrogenous fertilizer **Authors:** Pawase P.P., S.M. Nalawade, A.A. Walunj, G.B. Bhanage, P.B. Kadam, A.G. Durgude and M.R. Patil		https://doi.org/10.1016/j.compag.2023.108482

2. Publications of books under CAAST-CSAWM

Sr. No.	Title of Publications	Publication Type	Published by (Name and address of the organization)	Brief information about publications
1.	Village Level Agriculture Contingency Plans for Climate Proofing of Watersheds in Akole Block, Ahmednagar, Maharashtra	Book	**Name:** Mr. Somnath Choudhury Er. Sachin V. Kamble Dr. Ravi P. Andhale Dr. Prabhat Kumar Dr. Sunil D. Gorantiwar Dr. Mukund G. Shinde Dr. Snehal G. Kanade Dr. Vaibhav S. Malunjkar **Name of the Organizations:** Centre for Advanced Agricultural Science and Technology on Climate Smart Agriculture and	CAAST-CSAWM, MPKV Rahuri, has developed a Village Level Contingent Crop Plan (VLCCP) as part of the project objectives and considering the need to localize the available district and block-level contingent plans at the village level to effectively address the local vulnerability. This plan is innovative, rigorous, and developed for the seven villages of Akole Block (viz., Manhere, Ambevangan, Ladgaon, Titavi, Kodani, Pimparkane and Dongarwadi), Village Level Agriculture Contingency Plans for Climate Proofing of Watersheds in Akole

			Water Management (CAAST-CSAWM), Mahatma Phule Krishi Vidyapeeth Rahuri, Ahmednagar	Block, Ahmednagar, Maharashtra Ahmednagar district.
2	A Complete Objectives Agriculture books for ICARJRF, SRF, NET&ARS State Agri Services, IBPS and NABARD Exams	Book	**Name**: Dr. Sevak Dhenge, Dr. Shubhangi Ghadge, Dr. Prabhat Kumar, Dr. Milind Ahire, Dr. Sunil Gornatiwar and Dr. Sachin Sadaphal **Name of the Organizations:** Centre for Advanced Agricultural Science and Technology on Climate Smart Agriculture and Water Management (CAAST-CSAWM), Mahatma Phule Krishi Vidyapeeth Rahuri, Ahmednagar	This book is useful for competitive examinations like, ICAR- JRF, SRF, NET & ARS, IBPS, NABARD, FCI, CWC, NSC, and State Agri Services. In the light of this book is designed and framed according to the requirement of these exams. It includes objective questions on various disciplines of Agriculture like Agronomy, Soil Science and Agricultural Chemistry, Horticulture, Plant Breeding, Plant Pathology, Seed Science, Biochemistry, Agricultural Meteorology, Agricultural Biotechnology, Entomology, nematology, Agricultural Extension &Communication, Agricultural Economics, Farm Management & Power Engineering,
3	Agri-entrepreneurship challenges and opportunities	Book	**Name**: Dr. Sevak Dhenge, Dr. Shubhangi Ghadge, Dr. Prabhat Kumar, Dr. Milind Ahire, Dr. Sunil Gornatiwar and Dr. Sachin Sadaphal **Name of the Organizations:** Centre for Advanced Agricultural Science and Technology on Climate Smart Agriculture and Water Management (CAAST-CSAWM),	The book consists of 32 chapters presented in ten parts: Agri-Entrepreneurship Development, Market-Led Extension, Digital Marketing, Market Research, Farmer Producer Organizations, Supply Chain Management of Agriculture Produce, SWOT Analysis, Success stories, Case Studies and Techno-Economic Assessment. It allows readers new to the area to gain an understanding of agri-entrepreneurship and provides a solid basis for starting a business in the future.

			Mahatma Phule Krishi Vidyapeeth Rahuri, Ahmednagar	
4	Agriculture 4.0 Precision & Automated Ag. Technologies	Book	**Name:** Dr. M.G. Shinde Dr. S.D. Gorantiwar Dr. Prabhat Kumar Dr. S.M. Nalawade Dr.A.A. Atre Dr.J. Rajesh Dr.V.S. Malunjkar Dr. C.B.Pande Dr.N.J. Deshmukh Dr.Y.S. Dighe **Name of the Organizations:** Centre for Advanced Agricultural Science and Technology on Climate Smart Agriculture and Water Management (CAAST-CSAWM), Mahatma Phule Krishi Vidyapeeth Rahuri, Ahmednagar	Agricultural technologies are rapidly evolving towards a new paradigm-Agriculture 4.0. Precision and Automated Ag. Technologies. Within this paradigm, digitalization, automation, remote sensing, GIS, irrigation system and technologies, image analysis of unmanned aerial vehicles-based data for phenotyping applications, artificial intelligence, Global Positioning System, agriculture robotics, drones, information and communications technology, and Internet of things play a major role in crop production, including weeding,pest control and engagement practices.
5	Protected Cultivation Technologies for Climate Smart Agriculture	Book	**Name:** Dr. S.D. Gorantiwar Dr. Prabhat Kumar Mrs. J.S. Pachpute Dr. Shrikant Kulkarni Dr. Pradip N. Dalavi **Name of the Organizations:** Centre for Advanced Agricultural Science and Technology on Climate Smart Agriculture and Water Management (CAAST-CSAWM), Mahatma Phule Krishi Vidyapeeth Rahuri, Ahmednagar	The book is entitled “Protected Cultivation Technologies for Climate Smart Agriculture” encompasses a galore of relevant and plenteous information on all the keynotes of a course “Protected Cultivation Technologies for Climate Smart Agriculture”. For successful horticultural crop production in protected cultivation, detailed knowledge about different protected cultivation technology is essential.
6	Climate-Smart Digital Agricultural Villages: an MPKV initiative	Bulletin 2021-22	**Name of the Organizations:** Centre for Advanced Agricultural Science and Technology on Climate Smart Agriculture and Water Management (CAAST-CSAWM),	The climate-smart agriculture techniques with the Digital Agriculture techniques to constitute and establish Climate-Smart Digital Agricultural Village(CSDAV) (Figure 5). The adopted villages should be converted into Climate Smart Digital Agricultural Villages

			Mahatma Phule Krishi Vidyapeeth Rahuri, Ahmednagar	(CSDAV). It will ensure optimum productivity, profitability, resource use efficiency, sustainability (social, environmental, economical) and make farming more attractive and remunerative.

3. Publications of bulletin under CAAST-CSAWM

Sr. No.	Title of Publications	Publication Type	Published by (Name and address of the organization)	Brief information about publications
1.	Soil Management for Climate Smart Agriculture	Book	**Name:** Dr.B.D. Bhakare Dr. A.G. Durgude Dr.Prabhat Kumar DR. R.C. Agrawal Dr. S.D. Gorantiwar Dr. M.G. Shinde Dr. N.B. Kondhvilkar Dr. A.J. Musmade **Name of the Organizations:** Centre for Advanced Agricultural Science and Technology on Climate Smart Agriculture and Water Management (CAAST-CSAWM), Mahatma Phule Krishi Vidyapeeth Rahuri, Ahmednagar	This book is a very useful for the researchers, scientist and agriculture students for the understanding of the status and challenges of soils under climate change to select appropriate climate smart soil management options for enhancing the agriculture production system and effectively implement climate smart soil management practices and develop technical expertise for broader adoption of these measures.
2.	Climate Smart Organic Farming	Book	**Name:** Dr. Ulhas S. Surve, Dr. S. D. Gorantiwar Dr. M. G. Shinde Dr. R.C. Agrawal Dr. Prabhat Kumar Dr. S. D. Thorat Dr. R. K. Sonawane Er. M.A. Tamboli Dr. Shubhangi N. Ghadge **Name of the Organizations:** Centre for Advanced Agricultural Science and Technology on Climate Smart Agriculture and Water Management (CAAST-CSAWM),	This book is a very useful for the researchers, scientist, and agriculture students for the understanding of the status and challenges of organic agriculture and how it enhancs agro-ecosystem health including biodiversity, biological cycle, and soil biological activity.

			Mahatma Phule Krishi Vidyapeeth Rahuri, Ahmednagar	
3	Drones Technology and its Applications in Agriculture	Book	**Name:** Dr. S.M. Nalawade, Dr. S. D. Gorantiwar Dr. M. G. Shinde Dr. R.C. Agrawal Dr. Prabhat Kumar Dr. (Ms) Anuradha Agrawal Dr. G.B. Bhanage Er.Y.S. Dighe Er.S.R. Warale **Name of the Organizations:** Centre for Advanced Agricultural Science and Technology on Climate Smart Agriculture and Water Management (CAAST-CSAWM), Mahatma Phule Krishi Vidyapeeth Rahuri, Ahmednagar	Agricultural drone technology has advanced in recent years, and farmers are beginning to see the benefits of using drones in agriculture. Drones enable farmers to continuously monitor crop and livestock conditions remotely, allowing them to detect problems that would otherwise go undetected during ground-level spot checks. Agriculture drone applications range from mapping and surveying to crop dusting and spraying.
4	Basic Geoinformatics for Climate Smart Agriculture	Book	**Name:** Dr. B.K. Gavit Dr. S.A. Kadam Dr.S. D Gorantiwar Dr. R.C. Agrawal Dr. Prabhat Kumar Dr. (Ms) Anuradha Agrawal Dr. M. G. Shinde Dr. A.A. Atre Dr. S.B. Nandgude Dr. J. Rajesh Dr. C.B. Pande **Name of the Organizations:** Centre for Advanced Agricultural Science and Technology on Climate Smart Agriculture and Water Management (CAAST-CSAWM), Mahatma Phule Krishi Vidyapeeth Rahuri, Ahmednagar	Geo-informatics is an emerging field and there is a great demand for geoinformatics professionals due to its application potential in several fields such as agriculture, rural and urban planning, environmental monitoring, natural resources management, natural hazards and disasters management etc.
5.	Hyperspectral Imaging (HySpec) Laboratory	Bulletin	**Name of the Organizations:**	Hyperspectral imaging analyses the spectrum of reflected light and correlates it with crop and soil

			Centre for Advanced Agricultural Science and Technology on Climate Smart Agriculture and Water Management (CAAST-CSAWM), Mahatma Phule Krishi Vidyapeeth Rahuri, Ahmednagar	parameters using hyperspectral imaging cameras placed on unmanned aerial vehicles (UAVs). The applications of Hyperspectral imaging are most cost-effective technology in agriculture. Precision farming, climate-smart agriculture, and water management all benefit from hyper spectral imaging technologies.
6	Internet of Things (IoT) and Sensors Laboratory	Bulletin 2022-23	**Name of the Organizations:** Centre for Advanced Agricultural Science and Technology on Climate Smart Agriculture and Water Management (CAAST-CSAWM), Mahatma Phule Krishi Vidyapeeth Rahuri, Ahmednagar	Internet of Things (IoT) is the advanced technology of digital farming which connects the things with people on a tip of hand by providing the real time data and information. By adoption of IoT technologies, it is possible for farmers to optimize the use of inputs and save on the production cost. IoT is the network of smart devices, sensors and actuators that interconnects with each other and provides the decision on time.
7	Precision Machinery	Bulletin	**Name of the Organizations:** Centre for Advanced Agricultural Science and Technology on Climate Smart Agriculture and Water Management (CAAST-CSAWM), Mahatma Phule Krishi Vidyapeeth Rahuri, Ahmednagar	Precision agriculture (PA) is to strive for profitability, efficiency, and sustainability on the farm. Application of the different crop inputs according to the crop requirement at right place, right amount and right time by protecting the environment. Precision machinery can increase the profit of farmers by reducing the cost of cultivation and saving additional cost on input with higher crop yield
8	Robotics Laboratory	Bulletin	**Name of the Organizations:** Centre for Advanced Agricultural Science and Technology on Climate Smart Agriculture and Water Management (CAAST-CSAWM), Mahatma Phule Krishi Vidyapeeth Rahuri, Ahmednagar	The robot is autonomous operated machine which minimises human effort, robots may not resemble human beings in appearance, but they can function like human. A robot has a movable physical structure, motors, sensor system, power supply and a computer, that controls all of these elements.
9	Soil-Plant-Water Analysis Laboratory	Bulletin	**Name of the Organizations:** Centre for Advanced Agricultural Science and Technology on Climate Smart Agriculture and	Soil analysis is a valuable tool for determination of the agricultural inputs required for efficient and economic crop production. Soil, Plant, Water and Fertilizer analysis is essential for various of

			Water Management (CAAST-CSAWM),	reasons, including optimizing crop production, protecting the environment from contamination caused by runoff and leaching of excess fertilizers, assisting in the diagnosis of plant culture problems, improving the nutritional balance of the growing media, and saving money and energy by applying only the amount of fertilizer required.
10	Unmanned Aerial Vehicle (UAV) Laboratory	Bulletin	**Name of the Organizations:** Centre for Advanced Agricultural Science and Technology on Climate Smart Agriculture and Water Management (CAAST-CSAWM), Mahatma Phule Krishi Vidyapeeth	The drone is known as dynamically remotely operated navigator equipment which is also known as unmanned aerial vehicle (UAV). The UAVs are of different types based on the applications as well as different parameters like type of landing, weight of UAV etc. The UAVs are used for different applications like from agriculture to military.

Annexure-B

2.2 Knowledge Management Collaterals

Sr. No.	Title	Year of publication	Authors
Mobile Applications Developed			
1.	Teacher evaluation system (TES)	2021	1. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 2. Dr. Ashok L. Pharande, Former Dean & Director of Instruction, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 3. Dr. R.C. Agrawal, National Director, ICAR-NAHEP and DDG, Edu., ICAR, 513, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012 4. Dr. Prabhat Kumar, National Coordinator, CAAST, ICAR-NAHEP, 508, Krishi Anusandhan Bhawan- II, New Delhi-110012 5. Dr. Vaibhav S. Malunjkar, Research Associate, SWCE, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 6. Er. Mohasin A. Tamboli, Research Associate, Comp. App., CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 7. Dr. Mukund G. Shinde, Co-Principal Investigator, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722
2.	Real time estimation of location-specific evapotranspiration (Spatial Etr)	2021	1. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist: Ahmednagar, Maharashtra-413722 2. Dr. Sunil A. Kadam, Member, CAAST-CSAWM and Assistant Professor, IDE, AICRP on IWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 3. Dr. R.C. Agrawal, National Director, ICAR-NAHEP and DDG, Edu., ICAR, 513, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012 4. Dr. Prabhat Kumar, National Coordinator, CAAST, ICAR-NAHEP, 508, Krishi Anusandhan Bhawan- II, New Delhi-110012 5. Dr. Atul A. Atre, Member, CAAST-CSAWM and Professor, Dept. of SWCE, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 6. Dr. Mukund G. Shinde, Co-Principal Investigator, CAAST-CSAWM and Professor, Dept. of SWCE, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 7. Er. Mohasin A. Tamboli, Research Associate, CA, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722

			8. Dr. Mangesh N. Baviskar, Research Associate, Hort., CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar Maharashtra-413722
3.	Real time estimation of location-specific real-time irrigation water requirement (Spatial IWR)	2021	1. Dr. S. A. Kadam, Associate Professor of IDE and CAAST-CSAWM Team Member, MPKV, Rahuri 2. Dr. S. D. Gorantiwar, Head, Dept. of Agril. Engg. and PI, CAAST-CSAWM, MPKV, Rahuri 3. Dr. M. G. Shinde, Professor of SWCE and Co-PI, CAAST-CSAWM, MPKV, Rahuri 4. Dr. M. A. Patil, Ex-Research Associate (IDE), CAAST-CSAWM, MPKV, Rahuri 5. Dr. P. B. Jadhav, Research Associate (IDE), CAAST-CSAWM, MPKV, Rahuri 6. Dr. R.V. Salunkhe, Ex-Research Associate (IDE), CAAST-CSAWM, MPKV, Rahuri 7. Dr. M. N. Baviskar, Research Associate (Horticulture), CAAST-CSAWM, MPKV, Rahuri 8. Er. M. A. Tamboli, Research Associate (Computer Application), CAAST-CSAWM, MPKV, Rahuri
4.	Village level contingency crop plan (VLCCP)	2022	1. Dr. Ravi P. Andhale, Associate Professor, Agronomy and Member, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 2. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 3. Dr. Mukund G. Shinde, Co-Principal Investigator, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 4. Dr. R.C. Agrawal, National Director, ICAR-NAHEP and DDG, Edu., ICAR, 513, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012 5. Dr. Prabhat Kumar, National Coordinator, CAAST, ICAR-NAHEP, 508, Krishi Anusandhan Bhawan- II, New Delhi-110012 6. Dr. Atul A. Atre, Procurement Officer, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 7. Dr. Jaywant D. Jadhav, Professor, Agrometeorology, Member, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 8. Dr. Snehal G. Kanade, Research Associate, Agrometeorology, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 9. Dr. Vaibhav S. Malunjkar, Research Associate, SWCE, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722
5.	Phule Smart Weather (PSW)	2022	1. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 2. Dr. Ravi P. Andhale, Associate Professor, Agronomy and Member, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722

			3. Dr. Mukund G. Shinde, Co-Principal Investigator, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 4. Dr. R.C. Agrawal, National Director, ICAR-NAHEP and DDG, Edu., ICAR, 513, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012 5. Dr. Prabhat Kumar, National Coordinator, CAAST, ICAR-NAHEP, 508, Krishi Anusandhan Bhawan- II, New Delhi-110012 6. Dr. Atul A. Atre, Procurement Officer, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 7. Dr. Snehal G. Kanade, Research Associate, Agrometeorology, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 8. Dr. Vaibhav S. Malunjkar, Research Associate, SWCE, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722
6.	Phule Smart Fertilizer Calculator (PSTT)	2022	1. Dr. Mukund G. Shinde, Co-Principal Investigator, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 2. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 3. Dr. Ashok L. Pharande, Former Dean & Director of Instruction, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 4. Dr. R.C. Agrawal, National Director, ICAR-NAHEP and DDG, Edu., ICAR, 513, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012 5. Dr. Prabhat Kumar, National Coordinator, CAAST, ICAR-NAHEP, 508, Krishi Anusandhan Bhawan- II, New Delhi-110012 6. Dr. Atul A. Atre, Procurement Officer, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 7. Er. Kalpesh S. Borse, Research Associate, WREM, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 8. Dr. Vaibhav S. Malunjkar, Research Associate, SWCE, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722
7.	Phule Pest and Disease Management (PPDM)	2021	1. Dr. Pawan L. Kulwal, Member, CAAST-CSAWM and Professor of Agril. Botany, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 2. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist: Ahmednagar, Maharashtra-413722 3. Dr. Ashok L. Pharande, Dean, Faculty of Agriculture and Director of Instruction, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722

			4. Dr. R.C. Agrawal, National Director, ICAR-NAHEP and DDG, Edu., ICAR, 513, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012 5. Dr. Prabhat Kumar, National Coordinator, CAAST, ICAR-NAHEP, 508, Krishi Anusandhan Bhawan- II, New Delhi-110012 6. Dr. Sunil A. Kadam, Member, CAAST-CSAWM and Assistant Professor, IDE, AICRP on IWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 7. Dr. Ranjit V. Kadu, Senior Research Assistant, Dept. of Agril. Entomology, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 8. Dr. Nandlal J. Deshmukh, Research Associate, PP, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722
8.	Auto Phule Irrigation Scheduler (AutoPIS)	2021	1. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 2. Dr. Mukund G. Shinde, Co- Principal Investigator, CAAST-CSAWM and Associate Professor, SWCE, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 3. Dr. Sunil A. Kadam, Member, CAAST-CSAWM and Assistant Professor, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 4. Dr. R.C. Agrawal, National Director, ICAR-NAHEP and DDG, Edu., ICAR, 513, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012 5. Dr. Prabhat Kumar, National Coordinator, CAAST, ICAR-NAHEP, 508, Krishi Anusandhan Bhawan- II, New Delhi-110012 6. Dr. Pramod G. Popale, Scientist, AICRP on Irrigation Water Management, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 7. Er. Tejashree L. Nawale, Research Associate, ENTC, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 8. Er. Mohasin A. Tamboli, Research Associate, Computer Applications, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722
9.	Smart Phule Irrigation Scheduler (Smart PIS)	2022	1. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 2. Dr. Mukund G. Shinde, Co- Principal Investigator, CAAST-CSAWM and Associate Professor, SWCE, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 3. Dr. Sunil A. Kadam, Member, CAAST-CSAWM and Assistant Professor, Dept. of Agril. Engg., Mahatma Phule

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10.	Phule Soil Moisture based Irrigation Scheduling System (PSMISS)	2022	1. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 2. Dr. R.C. Agrawal, National Director, ICAR-NAHEP and DDG, Edu., ICAR, 513, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012 3. Dr. Prabhat Kumar, National Coordinator, CAAST, ICAR-NAHEP, 508, Krishi Anusandhan Bhawan- II, New Delhi-110012 4. Dr. Pradnya B. Jadhav, Research Associate, IDE, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 5. Dr. Anjali J. Musmade, Research Associate, IT, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722
11.	Services for Agricultural Mechanization (Phule SAM)	2021	1. Dr. Sachin M. Nalawade, Member, CAAST-CSAWM and Head, Dept. of FMPE , Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar Maharashtra-413722 2. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar Maharashtra-413722 3. Dr. Ashok L. Pharande, Dean, Faculty of Agriculture and Director of Instruction, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar Maharashtra-413722 4. Dr. R.C. Agrawal, National Director, ICAR-NAHEP and DDG, Education, ICAR, 513, Krishi Anusandhan, Bhavan-Ii, Pusa, New Delhi-110012 5. Dr. Prabhat Kumar, National Coordinator, CAAST, ICAR-NAHEP , 508, Krishi Anusandhan Bhawan - Ii, New Delhi-110012 6. Dr. Mukund G. Shinde, Co-Principal Investigator, CAAST-CSAWM and Professor, Dept. of SWCE , Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar Maharashtra-413722 7. Dr. Girishkumar B. Bhanage, Research Associate, FMPE, CAAST-CSAWM , Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar Maharashtra-413722 8. Er. Yogesh S. Dighe, Research Associate, Mechanical Engg., CAAST-CSAWM , Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar Maharashtra-413722

12.	Software to Assess Need of Mechanization and Available Network (Phule SANMAN)	2022	1. Dr. Sachin M. Nalawade, Member, CAAST-CSAWM and Head, Dept. of FMPE, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 2. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 3. Dr. Atul A. Atre, Procurement Officer, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 4. Dr. R.C. Agrawal, National Director, ICAR-NAHEP and DDG, Edu., ICAR, 513, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012 5. Dr. Prabhat Kumar, National Coordinator, CAAST, ICAR-NAHEP, 508, Krishi Anusandhan Bhawan- II, New Delhi-110012 6. Dr. Girishkumar B. Bhanage, Research Associate, FMPE, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 7. Er. Shivprasad S. Gunjkar, M.Tech. Student, Dept. of FMPE, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 8. Er. Yogesh S. Dighe, Research Associate, Mechanical Engg., CAAST-CSAWM, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722
13.	Phule IoT enabled Siphon System for irrigation from Farm Pond (Phule SiPond)	2023	1. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 2. Dr. Mukund G. Shinde, Co- Principal Investigator, CAAST-CSAWM and Associate Professor, SWCE, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 3. Dr. R.C. Agrawal, National Director, ICAR-NAHEP and DDG, Edu., ICAR, 513, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012 4. Dr. Prabhat Kumar, National Coordinator, CAAST, ICAR-NAHEP, 508, Krishi Anusandhan Bhawan- II, New Delhi-110012 5. Dr. Sunil A. Kadam, Member, CAAST-CSAWM and Assistant Professor, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 6. Dr. Pradnya B. Jadhav, Research Associate, IDE, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 7. Dr. Rajanee V. Salukhe, Research Associate, Ide, CAAST-CSAWM, Mahatma Phule Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 8. Dr. Anjali J. Musmade, Research Associate, IT, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 9. Dr. Vaibhav S. Malunjkar, Research Associate, SWCE, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722

			10. Dr. Mangal A. Patil, Former Research Associate, IDE, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 11. Er. Shraddha R. Warale, Former Research Associate, ENTC, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722
14.	Phule Smart Fertilizer Calculator	2022	1. Dr. Bapusaheb D. Bhakare, Member, CAAST-CSAWM and Head, Dept. of SSAC, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 2. Dr. Pramod N. Rasal, Dean and Director of Instruction, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 3. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 4. Dr. Anil G. Durgude, Member, CAAST-CSAWM and Assistant Professor, Dept. of SSAC, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 5. Dr. R.C. Agrawal, National Director, ICAR-NAHEP and DDG, Edu., ICAR, 513, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012 6. Dr. Prabhat Kumar, National Coordinator, CAAST, ICAR-NAHEP, 508, Krishi Anusandhan Bhawan- II, New Delhi-110012 7. Dr. Mukund G. Shinde, Co- Principal Investigator, CAAST-CSAWM and Associate Professor, SWCE, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 8. Dr. Vijaykumar S. Patil, Soil Chemist, AICRP on STCR, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 9. Dr. Nilam B. Kondvilkar, Research Associate, SCAC, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 10. Dr. Anjali J. Musmade, Research Associate, IT, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 11. Dr. Dalit Kumar Jayswal, Research Associate, Horticulture, PIU-NAHEP, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012
15.	Framework for crop information system (Phule crop apps)	2022	1. Dr. Ulhas S. Surve, Member, CAAST-CSAWM and Chief Agronomist, AICRP-IFS, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 2. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 3. Dr. Pramod N. Rasal, Dean and Director of Instruction, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra- 413722 4. Dr. Mukund G. Shinde, Co- Principal Investigator, CAAST-CSAWM and Associate Professor, SWCE, Mahatma Phule

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16.	Phule rainfall erosivity factor (R) calculator	2023	1. Dr. Mukund G. Shinde, Co- Principal Investigator, CAAST-CSAWM and Associate Professor, SWCE, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 2. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 3. Dr. Atul A. Atre, Procurement Officer, CAAST-CSAWM and Associate Professor, SWCE, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 4. Dr. Vaibhav S. Malunjkar, Research Associate, SWCE, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722
17.	Phule trench water level recorder	2023	1. Dr. Mukund G. Shinde, Co- Principal Investigator, CAAST-CSAWM and Associate Professor, SWCE, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 2. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722

			3. Dr. Vaibhav S. Malunjkar, Research Associate, SWCE, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 4. Er. Tejashree L. Nawale, Research Associate, ENTC, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722
18 - 40	Phule crop apps (22) Rice, Wheat, Maize, Sorghum, Pearl millet, Finger millet, Little millet, Barnyard millet, Chickpea, Pigeonpea, Green gram, Black gram, Soybean, Ground nut, Summer Ground nut, Sesamum, Niger, Cotton, Deshi Cotton, Sugarcane, Turmeric, Ginger.	2022	1. Dr. Ulhas S. Surve, Member, CAAST-CSAWM and Chief Agronomist, AICRP-IFS, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 2. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 3. Dr. Pramod N. Rasal, Dean and Director of Instruction, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra- 413722 4. Dr. Mukund G. Shinde, Co- Principal Investigator, CAAST-CSAWM and Associate Professor, SWCE, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 5. Dr. Atul A. Atre, Procurement Officer, CAAST-CSAWM and Associate Professor, SWCE, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 6. Dr. Sachin S. Sadaphal, Member, CAAST-CSAWM and Assistant Professor, Agril. Extn. Edu. & Comm., Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 7. Dr. Sunil A. Kadam, Member, CAAST-CSAWM and Assistant Professor, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 8. Dr. R.C. Agrawal, National Director, ICAR-NAHEP and DDG, Edu., ICAR, 513, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012 9. Dr. Prabhat Kumar, National Coordinator, CAAST, ICAR-NAHEP, 508, Krishi Anusandhan Bhawan- II, New Delhi-110012 10. Dr. Rohit K. Sonawane, Research Associate, Agro.., CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 11. Dr. Vaibhav S. Malunjkar, Research Associate, SWCE, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 12. Er. Mohasin A. Tamboli, Research Associate, Comp. App., CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 13. Dr. Dalit Kumar Jayswal, Research Associate, Horticulture, PIU-NAHEP, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012

Sr. No.	Title	Year of publication	Authors
Web Applications Developed			
1	Teacher evaluation system (TES)	2021	1. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 2. Dr. Ashok L. Pharande, Former Dean & Director of Instruction, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 3. Dr. R.C. Agrawal, National Director, ICAR-NAHEP and DDG, Edu., ICAR, 513, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012 4. Dr. Prabhat Kumar, National Coordinator, CAAST, ICAR-NAHEP, 508, Krishi Anusandhan Bhawan- II, New Delhi-110012 5. Dr. Vaibhav S. Malunjkar, Research Associate, SWCE, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 6. Er. Mohasin A. Tamboli, Research Associate, Comp. App., CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 7. Dr. Mukund G. Shinde, Co-Principal Investigator, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722
2	Real time estimation of location-specific evapotranspiration (Spatial Etr)	2021	1. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist: Ahmednagar, Maharashtra-413722 2. Dr. Sunil A. Kadam, Member, CAAST-CSAWM and Assistant Professor, IDE, AICRP on IWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 3. Dr. R.C. Agrawal, National Director, ICAR-NAHEP and DDG, Edu., ICAR, 513, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012 4. Dr. Prabhat Kumar, National Coordinator, CAAST, ICAR-NAHEP, 508, Krishi Anusandhan Bhawan- II, New Delhi-110012 5. Dr. Atul A. Atre, Member, CAAST-CSAWM and Professor, Dept. of SWCE, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 6. Dr. Mukund G. Shinde, Co-Principal Investigator, CAAST-CSAWM and Professor, Dept. of SWCE, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 7. Er. Mohasin A. Tamboli, Research Associate, CA, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 8. Dr. Mangesh N. Baviskar, Research Associate, Hort., CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar Maharashtra-413722

3	Real time estimation of location-specific real-time irrigation water requirement (Spatial IWR)	2021	1. Dr. S. A. Kadam, Associate Professor of IDE and CAAST-CSAWM Team Member, MPKV, Rahuri 2. Dr. S. D. Gorantiwar, Head, Dept. of Agril. Engg. and PI, CAAST-CSAWM, MPKV, Rahuri 3. Dr. M. G. Shinde, Professor of SWCE and Co-PI, CAAST-CSAWM, MPKV, Rahuri 4. Dr. M. A. Patil, Ex-Research Associate (IDE), CAAST-CSAWM, MPKV, Rahuri 5. Dr. P. B. Jadhav, Research Associate (IDE), CAAST-CSAWM, MPKV, Rahuri 6. Dr. R.V. Salunkhe, Ex-Research Associate (IDE), CAAST-CSAWM, MPKV, Rahuri 7. Dr. M. N. Baviskar, Research Associate (Horticulture), CAAST-CSAWM, MPKV, Rahuri 8. Er. M. A. Tamboli, Research Associate (Computer Application), CAAST-CSAWM, MPKV, Rahuri
4	Village level contingency crop plan (VLCCP)	2022	1. Dr. Ravi P. Andhale, Associate Professor, Agronomy and Member, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 2. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 3. Dr. Mukund G. Shinde, Co-Principal Investigator, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 4. Dr. R.C. Agrawal, National Director, ICAR-NAHEP and DDG, Edu., ICAR, 513, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012 5. Dr. Prabhat Kumar, National Coordinator, CAAST, ICAR-NAHEP, 508, Krishi Anusandhan Bhawan- II, New Delhi-110012 6. Dr. Atul A. Atre, Procurement Officer, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 7. Dr. Jaywant D. Jadhav, Professor, Agrometeorology, Member, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 8. Dr. Snehal G. Kanade, Research Associate, Agrometeorology, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 9. Dr. Vaibhav S. Malunjkar, Research Associate, SWCE, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722
5	CAAST Admin Dashboard (CAD)	2022	1. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 2. Dr. Ravi P. Andhale, Associate Professor, Agronomy and Member, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 3. Dr. Mukund G. Shinde, Co-Principal Investigator, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722

			4. Dr. R.C. Agrawal, National Director, ICAR-NAHEP and DDG, Edu., ICAR, 513, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012 5. Dr. Prabhat Kumar, National Coordinator, CAAST, ICAR-NAHEP, 508, Krishi Anusandhan Bhawan- II, New Delhi-110012 6. Dr. Atul A. Atre, Procurement Officer, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 7. Dr. Snehal G. Kanade, Research Associate, Agrometeorology, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 8. Dr. Vaibhav S. Malunjkar, Research Associate, SWCE, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722
6	Phule Smart Fertilizer Calculator (PSTT)	2022	1. Dr. Mukund G. Shinde, Co-Principal Investigator, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 2. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 3. Dr. Ashok L. Pharande, Former Dean & Director of Instruction, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 4. Dr. R.C. Agrawal, National Director, ICAR-NAHEP and DDG, Edu., ICAR, 513, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012 5. Dr. Prabhat Kumar, National Coordinator, CAAST, ICAR-NAHEP, 508, Krishi Anusandhan Bhawan- II, New Delhi-110012 6. Dr. Atul A. Atre, Procurement Officer, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 7. Er. Kalpesh S. Borse, Research Associate, WREM, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 8. Dr. Vaibhav S. Malunjkar, Research Associate, SWCE, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722
7	Phule Smart Fertilizer Calculator	2022	1. Dr. Bapusaheb D. Bhakare, Member, CAAST-CSAWM and Head, Dept. of SSAC, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 2. Dr. Pramod N. Rasal, Dean and Director of Instruction, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 3. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 4. Dr. Anil G. Durgude, Member, CAAST-CSAWM and Assistant Professor, Dept. of SSAC, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 5. Dr. R.C. Agrawal, National Director, ICAR-NAHEP and DDG, Edu., ICAR, 513, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012

			6. Dr. Prabhat Kumar, National Coordinator, CAAST, ICAR-NAHEP, 508, Krishi Anusandhan Bhawan- II, New Delhi-110012 7. Dr. Mukund G. Shinde, Co- Principal Investigator, CAAST-CSAWM and Associate Professor, SWCE, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 8. Dr. Vijaykumar S. Patil, Soil Chemist, AICRP on STCR, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 9. Dr. Nilam B. Kondvilkar, Research Associate, SCAC, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 10. Dr. Anjali J. Musmade, Research Associate, IT, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 11. Dr. Dalit Kumar Jayswal, Research Associate, Horticulture, PIU-NAHEP, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012
8	Framework for Training Evaluation web application	2022	1. Dr. Milind C. Ahire, Member, CAAST-CSAWM and Associate Dean, PAHCA, Halgaon, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 2. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 3. Dr. Mukund G. Shinde, Co- Principal Investigator, CAAST-CSAWM and Associate Professor, SWCE, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 4. Dr. Sachin S. Sadaphal, Member, CAAST-CSAWM and Assistant Professor, Agril. Extn. Edu. & Comm., Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 5. Dr. R.C. Agrawal, National Director, ICAR-NAHEP and DDG, Edu., ICAR, 513, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012 6. Dr. Prabhat Kumar, National Coordinator, CAAST, ICAR-NAHEP, 508, Krishi Anusandhan Bhawan- II, New Delhi-110012 7. Dr. Shubhangi N. Ghadage, Research Associate, Agril. Extn., CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 8. Dr. Vaibhav S. Malunjkar, Research Associate, SWCE, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, 9. Ahmednagar, Maharashtra-413722 10. Er. Mohasin A. Tamboli, Research Associate, Comp. App., CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 11. Dr. Sevak A. Dhenge, Former Research Associate, SS, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722

Annexure-C

Number of IPR (Intellectual Property Rights) Registered/Obtained

1. Copyrights

Sr. No.	Inventor/s (Authors) Name	Title of the Copyright	Copyright registration Date	Copyright registration Number (RoC)	Proof
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2.	1. Dr. Sachin M. Nalawade, Member, CAAST-CSAWM and Head, Dept. of FMPE , Mahatma Phule Krishi Vidyapeeth, Rahuri,	Services for Agricultural Mechanisation (Phule-SAM)	09.04.2021	SW-14384/2021	

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3.	1. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist: Ahmednagar, Maharashtra-413722 2. Dr. Sunil A. Kadam, Member, CAAST-CSAWM and Assistant	Spatial ETr	13.04.2021	SW-14399/2021	

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4.	1. Dr. Pawan L. Kulwal, Member, CAAST-CSAWM and Professor of Agril. Botany, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 2. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri,	Phule- Pest and Disease Management (PPDM)	13.04.2021	SW-14400/2021	

	Dist: Ahmednagar, Maharashtra-413722 3. Dr. Ashok L. Pharande, Dean, Faculty of Agriculture and Director of Instruction, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 4. Dr. R.C. Agrawal, National Director, ICAR-NAHEP and DDG, Edu., ICAR, 513, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012 5. Dr. Prabhat Kumar, National Coordinator, CAAST, ICAR-NAHEP, 508, Krishi Anusandhan Bhawan- II, New Delhi-110012 6. Dr. Sunil A. Kadam, Member, CAAST-CSAWM and Assistant Professor, IDE, AICRP on IWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 7. Dr. Ranjit V. Kadu, Senior Research Assistant, Dept. of Agril. Entomology, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 8. Dr. Nandlal J. Deshmukh, Research Associate, PP, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722				
5.	1. Dr. Mukund G. Shinde, Co-Principal Investigator, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 2. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 3. Dr. Ashok L. Pharande, Former Dean & Director of Instruction, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722	Phule Soil Textural Triangle	25.01.2022	SW-15219/2022	

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6.	1. Dr. Mukund G. Shinde, Co-Principal Investigator, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 2. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 3. Dr. Ashok L. Pharande, Former Dean & Director of Instruction, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 4. Dr. R.C. Agrawal, National Director, ICAR-NAHEP and DDG, Edu., ICAR, 513, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012 5. Dr. Prabhat Kumar, National Coordinator, CAAST, ICAR-NAHEP, 508, Krishi Anusandhan Bhawan- II, New Delhi-110012 6. Dr. Atul A. Atre, Procurement Officer, CAAST-CSAWM, Mahatma Phule Krishi	Phule Soil Textural Triangle (Web-based)	25.01.2022	SW-15220/2022	

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7.	1. Dr. Ravi P. Andhale, Associate Professor, Agronomy and Member, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 2. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 3. Dr. Mukund G. Shinde, Co-Principal Investigator, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 4. Dr. R.C. Agrawal, National Director, ICAR-NAHEP and DDG, Edu., ICAR, 513, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012 5. Dr. Prabhat Kumar, National Coordinator, CAAST, ICAR-NAHEP, 508, Krishi Anusandhan Bhawan- II, New Delhi-110012 6. Dr. Atul A. Atre, Procurement Officer, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 7. Dr. Jaywant D. Jadhav, Professor, Agrometeorology, Member, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 8. Dr. Snehal G. Kanade, Research Associate, Agrometeorology, CAAST-CSAWM, Mahatma Phule	Village Level Contingency Crop Plan (VLCCP)	25.01.2022	SW-15221/2022	

	Krishi Vidyapeeth, Rahuri, Maharashtra-413722 9. Dr. Vaibhav S. Malunjkar, Research Associate, SWCE, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722				
8.	1. Dr. Ravi P. Andhale, Associate Professor, Agronomy and Member, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 2. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 3. Dr. Mukund G. Shinde, Co-Principal Investigator, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 4. Dr. R.C. Agrawal, National Director, ICAR-NAHEP and DDG, Edu., ICAR, 513, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012 5. Dr. Prabhat Kumar, National Coordinator, CAAST, ICAR-NAHEP, 508, Krishi Anusandhan Bhawan- II, New Delhi-110012 6. Dr. Atul A. Atre, Procurement Officer, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 7. Dr. Vaibhav S. Malunjkar, Research Associate, SWCE, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 8. Dr. Snehal G. Kanade, Research Associate, Agrometeorology, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722	Village Level Contingency Crop Plan (VLCCP) (Web-based)	30.06.2022	SW-15550/2022	

9.	1. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 2. Dr. Ravi P. Andhale, Associate Professor, Agronomy and Member, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 3. Dr. Mukund G. Shinde, Co-Principal Investigator, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 4. Dr. R.C. Agrawal, National Director, ICAR-NAHEP and DDG, Edu., ICAR, 513, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012 5. Dr. Prabhat Kumar, National Coordinator, CAAST, ICAR-NAHEP, 508, Krishi Anusandhan Bhawan- II, New Delhi-110012 6. Dr. Atul A. Atre, Procurement Officer, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 7. Dr. Snehal G. Kanade, Research Associate, Agrometeorology, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 8. Dr. Vaibhav S. Malunjkar, Research Associate, SWCE, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722	Phule Smart Weather	25.01.2022	SW-15222/2022	
10.	1. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 2. Dr. Ravi P. Andhale, Associate Professor, Agronomy and Member, CAAST-CSAWM, Mahatma Phule Krishi	CAAST Admin Dashboard	25.01.2022	SW-15224/2022	

	Vidyapeeth, Rahuri, Maharashtra-413722 3. Dr. Mukund G. Shinde, Co-Principal Investigator, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 4. Dr. R.C. Agrawal, National Director, ICAR-NAHEP and DDG, Edu., ICAR, 513, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012 5. Dr. Prabhat Kumar, National Coordinator, CAAST, ICAR-NAHEP, 508, Krishi Anusandhan Bhawan- II, New Delhi-110012 6. Dr. Atul A. Atre, Procurement Officer, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 7. Dr. Vaibhav S. Malunjkar, Research Associate, SWCE, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 9. Dr. Snehal G. Kanade, Research Associate, Agrometeorology, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722				
11.	1. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 2. Dr. Mukund G. Shinde, Co-Principal Investigator, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 3. Dr. Atul A. Atre, Procurement Officer, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 4. Dr. R.C. Agrawal, National Director, ICAR-NAHEP and DDG, Edu., ICAR, 513, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012	CAAST-CSAWM Project Website	25.01.2022	SW-15223/2022	

	5. Dr. Prabhat Kumar, National Coordinator, CAAST, ICAR-NAHEP, 508, Krishi Anusandhan Bhawan- II, New Delhi-110012 6. Dr. Sunil A. Kadam, Associate Professor (CAS), IDE, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 7. Er. Mohasin A. Tamboli, Research Associate, Computer Applications, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 8. Dr. Vaibhav S. Malunjkar, Research Associate, SWCE, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722				
12.	1. Dr. Sachin M. Nalawade, Member, CAAST-CSAWM and Head, Dept. of FMPE, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 2. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 3. Dr. Atul A. Atre, Procurement Officer, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 4. Dr. R.C. Agrawal, National Director, ICAR-NAHEP and DDG, Edu., ICAR, 513, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012 5. Dr. Prabhat Kumar, National Coordinator, CAAST, ICAR-NAHEP, 508, Krishi Anusandhan Bhawan- II, New Delhi-110012 6. Dr. Girishkumar B. Bhanage, Research Associate, FMPE, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722	Software to Access Need of Mechanization and Available Network Solutions (Phule-SANMAN)	25.01.2022	SW-15225/2022	

	7. Er. Shivprasad S. Gunjkar, M.Tech. Student, Dept. of FMPE, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 8. Er. Yogesh S. Dighe, Research Associate, Mechanical Engg., CAAST-CSAWM, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722				
13.	1. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 2. Dr. R.C. Agrawal, National Director, ICAR-NAHEP and DDG, Edu., ICAR, 513, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012 3. Dr. Prabhat Kumar, National Coordinator, CAAST, ICAR-NAHEP, 508, Krishi Anusandhan Bhawan- II, New Delhi-110012 4. Dr. Pradnya B. Jadhav, Research Associate, IDE, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 5. Dr. Anjali J. Musmade, Research Associate, IT, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722	Phule Soil Moisture based Irrigation Scheduling System (PSMISS)	29.08.2022	SW-15797/2022	
14.	1. Dr. Bapusaheb D. Bhakare, Member, CAAST-CSAWM and Head, Dept. of SSAC, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 2. Dr. Pramod N. Rasal, Dean and Director of Instruction, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722	Phule Smart Fertilizer Calculator	29.08.2022	SW-15798/2022	

	3. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 4. Dr. Anil G. Durgude, Member, CAAST-CSAWM and Assistant Professor, Dept. of SSAC, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 5. Dr. R.C. Agrawal, National Director, ICAR-NAHEP and DDG, Edu., ICAR, 513, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012 6. Dr. Prabhat Kumar, National Coordinator, CAAST, ICAR-NAHEP, 508, Krishi Anusandhan Bhawan- II, New Delhi-110012 7. Dr. Mukund G. Shinde, Co-Principal Investigator, CAAST-CSAWM and Associate Professor, SWCE, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 8. Dr. Vijaykumar S. Patil, Soil Chemist, AICRP on STCR, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 9. Dr. Nilam B. Kondvilkar, Research Associate, SCAC, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 10. Dr. Anjali J. Musmade, Research Associate, IT, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 11. Dr. Dalit Kumar Jayswal, Research Associate, Horticulture, PIU-NAHEP, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012				

15.	1. Dr. Bapusaheb D. Bhakare, Member, CAAST-CSAWM and Head, Dept. of SSAC, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 2. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 3. Dr. Anil G. Durgude, Member, CAAST-CSAWM and Assistant Professor, Dept. of SSAC, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 4. Dr. R.C. Agrawal, National Director, ICAR-NAHEP and DDG, Edu., ICAR, 513, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012 5. Dr. Prabhat Kumar, National Coordinator, CAAST, ICAR-NAHEP, 508, Krishi Anusandhan Bhawan- II, New Delhi-110012 6. Dr. Vijaykumar S. Patil, Soil Chemist, AICRP on STCR, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 7. Dr. Mukund G. Shinde, Co-Principal Investigator, CAAST-CSAWM and Associate Professor, SWCE, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 8. Dr. Nilam B. Kondvilkar, Research Associate, SCAC, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 9. Dr. Dalit Kumar Jayswal, Research Associate, Horticulture, PIU-NAHEP, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012	Phule Smart Fertilizer Calculator (Web-based)	29.08.2022	SW-15799/2022	

	10. Dr. Anjali J. Musmade, Research Associate, IT, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722				
16.	1. Dr. Milind C. Ahire, Member, CAAST-CSAWM and Associate Dean, PAHCA, Halgaon, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 2. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 3. Dr. Mukund G. Shinde, Co-Principal Investigator, CAAST-CSAWM and Associate Professor, SWCE, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 4. Dr. Sachin S. Sadaphal, Member, CAAST-CSAWM and Assistant Professor, Agril. Extn. Edu. & Comm., Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 5. Dr. R.C. Agrawal, National Director, ICAR-NAHEP and DDG, Edu., ICAR, 513, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012 6. Dr. Prabhat Kumar, National Coordinator, CAAST, ICAR-NAHEP, 508, Krishi Anusandhan Bhawan- II, New Delhi-110012 7. Dr. Shubhangi N. Ghadage, Research Associate, Agril. Extn., CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 8. Dr. Vaibhav S. Malunjkar, Research Associate, SWCE,	Framework for Training Evaluation (Web-based)	29.08.2022	SW-15800/2022	

	CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, 9. Ahmednagar, Maharashtra-413722 10. Er. Mohasin A. Tamboli, Research Associate, Comp. App., CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 11. Dr. Sevak A. Dhenge, Former Research Associate, SS, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722				
17.	1. Dr. Ulhas S. Surve, Member, CAAST-CSAWM and Chief Agronomist, AICRP-IFS, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 2. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 3. Dr. Pramod N. Rasal, Dean and Director of Instruction, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 4. Dr. Mukund G. Shinde, Co-Principal Investigator, CAAST-CSAWM and Associate Professor, SWCE, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 5. Dr. Atul A. Atre, Procurement Officer, CAAST-CSAWM and Associate Professor, SWCE, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 6. Dr. Sachin S. Sadaphal, Member, CAAST-CSAWM and	Framework for Crop Information System	29.08.2022	SW-15801/2022	

	Assistant Professor, Agril. Extn. Edu. & Comm., Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 7. Dr. Sunil A. Kadam, Member, CAAST-CSAWM and Assistant Professor, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 8. Dr. R.C. Agrawal, National Director, ICAR-NAHEP and DDG, Edu., ICAR, 513, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012 9. Dr. Prabhat Kumar, National Coordinator, CAAST, ICAR-NAHEP, 508, Krishi Anusandhan Bhawan- II, New Delhi-110012 10. Dr. Rohit K. Sonawane, Research Associate, Agro.., CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 11. Dr. Vaibhav S. Malunjkar, Research Associate, SWCE, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 12. Er. Mohasin A. Tamboli, Research Associate, Comp. App., CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 13. Dr. Dalit Kumar Jayswal, Research Associate, Horticulture, PIU-NAHEP, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012				
18.	1. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri,	Location Specific Real Time Irrigation Water	08/02/2023	SW-15989/2023	

	Ahmednagar, Maharashtra-413722 2. Dr. Sunil A. Kadam, Member, CAAST-CSAWM and Assistant Professor, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 3. Dr. R.C. Agrawal, National Director, ICAR-NAHEP and DDG, Edu., ICAR, 513, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012 4. Dr. Prabhat Kumar, National Coordinator, CAAST, ICAR-NAHEP, 508, Krishi Anusandhan Bhawan- II, New Delhi-110012 5. Dr. Mukund G. Shinde, Co-Principal Investigator, CAAST-CSAWM and Associate Professor, SWCE, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 6. Dr. Atul A. Atre, Procurement Officer, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra-413722 7. Dr. Pradnya B. Jadhav, Research Associate, IDE, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 8. Dr. Rajnee V. Salunkhe, Research Associate, IDE, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 9. Dr. Vaibhav S. Malunjkar, Research Associate, SWCE, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 10. Er. Mohasin A. Tamboli, Research Associate, Comp. App., CAAST-CSAWM, Mahatma Phule Krishi	Requirement (Spatial IWR) Web-Based			

	Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722				
19.	1. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 2. Dr. Mukund G. Shinde, Co-Principal Investigator, CAAST-CSAWM and Associate Professor, SWCE, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 3. Dr. Sunil A. Kadam, Member, CAAST-CSAWM and Assistant Professor, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 4. Dr. R.C. Agrawal, National Director, ICAR-NAHEP and DDG, Edu., ICAR, 513, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012 5. Dr. Prabhat Kumar, National Coordinator, CAAST, ICAR-NAHEP, 508, Krishi Anusandhan Bhawan- II, New Delhi-110012 6. Dr. Pramod G. Popale, Scientist, AICRP on Irrigation Water Management, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 7. Er. Tejashree L. Nawale, Research Associate, ENTC, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 8. Er. Mohasin A. Tamboli, Research Associate, Computer Applications, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722	Automatic Phule Irrigation Scheduler (AutoPIS)	14/06/2023	SW-16593/2023	

20.	1. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 2. Dr. Mukund G. Shinde, Co-Principal Investigator, CAAST-CSAWM and Associate Professor, SWCE, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 3. Dr. R.C. Agrawal, National Director, ICAR-NAHEP and DDG, Edu., ICAR, 513, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012 4. Dr. Prabhat Kumar, National Coordinator, CAAST, ICAR-NAHEP, 508, Krishi Anusandhan Bhawan- II, New Delhi-110012 5. Dr. Sunil A. Kadam, Member, CAAST-CSAWM and Assistant Professor, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 6. Dr. Pradnya B. Jadhav, Research Associate, IDE, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 7. Dr. Rajanee V. Salukhe, Research Associate, Ide, CAAST-CSAWM, Mahatma Phule Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 8. Dr. Anjali J. Musmade, Research Associate, IT, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 9. Dr. Vaibhav S. Malunjkar, Research Associate, SWCE, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth,	IoT enabled Siphon System for Farm Pond (Phule SiPond)	14/06/2023	SW-16642/2023	

	Rahuri, Ahmednagar, Maharashtra-413722 10. Dr. Mangal A. Patil, Former Research Associate, IDE, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 11. Er. Shraddha R. Warale, Former Research Associate, ENTC, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722				
21.	1. Dr. Sunil D. Gorantiwar, Principal Investigator, CAAST-CSAWM and Head, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 2. Dr. Mukund G. Shinde, Co-Principal Investigator, CAAST-CSAWM and Associate Professor, SWCE, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 3. Dr. Sunil A. Kadam, Member, CAAST-CSAWM and Assistant Professor, Dept. of Agril. Engg., Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 4. Dr. Pradnya B. Jadhav, Research Associate, IDE, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 5. Dr. Mangal A. Patil, Former Research Associate, IDE, CAAST-CSAWM, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722 9. Er. Shraddha R. Warale, Former Research Associate, ENTC, CAAST-CSAWM, Mahatma Phule Krishi	Smart Phule Irrigation Scheduler (SmartPIS)	14/08/2023	SW-17089/2023	

	Vidyapeeth, Rahuri, Ahmednagar, Maharashtra-413722				

2. Patent

Sr. No.	Patent Application No.	Status of Patent (Published/ Granted)	Inventor/s Name	Title of the Patent	Applicant/s Name	Patent filed Date
1	202221059916	RQ filed	1. Dr. Sachin Madhukar Nalawade 2. Dr. Sunil Digambar Gorantiwar 3. Dr. Girishkumar Balasaheb Bhanage 4. Er. Yogesh Sopan Dighe 5. Er. Shraddha Raosaheb Warale 6. Dr. R. C. Agrawal 7. Dr. Prabhat Kumar 8. Er. Shridhar S Dudam	Plant Detection Module for Orchard Crops	Mahatma Phule Krishi Vidhyapeeth, Rahuri	20/10/2022

3. Other

Sr. No.	Title	Scientist involved	Recommendation	Year
1.	Design and Development of Web and Mobile-Based Applications for Real Time Estimation of Location-Specific Evapotranspiration “Spatial ETr”	1. Dr. S. A. Kadam, Member, CAAST-CSAWM, and Associate Prof (IDE), MPKV, Rahuri 2. Dr. S. D. Gorantiwar, Principal Investigator, CAAST-CSAWM, MPKV, Rahuri 3. Er. M. A. Tamboli, Research Associate (Comp.Apps), CAAST-CSAWM, MPKV, Rahuri 4. Dr. M. A. Patil, Research Associate (IDE), CAAST-CSAWM, MPKV, Rahuri 5. Dr.M.N.Baviskar, Research Associate (Horti), CAAST-CSAWM, MPKV, Rahuri	The web and mobile-based applications "Spatial ETr" developed by Mahatma PhuleKrishiVidyapeeth are recommended for the real time and location specific estimation of evapotranspiration for irrigation scheduling.	2021
2.	Development of mobile application for Software to Assess Need of	1. Dr. S. M. Nalawade, Member CAAST-CSAWM, and Head, Department of FMPE, Dr. ASCAE&T, MPKV, Rahuri.	It is recommended to use mobile application “Phule-SANMAN” for survey of present mechanization	2021

	Mechanization and Available Network Solutions ("Phule – SANMAN")	2. Dr. S. D. Gorantiwar, Principal Investigator, CAAST-CSAWM, MPKV, Rahuri 3. Dr. G. B. Bhanage, Research Associate (FMPE), CAAST-CSAWM, MPKV, Rahuri. 4. Er. Y. S. Dighe, Research Associate (Mechanical Engineering), CAAST-CSAWM, MPKV, Rahuri 5. Dr. P. B. Kadam, Assistant Professor, FMPE, Dr. ASCAE&T, MPKV, Rahuri. 6. Dr. A. A. Walunj, Assistant Professor, FMPE, Dr. ASCAE&T, MPKV, Rahuri. 7. Dr. S. U. Bhanage, Associate Professor, Extension Education, MPKV, Rahuri	status and dissemination of information on agricultural machinery as per crop, operation and type of farm machinery.	
3.	Development of mobile application for Services for Agricultural Mechanization ("Phule – SAM")	1. Dr. S. M. Nalawade, Member CAAST-CSAWM, and Head, Department of FMPE, Dr. ASCAE&T, MPKV, Rahuri. 2. Dr. S. D. Gorantiwar, Principal Investigator, CAAST-CSAWM, MPKV, Rahuri 3. Dr. G. B. Bhanage, Research Associate (FMPE), CAAST-CSAWM, MPKV, Rahuri. 4. Er. Y. S. Dighe, Research Associate (Mechanical Engineering), CAAST-CSAWM, MPKV, Rahuri. 5. Er. M. M. Pacharne, Assistant Professor (FMPE), All India Coordinated Research Project on Farm Implements and Machinery, Dr. ASCAE, MPKV, Rahuri	It is recommended to use mobile application "Phule-SAM" for connecting farmers with service providers for agricultural mechanization services like custom hiring, reparis and sales centres of farm machinery.	2021
4.	Development of mobile application for irrigation scheduling based on soil moisture measurement by sensor in real time	1. Dr. S. D. Gorantiwar, Head, Dept. of Agril. Engg. and PI, CAAST-CSAWM, MPKV, Rahuri 2. Dr. M. G. Shinde, Professor of SWCE and Co-PI, CAAST-CSAWM, MPKV, Rahuri 3. Dr. S. A. Kadam, Associate Professor of IDE and CAAST-CSAWM Team Member, MPKV, Rahuri 4. Dr. A. J. Musmade, Research Associate (IT), CAAST-CSAWM, MPKV, Rahuri	"Phule Soil Moisture based Irrigation Scheduling System (PSMISS)" mobile application developed by Mahatma Phule Krishi Vidyapeeth is recommended for real time irrigation scheduling for various irrigation methods and crops; for deciding duration of operation of pump based on the measurement of soil moisture; and subsequently making pump automatically	2022

		5. Dr. P. B. Jadhav, Research Associate (IDE), CAAST-CSAWM, MPKV, Rahuri	ON and OFF for the desired duration.	
5.	Development of Map-based Web and Mobile Applications for the Estimation of Location Specific Real Time Irrigation Water Requirement	1. Dr. S. A. Kadam, Associate Professor of IDE and CAAST-CSAWM Team Member, MPKV, Rahuri 2. Dr. S. D. Gorantiwar, Head, Dept. of Agril. Engg. and PI, CAAST-CSAWM, MPKV, Rahuri 3. Dr. M. G. Shinde, Professor of SWCE and Co-PI, CAAST-CSAWM, MPKV, Rahuri 4. Dr. M. A. Patil, Ex-Research Associate (IDE), CAAST-CSAWM, MPKV, Rahuri 5. Dr. P. B. Jadhav, Research Associate (IDE), CAAST-CSAWM, MPKV, Rahuri 6. Dr. R.V. Salunkhe, Ex-Research Associate (IDE), CAAST-CSAWM, MPKV, Rahuri 7. Dr. M. N. Baviskar, Research Associate (Horticulture), CAAST-CSAWM, MPKV, Rahuri 8. Er. M. A. Tamboli, Research Associate (Computer Application), CAAST-CSAWM, MPKV, Rahuri	The map-based web and mobile applications "Spatial IWR" developed by Mahatma Phule Krishi Vidyapeeth are recommended for the estimation of location specific real time irrigation water requirement.	2022
6.	Development of mobile and web-based applications for automatic weather stations	1. Dr. S. D. Gorantiwar, Head, Dept. of Agril. Engg. and PI, CAAST-CSAWM, MPKV, Rahuri 2. Dr. R. P. Andhale, Associate Professor (Agronomy) and Team Member, CAAST-CSAWM, MPKV, Rahuri 3. Dr. M. G. Shinde, Professor of SWCE and Co-PI, CAAST-CSAWM, MPKV, Rahuri 4. Dr. V. S. Malunjkar, Research Associate (SWCE), CAAST-CSAWM, MPKV, Rahuri 5. Dr. S. G. Kanade, Ex-Research Associate (Agrometeorology), CAAST-CSAWM, MPKV, Rahuri	“Phule Smart Weather” mobile application and “CAAST Admin Dashboard” web application developed by Mahatma Phule Krishi Vidyapeeth are recommended for viewing and managing the recorded weather data by different types of IoT enabled automatic weather stations in numerical and graphical forms.	2022
7.	Development of an IoT enabled location specific- real time irrigation scheduling system for single crop based on PIS: AutoPIS	1. Dr. S. D. Gorantiwar, Head, Dept. of Agril. Engg. and PI, CAAST-CSAWM, MPKV, Rahuri 2. Dr. M. G. Shinde, Professor of SWCE and Co-PI, CAAST-CSAWM, MPKV, Rahuri 3. Dr. S. A. Kadam, Associate Professor of IDE & Team	“Phule Auto Irrigation Scheduler (AutoPIS)” mobile application and pump controller developed by Mahatma Phule Krishi Vidyapeeth are recommended for automatically operating the pump for the duration	2022

		Member, CAAST-CSAWM, MPKV, Rahuri 4. Er. S. R. Warale, Ex-Research Associate (E&TC), CAAST-CSAWM, MPKV, Rahuri 5. Er. T. L. Nawale, Research Associate (E&TC), CAAST-CSAWM, MPKV, Rahuri 6. Dr. M. A. Patil, Ex-Research Associate (IDE), CAAST-CSAWM, MPKV, Rahuri 7. Dr. P. B. Jadhav, Research Associate (IDE), CAAST-CSAWM, MPKV, Rahuri	based on location specific real time irrigation scheduling for various irrigation methods and crops for single crop situation.	
8.	Development of an IoT enabled location specific- real time irrigation scheduling system for multiple crop based on PIS: SmartPIS	1. Dr. S. D. Gorantiwar, Head, Dept. of Agril. Engg. and PI, CAAST-CSAWM, MPKV, Rahuri 2. Dr. M. G. Shinde, Professor of SWCE and Co-PI, CAAST-CSAWM, MPKV, Rahuri 3. Dr. S. A. Kadam, Associate Professor of IDE and CAAST-CSAWM Team Member, MPKV, Rahuri 4. Er. S. R. Warale, Ex-Research Associate (E&TC), CAAST-CSAWM, MPKV, Rahuri 5. Dr. P. B. Jadhav, Research Associate (IDE), CAAST-CSAWM, MPKV, Rahuri 6. Dr. M. A. Patil, Ex-Research Associate (IDE), CAAST-CSAWM, MPKV, Rahuri	"Phule Smart Irrigation Scheduler (SmartPIS)" mobile application, pump controller and solenoid valves developed by Mahatma Phule Krishi Vidyapeeth are recommended for automatically operating the pump for the duration based on location specific real time irrigation scheduling for various irrigation methods and crops for multiple crop situation.	2022
9.	Development of mobile and web-based applications for display of soil type in USDA textural triangle	1. Dr. M. G. Shinde, Professor of SWCE and Co-PI, CAAST-CSAWM, MPKV, Rahuri 2. Dr. S. D. Gorantiwar, Head, Dept. of Agril. Engg. and PI, CAAST-CSAWM, MPKV, Rahuri 3. Dr. A. A. Atre, Professor of SWCE and Procurement Officer, CAAST-CSAWM, MPKV, Rahuri 4. Er. K.S. Borse, Ex-Research Associate (WREM), CAAST-CSAWM, MPKV, Rahuri 5. Dr. V.S. Malunjkar, Research Associate (SWCE), CAAST-CSAWM, MPKV, Rahuri	"Phule Soil Textural Triangle" mobile and web applications developed by Mahatma Phule Krishi Vidyapeeth are recommended for representing soil texture in USDA Soil Textural Triangle when data set is large.	2022
10.	Development of IoT enabled "Anti-Theft" system for agricultural pumps	1. Dr. M. G. Shinde, Professor of SWCE and Co-PI, CAAST-CSAWM, MPKV, Rahuri 2. Dr. S. D. Gorantiwar, Head, Dept. of Agril. Engg. and PI, CAAST-CSAWM, MPKV, Rahuri	IoT enabled "Phule Agricultural Pump Anti-Theft" system developed by Mahatma Phule Krishi Vidyapeeth is recommended for	2022

		3. Er. S. R. Warale, Ex-Research Associate (E&TC), CAAST-CSAWM, MPKV, Rahuri 4. Dr. V. S. Malunjkar, Research Associate (SWCE), CAAST-CSAWM, MPKV, Rahuri 5. Er. T. L. Nawale, Research Associate (E&TC), CAAST-CSAWM, MPKV, Rahuri	protecting agricultural pumps from theft.	
11.	Development of automatic double ring infiltrometer	1. Dr. M. G. Shinde, Professor of SWCE and Co-PI, CAAST-CSAWM, MPKV, Rahuri 2. Dr. A. A. Atre, Professor (SWCE) and Procurement Officer, CAAST-CSAWM, MPKV, Rahuri 3. Dr. S. D. Gorantiwar, Head, Dept. of Agril. Engg. and PI, CAAST-CSAWM, MPKV, Rahuri 4. Dr. S. A. Kadam, Associate Professor of IDE and CAAST-CSAWM Team Member, MPKV, Rahuri 5. Dr. V. S. Malunjkar, Research Associate (SWCE), CAAST-CSAWM, MPKV, Rahuri 6. Er. T. L. Nawale, Research Associate (E&TC), CAAST-CSAWM, MPKV, Rahuri	"Phule Automatic Ring Infiltrometer (PARI)" developed by Mahatma Phule Krishi Vidyapeeth is recommended for automatically measuring the soil infiltration rate.	2022
12.	Development of web and mobile applications for deciding the fertilizer quantities based on Soil Test Crop Response (STCR) equation, Recommended Dose of Fertilizer (RDF) and As per Soil Test (AST)	1. Dr. B. D. Bhakare, Head, Dept. of Soil Science &Agril. Chemistry & Team Member, CAAST-CSAWM, MPKV, Rahuri 2. Dr. S. D. Gorantiwar, Head, Dept. of Agril. Engg. and PI, CAAST-CSAWM, MPKV, Rahuri 3. Dr. A. G. Durgude, Assistant Professor (SSAC) and Team Member, CAAST-CSAWM, MPKV, Rahuri 4. Dr. M. G. Shinde, Professor of SWCE and Co-PI, CAAST-CSAWM, MPKV, Rahuri 5. Dr. V. S. Patil, Soil Chemist, AICRP-STCR, MPKV, Rahuri 6. Dr. Nilam Kondvilkar, Research Associate (SSAC), CAAST-CSAWM, MPKV, Rahuri 7. Dr. Anjali Musmade, Research Associate (IT), CAAST-CSAWM, MPKV, Rahuri	"Phule Smart Fertilizer Calculator" web and mobile based application developed by Mahatma Phule Krishi Vidyapeeth, Rahuri is recommended for the estimation of required fertilizers quantities to be applied to various crops based on soil testing, recommended dose of fertilizers and yield target equations.	2022
13.	Design and development of the mobile applications on "Crop Production	1. Dr. U. S. Surve, Professor of Agronomy & Team Member, CAAST-CSAWM, MPKV, Rahuri	The mobile-based applications for improved crop production technologies, management	2022

	Technologies, Management Practices and Value Addition for 22 Agronomical Crops (Cereals, Pulses, Oilseeds, Spices and Cash Crops)"	2. Dr. S. S. Sadaphal, Assisant Professor of Agril. Extension & Team Member, CAAST-CSAWM, MPKV, Rahuri 3. Dr. S. D. Gorantiwar, Head, Dept. of Agril. Engg. and PI, CAAST-CSAWM, MPKV, Rahuri 4. Dr. M. G. Shinde, Professor of SWCE and Co-PI, CAAST-CSAWM, MPKV, Rahuri 5. Dr. A. A. Atre, Professor of SWCE & Procurement Officer, CAAST-CSAWM, MPKV, Rahuri 6. Dr. S. A. Kadam, Associate Professor of IDE & Team Member, CAAST-CSAWM, MPKV, Rahuri 7. Dr. M. C. Ahire, Associate Dean, Punyashlok Ahilyadevi Holkar College of Agriculture, Halgaon & Team Member, CAAST-CSAWM 8. Dr. R. K. Sonawane, Research Associate, Agronomy, CAAST-CSAWM, MPKV, Rahuri 9. Dr. S. D. Thorat, Ex-Research Associate, Agronomy, CAAST-CSAWM, MPKV, Rahuri 10. Er. M. A. Tamboli, Research Associate, Computer Application, CAAST-CSAWM, MPKV, Rahuri	practices and value addition techniques developed by Mahatma Phule Krishi Vidyapeeth for various cereals, pulses, oil seeds, spices and cash crops are recommended for dissemination and adoption by farmers. ***Various crops:*** Rice, Wheat, Maize, Sorghum, Pearl millet, Finger millet, Little millet, Barnyard millet, Chickpea, Pigeonpea, Green gram, Black gram, Soybean, Ground nut, Summer Ground nut, Sesamum, Niger, Cotton, Deshi Cotton, Sugarcane, Turmeric, Ginger.	
14.	Development of mobile and web-based applications for village level contingency crop plan	1. Dr. R. P. Andhale, Associate Professor of Agronomy and Member (CAAST-CSAWM), MPKV, Rahuri 2. Dr. S. D. Gorantiwar, Head, Dept. of Agril. Engg., and Principal Investigator, CAAST-CSAWM, MPKV, Rahuri 3. Dr. M. G. Shinde, Professor of SWCE and Co-PI, CAAST-CSAWM, MPKV, Rahuri 4. Dr. A.A. Atre, Professor of SWCE and PO, CAAST-CSAWM, MPKV, Rahuri 5. Dr. V. S. Malunjkar, Research Associate (SWCE), CAAST-CSAWM, MPKV, Rahuri 6. Dr. S. G. Kanade, Ex-Research Associate (Agrometeorology), CAAST-CSAWM, MPKV, Rahuri	Mobile and web-based applications for mitigation strategies under aberrant weather conditions developed by Mahatma Phule Krishi Vidyapeeth are recommended for village level contingency crop planning of Manhere, Ambevangan, Ladgaon, Titavi, Kodani, Pimparkane and Dongarwadi of Akole block.	

15.	Development of sensor module for orchard plant detection	1. Dr. S. M. Nalawade, Head, Dept. of FMPE and CAAST-CSAWM Team Member, MPKV, Rahuri 2. Dr. S. D. Gorantiwar, Head, Dept. of Agril. Engg. and PI, CAAST-CSAWM, MPKV, Rahuri 3. Dr. M. G. Shinde, Professor of SWCE and Co-PI, CAAST-CSAWM, MPKV, Rahuri 4. Dr. G. B. Bhanage, Research Associate (FMPE), CAAST-CSAWM, MPKV, Rahuri 5. Er. Y. S. Dighe, Ex-Research Associate (Mechanical Engineering), CAAST-CSAWM, MPKV, Rahuri 6. Er. S. R. Warale, Ex-Research Associate (E&TC), CAAST-CSAWM, MPKV, Rahuri	MPKV developed 'LiDAR based sensor module' is recommended for detecting stem of orchard plants within defined range	2023

Annexure-D

List of beneficiaries along with training details

List of Beneficiaries (Students)

Sr. No.	Name of Student	Title of Training	Host Institute	Duration
1	Mr. Vijay Gajanan Raut	Drones and It's applications Google Earth Engine	Geoinformatics Centre, Asian Institute of Technology, Bangkok, Thailand	11 November to 10 December, 2019
2	Mr. Shinde Sachin Pandurang			
3	Mr. Prashant Ankush Ghadage			
4	Mr. Pankaj Bhaskarrao Ghodke			
5	Mr. Rushikesh Bapuso Kalamkar			
6	Ms. Ankita Prakash Kamble			
7	Mr. Ajit Pralhad Magar			
8	Mr. Mininath Sonyabapu Anarase			
9	Ms. Godase Mayuri Manikrao			
10	Mr. Vilas Shankarrao Ghule			
11	Ms. Vidya Uttam Kandekar			
12	Ms. Ubale Sonali Prabhakar			
13	Mr. Harshvardhan Namdev Markad			
14	Ms. Raut Amruta Dnyaneshwar			
15	Ms. Payal Arun Mahadule			
16	Ms. Chavan Komal Ashok			
17	Mr. Pradip Vasant Ambre			
18	Ms. Komal Ramesh Gadekar			
19	Mr. Bhusari Sandip Ashok			
20	Mr. Krisnpal Singh Parihar			
21	Miss. Khaire Prasanna Babanrao	Application of Google Earth Engine, IoT and Drones for Precision Agriculture	Geoinformatics Centre, Asian Institute of Technology, Bangkok, Thailand	16 October to 15 November 2023
22	Priya Pandey			
23	Mr. More Dnyaneshwar Devendra			
24	Yogesh Achyutrao Shaniware			
25	Aniruddha Nandkumar Barve			
26	Miss. Bhosale Swapnali Vitthal			
27	Miss. Tishyarakshita Vilas Wankhede			
28	Mr. Ikade Avishkar Rajkumar			
29	Mr. Kale Govind Vinayakrao			
30	Miss. Kadam Jyoti Balaji			
31	Miss. Raut Prachiti Vasant			
32	Miss. Chavan Snehal Sanjay			
33	Mr. Chavan Tanmay Sunil			
34	Miss. Kotangale Lochana Gandhi			
35	Lajurkar Manik Rameshrao			
36	Miss. Gurav Divyabharati Manik			
37	Miss. Meshram Pranali Ghansham			
38	Miss. Mahamuni Sneha Milind			
39	Mr. Bachhav Sujal Sanjay			
40	Ms. Biradar Sayali Uttam	Climate Smart Agriculture and Water Management	University Putra Malaysia (UPM), Selangor, Malaysia	06 November to 05 December, 2023
41	Mr. Gaikwad Aniket Sunil			
42	Mr. Vairavan C			
43	Ms. Jadhav Priyanka Shivaji			
44	Ms. Bhokse Devika Vitthal			

45	Ms. Chavan Gayatri Pandurang			
46	Ms. Gunjal Poonam Balasaheb			
47	Ms. Ingle Snehal Ramesh			
48	Ms. Parul Mehra			
49	Ms. Napte Nutan Ankush			
50	Mr. Gurav Mahesh Damu			
51	Ms. Kharbadkar Vaishnavi Pramod			
52	Ms. Negi Priyanka			
53	Mr. Pritam Prakash Patil			
54	Ms. Andhale Gauri Ravi			
55	Ms. Gorde Nikita Balasaheb			
56	Mr. Omkar Deepak Rajmane			
57	Ms. Shewale Shraddha Ashok			
58	Ms. Hukare Roshana Manohar			
59	Mr. Shinde Sudhir Subhas			
60	Ms. Adate Suchita Ankush	Smart Agriculture Programme	Can Tho University, Vietnam	04-30 December 2023
61	Ms. Limbore Pooja Dilip			
62	Ms. Ahire Samiksha Gangadhar			
63	Ms. Jagtap Mayuri Maruti			
64	Ms. Bhosale Bhagyashri Rameshwar			
65	Mr. Lashkare Siddheshwar Vishwanath			
66	Mr. Raut Mangesh Dattatray			
67	Ms. Ukey Pradnya Vasant			
68	Mr. Solanke Amol Pralhadrao			
69	Mr. Mhaske Shriram Mahadev			
70	Mr. Ralebhat Bhushan Namdev			
71	Ms. Kulkarni Pranali Satish			
72	Ms. Godse Dipti Digambar			
73	Miss. Dere Rutika Anil			
74	Omkar Gorakshanath Ghume			
75	Miss. Donadkar Shweta Anandrao			
76	Miss. Chavan Sonal Vitthal			
77	Mr. Keduyol LTU			
78	Mr. Lad Sudhir Arjun	Advanced Technologies for Climate Smart Agriculture	Geoinformatics Centre, Asian Institute of Technology, Bangkok, Thailand	23 November to 22 December, 2023
79	Miss. Lad Pranoti Arjunrao			
80	Mr. Bandgar Abhishek Nandkumar			
81	Miss. Kotramma			
82	Mr. Ragade Onkar Naganath			
83	Miss. Diwase Ankita Mukund			
84	Miss. Malshikare Pallavi Balaso			
85	Mr. Shreyash Balasaheb Sutar			
86	Miss. Dabhade Sanvedana Sanjay			
87	Miss. Tejal Dharamraj Ghutke			
88	Miss. Sathe Snehal Netaji			
89	Mr. Rajput Pruthviraj Padamsing			
90	Mr. Varad Vishwas Patil			
91	Miss. Bhondave Gauri Prabhakar			
92	Mr. Chavan Ganesh Mahendrasing			
93	Miss. Desale Pranjal Anil			
94	Mr. Bagade Praful Sukhdeorao			
95	Mr. Chopade Girish Ulhas			

96	Miss. Sampada Sanjay Deshmane			
97	Miss. Parihar Vaishali Mukesh			

List of Beneficiaries (Faculty)

Sr. No.	Name of faculty	Title of Training	Hosting Institute	Duration
1	Dr. A. A. Atre	Drones and It's applications Google Earth Engine	Geoinformatics Centre, Asian Institute of Technology, Bangkok, Thailand	11 November to 10 December, 2019
2	Dr. Sunil Arun Kadam	Applications of Google Earth Engine, IoT, and Drones for Precision Agriculture	Geoinformatics Centre, Asian Institute of Technology, Bangkok, Thailand	30 January to 01 March, 2023
3	Dr. Sachin Madhukar Nalawade			
4	Dr. Vikram Parasharam Kad			
5	Dr. Sachin Krishanrao Dingre			
6	Dr. Mahanand Shivajirao Mane	Advanced Technologies for Climate Smart Agriculture	Geoinformatics Centre, Asian Institute of Technology, Bangkok, Thailand	30 January to 01 March, 2023
7	Dr. Pawan Laxminarayan Kulwal			
8	Dr. Ulhas Shantaram Surve			
9	Dr. Ravi Pandharinath Andhale			
10	Dr. Somnath Hanumant Mane			
11	Mrs. Shitole L.S.	Advanced Technologies for Climate Smart Agriculture	Geoinformatics Centre, Asian Institute of Technology, Bangkok, Thailand	23 November to 22 December, 2023
12	Dr. A. A. Walnuj	The development of computer simulation model for the land applications of agricultural machinery	University of Wisconsin, River Falls, USA	16 January to 15 February, 2023
13	Dr. S.S. Dhumal	Smart Sensing System in Horticultural crop production System	University of Tsukuba, Japan	20 January to 19 February, 2023
14	Dr. D. H. Kankhare	Advanced Technologies for Climate Smart Agriculture	Geoinformatics Centre, Asian Institute of Technology, Bangkok, Thailand	01-15 December, 2023
15	Dr. S. K. Chavan			
16	Dr. T.B. Bastewad			
17	Dr. S. D. Magar			
18	Dr. D. H. Phalke			
19	Dr. Mrs. S. R. Shinde			
20	Dr. P. B. Kharde			
21	Dr. S. D. Patil			
22	Dr. V. Y. Pawar	Intelligent Technologies for Modern Agriculture	University of Agriculture and Forestry, HUE University, Vietnam	26 November to 11 December, 2023
23	Dr. D. D. Patange			
24	Dr. B. K. Gavit			
25	Dr. K. D. Kale			
26	Dr. A. V. Chandanshive			
27	Dr. P. B. Deore			

28	Dr V. S. Patil			
29	Dr. A. R. Aher			
30	Dr. Sunil Gorantiwar	Applications of Google Earth Engine, IoT, and Drones for Precision Agriculture	Geoinformatics Centre, Asian Institute of Technology, Bangkok, Thailand	06-20 February, 2023
31	Dr. Mukund Shinde			
32	Dr. S. A. Ranpise	Applications of Google Earth Engine, IoT, and Drones for Precision Agriculture	Geoinformatics Centre, Asian Institute of Technology, Bangkok, Thailand	02-10 December, 2023
33	Dr. V. S. Shirke			
34	Dr. S. B. Kharbade			
35	Dr. A. V. Solanke			
36	Dr. R. S. Wagh			
37	Shri. S. N. Patil			
38	Dr. K.P. Vishwnatha	Applications of Google Earth Engine, IoT, and Drones for Precision Agriculture	Washington State University, USA	March 6-14, 2020
39	Dr. A. L. Pharande			
40	Dr. P. G. Patil	Applications of Google Earth Engine, IoT, and Drones for Precision Agriculture	Geoinformatics Centre, Asian Institute of Technology, Bangkok, Thailand	6-12 February, 2023
41	Dr. D. D. Pawar			
42	Dr. S. D. Masalkar			
43	Dr. B.D. Bhakare			

Annexure:E

The list of trainings

1. Online Capacity building programmes organized by CAAST-CSAWM, MPKV, Rahuri

Sr. no.	Title of Trainings/ workshops/ seminars/ conference	Month & year	No.of Participants	Place
Online International Events (05)				
1.	Conservation Agriculture-based Crop Management Technologies in Climate Smart Agriculture	18- 22 May, 2020	920	MPKV, Rahuri
2.	Perspectives of Present and Future Weed Research under Climate Smart Agriculture	17-20 August, 2020	1222	MPKV, Rahuri
3.	Emerging Urban Farming Technologies for vegetable production	07 -15 September, 2020	440	MPKV, Rahuri
4.	Agriculture 4.0: Precision and Automated Ag Technologies	28 September - 02 October, 2020	1000	MPKV, Rahuri
5.	Water Resources Modelling	February 08-12, 2021	225	MPKV, Rahuri
A three-week online national certificate courses organized by CAAST-CSAWM, MPKV, Rahuri (14)				
1.	Climate Smart Organic Farming	February 15 to March 07, 2021	84	MPKV, Rahuri
2.	Basic Geo-informatics	February 22 to March 14, 2021	91	MPKV, Rahuri
3.	Fundamentals of UAVs	March 15 to April 04, 2021	97	MPKV, Rahuri
4.	Post-Harvest Management	April 05 to April 25, 2021	104	MPKV, Rahuri
5.	IT Applications in Precision **Irrigation**	April 26 to May 16, 2021	121	MPKV, Rahuri
6.	Watershed Hydrological Models	May 17 to June 06, 2021	81	MPKV, Rahuri
7.	Google Earth Engine with python	June 07 to June 27, 2021	91	MPKV, Rahuri
8.	Soil Management for Climate Smart Agriculture	June 14 to July 04, 2021	66	MPKV, Rahuri
9	Weather Based Agromet Advisory Services through ICT	August 02 to 22, 2021	107	MPKV, Rahuri

10.	Policies, Institutions and Marketing for Climate Smart Agriculture	August 09 to 29, 2021	65	MPKV, Rahuri
11	Integrated Farming System for Sustainable Agriculture	January 03 to 23, 2022	66	MPKV, Rahuri
12.	Application of RS and GIS on Natural Resources Management	**January 10 to 30, 2022**	15	MPKV, Rahuri
13	Land Use Planning for Climate Smart Agriculture	February 21 to March 13, 2022	31	MPKV, Rahuri
14.	Climate Smart Watershed Management	June 01 to June 21, 2022	19	MPKV, Rahuri
Online National training for faculties and students (34)				
1.	Fundamentals of Digital Marketing: I	7 -11 April, 2020	61	MPKV, Rahuri
2.	Digital Farming in Context of Precision Water Management	9 -13 April, 2020	100	MPKV, Rahuri
3.	Personality Development and Effective Communication, Skills and Stress Management	14-18 April, 2020	600	MPKV, Rahuri
4.	Fuzzy logic and its applications for Climate Smart Agriculture.	16-19 April, 2020	104	MPKV, Rahuri
5.	Fundamentals of Digital Marketing	20-24 April, 2020	71	MPKV, Rahuri
6.	E-Resources of Libraries and Publication Ethics	20-24 April, 2020	230	MPKV, Rahuri
7.	Protected Cultivation Technologies for Climate Smart Agriculture	21-28 April, 2020	235	MPKV, Rahuri
8.	Effective Utilization of New Age e-Resources Technologies in Agriculture	20-24 April, 2020	325	MPKV, Rahuri
9.	Fundamentals of Drone Technology for Precision Agriculture	25-29 April, 2020	109	MPKV, Rahuri
10.	Aeroponics and Hydroponics Technologies for Precision Agriculture	25-29 April, 2020	35	MPKV, Rahuri
11.	Introduction to MATLAB and its Applications in Climate Smart Agriculture	25-30 April, 2020	127	MPKV, Rahuri
12.	Advanced Agrometeorological Techniques for Climate Smart Agriculture	30 April-04 May, 2020	71	MPKV, Rahuri
13.	Fundamentals of Pressurized Irrigation Methods	05-10 May, 2020	154	MPKV, Rahuri
14.	Introduction to Python Programming and its Applications in Climate Smart Agriculture	07-10 May, 2020	139	MPKV, Rahuri
15..	Smart Handling and Processing Systems of Horticultural Produce	04-14 May, 2020	916	MPKV, Rahuri

16.	Carbon Sequestration in Climate Smart Agriculture	11- 13 May, 2020	70	MPKV, Rahuri
17.	Machine Learning and its Applications in Climate Smart Agriculture	15-17 May, 2020	552	MPKV, Rahuri
18.	Use of Media for Transfer of Agriculture Technology	24-28 May, 2020	325	MPKV, Rahuri
19	Fundamentals of Robotics for Precision Agriculture	26-30 May, 2020	497	MPKV, Rahuri
20.	Advances in Smart Food Processing and Technologies	04 June - 15 June, 2020	430	MPKV, Rahuri
21.	Soil and Water Conservation Interventions for Climate Smart Watershed	22-26 June, 2020	274	MPKV, Rahuri
22.	Advanced Agro-meteorological Techniques for Climate Smart Agriculture	29 June - 03 July, 2020	345	MPKV, Rahuri
23.	Competitive Examination AIEEA(PG)JRF, AICE-JRF/SRF (Ph.D.) and ICAR	02 July - 09 August, 2020	600	MPKV, Rahuri
24.	Soft Skills to Enhance Professional Efficiency and Effectiveness	17-31 August, 2020	203	MPKV, Rahuri
25.	Agricultural Drainage for Waterlogged and Salt Affected Soils	24-29 August, 2020	430	MPKV, Rahuri
26.	Writing Research papers for high impact factor journals and Effective proposals	15-17 December, 2020	215	MPKV, Rahuri
27.	Crop weather modeling tools for climate smart Agriculture	21-25 December, 2020	250	MPKV, Rahuri
28.	Adaptive measures for efficient utilization of irrigation water on farm	28-30 December, 2020	367	MPKV, Rahuri
29	National and International Agricultural Higher Education Opportunities	15-18 February, 2021	92	MPKV, Rahuri
30	Emerging Urban Farming Technologies for Vegetable Production	18-22 February, 2021	295	MPKV, Rahuri

31	Hands on Training program on operation of UAV for precision agriculture	22-25 February, 2021	11	MPKV, Rahuri
32	Intellectual Property Rights and patents in Agriculture	09-17 March, 2021	101	MPKV, Rahuri
33	Open-Source Resources and Copy Right Issues	10-13 March, 2021	174	MPKV, Rahuri
34.	One Month Training program on Hydrological Modeling in Context of Climate Smart Watershed Management	June 01 to June 28, 2022	19	MPKV, Rahuri
Online National Workshops/Student Industry Interface (27)				
1.	Fuzzy logic and its applications for Climate Smart Agriculture.	16-19 April, 2020	104	MPKV, Rahuri
2.	Aeroponics and Hydroponics Technologies for Precision Agriculture	25-29 April, 2020	35	MPKV, Rahuri
3.	Organic Farming Inputs, Production, Certification and Marketing System.	11-15 May, 2020	300	MPKV, Rahuri
4.	Fundamentals of Pressurized Irrigation Methods	05-10 May, 2020	154	MPKV, Rahuri
5.	Introduction to Python Programming and its Applications in Climate Smart Agriculture	07-10 May, 2020	139	MPKV, Rahuri
6.	Farmers Producer Organization for Sustainable Income	22 -27 May, 2020	175	MPKV, Rahuri
7.	Fundamentals of Robotics for Precision Agriculture	26-30 May, 2020	497	MPKV, Rahuri
8.	Advances in Smart Food Processing and Technologies	04 June-15 June 2020	430	MPKV, Rahuri
9.	Soil and Water Conservation Interventions for Climate Smart Watershed	22-26 June, 2020	274	MPKV, Rahuri
10.	Refinement of Plant Protection and Agril. Botany Course Curricula for the Implementation of the Post Graduate Diploma in Climate Smart Agriculture	25 December, 2020	15	MPKV, Rahuri
11.	Heralding the next decade emerging trends opportunities and challenges in irrigation water Management.	27 December, 2020	11	MPKV, Rahuri
12.	Refinement of Plant Protection Course Curricula	29 December, 2020	11	MPKV, Rahuri
13.	Brainstorming Workshop Panel Discussion on Drought Early Warning System	13 January, 2021	17	MPKV, Rahuri

14.	Finalization of Audit Course on ICT	17 January, 2022	18	MPKV, Rahuri
15.	Finalization of Audit Course Syllabus of Precision Agricultural Machinery"	27 January, 2021	125	MPKV, Rahuri
16.	Finalization of Audit Course Syllabus of UAV, Robotics and IoT for Precision Agriculture	15 February, 2021	97	MPKV, Rahuri
17.	Introductory workshop on Jagarati Yatra	10 March, 2021	114	MPKV, Rahuri
18.	Intellectual Property Rights and patents in Agriculture	March 09-10 and 17, 2021	127	MPKV, Rahuri
19.	One-day online workshop on "TES (Teacher Evaluation system) application	May 27, 2021	274	MPKV, Rahuri
20.	A three-day online workshop on "Climate Proofing of Watershed Development Projects in the context of Climate-Smart Agriculture and Water Management"	26-28 July, 2021	55	MPKV, Rahuri
21	Workshop of Post Graduate Diploma in CSAWM: Practitioners and perspectives	9 September, 2021	32	MPKV, Rahuri
22.	Climate Change and Cropping pattern	05 August, 2022	101	MPKV, Rahuri
23	3.9 Automation in Agriculture	11 Septmber, 2021	112	MPKV, Rahuri
24	Workshop on Drone Technology for Precision Agriculture	23 Feburuary, 2022	56	
25	Workshop on Sustainable Soil Management courses	16 November, 2021	37	MPKV, Rahuri
26	One Week National Online workshop on Hydrological Modeling using Soil and Water Assessment Tool (SWAT)	June 22 to June 28, 2022	19	MPKV, Rahuri
27		30 June to 01 July, 2022	55	MPKV, Rahuri
Online Webinar /symposium (21)				
1.	Applications of Omics in Climate Smart Agriculture	30 April to 02 May, 2020	686	MPKV, Rahuri
2.	Soil Dynamics for Smart Machineries	18- 21 May, 2020	150	MPKV, Rahuri
3.	Locusts: Myths and Reality, how to tackle if we come across?	09 June, 2020	380	MPKV, Rahuri
4.	Bio-energy a Climate Smart Renewable Energy	30 June, 2020	1500	MPKV, Rahuri
5.	Honey Bee: Architect of Green and Sweet Resolution	20 May, 2020	500	MPKV, Rahuri
6.	Online Webinar on World Environment: World Environment Day 2020 is, Time for Nature	05 June, 2020	497	MPKV, Rahuri

7.	Climate Smart Agriculture	22 July, 2020	675	MPKV, Rahuri
8.	Higher Education and Research in Natural Resources Management for Environmental Sustainability	14 August, 2020	743	MPKV, Rahuri
9.	Present Status of Protection of Plant Varieties and Farmer's Rights Act 2001 (PPVFRA) & Commercialization of Varieties Registered under PPVFRA 2001	11 August, 2020	2400	MPKV, Rahuri
10.	National symposium on Decoding Agritech: Towards Atmanirbhar Bharat	12 September, 2020	225	MPKV, Rahuri
12.	Advances in basic plant research in relation to climate change	08-09 October, 2020	256	MPKV, Rahuri
13.	Agricultural Education Day	03 December, 2020	117	MPKV, Rahuri
14	World water day	March 22, 2021	97	MPKV, Rahuri
15.	World Environment Day-2021	June 05,2021	263	MPKV, Rahuri
16.	Webinar series Developing Entrepreneurship and Employability of Students in Agro-Industries and a first webinar on Tractor Industry	June 23, 2021	157	MPKV, Rahuri
17.	Recent Advances in Micro-Irrigation, Fertigation and Digital Farming Solutions	July 27, 2021	91	MPKV, Rahuri
18.	"Developing Entrepreneurship and Employability of Students in Food Processing Industry"	July 27, 2021	398	MPKV, Rahuri
19	Climate Change and Cropping pattern	05 August, 2021	101	MPKV, Rahuri
20	Fort in Maharashtra	29 August, 2021	51	MPKV, Rahuri
21	Celebration of World Honey Bee Day	20 May,2022	171	MPKV, Rahuri
Online Farmers programmes (13)				
1.	Use of Digital Technology for Marketing of Agricultural Commodities	30 April to 04 May, 2020	149	MPKV, Rahuri
2.	Use of Organic Farming Inputs, Production, Certification and Marketing System.	11 – 15 May, 2020	300	MPKV, Rahuri
3	Climate Change and its Effect on Pest And Disease on Crops	17 – 18 May, 2020	188	MPKV, Rahuri

4	Farmers Producer Organization for Sustainable Income	22 -27 May, 2020	175	MPKV, Rahuri
5	Climate Protection for Pomegranate from Pests and Diseases	29 May to 02 June, 2020	143	MPKV, Rahuri
6	Sustainable Sugarcane Production	10 -12 June, 2020	120	MPKV, Rahuri
7	Climate Change and cotton production technology	15 -16 June, 2020	113	MPKV, Rahuri
8	Sugarcane Production Technology	01 July, 2020	91	MPKV, Rahuri
9	Precision Water Management and Mechanization Technology for Sustainable Sugarcane Production with Changing Climate-I	06-08 July, 2020	123	MPKV, Rahuri
10	Precision Water Management and Mechanization Technology for Sustainable Sugarcane Production with Changing Climate-II	13-15 July, 2020	149	MPKV, Rahuri
11	Onion Crop Production Technology and Precision Irrigation Management	29 January, 2021	52	Buchkewadi, Tal. Junnar, Dist. Pune
12	“Insect, Pest and Disease Management of Onion and Tomato Crops”	July 08, 2021	37	Buchkewadi, Tal. Junnar, Dist. Pune
13.	Climate Change and Cropping pattern	05 August, 2021	111	Pune

2. Offline capacity building programmes in context of CSA&WM organized by CAAST-CSAWM, MPKV, Rahuri (2018 to 31 December, 2023)

Sr. No.	Title of event	Duration	No. of Participants	Place
International training for PG students & faculties				
1.	Drones and It's applications Google Earth Engine"	11 November to 10 December, 2019	21	Asian Institute of Technology, Bangkok, Thailand
2.	Applications of Google Earth Engine, IoT, and Drones for Precision Agriculture	30 January to 01 March, 2023	04	Asian Institute of Technology, Bangkok, Thailand
3.	Advanced Technologies for Climate Smart Agriculture	30 January to 01 March, 2023	05	Asian Institute of Technology, Bangkok, Thailand
4.	Smart Sensing System in Horticultural crop production System	20 January to 19 February, 2023	01	University of Tsukuba, Japan
5.	The development of computer simulation model for the land applications of agricultural machinery	16 January to 15 February, 2023	01	University of Wisconsin, River Falls, USA
6.	Application of Google earth engine, IoT and Drones forprecision agriculture	16 October to 15 November, 2023	19	Asian Institute of Technology, Bangkok, Thailand
7. 8.	Advanced technologies forclimate smart agriculture	23 November to 22 December, 2023	21	Asian Institute of Technology, Bangkok, Thailand
9.	Climate Smart Agriculture andWater Management	06 November to 05 December, 2023	20	University Putra Malaysia, Selangor, Malaysia
10	Smart Agriculture Programme	4-30 December, 2023	18	Can Tho University, Vietnam
12	Applications of Google Earth Engine, IoT, and Drones for Precision Agriculture	06-20 February, 2023	02	Asian Institute of Technology, Bangkok, Thailand
13	Intelligent Technologies for Modern Agriculture	26 November to 11 December, 2023	08	HUE University of Agriculture and Forestry (HUAF), Vietnam
14	Advanced technologies for climate smart agriculture	01-15 December, 2023	08	Asian Institute of Technology, Bangkok, Thailand
International Short visit for faculties				
1.	International Short visit for Faculties	March 6-14, 2020	02	Washington State University, USA
2.	Applications of Google Earth Engine, IoT, and Drones for Precision Agriculture	06-12 February, 2023	04	Asian Institute of Technology, Bangkok, Thailand

3.	Applications of Google Earth Engine, IoT, and Drones for Precision Agriculture	02-10 December, 2023	06	Asian Institute of Technology, Bangkok, Thailand
International symposiums				
1.	Strategizing Education and innovations in Robotics, Drones and IoTs for Climate Smart Agriculture	23-25 July, 2019	200	MPKV, Rahuri and Pune
2.	International Symposium on Artificial Intelligence Based Future Technologies in Agriculture	7-9 January, 2020	335	Hyatt Regency, Pune
3.	International Conference on Advanced Agricultural Technologies	December 20-21, 2023	76	Pune
4	International Symposia on Drones for Agriculture	December 20-21, 2023	59	Pune
5	International Symposia on Hyper-spectral Imaging for Agriculture	December 20-21, 2023	61	Pune
6	International Symposia on IoT for agriculture	December 20-21, 2023	51	Pune
7	International Symposia on Indoor Farming	December 20-21, 2023	50	Pune
8.	International Symposia on Robotics in Agriculture	December 20-21, 2023	49	Pune
International scientists students' interface/International workshops/workshops				
1.	International Scientist-Students Interface on Drones Robotics AI and FM	10 January, 2020	331	College of Agriculture, Pune
2.	International Scientist-Students Interface on Drones Robotics AI& FM at Rahuri	12 January, 2020	261	MPKV, Rahuri
3.	International workshop on Course Curricula Development for Post Graduate Diploma in CSA	11-12 January, 2020	150	MPKV, Rahuri
1.	Inception workshop	15-17 July, 2018	76 Faculties	MPKV, Rahuri
2.	One day workshop on social science course contents for PG Diploma	28 August, 2018	49 Faculties	MPKV, Rahuri
3.	Student- Industry Interface on Application of drone technology in Agriculture	28th February, 2019	172	MPKV, Rahuri
4.	Student- Industry Interface on Application of Drone technology in Agriculture	27th March, 2019	393	MPKV, Rahuri
5.	Student- Industry Interface on Robotics and Automation for Climate Smart Agriculture	28th March, 2019	261	MPKV, Rahuri
6.	Stakeholder workshop Agrio-climatic Networking	9th April, 2019	60	MPKV, Rahuri

7.	Developing village level contingency crop plans for Akole block	20-21 June, 2019	50	MPKV, Rahuri
8.	Soil Health and Land Use Planning	04-05 July, 2019	104	MPKV, Rahuri
9.	A workshop on village level crop contingency plan organized	09 July, 2019	71	MPKV, Rahuri
10.	One Week Workshop on Protected Cultivation Technology	15-19 July, 2019	33	MPKV, Rahuri
11.	Protected Cultivation: Opportunities and Challenges	27 August, 2019	84	MPKV, Rahuri
12.	Student Industry Interface on Applications of Drone in CSA & WM	11 September, 2019	25	MPKV, Rahuri
13.	Water Budgeting for Efficient Water Resources Management in Watersheds	20-21 September, 2019	36	MPKV, Rahuri
14.	Two days Industry-Government-Academica-Students Interface programme on “Quality, Technical and Financial Aspects of Protected Cultivation Structures	26-27 September, 2019	100	MPKV, Rahuri
15.	Irrigation Planning and Water Management	04-05 October, 2019	25	MPKV, Rahuri
16.	One day workshop on Agriculture Drone for spraying	22 November, 2019	37	MPKV, Rahuri
17.	One day workshop programme on “Smart Irrigation and Water Productivity	27 November, 2019	47	MPKV, Rahuri
18.	Planning and Design of Micro Irrigation System	02 & 03 December, 2019	21	MPKV, Rahuri
19.	Disaster Risk Reduction	07 December, 2019	56	MPKV, Rahuri
20.	Farmers Scientists Interface cum Workshop	10 January, 2020	158	MPKV, Rahuri
21.	Workshop on Climate Smart Agriculture	07 February, 2020	130	MPKV, Rahuri
22.	Precision water management technologies: Prospective and opportunities	07 February, 2020	19	MPKV, Rahuri
23.	Advances in Micro Irrigation System	14 February, 2020	94	MPKV, Rahuri
24.	Brainstorming cum workshop session on finalization of proforma for pre and post training evaluation	24 February, 2020	27	MPKV, Rahuri
25.	Advance irrigation system and fertilizer management	04-06 March, 2020	78	MPKV, Rahuri
26.	Workshop on Social Science Course Curriculum development for PG Diploma	07-08 March, 2020	35	MPKV, Rahuri
27.	Brainstorming cum workshop session on Strategizing Research and Education in Aeroponics	16 March, 2020	44	MPKV, Rahuri

28.	Workshop on Water conservation and management including protected cultivation technology	07 January, 2022	67	MPKV, Rahuri
29.	One-week workshop on Hyperspectral Imaging Techniques for Climate Smart Agriculture	23-27 May, 2022	16	MPKV, Rahuri
30.	Hyperspectral Imaging Techniques	23 May, 2022	11	MPKV, Rahuri
31.	Workshop on seed production techniques	03 June, 2013	57	MPKV, Rahuri
32.	Prepare Strategy and Road Map for Sustainable Agriculture	30 June-01 July, 2022	55	MPKV, Rahuri
33.	Intellectual Property Rights	24 June, 2022	57	MPKV, Rahuri
34	Precision water management technologies	23July, 2022	51	MPKV, Rahuri
35	Application of Drone for Agriculture	12 August, 2022	76	MPKV, Rahuri
36	Google Earth Engine, IoT, and Drones for Precision Agriculture and Advanced Technologies for Climate Smart Agriculture	26-27 March, 2023	56	MPKV, Rahuri
37	Brain Storming on networking of MPKV with institution in South Asian Countries.	27 April, 2023	35	MPKV, Rahuri
38	State level one day workshop on Agriculture spraying drone	15 June, 2023	56	Pune
39	Workshop on Niramay Aarogya	23 June, 2023	106	MPKV, Rahuri
40	Meet of Emerging Entrepreneurs (MEE)			MPKV, Rahuri
41	One day workshop on Digital Technologies for Agriculture Value Chain Management	09 September, 2023	175	Sahyadri, Nashik
42	AMS software	15 September, 2023	108	MPKV, Rahuri
43	A one-day workshop on "Entrepreneurship Development through Drone Training"	13 October, 2023	350	Pune
44	One day Workshop on Hydroponics and Aeroponics	October 27, 2023	70	Pune
45	Brainstorming workshop on IoT-enabled Livestock Management Advances and Adoption in Indian Situation	03 November, 2023	105	Pune
46	Role of Journalism and Media in Promoting the Climate Smart and Digital Agriculture	December 08, 2023	100	Pune
47	Carbon Credits can we earn additional revenue from agriculture	December 15, 2023	75	Pune
Three Week Certificate Course				
1.	Three Weeks Certificate Course on Tally	September 20 to October 10, 2021	19	MPKV, Rahuri
National Training Programmes				

1	Python Programming in CSA	04-05th May, 2019	39	MPKV, Rahuri
2	Application of Precision Farm Machinery	22- 27th May, 2019	29	MPKV, Rahuri
3	ICT for Effective Knowledge and Extension Delivery for CSAWM	11-12th June, 2019	108	MPKV, Rahuri
4	Hyper spectral Remote Sensing and Spectroradiometer in CSA	14-15th June, 2019	120	MPKV, Rahuri
5	Linux Programming, MPKV, Rahuri	01-03rd July, 2019	42	MPKV, Rahuri
6	Protected Cultivation Technology	15-19, July, 2019	47	MPKV, Rahuri
7	Precision Irrigation Management	30-31 July, 2019	27	MPKV, Rahuri
8	Application of advance python computation in CSA	01-03 August, 2019	54	MPKV, Rahuri
9	One Day Training on IoT applications and advanced technologies for CSA and WM	19 August, 2019	25	MPKV, Rahuri
10	Climate Resilient Agriculture and Smart Technologies	26-30 August, 2019	71	College of Agriculture, Pune
11	Data Loggers and Sensors for CSA & WM	20-22 August, 2019	36	MPKV, Rahuri
12	Climate Resilient Agriculture and Smart Village Approach	06-07 September, 2019	76	MPKV, Rahuri
13	Two days training on Precision Irrigation Management	20-21 August, 2020	65	MPKV, Rahuri
14	Training program on Fostering Employment and Empowerment through Agriprenureship Development	12-13 September, 2019	120	MPKV, Rahuri
15	Training on Basics of Drones, AI and Geo-informatics for CSA & WM	18 September -01 October, 2019	25	MPKV, Rahuri
16	Training on Integrated Farming System for CSA & WM	18-19 September, 2019	49	MPKV, Rahuri
17	Water Budgeting for Efficient Water Resources Management in Watersheds	20-21 September, 2019	79	MPKV, Rahuri
18	Hyperspectral Remote Sensing, Thermal and 3D Lidar sensor based on precision farming and water resource management	13-14 November, 2019	39	MPKV, Rahuri
19	Beekeeping for Climate Smart Agriculture and Sustainability	22-23 November, 2019	59	MPKV, Rahuri
20	Carbon and Water Foot printing for Climate Smart Agriculture	23-24 December, 2019	78	MPKV, Rahuri
21	Communication Skills & Personality Development	02 January, 2020	69	College of Agriculture, Pune
22	Stress Management	03 January, 2020	69	College of Agriculture, Pune
23	Application of Drone on agriculture	11 February, 2020	53	MPKV, Rahuri

24	Installation, Calibration of ERP software	13 February, 2020	10	MPKV, Rahuri
25	Subsurface Drainage and Reclamation of soil	24th February, 2020	40	MPKV, Rahuri
26	Nanotechnology and its applications	04 March, 2020	176	MPKV, Rahuri
27	Fruit Crop Production and Insect Pest Disease Management	13 March, 2020	68	MPKV, Rahuri
28	Post training programme on Geo-informatics and Google earth engine in precision farming and CSA	15 -30 December, 2019	20	MPKV, Rahuri
29	Two weeks training programmes faculty Advanced training on IRRICAD	21 September to 01 October, 2021	57	MPKV, Rahuri
30	Two days training programmes on "Airborne Hyperspectral Sen**sor"**	October 06-07, 2021	34	MPKV, Rahuri
31	Protected technologies for Agriculture	13 December, 2021	123	MPKV, Rahuri
32	Two days training programme on "IRRICAD32"	16-17 December 2021	27	MPKV, Rahuri
33	Climate Smart Digital Technology	07-09 July, 2022	67	
34	Three-day training programme on "Solar Power Irrigation System"	26-28 July, 2022	27	BISA, Jabalpur
35	Three-day training programme on "Solar Power Irrigation System"	02-05 August, 2022	33	BISA, Jabalpur
36	Three-day training programme on "Solar Power Irrigation System	06-08 September, 2022	40	BISA, Jabalpur
37	One-day programme on "Onion Crop Production Technology and Precision Irrigation Management	29 January, 2021	56	Buchkewadi, Pune
38	One-day programme on "Insect, Pest and Disease Management of Onion and Tomato Crops"	08 July, 2021	67	Buchkewadi, Pune
39	One day programme on "Climate Change and Cropping pattern"	05 August, 2021	91	Buchkewadi, Pune
40	One-day programme on "Precision Irrigation Management"	**20 October, 2021**	37	Buchkewadi, Pune
41	Climate Protection for Pomegranate from Pests and Diseases	05 November, 2021	39	Buchkewadi, Pune
42	Sustainable Sugarcane Production	11 December, 2021	45	Buchkewadi, Pune
43	Climate Change and cotton production technology	05 January, 2022	47	Buchkewadi, Pune
44	Sugarcane Production Technology	18 Januarry, 2022	51	Buchkewadi, Pune
45	Climate Change and Cropping pattern	22 Feburuary, 2022	45	Kasare, Tal. Parner, Ahmednagar
46	IoT and Sensor based Technologies for Precision Agriculture	27 March, 2023	42	Buchkewadi, Pune
47	Digital technologies	21 May, 2023	49	Kasare, Tal. Parner, Ahmednagar
48	Two days training programme on Fundamentals of geo-informatices for climate smart and Precesion Agriculture	12-13 October, 2023	20	MPKV, Rahuri

49	One week (seven days) training programme on Digital Technologies for Climate Smart and Precision Agriculture (Pre training)	October 17-23, 2023	20	MPKV, Rahuri
50	One week (seven days) training programme on Geo-informatics and Drone Technologies for Climate Smart Agriculture (Pre training)	October 30 to November 05, 2023	20	MPKV, Rahuri
51	Three days training programme on Fundamentals of geo-informatices for climate smart	November 18-20, 2023	18	MPKV, Rahuri
52	Three days pre -training programme on Fundamentals of geo-informatices for climate smart and Precesion Agriculture	November 25-27, 2023	08	MPKV, Rahuri
Expert Lectures				
1	Management of Export Oriented Protected Cultivation	26 February, 2019	59	College of Agriculture, Pune
2	Application of Micro-Irrigation Technology in Crop Water Management	27 February, 2019	80	College of Agriculture, Pune
3	You are the author of your own Destiny	26 September, 2019	189	MPKV, Rahuri
4	Developing Village Level Contingency Crop Plan	04 October, 2019	57	MPKV, Rahuri
5	Seriousness of Hazardous Waste & its Disposal	11 October, 2019	110	MPKV, Rahuri
6	Water Resources Management: Sharing the Experience of Brahmaputra - Meghana River Basin	18 October, 2019	45	MPKV, Rahuri
7	Water Productivity: Status and Strategies for Improvement	27 November, 2019	45	MPKV, Rahuri
8	Water resources management in Command Area	04 January, 2020	75	MPKV, Rahuri
9	Socio Economic aspects for Climate Smart Agriculture	11 January, 2020	123	MPKV, Rahuri
10	Expert Lecture on "Aeroponics"	17 March, 2020	44	MPKV, Rahuri
11.	Expert Lecture on "Irrigation Water Management: An International Perspective	14th February, 2020	57	MPKV, Rahuri
12.	The Language of Science and Technology, by	25 September, 2021	27	MPKV, Rahuri

13.	Scientific and Technical Report writing, by	26 September, 2021	26	MPKV, Rahuri
14.	Developing Presentation Skills: Scientific Writing essential, by	27 September, 2021	29	MPKV, Rahuri
15	Natural Resources Management for Climate Smart Agriculture	14 March, 2022	111	MPKV, Rahuri
16	Success story of Fruit fly Management in Gujrat	28 March, 2022	123	MPKV, Rahuri
17	Sustainability Concern in Indian Agriculture: Demand Science -led Innovations	28 April, 2022	137	MPKV, Rahuri
18	Expert lecture on "Sustainability Concern in Indian Agriculture: Demand Science -led Innovations"	28 April, 2022	87	MPKV, Rahuri
19	Expert lecture on "Water Budgeting for Efficient Water Resources Management in Watersheds"	15 May, 2002	91	MPKV, Rahuri
20	Expert lecture on "Water Management Options in canal Command Areas"	20 June, 2022	78	MPKV, Rahuri
21	Expert lecture on "Organic food-consumers point of view."	05 August, 2022	98	MPKV, Rahuri
22	Expert lecture on "Eat Right India Movement."	05 August, 2022	98	MPKV, Rahuri
23	Soft skill Development	14 July, 2023	275	MPKV, Rahuri
25	Finance	07 September, 2023	35	MPKV, Rahuri
26	Spectroradiometer instrumentation and application in agriculture by Thomas Corl, SVC, Crop, Scotland	17 October, 2023	80	MPKV, Rahuri
27	Hyperspectral imaging camera in agriculture -Lab, field and airborne and airborne analysis by Alex Lussier, application engineer, resonan inc. Bozeman, USA	18 October, 2023	229	MPKV, Rahuri
28	UAV based hyperspectral and multispectral imaging sensor and application in agriculture by Dr. Sunil Kadam Associate Professor CAAST, MPKV, Rahuri	19 October, 2023	331	MPKV, Rahuri
29	Spectroscopy in Agriculture by Dr.K. Ramesh, Chief Executive Officer, Sinsil international Pvt. Ltd. Mumbai	20 October, 2023	204	MPKV, Rahuri