

ICAR-National Agricultural Higher Education Project

Annual Progress Report
(April'19 to March'20)

Component 1b: Centres for Advanced Agricultural Sciences and
Technology



1. Executive Summary

NAHEP Project Objective:

NAHEP is designed to strengthen the national agricultural education system in India with overall objective to provide more relevant and high-quality education to agricultural university students. This programme will promote efficiency and competitiveness through changes in working mechanism of agricultural universities, raising the teaching and research standards through improved research and teaching infrastructure and enhanced faculty competency and commitments, and making agricultural education more attractive to talented students. There are four key components under NAHEP, namely; Institutional Development Plan (IDP), Centres for Advanced Agricultural Sciences and Technology (CAAST), ICAR to support excellence in agricultural universities (AUs), and ICAR Innovation Grants to AUs. It is envisaged that improved AU performance through quality enhancement, better employment and entrepreneurship opportunities created for agriculture graduates, non-accredited AUs attaining ICAR accreditation, and institutional reforms implemented in education division of ICAR and AUs under these components together shall contribute to the achievement of the overall program objective.

Progress made during period: The progress made across each component of NAHEP during April 19 to March'20 has been captured herewith.

Component 1 b: Support to Centres for Advanced Agricultural Sciences and Technology (CAAST)

While IDP focusses on improving standard and quality of agricultural higher education, the investments under CAAST component contribute more towards enhancing the relevance of the teaching and research. The focus of CAAST hinges upon development of multidisciplinary faculty, innovative approaches to teaching and research, technology development and commercialization. The holistic approach to teaching and research for agriculture and rural development would be building capacities in a specialized thematic area and cutting-edge agricultural science and make AUs globally competitive and locally relevant. High emphasis on industry orientation of agricultural science and technology generation system through strengthened association and partnership will be laid under this component. It is envisaged that the support and efforts under CAAST would strengthen agricultural higher education with better employment and entrepreneurship opportunities for agriculture graduates.

Broad Activities/ Achievements during year 2019-20

Mahatma Phule Krishi Vidyapeeth, Rahuri has been awarded with CAAST on Climate Smart Agriculture and Water Management with the main objectives of:

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, modeling 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 and
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.

The broad activities emphasizing the major achievements are highlighted below

1. Capacity Building

(a) Twenty PG Students and one faculty of MPKV Rahuri successfully completed one-month International level training on “Drones and Its Application and Google Earth Engine” at Geoinformatics Centre, Asian Institute of Technology (AIT), Bangkok, Thailand during November 11, 2019 to December 10, 2019. Out of 20 students, 4 students were offered internship at AIT, Bangkok after completion of their M.Tech studies.

(b) Successfully organised 86 national events viz. trainings (28), workshops (27), guest lectures (12), exposure visits (14), field demonstrations (05); and 05 international events viz. symposia (02) and scientists- student interface (03). The number of beneficiaries of the project were 5704 including faculties, students and farmers.

(c) One CAAST-CSAWM member of this University has been offered with the Post Doctorate Research Fellowship in one of the International collaborating Universities (Washington State University, Pullman, USA) and he joined this assignment in USA in December 2019.

2. Academic Programmes

(a) The framework of the PG Diploma along-with the courses to be offered in each module has been finalized during eight Workshops and Brain-storming sessions conducted at MPKV, Rahuri and Pune campuses with 24 National and International partners. This Diploma is novel in the sense that it is module based. There are four modules spread over 52 weeks i.e. one year. Module -1 is of 10 weeks duration; consisting of 3 courses of 3 weeks and followed by “Industry and Farmers Day”. Module-2 and 3 are of 13 weeks duration each; consisting of 3 courses of 3 weeks duration each followed by project of 3 weeks duration. Module-4 is of 16 weeks duration followed by Project of 6 weeks duration. 71 courses of three weeks duration were developed for climate smart agriculture and water management in context of Natural Resources Management, Precision Agricultural Machineries, Precision Irrigation Management and Protected Cultivation, Robotics, Drones and IoT, Geo-informatics and Social Science

(b) Started the Post Doctorate Research Programmes

(c) Finalised the certificate courses

(d) Formulated the courses related to climate smart agriculture and water management to be offered to the M.Sc/M. Tech and Ph D programmes as non-gradual or audit courses

(e) Two University officers visited Washington State University, Pullman, USA during March 6-16, 2020 for studying the state of art facilities of drones, hyper-spectral remote sensing, robotics; and discussing on formalisation of the collaborative research and post-doctoral research programmes.

(f). Developed Drone/Robotics laboratories and up gradated RS & GIS and CAD-CAM laboratories.

3. Out of box research initiatives

(a) An automatic ring infiltrometer was designed, developed and tested to measure the rate of water infiltration into the soil or other porous media in the field in order to overcome the difficulties and limitations of a conventional double-ring infiltrometer for infiltration rate measurement. This instrument is accurate in measurement and time convenient as compared to existing infiltrometers.

(b) Phule SANMAN Software and mobile app was developed to access the need of mechanization and available network solutions. This mobile application has been designed for data acquisition of current utilization agricultural machinery by farmers, finding the gap and to suggest optimum solution for mechanization with location and facilities of the service provider.

(c) Web based and Mobile based Spatial Evapotranspiration (ET) calculator was developed to calculate Spatial Reference ETr (mm/day) required to estimate water requirement of crop by entering name of location or by clicking on the location on Google Map. This calculator provides ETr of desired location for current day and next four days based on the forecast weather using Penman Monteith method.

4. Knowledge Destination

- (a) Developed climate smart agriculture blocks for research, experimentation and demonstration related to climate smart agriculture and water management.
- (b) Developed Village level Contingency Crop Plan for seven adopted villages of Akole Block, Maharashtra.
- (c) Started the activities for developing the Buchkewadi in Junnar Tehsil of Pune as digital village in context of the precision water management
- (d) Organised the training programme for building the capacity of the farmers for climate smart agriculture and precision water management.

Plan Ahead

1. Capacity Building

(a) In order to provide the exposure to the postgraduate students and faculties of the Mahatma Phule Krishi Vidyapeeth, Rahuri; it is proposed to depute the 60 students for International Training abroad (40 students with Agricultural Science Background to Malaysia Putra University, Malaysia and 20 students with Agricultural Engineering background to the Asian Institute of Technology, Bangkok (Thailand), once the restrictions imposed due to COVID19 are removed and permission from the NAHEP is obtained. Similarly, 10 faculties will be deputed for the International Training to the Washington State University, Pullman, USA; University Putra Malaysia and AIT, Bangkok, Thailand. The possibility will also be explored to depute the students and faculties to other Universities/Organisations abroad depending on the fund situation and removal of the restrictions due to the COVID 19 situation.

(b) The CAAST-CSAWM has started the online training programme since the first week of April, 2020 to provide the learning opportunities to the students and faculties not only of Mahatma Phule Krishi Vidyapeeth but of other Agricultural Universities and Organisations. This also enabled the CAAST-CSAWM to take the benefits of the east availability experts from all over India due to lock-down period, to develop the networking of CAAST-CSAWM with the experts and the corresponding organisations; and to keep the staff working in CAAST-CSAWM engaged positively during lock down period and more importantly provide them the opportunities to conduct the on line programme along with the learning opportunities. Till date we conducted thirty 1-2 weeks on line training programmes with daily two sessions of two hours (before noon and afternoon). We subjected the participants to quizzes and in some training programmes, the participants were asked to submit the online assignments. The participants were asked to complete the on-line pre and post evaluation proforma. The response was tremendous and feedback was excellent. We also developed the model for the conduct of the on-line training programme as “NAHEP-CAAST-CSAWM Model”. We intend to plan more on-line training programmes and webinars in online mode in the different subjects related to climate smart agriculture and water management.

(c) As on now, we don't have any plan to conduct the on-campus training programme; but depending on the relaxation of COVID-19 situation, we shall plan for the on-campus training programme on the aspects related to precision agriculture (drones, robotics and IoT), climate smart agriculture (conservation agriculture, contingent planning, climate smart and digital villages, protected cultivation technologies), precision water management (precision irrigation, mobile and web based applications), modelling and decision support systems for climate smart agriculture and water management (Artificial Intelligence, machine learning, Python and MATLAB software; and soft computing techniques including evolution algorithm), knowledge dissemination for climate smart agriculture and water management.

2. Academic Programmes

(a) The framework, course outline and course curricula for the Post Graduate Diploma have been finalised in consultation with the National and International Collaborators by organising eight national and international workshops and brainstorming sessions. The documents were emailed to the experts and upon considering the suggestions from the experts; the proposal will be submitted to the NAHEP for further approval. Upon approval and depending on the COVID 19 situation; the PG Diploma will be

started from the month of September, 2020.

(b) The certificate courses of three weeks either in online mode or on campus mode will be organised as below.

- (i) Agripreneurship Development and Management
- (ii) Protected Cultivation Technology for Vegetables and Flowers
- (iii) Climate Smart Organic Agriculture
- (iv) Integrated Farming System for Sustainable Agriculture
- (v) Basic Geoinformatics for Climate Smart Agriculture
- (vi) Google Earth Engine in Precision Farming and Climate Smart Agriculture

(c) The research studies related to climate smart agriculture and water management for the development of tools and techniques will be conducted through the post graduate and Post-Doctoral Students.

(d) The courses developed for the strengthening of the M.Sc/M.Tech and PhD degree courses for the climate smart agriculture and water management will be offered to the students as non-gradual or audit courses from the ensuing semester.

3. Development of the tools and technologies

We plan to complete the following tools and technologies during the current year

- Development of linear conjunctive use model for selected region
- IoT based crop monitoring and controlling in Green house
- Design and development of Robotic harvester for selected crops
- Optimization of different parameters of spraying drone for effective operation
- Development of Soil Moisture App and its integration with soil moisture sensor
- Development of site-specific organic slurry applicator for orchard crops
- Design and development of variable rate fertilizer applicator
- Development of mobile application for Services for Agricultural Mechanization (“Phule – SAM”)
- Estimation of crop growth development by using the hyperspectral imaging camera.
- Estimation of soil mapping by using the satellite data and hyperspectral imaging camera.
- Development spectral signature from crops by using hyperspectral imaging camera.

4. Knowledge Destination

(a) Climate Smart and Digital Villages: The villages namely *Manhere, Ambevangan, Ladgaon, Titavi, Kodani, Pimparkane* and *Dongarwadi* in *Akole* Tahsil of the Ahmednagar district were selected to develop as the climate smart villages in association with BAIF and NABARD; village *Buchkewadi* in *Junnar* Tehsil of Pune district and village *Bomurdi Ghumat* in *Nagar* Tahsil of Ahmednagar district were selected to develop as the digital villages in association with LUPIN and NABARD; and Alumni Association of Agricultural Engineer, SEWA and NABARD. The activities to be performed for the development of the climate smart villages and digital villages will be sped up (these activities are almost halted; except for the organisation of on-line training programmes for the farmers in those villages)

(b) Training Programme: 05 Online training programmes in Marathi language were organised for the farmers in the State of Maharashtra to train them on different aspects of the climate smart agriculture and water management. The farmers were found receptive for the online training programme and the responses from them were encouraging. More on-line training programmes will be organised for the farmers and upon the removal of the restrictions due to COVID-19; the possibility of conducting on campus or in-village training programme will be explored.

(c) Crop Contingent Plan: The crop contingent plans developed for the seven villages to be developed as the climate smart villages will be released along with the procedure developed for the downscaling of the district level crop contingent plan to the village level. The crop contingent plan will be developed for the *Buchkewadi* and *Bamburdi Ghumat* villages (to be developed as the digital villages)

(d) The platform will be provided for the start-ups and the entrepreneurs for the development and the adoption of the IoT based technology and tools on the farmers filed.

(e) MoUs will be signed for the 26 National and 07 International collaborators (though the collaborating activities are going on but to provide the formal approval, signing of MoUs is necessary).

(d) Organised the International Symposium on "Artificial Intelligence based Future Technologies in Agriculture" spanned over three days concurrent to ISAE Convention (January 07-09,2020)

First day (7 Jan., 2020): The inaugural function, Theme session with four theme lectures on Artificial Intelligence and Startups; two industry-scientists-students interface sessions.

Second Day (8 Jan., 2020): Five concurrent sessions on the four disciplines of agricultural engineering viz. Soil and Water Engineering (five sessions), Farm Machinery and Power Engineering (four sessions), Processing, Dairy and Food Engineering (four sessions), Energy and Other Areas (three sessions); and the International Symposium on Artificial Intelligence (five sessions) were conducted. Thus there were 21 Technical Sessions with 10 Key Note Speeches (during the International Symposium), 351 research papers selected for oral presentations, out of which 173 research papers were presented.

Concurrently the Poster Session was also organised using the digital platform for four disciplines of agricultural engineering viz. Soil and Water Engineering, Farm Machinery and Power Engineering, Processing, Dairy and Food Engineering, Energy and Other Areas; and the International Symposium on Artificial Intelligence. 240 papers were selected for poster presentations, out of which 78 papers were presented.

Third day (9 Jan., 2020): Plenary session on two themes namely "Agricultural Engineering Technologies for Start-ups" and "Artificial Intelligence based future technologies in Agriculture" and valedictory function followed by Special Sessions for farmers-scientists interaction were held.

Component 1 b

Support to Centres for Advanced Agricultural Sciences and Technology (CAAST)

Component cost

USD 46.2 Mn

1. Output-outcome monitoring

S. N.	Particulars	April'18 to March'19		Apr'19 to March'20		Remarks (Action plan for areas where improvement is needed)
		Plan	Achievement ¹	Plan	Achievement	
1.	Number of technologies transferred to industry / private sector / national / international organisations	NIL	10 (1)	10 (2)	15 (3)	The numbers in bracket are from the CAAST-CSAWM project and numbers outside the bracket are from where the NAHEP is being implemented. Action Plan: The technologies developed under CAAST-CSAWM are as such ready to be transferred but as suggested during the Review meetings, the possibility of the patent and copyright will be explored.
2.	Number of students selected in JRF / SRF / ARS	35	55	35	37	Action Plan: Special trainings/ workshops on competitive examinations for the PG Students will be organized by inviting subject experts; and the capability of the students to excel in theses examinations including GATE for the Agril. Engg. Students will be developed
3.	Number of students who were admitted in foreign universities	0	1	1	1	Action Plan: Collaboration with the foreign Universities through CAAST will be initiated for higher enrollment of PG students in Foreign Universities. The process of signing MoUs with the International Universities/Organizations will be sped up for this purpose.
4.	Number of students received National Young Scientist Award	-	-	-	-	Action Plan: Awareness among the students regarding National Awards and its criteria will be created through continuous

¹Inputs captured from NAHEP Annual Report 2018-19

S. N.	Particulars	April'18 to March'19		Apr'19 to March'20		Remarks (Action plan for areas where improvement is needed)
		Plan	Achievement ¹	Plan	Achievement	
						interaction with students using various social media platforms
5.	Number of students received ICAR's Jawaharlal Nehru thesis Award	-	-	-	-	Action Plan: 1. Awareness about ICAR's Jawaharlal Nehru thesis Award with in-house screening before submission to ICAR 2. Organizing workshops for technical writing skills and research methodology
6.	Number of students awarded at Agri-unifest	1	3	1	1	-
7.	Number of students awarded at Agri uni sports meet	3	5	10	12	-
8.	Number of industry- sponsored projects and positions in cutting-edge areas of agri-science	2	2	2	2	Action Plan: 1. Young faculties will be exposed to new cutting-edge research areas through national and international trainings. 2. The collaboration with the industries is already being developed through CAAST-CSAWM for this purpose; and more number of faculties will be encouraged to earn the industry sponsored projects.
9.	Number of competitive grants from a national/international funding agency	5	8	5	5	Action Plan: Workshops and interaction with industries will be organized for preparation of winning project proposals for external funding
10.	Number of international trainings undertaken by faculties under CAAST comp	-	-	8	1 (1) (No. of faculties: 3)	a) One faculty successfully completed One-month International training on "Drones and its applications and Google Earth Engine" at Asian Institute of Technology, Bangkok, Thailand during 11 November to 10 December 2019 from the CAAST-CSAWM. b) Seven more faculties were to undergo One-month international

S. N.	Particulars	April'18 to March'19		Apr'19 to March'20		Remarks (Action plan for areas where improvement is needed)
		Plan	Achievement ¹	Plan	Achievement	
						<p>training on Precision Agriculture and water management at Washington State University, Pullman, USA during March 2020; however, the training programme could not be started due to COVID-19 pandemic. However, this planned training will now be rescheduled in consultation with Washington State University, Pullman, USA until situation gets normal.</p> <p>c) The numbers in bracket are for the short International interaction visit of University Officials at WSU, Pullman, USA for betterment of collaboration and future programme planning during 6-16 March 2020.</p>
11.	Number of national trainings undertaken by faculties under CAAST comp	3	5	25	No of Trainings: 34 No. of Faculties: 1717	Faculties attending more than one training are counted for the number trainings completed.
12.	Number of international trainings undertaken by students under CAAST comp			No. Trainings: 4 No. of Students: 80	No of Trainings: 1 No. of Students: 20	<p>a) Twenty students successfully completed One-month Students International training on “Drones and its applications and Google Earth Engine” at Asian Institute of Technology, Bangkok, Thailand during 11 November to 10 December 2019 from CAAST-CSAWM project</p> <p>b) Sixty more students for International Training (40 students with Agricultural Science Background to Malaysia Putra University, Malaysia and 20 students with Agricultural Engineering background to the Asian Institute of Technology, Bangkok, Thailand) could not be undertaken for want of permission from NAHEP. This training will be undertaken upon granting the permission from the NAHEP and depending on the relaxation of COVID 19 situation.</p>

S. N.	Particulars	April'18 to March'19		Apr'19 to March'20		Remarks (Action plan for areas where improvement is needed)
		Plan	Achievement ¹	Plan	Achievement	
13.	Number of national trainings undertaken by students under CAAST comp	20	19	25	28 No. of Students: 3276	Students attending more than one training are counted for the number trainings completed.
14.	Number of direct beneficiaries of the project	1000	1014	4000	4690	-
15.	Number of female beneficiaries out of total direct beneficiaries	300	337	1500	1951	-

2. Input and activity monitoring

Input / Activity indicator	Sub-head / category	April'18 to March'19		Apr'19 to March'20		Activity elaboration ²
		Expenditure / input in INR lakhs		Expenditure / input in INR lakhs		
		Planned	Utilized ³	Utilization	Planned	
Goods and equipments	Equipment, Plant & Machinery	1191.88	653.43	95.24	0.00	Purchase orders amounting to Rs. 95.26 lakhs in this category were placed before 31 March 2020. The activity is expected to be completed before 30 September 2020.
	Office equipment	45.22	31.58	0.00	0.00	NA
	Laboratory equipment	1414.32	454.54	55.51	14.56	Lab equipment namely software (PROTEUS, Automation Studio Software, ERP Library software), IoT compatible mini PCs (17 Nos) for enabling

² Mention the physical numbers and specify the activities / purposes against each input category

³ Figures mentioned here are from NAHEP Annual Report 2018-19

Input / Activity indicator	Sub- head / category	April'18 to March'19		Apr'19 to March'20		Activity elaboration ²
		Expenditure / input in INR lakhs		Expenditure / input in INR lakhs		
		Planned	Utilized ³	Utilization	Planned	
						different sensors and objects to connect and exchange data, Data storage devices - computer server (2 Nos) were purchased. Purchase orders for Material amounting to Rs. 40.23 lakhs consisting of soil moisture system for measuring soil moisture content in the root zone, data loggers for data acquisition and storage, leaf wetness sensors for monitoring leaf wetness required for pest and disease incidences, nutrient/elemental sensors are placed. The activity is expected to be completed before 30 September 2020.
	Furniture & fixtures	90.19	51.93	0.00	0	NA
	Computers and Peripherals	93.64	70.42	4.13	4.26	09 Desktop computers and 3 printers were purchased for training, data analysis and completion of day to day activities of the project.
	Books and Journals	25.54	12.03	4.14	6.39	150 copies of books from different disciplines of thematic areas of the project were purchased which includes reference books also.
Civil works	Minor repair and renovation works	441.53	245.53	0.00	0.00	NA
Human capacity building	National level training	NIL	NIL	NIL	NIL	NA
	International level training	177.55	47.05	20.71	11.46	One faculty member successfully completed the International level training at AIT, Bangkok for 1-month duration. Further, the amount of Rs. 9.67190 lakh was transferred towards international level

Input / Activity indicator	Sub-head / category	April'18 to March'19		Apr'19 to March'20		Activity elaboration ²
		Expenditure / input in INR lakhs		Expenditure / input in INR lakhs		
		Planned	Utilized ³	Utilization	Planned	
						training of seven faculties to WSU, USA. However, due to COVID 19 situation, the training could not be completed. The training will be completed by utilizing remaining amount of approximately Rs. ** once the restrictions due to COVID19 are removed
	Short visit/ seminars	37.67	8.9836	4.14	5.35	University officials (2) visited WSU, USA on a short visit to develop networking and collaboration between universities.
	Meetings and workshops	26.13	11.9391	2.90	1.79	The amount was utilized to meet the expenditure during state and national meetings and workshops.
Consultancy	National level consultancies	227.3	10.78	28.99	0.00	Renewed attempts will be made to utilize the grants under national level consultancy.
Recurrent cost / Miscellaneous	Travel	42.92	23.32127	11.00	1.70	The expenditure was incurred on field visits for students, meeting of staff for collaboration with national partners etc.
	Contractual services	1000.76	234.62	194.78	192.65	Salary of contractual staff, skilled workers, and office and field assistants and contractual labourer wages were incurred from this head.
	Operational costs	2624.49	1497.16	146.23	123.63	Expenditure on recurring contingent charges for management and operating laboratories, farm inputs, purchase of spare parts etc. was done through this head. Expenditure for contingencies required for innovative research projects was incurred. One-month International Training to postgraduate students (20 students) was successfully conducted

Input / Activity indicator	Sub- head / category	April'18 to March'19		Apr'19 to March'20		Activity elaboration ²
		Expenditure / input in INR lakhs		Expenditure / input in INR lakhs		
		Planned	Utilized ³	Utilization	Planned	
						during 11 th November 2019 to 10 th December 2019 at AIT, Bangkok. The remaining expenditure could not be done for want of the approval to the proposal for International Training to second batch of students to Malaysia and Thailand.
	Institutional charges	204.7	174.11	20.45	20.45	Expenditure has been incurred on the development of farm improvement activities through University.
Total		7444.4	3466.82	588.22	382.27	

3. Case study/Success story: Request you to please provide the case study/ success story

Major categories of success stories / case studies:

Please select any of the category /categories below and mention the category name on the top of the story in the below mentioned box

1. Experience sharing:

a. Students visited abroad for International training:

- Student International Training at AIT, Bangkok (Page no. 16)

b. Faculties sent abroad for International training:

- Faculty International Training at AIT, Bangkok (Page no. 17)
- International Short visit of University Officers at WSU, Pullman, USA (Page no. 19)

c. Foreign faculties visited awarded AUs/ Institute of NAHEP

- 24 Faculties/ scientists/ students visited CAAST-CSAWM, MPKV Rahuri during 2019-20 (Page no. 21)

2. MoUs signed:

- Signed with industry
- Signed with globally recognized Higher Educational Institutions (HEIs)
- Signed with other participating agricultural universities of NAHEP / National Institutes
- Others (Specify):** Collaborating partners and Status of MoUs (Page no. 28)

3. Media coverage of project activities and achievements:

- Print / press release:** Activities under CAAST-CSAWM Published in newspapers (Page no.30)
- Television coverage:** Two activities under CAAST-CSAWM got coverage on Sahyadri channel (local Marathi channel) (Page no. 32)
- Social media coverage:** Activities under CAAST-CSAWM covered on different social media platforms (Page no. 32)
- Others (Specify)

4. Establishment of facilitative centers:

- Artificial intelligence (AI) lab / Centre** (Page no. 34)
- Industry Institution Interaction Cell** (Page no. 35)
- Start-up incubation cell** (Page no. 36)
- Other enabling infrastructures (Specify):**
 - Upgradation of computers in Remote Sensing and GIS and Computer-Aided Design and Graphics laboratories (Page no. 36)
 - Precision Agriculture Machinery (Page no. 37)
 - Abiotic Stress Experimentation Facility (Page no. 38)

5. Digital initiatives undertaken:

a. Application developed (Mobile / Web based)

- Design and Development of Spatial ETr-Android Mobile App (Page no. 40)
- Design and Development of Spatial ETr- Web based App (Page no. 40)
- Development of Android Application with database, Web API system for Student's Attendance and Teacher's performance evaluation (Page no. 41)

Note:

- **Provide maximum 2 success story/case study** in maximum 1000 words
- Provide high-resolution maximum 2 photographs

- Software to Access Need of Mechanization and Available Network Solutions (Phule-SANMAN) (*Page no. 43*)
- Development of Phule-Pest and Disease Management Mobile Application (*Page no. 43*)
- b. AMS (Academic Management System)
- c. MIS (Management Information System) / FMS (Financial Management System)
- d. Digitization of library**
 - Installation and Calibration of ERP software for CAAST Library (*Page no. 44*)
- e. e-learning / modules developed
- f. Other e-enabled initiatives undertaken**
 - Development of tool for identification and management of insect pests of Cotton (*Page no. 45*)

6. Innovations and out of box initiatives undertaken:

- a. **Field innovations:**
 - Climate Smart Agriculture Blocks for Research, Experimentation and Demonstration (*Page no. 46*)
 - Village level Contingency Crop Plan for Akole Block (*Page no. 49*)
- b. Classroom innovation
- c. Teaching innovation:** Educational Programs in Climate Smart Agriculture and Water Management being implemented/to be implemented under NAHEP Program (*Page no. 51*)
- d. Others (Specify)**
 - Surface Water Dynamics Analysis Based on Sentinel Imagery and Google Earth Engine Platform: A Case Study of Jayakwadi Dam (*Page no. 53*)
 - Prediction of soil chemical properties for semi-arid region using multispectral satellite images and wavelet transforms methods (*Page no. 54*)
 - Monitoring of Vegetations Health Conditions using Multispectral Satellite Data: A Case Study of Shrirampur Block, (MS), India
 - Identification of Rabi Crops mapping from Sentinel-2 Satellite Images in

the Sina Dam, Maharashtra, India

- Prediction of Wheat crops yield through Sentinel-2 Satellite data: A case study of the Semi-arid region, Maharashtra, India
- Estimation of the Land surface temperature by using Algorithm and remote sensing techniques: A Case study of Rahuri taluka, Ahmednagar District
- Development of spectral signature for wheat crop under different moisture regimes of deficit irrigation
- Assessment of Land Suitability Mapping by using Weighted Overlay Analysis Method and Satellite data in the Mula basin of Ahmednagar district, (MS), India
- Exploration of Groundwater Potential Zones for Upper Godavari River basin using Analytical Hierarchical Process (AHP)
- Use of Sentinel-2 Satellite Images for Prediction of Sugarcane Crop Yield in the Semiarid Region, Maharashtra, India
- Monitoring of Wheat Crop Growth Stages during Rabi Season by using Hyperspectral Imaging Camera
- Analytical Study of Land Surface Temperature in the Nashik Taluka by using Google Earth Engine
- Assessment of Change Detection of Agriculture and Non-Agriculture Land Use in Rahuri Region, (MS), India by using remote sensing and Classification Methods
- Assessment of Groundwater Quality Mapping for irrigation purpose in the Upper Godavari River Basin

1. Experience sharing

1.a. Students visited abroad for International training

Student International Training at AIT, Bangkok: Twenty (20) postgraduate (M.Sc./M.Tech and Ph.D.) students of MPKV, Rahuri were selected for one-month International level training on “Drones and Its Application and Google Earth Engine” at Geoinformatics Centre, Asian Institute of Technology (AIT), Bangkok, Thailand during November 11, 2019 to December 10, 2019. These selected students completed international level training in three phases.

- Two weeks on campus pre-training at CAAST-CSAWM, MPKV, Rahuri as pre-requisite to one-month training at Geoinformatics Centre, AIT, Bangkok, Thailand for providing the overview and basic knowledge of different aspects of the subject;
- One-month training at Geoinformatics Centre, AIT, Bangkok, Thailand; and
- Two weeks case study-based learning programme at CAAST-CSAWM, MPKV, Rahuri after the completion of one-month training at Geoinformatics Centre, AIT, Bangkok, Thailand.

During pre-training programme, students were educated with the basics of remote sensing and geographical information system, basics of climate change modelling, about drones, map products of drones, specific applications of drones, flight planning, different flight planning softwares, digital photogrammetry, the introduction of Google Earth engine, accessing remote sensing data and processed data through java script, Supervised classification and unsupervised classification of satellite imagery, introduction to QGIS and basic map-making, Introduction to the Python programming, Installation, fundamentals of Python, Plotting and visualization in Python, raster and vector data analysis with Python, introduction to JavaScript, built-in data Structures in JavaScript, etc.

After completion of this pre-training, students completed one month International level training at Geoinformatics Centre, AIT, Bangkok, Thailand, where they got exposure to Drones, flight planning of drones, applications of drones in agriculture, rules and regulations of using the drones, Introductions to Photogrammetry and mapping with drones, aerial photographs, various cameras used in drones for mapping and its selection, working, lenses, capturing images with drone and its processing, basic concepts of Remote Sensing and GIS, and its use in agriculture for different applications like crop monitoring, change detection, yield monitoring etc., understanding of Global Navigation Satellite System (GNSS) and GPS, Theoretical aspects of Drone, Significance in agriculture; basics concepts of applications like Hyper spectral sensing, Thermal sensing, Scouting, Spraying, Land management, Multispectral data collection, etc., crop yield estimation, use of ArcMap for image processing, Programming language, introduction to PPL, Notepads/notebooks, fundamental of python,-variables/strings, Boolean literals, Google Earth Engine (GEE)-different satellites, GEE-Catalogue, API; data types and geo spatial processing functions, data models, Data structures, Assessing and visualization of images, exploring images from GEE, case studies, Basics of Internet-of-Things (IoT), installation of Python, running of Python, basics of Python programming etc.

Based on the one-month International level training, on-campus two weeks case study-based learning programme was scheduled in which the students were allotted with case studies whose outcome is to be published in the form of research paper in journals having NAAS rating 7 and above.

The students completed their two-week post training and based on their case studies drafted following research papers.

1. Surface Water Dynamics Analysis based on Sentinel Imagery and Google Earth Engine Platform: A Case Study of Jayakwadi Dam
2. Analytical study of Land Surface Temperature with NDVI and NDBI using Google Earth Engine and GIS for Nasik tehsil
3. Flood Mapping and Damage Assessment utilizing Sentinel-1 information in Google Earth Engine for Kolhapur district in 2019
4. Assessment of crop health condition in Rahuri tehsil using Sentinel-2 satellite imagery

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5. Applications of Drones in Agriculture: A review
 6. Application of NDVI in vegetation monitoring using SENTINAL-2 data for Srirampur region of Maharashtra
 7. Assessing training needs of MPKV students towards application of Drone technology in agriculture
 8. Seasonal and land cover change detection of Rahuri region using satellite data
 9. Determination of crop health monitoring in MPKV, Rahuri using remote sensing approach
 10. Land suitability assessment of Mula basin of Ahmednagar district for agriculture using weighted overlay analysis in ArcMap
 11. Crop growth condition assessment at Dhamori Budruk village using Sentinel-2 data
 12. Identification of cropping pattern in Khadambe Budruk using sentinel 2 images and Arc GIS software
 13. Grape area mapping for Mavadi village of Nashik region using satellite data
 14. Yield estimation of cotton in Rahuri region using sentinel-2 imagery
 15. IoT based smart farming: Empowering agriculture for rural transformation
 16. Identification of cropping pattern in Padegaon using sentinel 2 imagery and ArcGIS software by supervised and unsupervised method
 17. Identification of cropping pattern of Rahuri tehsil using Sentinel 2 satellite imagery and geographical information system
 18. Land use land cover change detection of MPKV campus using Google Earth Engine
 19. Spatial analysis of land use/land cover of Rahuri tehsil using satellite imagery
 20. Identification of sugarcane area in Rahuri tehsil using sentinel 2 satellite imagery and ArcGIS software

Furthermore, GIC, AIT, Bangkok, Thailand has offered research internship in the expected FAO project to four students who have attended the international level training at GIC, AIT, Bangkok after the completion of degree.

1.b. Faculties sent abroad for International training

- **Faculty International Training at AIT, Bangkok:** Along with twenty students, one faculty member was also deputed for International Level Training at Geoinformatics Centre, Asian Institute of Technology, Bangkok. The faculty also attended the pre-training and helped students during their two-week case study-based post training. The training at Geoinformatics Centre, Asian Institute of Technology, Bangkok was useful in designing the projects for new M.Tech and Ph.D. students of the Department of Soil and Water Conservation Engineering, MPKV, Rahuri. He also had discussions with other faculty members from different departments/ schools in AIT regarding admissions and scholarships for graduate and postgraduate students of MPKV, Rahuri. Accordingly, one passed out postgraduate student from the Department of SWCE is offered partial scholarship and admission for Ph.D. at the Asian Institute of Technology, Bangkok.



20 PG/ Phd students from MPKV Rahuri visited AIT Bangkok under Student International Training by CAAST-CSAWM, MPKV Rahuri



Dr. A.A. Atre, Professor (SWCE) and Procurement Officer (CAAST-CSAWM), along with 20 students attended one-month Faculty International Training at AIT Bangkok.

- **International Short visit of University Officers at WSU, Pullman, USA:** Dr. K.P. Viswanatha, Hon. Vice Chancellor, MPKV, Rahuri and Dr. A.L. Pharande, Dean (F/A) and Director of Instructions, MPKV, Rahuri started for USA on March 6, 2020, from India for the International short visit and reached on March 8, 2020. Comprehensively, the short visit of both the MPKV officials included visit to Pullman and Prosser campuses of WSU, USA, field tours, to Tri-cities and Seattle, USA. They have attended various activities viz., meeting with CAAST collaborating team members at WSU Campus, WSU College of Agriculture Administrators, WSU AgWeatherNet Director and faculties. At Prosser campus they attended meetings with WSU, IAREC Director and WSU CPAAS Director; visited WSU IAREC/ CPAAS and AgWeatherNet facilities, WSU Research Farms and also commercial vineyard operations sites along with visit to Yakima valley which is also called as “Fruit basket” of Washington State (specialty crop production & storage/packaging houses). At Pullman campus, they had meetings with Dr. Asif Chaudhary, US Ambassador and Vice President, Office of International Programs WSU, USA, Dr. Shulin Chen, Professor of Bioenergy and Biofuels programs, Dr. Scot Hulbert, Associate Dean and Research Director of Agriculture Research Centre, CAHNRS, WSU, Dr. Claudio Stockle and Kirti Rajgopalan from Biological Systems Engineering (BSE), and Dr. David Brown, Director, WSU, AgWeatherNet and discussed about the integrated agricultural research and extension, disseminated scientific knowledge to enhance the irrigated agriculture. Furthermore, they had also meetings with Dr. Sindhuja

Sankaran, Associate Professor, WSU Phenomics program, Dr. Brenda Schroder, University of Idaho and Dr. Devendra Shan, Associate Professor, Department of Veterinary Microbiology and Pathology, WSU Veterinary medicine and discussed about the different perspectives and opportunities in the field of biotechnology, Phenomics, genomics, animal sciences etc. From Pullman campus the officials had arrived to Prosser campus of WSU and had meetings with Dr. Rayapati Naidu, Director, WSU Irrigated Agriculture Research and Extension Centre (IAREC) & CAHNRS and also with Dr. Qin Zhang, Director, WSU Centre for Precision and Automated Agricultural Systems (CPAAS) and discussed the different research and collaborative opportunities. They have visited WSU Tri-cities campus.

They delivered the seminars on

1. Climate Smart and Precision Agriculture
2. Agriculture Start Ups

Overall both the officials visited all the academic sections/laboratories/ research facilities as per scheduled by WSU, Pullman, USA and explored the possibilities of research and development in the field of Climate Smart Agriculture and Precision Water Management. Further officials stated that the short visit to WSU, Pullman, USA provided them ample opportunity to explore the areas of Precision farming, precision machineries, water management, development of new technologies related to climate smart agriculture, biotechnology, Phenomics, genomics, animal sciences etc. Both the officials were returned to India from USA on 16th March 2020 after successful completion of short visit.





Glimpses of International Short Visit of MPKV University officers to Washington State University (WSU), Pullman, USA

1.c. Foreign faculties visited awarded AUs/ Institute of NAHEP: Total 25 international faculties/ scientists / students from other countries visited Mahatma Phule Krishi Vidyapeeth (Agricultural University), Rahuri, mostly from collaborating partner Institutes of CAAST-CSAWM, ICAR-NAHEP project, during April 1, 2019 to March 31, 2020. These visits were organized for helping in developing the capacity amongst the faculties, scientists and students of MPKV, Rahuri; for the development and adoption of ‘Climate Smart Agriculture and Water Management’ technologies; and for development of framework of various programs of CAAST-CSAWM (e.g. short-courses to be offered at postgraduate level, postgraduate diploma and post-doctoral programs). The details of delegates along with their purpose of visits are provided below in the following table,

Sr. No.	Name of the foreign delegates	Designation	Institute	Purpose of visit
Country: Uzbekistan				
1.	Dr. Raviprakash G. Dani	Visiting Faculty	Namangan Institute of Engineering and Technology, Uzbekistan	1. To observe the best practices and explore the dimensions of collaboration between the two institutes 2. Presented about sites of Uzbekistan country, about Namangan Institute of Engineering and Technology, Uzbekistan, various departments, objectives of the collaborative projects, International tourisms of Uzbekistan, different training programmes for students and faculties.
2.	Mr. Rahimov Iyuldoshali Rakhimovich	Professor		
3.	Mr. Ikramov Murad Akramovich	Professor		
4.	Mr. Israilov Rustambek Ibragimovich	Assistant Professor		

5.	Mr. Ismoilov Ravshan Baxriddinovich	Assistant Professor		
6.	Mr. Abdullayev Shokir Ibrohimkhonovich	Teacher		
7.	Mr. Rakhimov Kamolddin Isroilovich	Teacher		
8.	Mr. Abdullaev Zokir Ikronjonovich	Teacher		
9.	Mr. Boytorayev Sarvar Abdufozilovich	Teacher		
10.	Mr. Mukhiddinov Dostonbek Xasanboyevich	Student		
11.	Mr. Baxromjonov Jaxongir Bakhtiyarovich	Student		
12.	Mr. Bakhritdinov Azambek Ravshanjonovich	Student		
13.	Mr. Saloxiddinov Shavkat Ilkhomovich	Student		

Country: United States of America

14.	Dr. Aavudai Anandhi	Biological Systems Engineering Program, College of Agriculture and Food Sciences	Florida A & M University, Florida, USA	To attend 1. International Symposium on Artificial Intelligence based Future Technologies in Agriculture held during 7-9 January, 2020 Topic: Artificial intelligence applications in Agriculture
15.	Dr. David Brown	Director, AgWeatherNet	Washington State University, Pullman, USA	To attend 1. International Symposium on Artificial Intelligence based Future Technologies in Agriculture held during 7-9 January, 2020 Topic: Hyperlocal Weather Forecasting for Agricultural Decision Support 2. International Scientists–Students Interface Programs on 10 January, 2020 at College of Agriculture, Pune and on 12 January, 2020 at Central Campus, MPKV, Rahuri (Agril. University), India

				<p>Topic: Hyperlocal Weather Forecasting for Agricultural Decision Support</p> <p>3. International Workshop on Course Curricula Development for Post Graduate Diploma held during 11-12 January, 2020</p> <p>Topic: Involvement in the development of course curricula of different courses of the PG Diploma.</p>
16.	Dr. Lav Khot	Assistant Professor, Agricultural Automation Engineering, Department of Biological Systems Engineering		<p>To attend</p> <p>1. International Symposium on Artificial Intelligence based Future Technologies in Agriculture held during 7-9 January, 2020</p> <p>Topic: Crop production management in digital agriculture era: a few case studies</p> <p>2. International Scientists–Students Interface Programs on 10 January, 2020 at College of Agriculture, Pune and on 12 January, 2020 at Central Campus, MPKV, Rahuri (Agril. University), India</p> <p>Topic: Crop Production Management in Digital Agriculture Era: A few Case studies</p> <p>3. International Workshop on Course Curricula Development for Post Graduate Diploma held during 11-12 January, 2020</p> <p>Topic: Involvement in the development of course curricula of different courses of the PG Diploma.</p>
17.	Dr. Sindhuja Sankaran	Associate Professor, Department of Biological Systems Engineering		<p>To attend</p> <p>1. International Symposium on Artificial Intelligence based Future Technologies in Agriculture held during 7-9 January, 2020</p> <p>Topic: Artificial Intelligence/Machine Learning guided Crop Improvement: Phenomics Perspective</p> <p>2. International Scientists–Students Interface Programs on 10 January, 2020 at College of Agriculture, Pune and on 12 January, 2020 at Central Campus, MPKV, Rahuri (Agril. University), India</p> <p>Topic: Artificial Intelligence / Machine Learning Guided Crop Improvement: Phenomics Perspective</p> <p>3. International Workshop on Course Curricula Development for Post Graduate Diploma held during 11-12 January, 2020</p> <p>Topic: Involvement in the development of course curricula of different courses of the PG Diploma.</p>
18.	Dr. Ganesh C Bora	Associate Professor of Precision Agriculture and	Mississippi State University, Starkville,	<p>To attend</p> <p>1. International Symposium on Artificial Intelligence based Future</p>

		Machinery Systems	MS, USA	<p>Technologies in Agriculture held during 7-9 January, 2020 Topic: AI driven controls for agriculture</p> <p>2. International Scientists–Students Interface Programs on 10 January, 2020 at College of Agriculture, Pune and on 12 January, 2020 at Central Campus, MPKV, Rahuri (Agril. University), India Topic: AI driven controls for agriculture</p> <p>3. International Workshop on Course Curricula Development for Post Graduate Diploma held during 11-12 January, 2020 Topic: Involvement in the development of course curricula of different courses of the PG Diploma.</p>
Country: Thailand				
19.	Dr. Manzul Kumar Hazarika	Director, Geoinformatics Centre	Asian Institute of Technology, Bangkok, Thailand	<p>To attend</p> <p>1. International Symposium on Artificial Intelligence based Future Technologies in Agriculture held during 7-9 January, 2020 Topic: Drones and Google Earth Engines for Agriculture and Water Management</p> <p>2. International Scientists–Students Interface Programs on 10 January, 2020 at College of Agriculture, Pune and on 12 January, 2020 at Central Campus, MPKV, Rahuri (Agril. University), India Topic: Drones and Google Earth Engines for Agriculture and Water Management</p> <p>3. International Workshop on Course Curricula Development for Post Graduate Diploma held during 11-12 January, 2020 Topic: Involvement in the development of course curricula of different courses of the PG Diploma.</p>
Country: Malaysia				
20.	Dr. Sagaya Sabestinal Amalathas	Associate Professor and Programme Director School of Computing & IT Faculty of Innovation & Technology	Taylor’s University, Petaling Jaya, Selangor, Malaysia	<p>To attend</p> <p>1. International Symposium on Artificial Intelligence based Future Technologies in Agriculture held during 7-9 January, 2020 Topic: Managing yield production using predictive analytics</p> <p>2. International Scientists–Students Interface Programs on 10 January, 2020 at College of Agriculture, Pune and on 12 January, 2020 at Central Campus, MPKV, Rahuri (Agril. University), India Topic: Managing yield production using predictive analytics</p>

				3. International Workshop on Course Curricula Development for Post Graduate Diploma held during 11-12 January, 2020 Topic: Involvement in the development of course curricula of different courses of the PG Diploma.
21.	Dr. Siva K Balasundram	Associate Professor (Precision Agriculture) Department of Agriculture Technology Faculty of Agriculture	University Putra Malaysia, Selangor, Malaysia	To attend 1. International Symposium on Artificial Intelligence based Future Technologies in Agriculture held during 7-9 January, 2020 Topic: Role of precision agriculture in mitigating climate change 2. International Workshop on Course Curricula Development for Post Graduate Diploma held during 11-12 January, 2020 Topic: Involvement in the development of course curricula of different courses of the PG Diploma.
22.	Dr. Saravanan Ravan	Director	Adroit College, Acon City, Malaysia	To attend 1. International Symposium on Artificial Intelligence based Future Technologies in Agriculture held during 7-9 January, 2020 Topic: Managing yield production using predictive analytics 2. International Scientists–Students Interface Programs on 10 January, 2020 at College of Agriculture, Pune and on 12 January, 2020 at Central Campus, MPKV, Rahuri (Agril. University), India Topic: Managing yield production using predictive analytics 3. International Workshop on Course Curricula Development for Post Graduate Diploma held during 11-12 January, 2020 Topic: Involvement in the development of course curricula of different courses of the PG Diploma.
Country: United States of America				
23.	Mr. Edward W. Bresnyan	Senior Agriculture Economist	World Bank	For evaluating CAAST-CSAWM, ICAR-NAHEP project being implemented at MPKV, Rahuri (22 to 25 January, 2020)
24.	Mr. Mansur Ahmed	Economist at the Agriculture Global Practice	World Bank	
25.	Mr. David Nielson	Lead Agricultural Services Specialist	World Bank	



Delegation of Namangan Institute of Engineering & Technology, The Republic of Uzbekistan, visit at MPKV Rahuri





International Scientist-Students Interface on Drones Robotics & AI at MPKV Rahuri and CoA, Pune



World Bank Officials visited CAAST-MPKV Rahuri for Project evaluation

2. MoU Signed:

2.d Other

- **Collaborating partners and Status of MoUs:** The status of MoU with different collaborative partners including educational institutes, research organizations and industries of CAAST-CSAWM is shown in following table

Educational institutes

Sr. No.	Institute	Purpose	Status
International institute(s)			
1.	Washington State University, Pullman, WA, USA	International training for capacity building of MPKV faculties	Draft has been shared with WSU
2.	Mississippi State University, Starkville, MS, USA	International training for capacity building of MPKV faculties	In progress
3.	Asian Institute of Technology, Bangkok, Thailand	International training for capacity building of MPKV faculties	In progress
4.	International Water Management Institutes (IWMI), Colombo, Sri Lanka	Collaborative research related to water management techniques in climate smart agriculture, trainings on capacity building	In progress
National institute(s)			
1.	Indian Institute of Technology (IITB), Powai, Mumbai, Maharashtra (IN)	Collaborative research on Micrometeorology, Data sharing of Eddy Covariance Tower	Draft has been shared

Research Organisations

Sr. No.	Organisation	Purpose	Status
National Organisation(s)			
1.	BIAF Development Research Foundation, Warje, Pune 411058, Maharashtra (IN)	Village level contingency crop planning, data-exchange and trainings on capacity building	Draft has been shared with WSU
2.	Indian Institute of Remote Sensing (IIRS), Dehradun (IN)	Trainings on capacity building for faculties, collaborative research work on RS- GIS	In progress
3.	National Institute of Abiotic Stress Management (NIASM), Malegaon (Kh), Baramati, Maharashtra (IN)	Trainings on capacity building for students and collaborative research related to climate smart agriculture	In progress
4.	Central Research Institute for Dryland Agriculture (CRIDA), Hyderabad (IN)	District, Block and Village level contingency crop planning, compilation and incorporation, suggestions, modifications and trainings on capacity building	In progress
5.	National Bureau of Soil Science and Land Use	Trainings on capacity building for students, collaborative research	In progress

	Planning (NBSS and LUP), Nagpur, Maharashtra (IN)	related to Natural Resource Management, Data sharing	
6.	Indian Meteorological Department (IMD), Pune, Maharashtra (IN)	Weather based agro advisory documentation, Agrometeorological data sharing, Forecasting for preparation of advisory	In progress
7.	Maharashtra Remote Sensing Application Centre (MRSAC), Nagpur, Maharashtra (IN)	Trainings on capacity building for students, collaborative research work on RS- GIS	In progress
8.	Water and Land Management Institute, Aurangabad, Maharashtra (IN)	Collaborative research related to water management in climate smart agriculture	In progress
9.	Watershed Organisation Trust (WOTR), Pune, Maharashtra (IN)	Collaborative research on climate smart agriculture, documentation of weather based agro advisory for management of major field crop	In progress
10.	Grass Roots Action for Social Participation (GRASP), Aurangabad, Maharashtra (IN)	Trainings on capacity building for students and farmers, Collaborative work on development of climate smart villages	In progress
11.	Lupin Foundation, Maharashtra (IN)	Collaborative work on development of climate smart villages	In progress

Industries

Sr. No.	Organisation	Purpose	Status
International			
1.	KisanHub, St John's Innovation Centre, Cambridge, United Kingdom.	Digital Assets Mapping of MPKV, Rahuri and course content developments	Draft has been shared with KisanHub
2.	Climate Change Agriculture and Food Security, CCAFS (CGAIR Organization)	Collaborative research on weather modification and climate change	In progress
3.	AECOM, USA based multinational (industry partner)	Trainings on capacity building for students	In progress
National			
1.	AYAAN Autonomous Systems, Pune, Maharashtra (IN)	Trainings on capacity building for students related Artificial Intelligence, Machine Learning, Cloud, IoT, deployed with Unmanned Vehicles & Robotics etc.	Draft has been shared with AYAAN Autonomous Systems
2.	In-tech Harness Pvt. Ltd. Someshwarwadi, Pune 411008, Maharashtra (IN)	To do collaborative research work in IoTs (e.g. Pump controller)	Draft has been finalised
3.	Sayadri –Agro, Nashik, Maharashtra (IN)	Trainings to students and farmers based on Processing of agro products	In progress
4.	Netafim Irrigation, Pune, Maharashtra (IN)	Collaborative research work in water management, training for students	In progress

5.	Jain Irrigation Systems Limited, Jalgaon, Maharashtra (IN)	Trainings on capacity building for students and farmers, collaborative research related to micro irrigation.	In progress
6.	InnosapienAgro. Technologies Pvt. Ltd., Mumbai, Maharashtra (IN)	Trainings on capacity building for students related to IOT application in agriculture, to do collaborative research related to IOT	In progress
7.	Quantela Inc, Banglore (IN)	Trainings on capacity building for students related to IoTs, Artificial Intelligence, Drones etc.	In progress
8.	Parth Infotech, Pune, Maharashtra(IN)	Collaborative research work in IoTs.	Draft has been shared
9.	Yorient Technologies Private Limited, Pune, Maharashtra(IN)	Collaborative research work in Artificial Intelligence (AI) / Machine Learning (ML) and Robotics.	Draft has been shared
10.	John Deere India Pvt. Ltd, Pune(IN)	Collaborative research work and trainings to students and farmers based on precision agricultural machineries	In Progress
11.	Indiasoft Technologies Pvt. Ltd, Pune(IN)	Collaborative research work in IoTs	In Progress
12.	Pratik Enterprises, Pune(IN)	Collaborative research work in IoTs	Draft has been shared
13.	ASAP Agritech LLP, Nasik(IN)	Collaborative research work in IoTs, Drone and robotics	Draft has been finalised
14.	SPL Technologies Pvt. Ltd. New Delhi(IN)	Collaborative research work in IoTs, Drone and robotics	In Progress
15.	SIFA, Mumbai(IN)	Collaborative research work in IoTs, Drone and robotics	In Progress

3. Media coverage of project activities and achievements:

3.a. Print / press release: Different activities were conducted by CAAST-CSAWM that attracted the attention of print media; and hence published in newspapers: Different activities performed under CAAST-CSAWM project were flashed in 17 National and Local Newspapers regularly. Following table shows the number of news flashed in corresponding newspaper.

Sr. No.	Name of Newspaper	Activities Published Under CAAST-CSAWM, MPKV, Rahuri	Sr. No.	Name of Newspaper	Activities Published Under CAAST-CSAWM, MPKV, Rahuri
1	Navbharat Hindi	08	11	Punyanagari	47
2	Dainik bhaskar	05	12	Diyamarathi	32
3	Agrowon	27	13	Lokmanthan	51
4	Laksatta	05	14	Lokved	37
5	Lokmat	45	15	Janpravash	17
6	Sakal	22	16	Kesari	42
7	Pudhari	09	17	Faujdar Times	13
8	Kesari	28			
9	Maharashtra Times	11			
10	Sarvatmat	52			

लोकमत

यंत्रमानवामुळे शेती समस्या दूर होण्यास मदत

दिनेश फाटक : स्वयंचलित यंत्रमानव तंत्रज्ञानविषयक मार्गदर्शन

लोकमत न्यूज नेटवर्क

राहुरी : शेतीमध्ये स्वयंचलित यंत्रमानव वापर केल्यास शेतीच्या उत्पादकतेत सुधारणा घडून येते. यंत्रमानव हाताळण्याच्या यंत्रणेला अडकता देता येत नाही. कुठल्याही बाबत होत. घाबरतार समस्यांची व फसवारी कसोटी जाणत नाही. एक एकरी एकपेक्षा जास्त यंत्र सहजपणे हाताळून शेतीतील कामांचे बळकत होत. यंत्रमानव शेती समस्यांच्या निवारणासाठी मदत होते. असे प्रतिपादन राहुरी जिल्हा येथे उपमहासंचालकांक दिनेश फाटक यांनी केले.

राहुरी कृषी विद्यापीठात येथे हवामान जवळपास शेतीसाठी

स्वयंचलित यंत्र मानवविषयक यंत्रमानव वापर वा निवारणासाठी एक दिवसीय विद्यार्थी व उद्योग संघाद्वारे आयोजन करण्यात आले होते. याप्रसंगी ते बोलत होते.

यावेळी कुठेतरीपरत तंत्रज्ञानचे व्याख्यानसत्रांचे संचालक सागर शंकर, एम. एम. प्रणालीचे व्यवस्थापकीय संचालक सुरेशी मारी, कृषी अभियांत्रिकी व तंत्रज्ञान शाखेतील प्राध्यापक बलराम होत. यंत्रमानव शेती समस्यांच्या निवारणासाठी मदत होते. असे प्रतिपादन राहुरी जिल्हा येथे उपमहासंचालकांक दिनेश फाटक यांनी केले.

राहुरी कृषी विद्यापीठात येथे हवामान जवळपास शेतीसाठी

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दिव्य मराठी

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टिटवी गावामध्ये स्वयंचलित हवामान केंद्र

महाराष्ट्र शासनकडून विद्यार्थी यांच्या विद्यार्थी संस्थेत

शिवार संस्थाकडून

हवामान तंत्रज्ञान केंद्राचे उद्घाटन करण्यात आले. यावेळी उपस्थित होते उपमहासंचालक सागर शंकर, एम. एम. प्रणालीचे व्यवस्थापकीय संचालक सुरेशी मारी, कृषी अभियांत्रिकी व तंत्रज्ञान शाखेतील प्राध्यापक बलराम होत. यंत्रमानव शेती समस्यांच्या निवारणासाठी मदत होते. असे प्रतिपादन राहुरी जिल्हा येथे उपमहासंचालकांक दिनेश फाटक यांनी केले.

राहुरी कृषी विद्यापीठात येथे हवामान जवळपास शेतीसाठी

नवभारत

राहुरी में आधुनिक कृषि तकनीकी केंद्र शुरु

शोध दलों का 1 दिवसीय अभ्यास दौरा संपन्न

बदलते मौसम का खेती पर असर

समन्वयक डॉ.एस. डी. गोरटीवार और सहसमन्वयक डॉ. एम. जी. शिंदे के मार्गदर्शन में इस नई टीम के लिए बारा महीने की कृषि विज्ञान केंद्र और मातंगेश में राष्ट्रीय अजैविक तान व्यवस्थापन संस्था में अभ्यास दौरा का आयोजन किया था.

ICAR-NATIONAL INSTITUTE OF ABIOTIC STRESS MANAGEMENT

इस दौरा के दौरान अनुसंधानकर्ताओं ने मृदा परीक्षण प्रयोगशाला, दुग्धशास्त्र विभाग, मत्स्य विभाग, खेत तालाब, सौरपंप, ड्रॉपिंग पट्टन, आधुनिक अनुसंधान आदि के बारे में बारीकी से जानकारी हासिल की.

Navabharat Pune Edition
12 Apr, 2019 Page No. 6

बदलत्या वातावरणानुसार संशोधन आवश्यक

चारही विद्यापीठांच्या कुलगुरुंची अपेक्षा, राहुरी कृषी विद्यापीठात 'जॉइंट ऑफिस'ला प्रारंभ

संशोधन केंद्रे

गवामान वांगले, स्वात काय ते शोध

राहुरी, वि. एम. उपाखंडात राहुरी कृषी विद्यापीठाचे वरील काम सुरू आहे. या कामात सहभाग घेणाऱ्या विद्यापीठांच्या कुलगुरुंची अपेक्षा आहे. या कामात सहभाग घेणाऱ्या विद्यापीठांच्या कुलगुरुंची अपेक्षा आहे. या कामात सहभाग घेणाऱ्या विद्यापीठांच्या कुलगुरुंची अपेक्षा आहे.

राहुरी कृषी विद्यापीठात शोध सहाय्यी

राहुरी कृषी विद्यापीठात शोध सहाय्यी

दिव्य मराठी

अहमदनगर, रविवार, १८ जानेवारी २०२०

शैक्षणिक • कार्यशाळेत महात्मा फुले कृषी विद्यापीठाचे कुलगुरु डॉ. के. पी. विश्वनाथा यांचे प्रतिपादन

हवामान बदलाला सामोरे जाण्यासाठी अभ्यासक्रम उपयुक्त

प्रतिनिधी | राहुरी शहर

जागतिक तापमानात बदल घडत असण्यात पिकांच्या उत्पादनात मोठ्या प्रमाणात घट येत आहे. या बदलांना सामोरे जाण्यासाठी हवामान अद्ययावत शेती पदव्युत्तर पदविका उपयुक्त ठरेल, हा विश्वनाथ कुलगुरु डॉ. के. पी. विश्वनाथा यांनी बोलून दाखवला.

पदव्युत्तर पदविकांचे विविध विषयांचे अभ्यासक्रम तयार करण्यासाठी कृषी विद्यापीठातील डॉ. अण्णासाहेब शिंदे कृषी अभियांत्रिकी व तंत्रज्ञान महाविद्यालयाच्या साभागृहात आयोजित आंतरराष्ट्रीय कार्यशाळेत ते बोलत होते. जागतिक बँक अर्थसहाय्यत राष्ट्रीय कृषी उच्च शिक्षण प्रकल्प व भारतीय कृषि अनुसंधान परिषद, नवी दिल्ली यांच्या संयुक्त विद्यमाने कृषी संचालक डॉ. किरण कोकाटे म्हणाले, या अभ्यासक्रमातर्गत हवामान अद्ययावत शेतकरी व जल व्यवस्थापन क्षेत्रात तरुणांना रोजगार प्राप्तीबरोबरच हवामान बदलाविषयी संशोधन व विस्तार कार्यात तरुणांची भूमिका अत्यंत महत्त्वाची ठरणार आहे. डॉ. डेविड ब्राऊन यांनी चाॅरिंश्टन विद्यापीठ अमेरिका येथे सुरू असलेल्या शिक्षण, संशोधन व विस्तार कार्याची माहिती दिली. या कार्यशाळेला गुजरात येथील कामधेनु विद्यापीठाचे माजी कुलगुरु डॉ. एम. सी. बार्मन, भारतीय कृषि अद्ययावत संघटनेचे सल्लागार डॉ. विश्वनाथ सदायते, राहुरी कृषी विद्यापीठाचे माजी विस्तार शिक्षण संचालक डॉ. किरण कोकाटे, डॉ. सुनील गोरटीवार, चाॅरिंश्टन स्टेट विद्यापीठाचे प्राध्यापक, डॉ. अशोक फारदे, सहयोगी अधिकाऱ्यात डॉ. दिलीप पवार, अमेरिका, मलेशिया, थायलंड येथील शास्त्रज्ञ, तसेच भारतातील विविध आंतरराष्ट्रीय व राष्ट्रीय संशोधन संस्थांचे शास्त्रज्ञ, कृषी विद्यापीठातील विभागप्रमुख, प्राध्यापक उपस्थित होते.



कृषी अभ्यासक्रमात रोबोटिक्स

महात्मा फुले कृषी विद्यापीठाचा निर्णय; २४ विद्यार्थ्यांना संधी

महत्वाचे काटे

- कृषी विद्यापीठाने निवडले आहे. ह्यामध्ये अद्ययावत कृषी तंत्रज्ञानाचा समावेश करून, असा अभ्यासक्रम सुरू होईल. यात २४ विद्यार्थ्यांना संधी देण्यात येईल. यात १२ विद्यार्थ्यांना शेतकरी विद्यापीठात (अभियांत्रिकी) आणि १२ विद्यार्थ्यांना शेतकरी विद्यापीठात (कृषिशास्त्र) येण्याची संधी देण्यात येईल.

अशी आहेत अभ्यासक्रमाची वैशिष्ट्ये

कृषी विद्यापीठात अभ्यासक्रम निश्चित	विद्यार्थ्यांना संधी देण्यात येईल	शेतकरी विद्यापीठात अभ्यासक्रम निश्चित	विद्यार्थ्यांना संधी देण्यात येईल
प्राधान्य कृषी विद्यापीठात देण्यात येईल	विद्यार्थ्यांना संधी देण्यात येईल	शेतकरी विद्यापीठात अभ्यासक्रम निश्चित	विद्यार्थ्यांना संधी देण्यात येईल

विद्यापीठाच्या प्रशासनाला वाढते. त्यामुळेच शेतकरी विद्यापीठात निवडिले जाऊन कृषिशास्त्रात अभ्यासक्रम सुरू होईल. या अभ्यासक्रमाचा प्रारंभ २०२०-२१ मध्ये होईल. या अभ्यासक्रमात २४ विद्यार्थ्यांना संधी देण्यात येईल. या अभ्यासक्रमात २४ विद्यार्थ्यांना संधी देण्यात येईल. या अभ्यासक्रमात २४ विद्यार्थ्यांना संधी देण्यात येईल.

'आयवोटी' तंत्रज्ञानाने शेती उत्पादकतेत वाढ शक्य : डॉ. सिंग



महात्मा फुले कृषी विद्यापीठात अयोजित अंतरराष्ट्रीय परिसंवादात डॉ. सिंग यांनी भाष्य केले. या परिसंवादात डॉ. सिंग यांनी भाष्य केले. या परिसंवादात डॉ. सिंग यांनी भाष्य केले.

शेतकऱ्यांसाठी सोप्या तंत्रज्ञानाची गरज - डॉ. तोमर



महात्मा फुले कृषी विद्यापीठात डॉ. तोमर यांनी भाष्य केले. या परिसंवादात डॉ. तोमर यांनी भाष्य केले. या परिसंवादात डॉ. तोमर यांनी भाष्य केले.

लोकातम

रोबोटद्वारे शेती उत्पादन : हवामान, शेती व पाणी व्यवस्थापनात कृत्रिम बुद्धिमत्तेचा वापर

महात्मा फुले कृषी विद्यापीठात आर्टिफिशियल इंटेलिजंट अभ्यासक्रम

महात्मा फुले कृषी विद्यापीठात आर्टिफिशियल इंटेलिजंट (कृत्रिम बुद्धिमत्ता) अभ्यासक्रम सुरू होईल. या अभ्यासक्रमात २४ विद्यार्थ्यांना संधी देण्यात येईल. या अभ्यासक्रमात २४ विद्यार्थ्यांना संधी देण्यात येईल.

पॉलिहाउस तंत्रज्ञानामध्ये निर्यातीच्या संधी

निर्यात विभागाचे तांत्रिक सल्लागार गोविंद हांडे; एकादिसीय संचारस

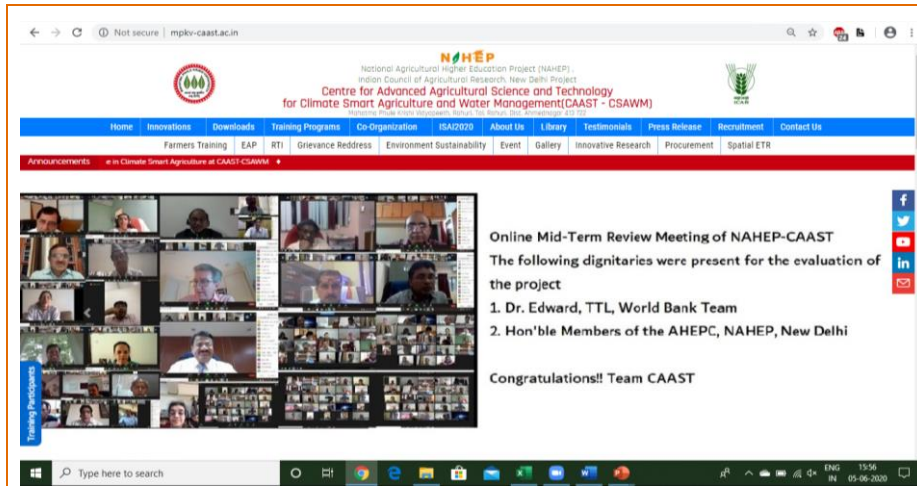
महात्मा फुले कृषी विद्यापीठात पॉलिहाउस तंत्रज्ञानामध्ये निर्यातीच्या संधी देण्यात येईल. या अभ्यासक्रमात २४ विद्यार्थ्यांना संधी देण्यात येईल.

3.b. Television coverage: Two activities under CAAST-CSAWM got coverage on Sahyadri channel (local Marathi channel)

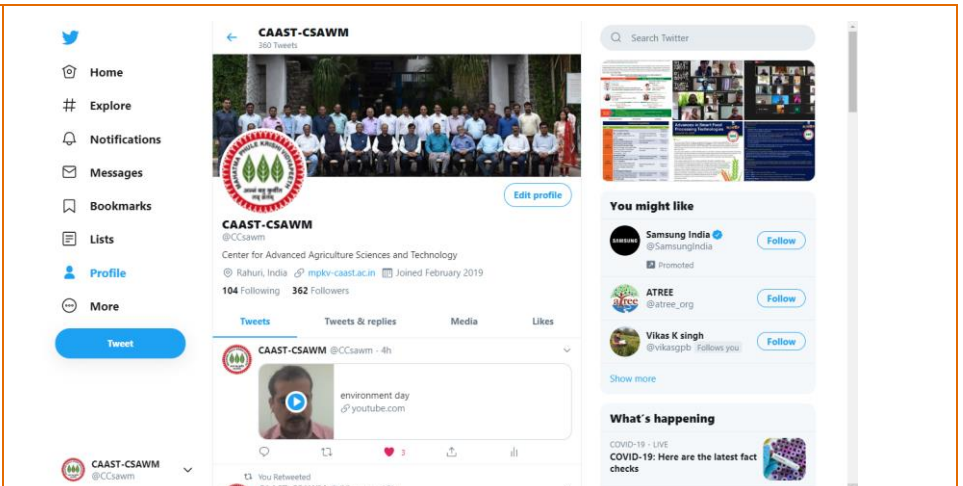
3.c. Social media coverage: Activities of CAAST-CSAWM were covered on different social media platforms: Following are the links of CAAST-CSAWM on different social media platforms.

- Website: <https://www.mpkv-caast.ac.in>
- LinkedIn: <https://www.linkedin.com/company/ccsawm>
- Facebook: <https://m.facebook.com/ccsawm/>

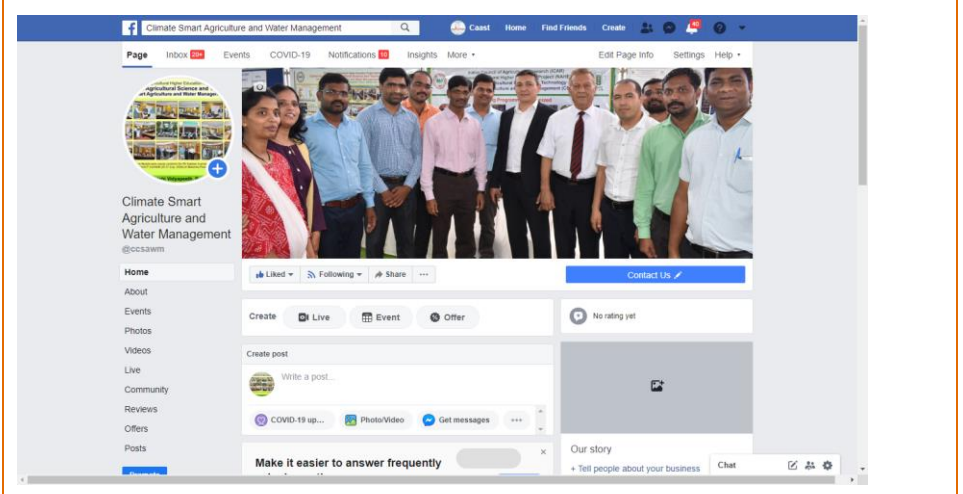
- Twitter: <https://mobile.twitter.com/CCsawm>
- YouTube channel: https://www.youtube.com/channel/UCes_ccoeScXBcf12pOx7C_A
- Instagram: <https://www.instagram.com/ccsawm>



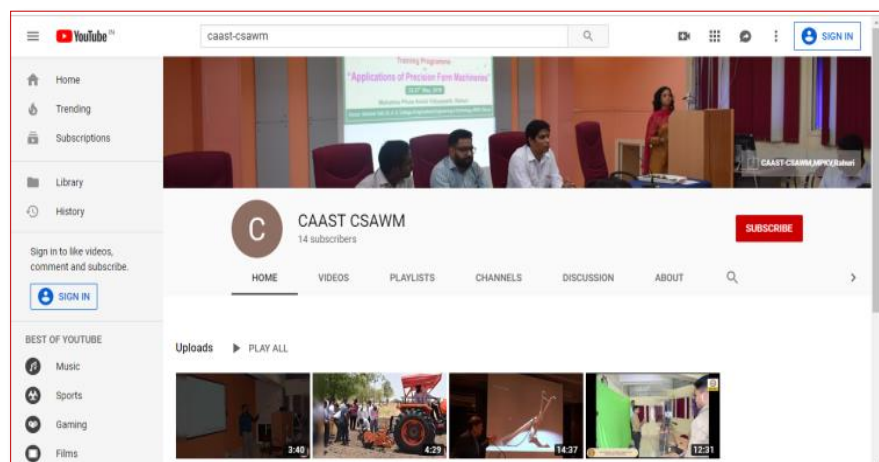
Website of CAAST-CSAWM, Rahuri (www.mpkv-caast.ac.in)



Twitter Handle of CAAST-CSAWM, Rahuri (twitter.com/ccsawm)

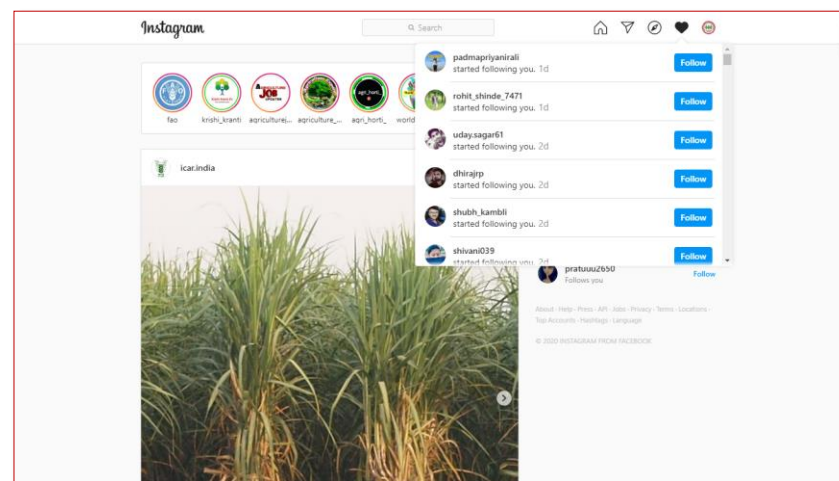


LinkedIn account of CAAST-CSAWM, Rahuri (Linkedin/caast-csawm)



YouTube channel of CAAST-CSAWM, Rahuri

Facebook Page of CAAST-CSAWM, Rahuri (Facebook/caast-csawm)



Instagram page of CAAST-CSAWM, Rahuri

4. Establishment of facilitative centers:

4.a. Artificial intelligence (AI) lab/Centre

NAHEP project provided an opportunity to develop research and development centre for AI based robotics, drones and IoT for climate smart agriculture and water management at CAAST-CSAWM MPKV Rahuri. Under this initiative, laboratory was developed with various types of agricultural UAVs for training, Photography, Mapping (with NIR, thermal and hyperspectral imaging scanners) Spraying, fixed wing (VITOL), and first person view (FPV) camera for monitoring. Robotics section consist of various types of robots like FIRD Bird V, Lego Mindstorm, Lego mindstorm with EV3, Mobile robotic arm, Line following robot etc to understand the building blocks of robot and programming for robot. E-Yantra project with support from IIT, Mumbai is being implemented for promotion of robotics amongst students. IoT section consists of several electronics components for development of different electronics circuits for automation and as per the required application. 3D printer is used to manufacture small parts required for research projects.

The laboratory is providing practical and hands-on exposure to PG and PhD students for the applications of robotics, drones and IoT in precision agriculture with design and assembly of robots, drones and to make various kind of electronics circuit for IoT systems like automation of water pump, wireless sensors network etc.

Completed projects:

- GIS mapping of university campus for asset management.
- Mobile app 'Phule Irrigation Scheduler' based pump controller for precise irrigation.
- Capacitive type soil moisture sensor system for different types of soil and pump controller for irrigation.

Ongoing projects:

- Identification of pest and diseases of cotton through RGB image processing and AI has been initiated in collaboration with John Deere India Pvt. Ltd.
- Harvesting robot for tomato and capsicum with image sensing robotic arm for teaching AI and robotic applications in agriculture.
- Spraying robot is under development for spraying horticultural crops.
- Development of proximal sensing platform for collection of agricultural data
- Optimization of operational parameters for spraying drones.

4.b. Industry Institution Interaction Cell

Industries having expertise in area of climate smart technologies, robotics, drones automation, precision agriculture have been brought together on single platform for interaction and collaboration through Industry-Institution Interaction cell. Eight Industry-Government-Academia-Students Interface programs were organized in year 2019-20. Beneficiaries of these programs were 1421 students and 143 faculties. 5 demonstrations on modern technologies like robotics, drones and automation for Climate Smart Agriculture were organized for students and farmers. Also, the course curriculum of PG diploma has been finalized in consultation with industries. All the research projects are being implemented in collaboration with industries only. The different collaborating industries are as follows: John Deere India Pvt. Ltd, Pune

- KisanHub, Cambridge, UK
- Innosepien Technologies Pvt. Ltd. New Mumbai
- Aayan Automation Industries Pvt. Ltd, Pune
- Jain Irrigation Ltd, Jalgaon
- Netafim Irrigation India Pvt Ltd.
- Lupin Human Welfare and Research Foundation, Pune
- Indiasoft Technologies Pvt. Ltd, Pune
- Pratik Enterprises, Pune
- ASAP Agritech LLP, Nasik
- SPL Technologies Pvt. Ltd. New Delhi
- SIFA, Mumbai



Drone/ Robotics Laboratory, CAAST-CSAWM, MPKV Rahuri

4.c. Start-up incubation cell

Proposal for Incubation centre for inculcating culture of innovation in students of the University has been submitted for funding from government of Maharashtra through Maharashtra State Innovation Society with following objectives:

- To upgrade and commercialize ideas for precision agriculture technologies.
- To create startup ecosystem for precision agriculture.
- To validate technologies and transfer to established industries for commercialization.

4.d. Other enabling infrastructures (Specify):

- **Upgradation of computers in Remote Sensing and GIS and Computer Aided Design and Graphics laboratories:** The M.Tech and PhD students of Mahatma Phule Krishi Vidyapeeth, Rahuri uses following laboratories for their academic and research work. As the Laboratories were established in 2009-10, the hardware configuration of the computers in theses labs did not support to latest software. Therefore, the hardware configuration has been upgraded through CAAST-CSAWM project in 2019-20 as mentioned below table. Upon this up-gradation, the students are able to use these laboratories for the projects and trainings related to geo-informatics and CAD-CAM.

Remote Sensing and GIS laboratory, Department of Irrigation and Drainage Engineering, Dr. ASCAET, MPKV, Rahuri		Computer Aided Design and Graphics laboratory, Department of Farm Machinery and Power Engineering, Dr. ASCAET, MPKV, Rahuri	
Upgradation 20 Computers		Upgradation of 25 Computers	
RAM DDR3 type (4 GB) [For 05 Desktop Computers having 2 Slots] with installation and testing. Compatible with Intel Quad Core 2.33 GHz Intel (R) Core (Tm) i3-2120 CPU @ 3.30 GHz PC	10	RAM DDR2 type (4 GB) with installation and testing. Compatible with Intel (R) Core (Tm) i3-2120 CPU @ 3.30 GHz PC- Think Center M72e	25
RAM DDR2 type (2 GB) [For 15 Desktop Computers having 4 Slots] with installation and testing Compatible with Assembled PC	45	UPS APC make UPS RS 600 with installation and testing	25
Solid State Drive 240 GB with installation and testing. Compatible with Intel Quad Core 2.33 GHz Assembled PC and testing Compatible with Intel (R) Core (Tm) i3-2120 CPU @ 3.30 GHz PC	20	Graphics Card (02 GB) with installation and testing Compatible with Intel Quad Core 2.33 GHz Assembled PC and testing Compatible with Intel (R) Core (Tm) i3-2120 CPU @ 3.30 GHz PC	25
UPS Batteries for - APC make UPS RS 600 (Change and Install with testing)	20	Wi-Fi Adapter (20+25) with installation and testing for GIS and CAD Laboratory	45
Switched Mode Power Supply (SMPS) Change and Install with testing Compatible with Intel Quad Core 2.33 GHz Assembled PC and testing Compatible with Intel (R) Core (Tm) i3-2120 CPU @ 3.30 GHz PC	10		

- Precision Agriculture Machinery:** To strengthen the existing farm machine and power engineering department under NAHEP CAAST, the initiative was taken so that students of the university can understand, get trained, use as well as to do further research and estimate the performance of precision agriculture machineries. As a part of this, different machinery are made available for students. The advanced machinery procured are Laser Land Leveller for precise levelling of agriculture Land, Vacuum Precision planter for precision sowing of bold seeds, belt type planter for precision sowing of vegetable seeds, variable rate fertiliser applicator with prime mover (tractor- Kubota MU5501).



- **Abiotic Stress Experimentation Facility**

- **Facility 1: Polycarbonate House**

- *Dimensions:* 4 m X 8 m (Two chambers, carbon dioxide and temperature controllers)

- *Working concept:*

- This facility provides elevated carbon dioxide and temperature effects in a controlled environment. Air in the chambers is heated by natural solar radiation additionally the temperature within chambers is elevated by installed heaters. The temperature is maintained by air inlet - outlet using cooling pads and exhaust fans system.
 - The facility is equipped with replaceable compressed carbon dioxide gas cylinders, which allows maintenance of carbon dioxide levels.
 - The levels of cooling/heating rates and carbon dioxide can be controlled based on experimental requirements.

- *Purpose of development:*

- Polycarbonate house with carbon dioxide controller facility provides capability to carry screening experiments in elevated carbon dioxide and temperature for plants.
 - Effect of these conditions can be observed on controlled population of insects.
 - Interactive effects of temperature and carbon dioxide on crop and insect's interaction.
 - The facility can be used to demonstrate students and farmers.
 - The data generated using the facility could be used for the estimation of promising and resilient crops under climate change.

- **Facility 2: Rainout Shelter**

- *Dimensions:* 10 m X 30 m (150 sq meter working shelter area)

- *Working concept:*

- This facility provides protection to the trials of drought screening experiments. Also avoids undesired irrigation due to precipitation in drought experiments.
- The facility is consisting of a frame supported by polycarbonate sheet with rolling mechanism called shelter.
- The rolling mechanism is for movement of shelter across the length of structure over roller track.

Purpose of development:

- Rainout shelter facility provides capability to conduct drought experiments in monsoon/ rainy season.
- Screening of water use efficient genotypes is possible.
- Promising and climate resilient genotypes can be selected for breeding purpose.

Facility 3: Carbon Dioxide Application Rig

Dimensions: 8 m diameter ring with ambient portal

Working concept:

- It is a combination of Free-Air Carbon Dioxide Enrichment (FACE) and Free Air Temperature Enrichment (FATE) technologies in open field conditions.
- This will facilitate both temperature and carbon dioxide monitoring system with control of temperature and carbon dioxide concentration.
- Monitoring system is able to collect data with the help of carbon dioxide sensors and weather station.

Purpose of development:

- This facility provides capability to carry experiments in elevated carbon dioxide and temperature conditions in open field condition.
- The facility could be used for the identification of promising and resilient genotypes to the climate change in open field conditions.

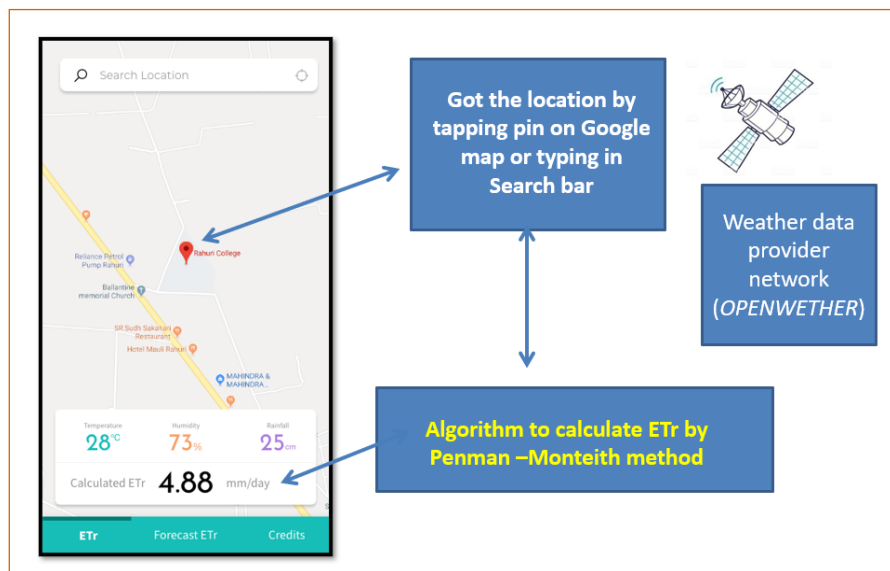


Abiotic Stress Facilities: a. Polycarbonate house, b. Rainout shelter, c. Co2 application rig developed under CAAST-CSAWM, MPKV Rahuri

5. Digital initiatives undertaken

5.a. Application developed (Mobile / Web based)

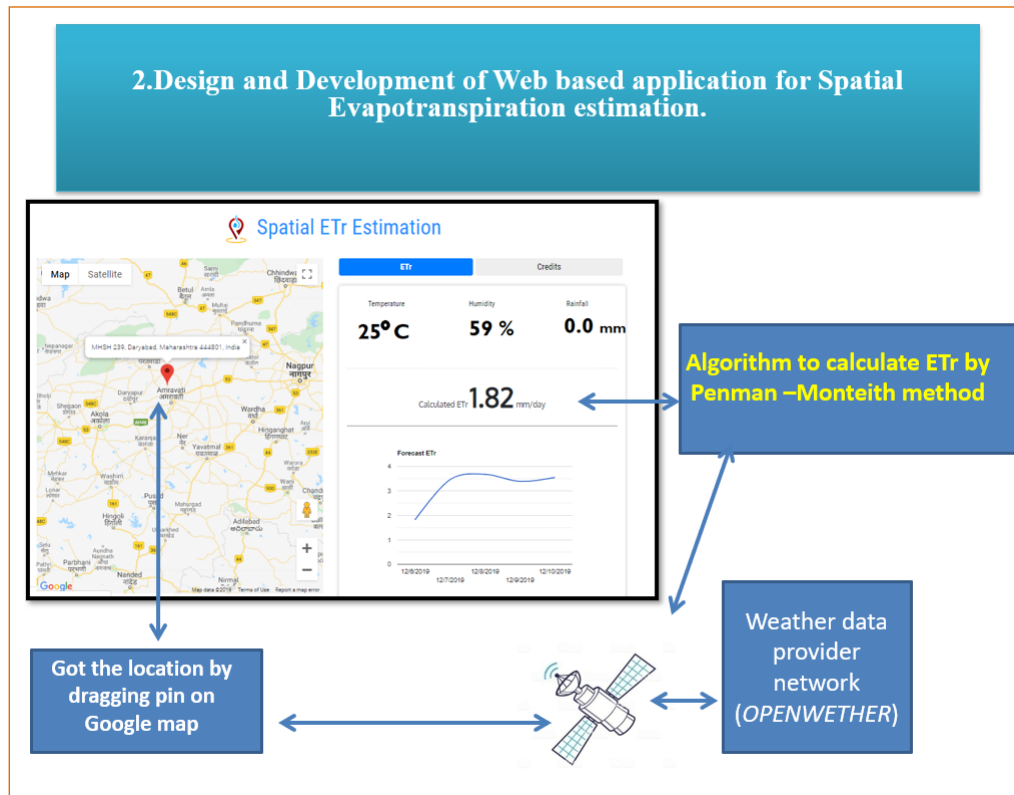
- **Design and Development of Spatial ETr-Android Mobile App:** The evapotranspiration consists of the water lost to the atmosphere, through evaporation and transpiration. The evapotranspiration can be estimated from evaporimeters and lysimeters (direct methods) and empirical and semi-empirical models (indirect methods). As per the recommendation by the UN-FAO, the Penman-Monteith model, is the most accurate estimating method for evapotranspiration. A determination of evapotranspiration is essential for irrigation management, to plan system and develop irrigation schedules. The present research activity was aimed to develop an Android based tool to estimate evapotranspiration through Penman-Monteith model. It uses the Spatial Google map on background and code based on Penman-Monteith model algorithm to estimate reference evapotranspiration (ETr) in mm/day. The application developed in this work is user friendly and easy to use, giving farmers and technicians the ability to evaluate daily evapotranspiration useful for many water managements tasks in agriculture using Android mobile device. User can search the desired location by entering the its name in search box or can drag and tap on the Google map to estimate the ETr in mm per day. Also, there is a facility to view the ETr of next five days based on the forecasted weather parameter provided by *openweather.org*



Framework of Spatial ETr-Android Mobile App Android app

- **Design and Development of Spatial ETr-Web based App:** The evapotranspiration consists of water lost to the atmosphere, through evaporation and transpiration. The evapotranspiration can be estimated from evaporimeters and lysimeters (direct methods) and empirical and semi-empirical models (indirect methods). As per the recommendation by the UN-FAO, the Penman-Monteith model, is the most accurate estimating method for evapotranspiration. A determination of evapotranspiration is essential for irrigation management, to plan system and develop irrigation schedules. The present research activity was aimed

to develop a Web based application to estimate evapotranspiration through Penman-Monteith model. It uses the Spatial Google map on background and code based on Penman-Monteith model algorithm to estimate reference evapotranspiration (ET_r) in mm/day. The web based application developed in this work is user friendly and easy to use, giving farmers and technicians the ability to evaluate daily evapotranspiration useful for many water managements tasks in agriculture on web site . User can search the desired location by entering the its name in search box or can drag and tap on the Google map to estimate the ET_r in mm per day. Also, there is a facility to view the ET_r of next five days based on the forecasted weather parameter provided by openweather.org. One can use this app by visiting <http://www.mpkv-caast.ac.in/ETR/spatialetr/details>



Framework of Spatial ETr Web based app.

- **Development of Android Application with database, Web API system for Student's Attendance and Teacher's performance evaluation:** To strengthen the performance and quality of teachers and students under MPKV, Rahuri this Android application was developed under CAAST-CSAWM. This meets

the mandate of the project. The Application has web-based portal for Administrator settings, to download and print reports, other settings. This application has following hierarchy of privileges:

Administrator: Can add, edit and delete all the users; Can add, edit and delete the Performance evaluation parameters (e.g. Subject Knowledge, Communication, environment etc); Can add, edit and delete the ranks for Performance evaluation parameters (e.g. Excellent, Good, Average etc)

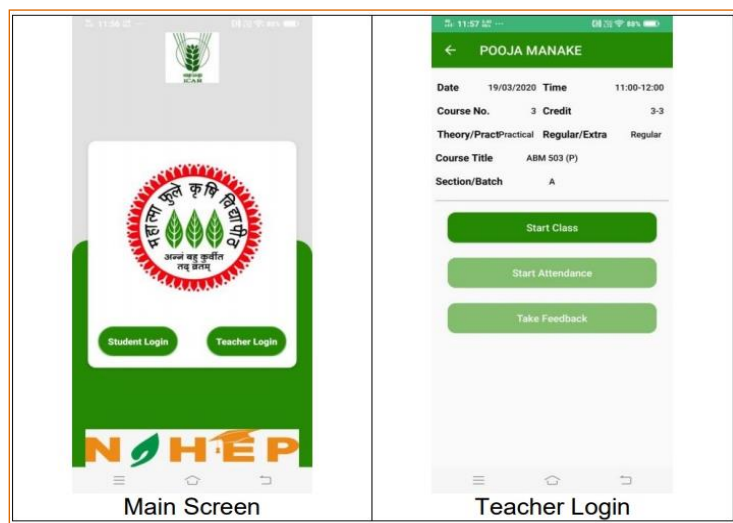
Dean: Can add, edit and delete List of Constituent and Affiliated Collages and its Associate Deans information; Can View the reports of Teacher's performance evaluation report and students' attendance of all the Constituent and Affiliated Collages as per semester, month, week and day wise

Associate Dean: Can add, edit and delete List of HoDs and Teacher associated at its Collages; Can add, edit or delete the Time table of its collage; Can View the reports of Teacher's performance evaluation report and students' attendance of all the department in the collage as per semester, month, week and day wise

Teacher: Can take attendance of Students at each class/period; Can reschedule the Class with permission of Associate Dean; Only Android login

Students: Can Submit the feedback at end of every period, if notified and permitted by teacher; Only Android login

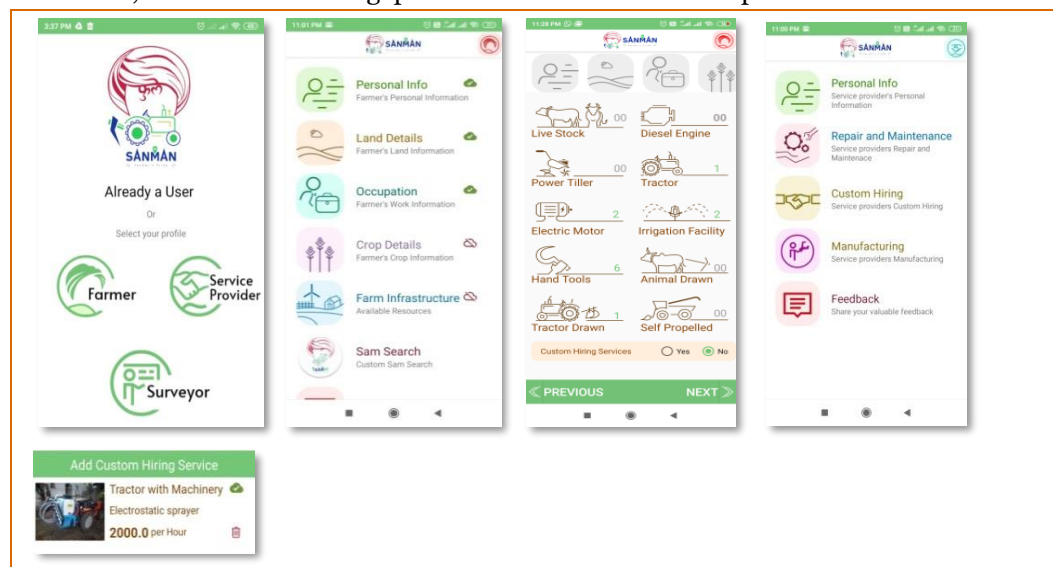
The app works on Android 5.1 onward based mobile phone and tablet. One can find the app on <https://play.google.com/store/apps/details?id=com.sapeksh.www.tes>. This app is being tested and will be deployed at constituent colleges of MPKV, Rahuri for proper implementation.



Framework of Android Application with database, Web API system for Student's Attendance and Teacher's performance evaluation

- **Software to Access Need of Mechanization and Available Network Solutions (Phule-SANMAN):** Farm mechanization is the need of hour to increase production and productivity of agricultural produce at minimum cost, saving energy and environment. Implements/machinery used for different agricultural operation ensures timeliness of operation and increase the work efficiency per unit time. In this context, assessment of the available machinery and finding the gap in mechanization is important for introduction of technology. In this context mobile application ‘Software to Access Need of Mechanization and Available Network Solutions’ (Phule-SANMAN) has been designed for survey of agricultural mechanization through farmers and service providers. The assessment includes personal, land and crop information along with available animals, mechanical and electrical power availability, hand tools, implements and machinery available with farmers as well as the available mechanization services (custom hiring, repair and maintenance and manufacturer of implements/machinery).

The farmer service provider and the surveyor (student, NGOs, and government organization) can register on this mobile application for collecting mechanization data. The information collected from this application will be beneficial for policy makers, organization, NGOs, service providers and farmers. The application can provide information for the mechanization solutions for specific crops or operation with its working principal, application, adjustment/settings, repairs and maintenance, current status and gaps in mechanization and also provide information of available machinery from manufacturers as well as service providers.



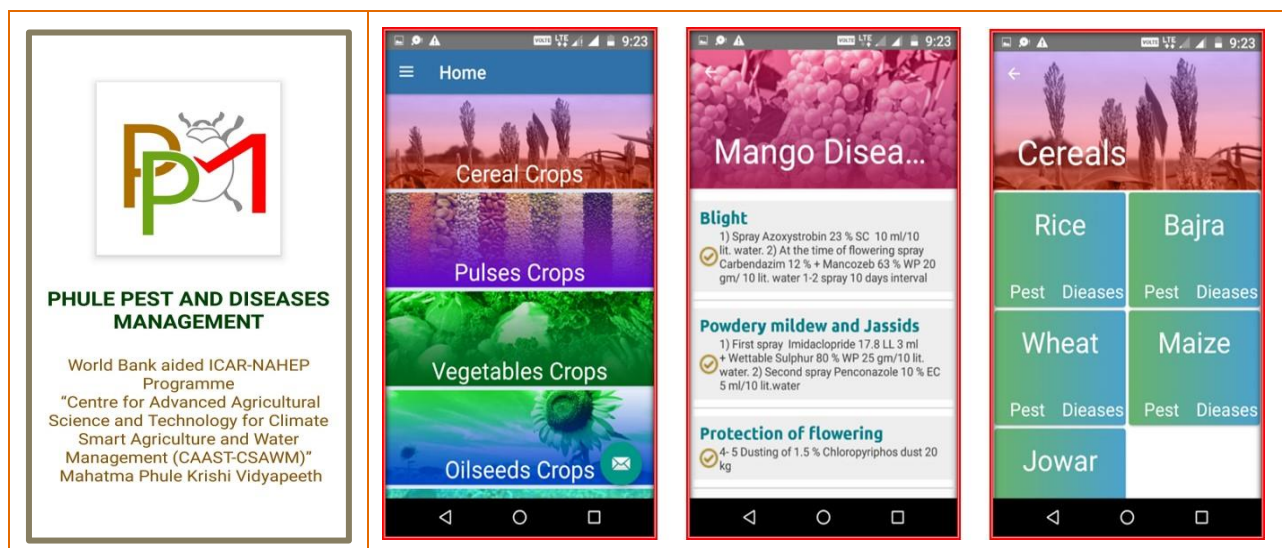
Framework of Software to Access Need of Mechanization and Available Network Solutions (Phule-SANMAN)

- **Development of Phule-Pest and Disease Management Mobile Application:** The developed mobile application is informative and can help farmers get access to crucial information in context to plant protection measurement. This application provides the detailed advisory with accurate doses of chemicals

recommended by Mahatma Phule Krishi Vidyapeeth, Rahuri and CIBRC (Central Insecticide Board and Recommendation Committee, Faridabad) for the management of different pest and diseases of various crops.

Application Features:

- Includes recommendation given by Mahatma Phule Krishi Vidyapeeth Rahuri and CIB (Central Insecticide Board)
- Provides list of Insecticides, Pesticides and Fungicides with their trade name or market name available in market.
- App. is free of cost & works in offline and online mode.
- The app. is also a useful tool for the farmers, researchers, scientists, students and village level workers.
- Multilingual facility (Marathi and English etc.) has been provided.
- Works in Android 5.1 and above mobiles and tablets.

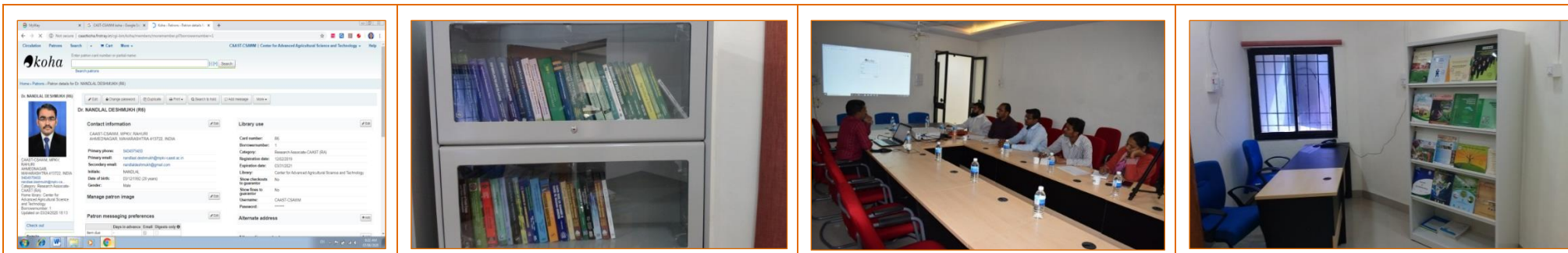


Framework of Phule-Pest and Disease Management Mobile Application

5. d. Digitization of library

- **Installation and Calibration of ERP software for CAAST Library:** Centre for Advanced Agricultural Science and Technology for Climate Smart Agriculture and Water Management, MPKV, Rahuri has purchased, installed and calibrated the Enterprise Resource Planning (ERP) Software for library that could be useful to digitalize the library of CAAST-CSAWM and integrate it with Central library of MPKV, Rahuri. Further, in order of library automation and development of national

network of the agricultural universities by integrating libraries, Indian Council of Agricultural Research (ICAR) recommended installing KOHA software which is a common platform for enterprise resource planning. Koha is an open source Integrated Library System used world-wide by public, school and special libraries. The name comes from a Māori term for a gift or donation (Wikipedia). Koha has been taken up to bring the libraries on a common standard platform with improved digital experience for the end-users. Koha has all the modules for day to day library operations and has facilities for creating group catalogue for sharing resources, like the AgriCat interface.



5.f. Other e-enabled initiatives undertaken

- Development of tool for identification and management of insect pests of Cotton:** Cotton is one of the most important fibre and cash crop of India and plays a dominant role in the industrial economy of the country. India being the second largest producer of cotton in the world. Maharashtra is the important cotton growing state in India with 42 lakh ha area. The average yield loss caused by insect pests is 25 to 30 per cent. There is a strong need for early identification and management of the insect pests for effectively applying the management strategy for control. This will lead towards the enhancement in production and minimizing uses of chemicals for cotton crop. Hence, CAAST-CSAWM, MPKV Rahuri and John Deere are jointly developing an AI and ML based program that will be used to identify the insect pest for cotton and subsequently advice corresponding management strategy.

Objectives:

- To finalize important insect pests of cotton and develop the library of images
- To develop AI, ML based algorithm for identification of insect pests
- To develop suitable user-friendly tool such as web application, mobile application, etc.
- To prepare and put the advisory for the management of insect pests into developed tool
- To pilot the tool for feedback and comments

Progress:

- Finalized the university and farmer's cotton experimental fields for taking observations and capturing the image.
- Finalized important insect pests of cotton crop for capturing the images.

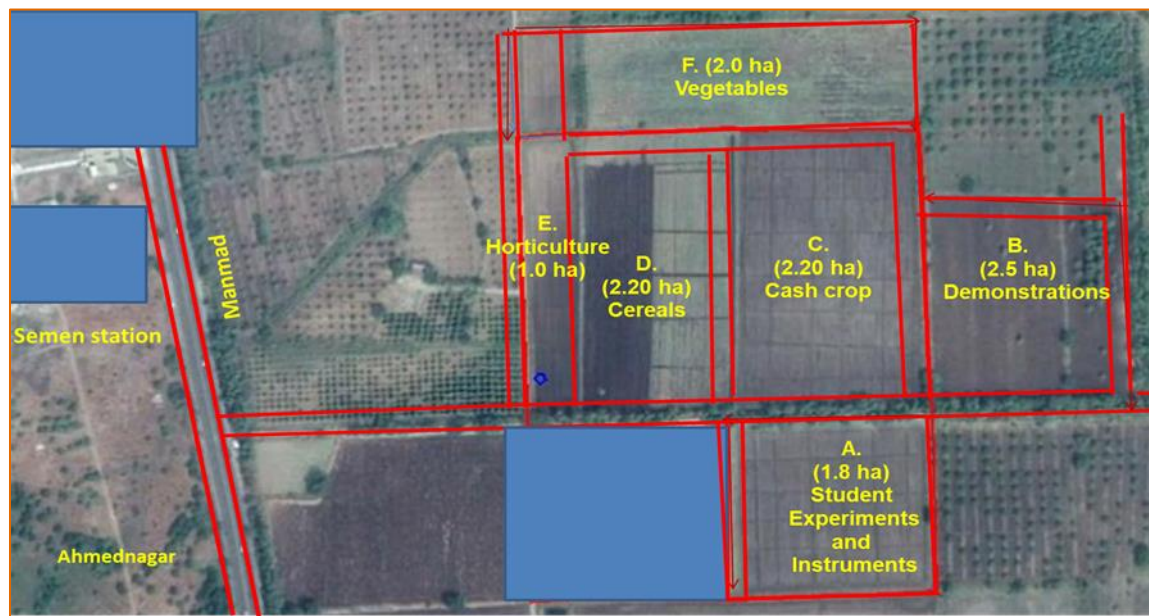
- Captured the images of insect pest by mobile camera and labeled insect wise, stage wise.
- Developed the insect pest images classified library and handover images to John Deere India, Pune.
- John Deere is developing AI and ML based algorithm for identification of insect pest.
- John Deere will develop suitable user-friendly tool such as web or mobile application and we will test and validate this develop tool in upcoming season.



6. Innovations and out of box initiatives undertaken

6.a. Field innovations:

- **Climate Smart Agriculture Blocks for Research, Experimentation and Demonstration:** CAAST- CSAWM project has been allotted 11.70 ha farm at 'D' Block Group No. 3/4 Central Campus Mahatma Phule Krishi Vidyapeeth, Rahuri for conducting research trial on various aspects of climate smart agriculture and water management of dry land and irrigated row, field and horticultural crops. Geographically, the farm is situated between 19° 33' E and 74° 64' N latitude and longitude. Accordingly, the present Climate Smart Agriculture Blocks was developed and Automatic Weather Station (AWS) as well as Micro climate monitoring station were installed at Experimental Farm. The salient features of Climate Smart Agriculture Blocks for Research, Experimentation and Demonstration as given below.



Google Map of Climate Smart Agriculture Blocks for Research, Experimentation and Demonstration

Table: Details of Climate Smart Agriculture Blocks for Research, Experimentation and Demonstration

Block	Particular	Area (ha)	Details
A.	Student Research	1.80	<ul style="list-style-type: none"> To conduct research experiments of post doctorate, PG Diploma, M. Sc. and Ph. D students on various aspects of climate smart agriculture and water management of dry land and irrigated crops.
B.	Demonstrations	2.50	<ul style="list-style-type: none"> Conducting Demonstration trialson various aspects of climate smart agriculture and water management of dry land and irrigated crops.
C.	Cash Crop	2.20	<ul style="list-style-type: none"> Ongoing research trial on Climate Resilient Resource Conservation Technologies for Sustainable Sugarcane Production The experiment laid out in strip plot design with. Three main plot treatments viz., M₁: Farmers practice, M₂: In situ trash management and M₃: Trash Management with Shredder Machine split into four sub plot treatments viz., S₁: Surface Irrigation (Furrow Irrigation), S₂: Surface Drip Irrigation, S₃: Subsurface Drip Irrigation and S₄: Surface Drip Irrigation + Inverted Sprinkler Irrigation resulting twelve treatment combinations replicated four times in strip plot design.



Outcome:

- The climate resilient resource conservation techniques can mitigate greenhouse gas emission and help in climate change adaptation by promoting carbon sequestration, reducing fuel-energy use and improving input use efficiency in sugarcane crop and farmers' income will increase with the use of resource conservation technique.

D.	Cereals	2.20	<ul style="list-style-type: none"> • for conducting research trial on various aspects of climate smart agriculture and water management of dry land and irrigated cereals crops
E.	Horticulture	1.00	<ul style="list-style-type: none"> • for conducting research trial on various aspects of climate smart agriculture and water management of dry land and irrigated Horticulture crop
F.	Vegetable	2.00	<ul style="list-style-type: none"> • for conducting research trial on various aspects of climate smart agriculture and water management of dry land and irrigated Vegetable crops

Agrometeorological instrumentations such as Automatic weather station (AWS) and Micro climate monitoring stations were installed in to the climate smart blocks. AWS captures the data that is helpful to study the effect of weather parameters on development of important field crops over their growth period; and to estimate climatic requirement of different field crops and development of weather based agro advisory for efficient crop management. Micro climate monitoring station collect continuous microclimate monitoring variables such as temperature, humidity, and soil moisture. This information is needed to understand how each climatic factor influences growth and how to manage maximum plant productivity.



Automatic weather station installed at CAAST-CSAWM, Climate Smart Blocks



Microclimate monitoring station installed at CAAST-CSAWM, Climate Smart Blocks

- **Village level Contingency Crop Plan for Akole Block:** Agriculture in India is highly vulnerable to climate change especially in rainfed regions which comprises over 60 % of India's total cultivated area. Maharashtra comes under Western Ghat zone which is directly dependent on the monsoon for agricultural production. Changing weather patterns- early or late onset and withdrawal dates of monsoon, unseasonal dry and wet spells, erratic rainfall, extreme temperature fluctuations and unexpected events like hailstorms, and cloud bursts increase the risks to crops, livestock and livelihoods, thus, making the farmer sensitive to losses and damages. Unusual weather patterns and shifts in local weather dynamics increasingly subject farmers to losses. Hence, their traditional knowledge and experience need to be complemented by advance information like weather occurrences and contingent crop plans. In rainfed areas, as a general rule early sowing of crops with the onset of monsoon is the best-bet practice that gives higher reliable yield. But the crop yields are affected due to delay in monsoon or prolonged breaks during cropping season and also with early withdrawal or continuation of monsoon for longer periods. These aberrant situations often lead to poor crop performance or total crop failures in major crops. There is a need to develop appropriate strategies to deal with such eventualities.

CRIDA (Central Research Institute for Dryland Agriculture) has developed district level contingency crop plans based on soils, rainfall and micro farming situations with association of network of AICRPDA, Agromet centers and Agricultural Universities for were 650 districts. In present situation, the contingency crop plans are currently available at district and the state level. Many times, the major weather aberrations happen at the micro level, for example a village may experience drought

and flood simultaneously which may not be the case at the district level. Contingency crop planning at the village level will address these climatic anomalies for quicker response mechanisms and help the administration to channelize the resources appropriately for effective mitigation of the adverse impacts of such eventualities.

The Maharashtra state is divided into nine broad agro climatic zones. Ahmednagar district Comes under the Deccan Plateaus, Hot semi- arid Eco- Region (6.1), Western Plateau and Hills Region (IX), Western Maharashtra Scarcity Zone (MH-6) with average annual rainfall of 561 mm, The Ahmednagar district has total geographical area 1702 ha out of which total cultivable area is 1146 ha having shallow Red/ Grey soils, deep black soils and medium deep black soils. Akole block of Ahmednagar district comes under Transition zone II. The rainfall in transition zone II ranges from 700 to 1200 mm. Principal crops grown in *Kharif* and *Rabi* seasons are paddy, finger millet, groundnut, wheat and gram. The soils of the Akole block are classified as shallow (up to 30 cm), medium (30-60 cm), and deep soils (60-90 cm). Scientists of CAAST-CSAWM, MPKV, Rahuri visited. Akole block of Ahmednagar district, studied and discussed the major problems in farming, about the cultivation practices, livestock management and weather abnormalities. Farmers from Akole Block were found doing traditional practices for the production of food grains which results in less productivity and income. As such the need was the realized to have the micro level crop contingent plan to giude the farmers to cope up with the variable weather, soils and crop situation. After the completion of several visits and surveys scientists from MPKV, Rahuri we identified cluster of seven villages from Akole Block viz., Manhere, Ambevangan, Ladgaon, Titavi, Kodani, Pimparkane and Dongarwadi for study. This cluster is dominated by tribal community with minimum resource availability in terms of agricultural enterprises. In the view of need village level crop contingency plan and implementation of climate smart technologies for doubling the farmer's income, CAAST-CSAWM, MPKV, Rahuri decided to develop a contingency crop plan for seven villages of Akole block.

Accordingly, CAAST-CSAWM organized two days workshop for development of village level contingency crop plan involving different stakeholder. Village level contingency crop plan was developed in consultation with various stakeholders including MPKV, Rahuri, NABARD, State Agriculture Department, KVKs, Farmers, and Experts from line departments including NGOs and expert facilitation from CRIDA and ATARI. CAAST-CSAWM developed contingency crop plan broadly for four groups viz., Agriculture, Horticulture, Livestock and Soil and Water Conservation. Before the development of village level crop contingency plan farmers used indigenous traditional practices for crop cultivation but after the technology transfer form of micro level crop contingent crop plan, farmers started to use improved varieties, intercrops, crop rotations, water conservation techniques and livestock management suggested by MPKV. Paddy is the major food grain crop in selected villages. After the inception by CAAST team, the farmers adopted improved package of practices for paddy cultivation, new varieties, proper nursery management for the better production and productivity. Farmers are satisfied with the initiative taken by CAAST-CSAWM to reduce the risk of disasters caused by climate change and the better implementation of innovative technologies for mitigation through the knowledge of village level contingency crop plan.



6.c. Teaching innovation

- Educational Programs in Climate Smart Agriculture and Water Management being implemented/to be implemented under NAHEP Program:**

The Mahatma Phule Krishi Vidyapeeth, Rahuri is well aware of the distress, the farmers have to face because of the aberrant weather; and heterogeneity in soil, crop and climate; and the associated risks to which farmers are exposed to. Hence this University has taken lead to develop the human resources and technologies for climate smart agriculture; and also, to build the capacity amongst the field personnel and farmers to adopt the climate smart technologies.

The Climate Smart Agriculture and Water Management (CSAWM) is the science of adapting and building the resilience of agricultural and food security systems to climate change through smart agricultural and water management practices for enhancing productivity and input resource use efficiency, reducing greenhouse gas emissions from agriculture (including crops, livestock, and fisheries) sustainable use of resources; and protecting the environment; using state of art technologies. More productive and more resilient agriculture require a major shift in the way land and water are managed to ensure that these resources are used more efficiently and precisely. Cultural, environmental, social, institutional, political and governance factors affect the adaptation and mitigation processes in agriculture. It is therefore important to produce the suitable human resources and identify the appropriate practices, methods and technologies to transform the larger scale

agriculture into the climate-smart and precision agriculture with emphasis on smart and precision water management approaches in context of constantly increasing water scarcity.

Hence one of the objectives of "Center for Advanced Agricultural Science and Technology on Climate Smart Agriculture and Water Management (CAAST-CSAWM)" being implemented under National Agricultural Higher Education Program (NAHEP) at Mahatma Phule Krishi Vidyapeeth, Rahuri is 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. programs (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. Hence the CAAST-CSAWM has developed the following educational programs in context to Climate Smart Agriculture and Water Management.

- Post Graduate Diploma
 - Certificates Courses
 - Post-Doctoral Research Program
-
- **Post Graduate Diploma:** One-year Post Graduate Diploma in "Climate Smart Agriculture and Water Management" was to be started from July, 2020 at MPKV, Rahuri. But now will be rescheduled in view of the current COVID19 situation. This Diploma is module based. There are four modules spread over 52 weeks i.e. one year. Module -1 is of 10 weeks duration; consisting of 3 courses of 3 weeks and followed by "Industry and Farmers Day". Module-2 and 3 are of 13 weeks duration each; consisting of 3 courses of 3 weeks duration each followed by project of 3 weeks duration. Module-4 is of 16 weeks duration followed by Project of 6 weeks duration. The framework of the PG Diploma along-with the courses to be offered in each module has been finalized during eight Workshops and brain-storming session conducted at MPKV, Rahuri and Pune campuses with 24 National and International partners. The Post Graduate Diploma will be offered in different specialization depending on the courses completed by the student as below.
 1. Climate Smart Agriculture
 2. Climate Smart Agriculture – Natural Resources Management
 3. Climate Smart Agriculture – Precision Agricultural Machineries
 4. Climate Smart Agriculture – Precision Irrigation Management and Protected Cultivation
 5. Climate Smart Agriculture – Robotics, Drones and IoT
 6. Climate Smart Agriculture – Geo-informatics.
 - **Certificate Courses:** The project aims at building the capacity and providing the training to the graduate or post graduate individuals, faculties/scientists of the University and Research Organizations; and the practitioners from the Development Departments/NGOs and other concerned organizations in climate smart agriculture and water management to enable them to adopt these technologies for the productive and sustainable agriculture. Hence this CASST-CSAWM decided to formulate the certificate courses of different durations as proposed in and offer to the interested personnel. Accordingly, the courses that are proposed for the PG Diploma will be offered as: (i) one course of three weeks, (ii) the combination of different courses of three weeks, (iii) one module with or without project or (iv) the combination of different modules. The Certificate Program will be started once the restrictions due to COVID19 situation is relaxed.

- **Post-Doctoral Research Programs:** Every year approximately 10 post-doctoral research students will be admitted to perform in depth and focused research studies on climate smart and precision agriculture and water management involving the conventional, ICT, IoT, drones, robotics and geo-informatics-based approaches. The program is residential (i.e. students will have to work full time for post-doctoral research studies) and the duration of the post-doctoral research program is 1 to 2 years depending on the students' option. The post-doctoral research students are expected to strengthen his/her compatibility in precision agriculture, climate smart agriculture and water management; and develop the tools and techniques with active association from twinning Universities and collaborating organizations and industries. Hence the post-doctoral research studies can be undertaken with the collaborating national and international organizations and industries. They will also be encouraged to write and publish the high-quality peer-reviewed research papers in the journals of high impact factor. This program has already started. Currently no fellowship is offered for this program but the CAAST-CSAWM will assist in obtaining the fellowships from other organizations, if required.
- **Strengthening of on-going Masters and Doctoral programs:** Existing masters (M. Sc., M. Tech.) and doctoral (Ph. D) programs in different related disciplines are being strengthened by offering the courses related to climate smart agriculture and water management as audit, non-gradual or optional courses; and providing the opportunities for the M. Sc., M. Tech. and Ph. D students to complete their research projects on the topics related to climate smart agriculture and water management in CAAST-CSAWM. The main aim of the strengthening M.Sc./M.Tech and Ph. D. programs is to make the students expert in Climate Smart Agriculture and Water Management, develop the useful tools and technologies and write the research papers in high quality peer-reviewed journals. The students have already started undertaking the projects related to climate smart agriculture and water management with the facilities and knowledge networking developed in CAAST-CSAWM. The audit and optional courses will be offered from the ensuing semester (i.e. July/August, 2020).

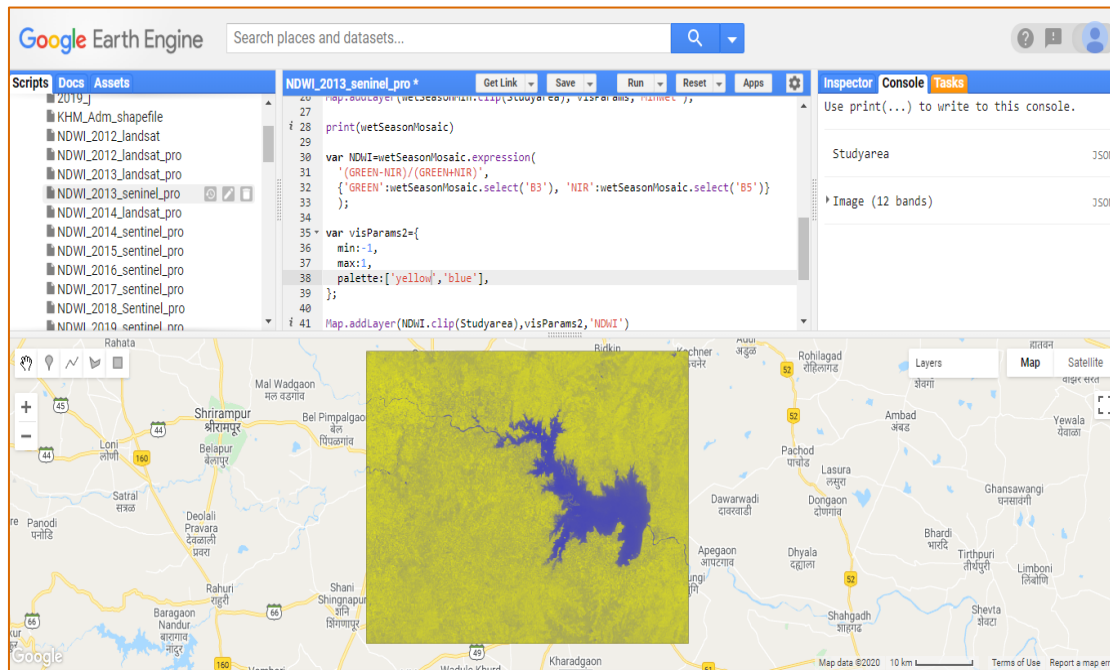
6.d. Other

- **Surface Water Dynamics Analysis Based on Sentinel Imagery and Google Earth Engine Platform: A Case Study of Jayakwadi Dam**

Objectives:

- To extraction of the water spread-out area of the Jayakwadi dam through the NDWI index.
- To develop the algorithm for the analysis of the water spread-out area of the dam.
- To the analysis of changing, year-wise water spread-out area trends will measure in the GEE platform.

This study focuses on monitoring the dynamics of surface water is a great importance of climate change for natural environmental health and understand the impact of global changes and human activities on the available water resources. This study used the cloud platform dedicated to data processing and analysis of geoscience by using Google Earth Engine (GEE) integrates many excellent remote sensing image processing algorithms. Based on the series data of Sentinel-2 which is available on the Google Earth Engine Data Catalogue and these data were used for the study of the water body area in the Jayakwadi dam, which is located on Godavari river at the site of the Jayakwadi village in the Paithan taluka of the Aurangabad district of the Maharashtra State in India. From satellite data was extracted by common water body index method is called NDWI i.e. Normalized difference water index. The water spread-out area of the Jayakwadi dam was calculated for five years from 2015 to 2019 by using the Google Earth Engine platform. Secondly, by calculating the NDWI index, extract waterbody according to the appropriate threshold. The results of the study area have been shown that the water spread-out area of the dam was 171.9684, 335.1256, 370.827, 208.4242, and 410.9113 sq.km during the year of 2015, 2016, 2017, 2018 and 2019 respectively. These water spread-out area changes were analyzed by using algorithms. These results can be useful for planning of flood control, irrigation management, and other purposes in the Dam area.



Google Earth Engine Platform Data Processing

Outcomes:

- The Aurangabad district has a large population and rapid economic development, meanwhile frequent droughts and changeable hydrological conditions threaten the economy and ecology.
- The results are shown water spread-out from 2015 to 2019 there is much increase in the water area of the Jayakwadi dam due to various reasons like pumping, heavy rain and it can be used for various purposes and water management is very important in this manner.

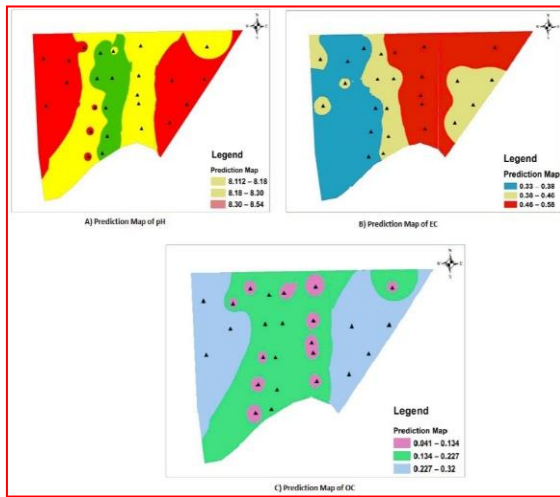
• Prediction of soil chemical properties for semi-arid region using multispectral satellite images and wavelet transforms methods

Objectives

- To develop the algorithm for prediction of soil chemical properties using multispectral images and wavelet transforms method.
- To correlation of PCA for selected four wavelet transforms method with soil chemical properties.
- To predicted the soil chemical properties using algorithms

The aim of this paper rapidly and precisely mapping of soil chemical properties is important for farming, forestry, and ecological planning, development, and management. The main objective of the current study, which anew Wavelet transforms methods and multispectral satellite images for soil chemical properties prediction

was developed and validated in situated in India County. Multispectral images were collected in a total of 25 soil sample points. At a similar period, soil samples were acquired at the study area sites and soil chemical properties including organic carbon, pH, and EC were calculated by laboratory analysis. The actual soil chemical properties were correlated with predicated soil chemical properties. The analyzed correlations of the soil properties with various bands and enhanced spectral variables obtained from the field as well as satellite multispectral data were processed and therefore four wavelet transforms methods such as Daubechies, Symlet, Biorthogonal, and Coiflet selected to values prediction of soil chemical properties by using multispectral data. Subsequently, in this study an exploit wavelet a neural network model was used for the prediction of soil properties for the semi-arid region. Thus, the developed a polynomial and ANN models have validated and compared for precise predicted soil properties values using Coefficient determination (R^2) and RMSE.



Soil Prediction Map

Outcomes:

- These satellite images can help for better understanding the character of the soil chemical properties, its properties enhancement.
- The correlation analysis has exposed the dominating wavelets and their study of principle components that correlation is good with the chemical report.

4. Please provide the photographs of the activities (photographs should show some impact/achievement)

Photographs attached separately in the mail.



Visit of World Bank Officials at CAAST-CSAWM, MPKV Rahuri, 23-24 January 2020



International Symposium on Artificial Intelligence based Future Agricultural Technologies, 7-9 January 2020



Inauguration of Automatic Weather Station in presence of NABARD Officials, NGO Personnel's, Farmers and CAAST Team, Buchkewadi, 3 March 2020



Installation of IoT and Soil Moisture Sensor based Automated Precision Irrigation System at Buchkewadi by CAAST Team, 19 February 2020



Students International Training at AIT Bangkok during November 11, 2019 to December 10, 2019



Shri. Bhagat Singh Koshiyariji, Hon' Governor of Maharashtra visited CAAST-CSAWM exhibition stall at MPKV Rahuri, 05 December 2019



Shri. Sharad Pawariji, visited CAAST-CSAWM exhibition stall at MPKV Rahuri, 07 January 2020



Shri. BalasahebJi Thorat, Hon' Minister of Revenue and Shri. DadaJi Bhuse, Hon' Agriculture Minister, Government of Maharashtra visited CAAST-CSAWM Exhibition stall, MPKV Rahuri, 11 January 2020



International Scientist-Student Interface on Drones, Robotics, Artificial Intelligence and Farm Machineries Organised by CAAST-CSAWM, MPKV Rahuri, 12 January 2020

5. Challenges faced and lessons learnt under Component:

1	The lockdown period was totally unexpected and it caused the severe problems in the procurement process. Major includes: The purchase orders were issued by following all the proper procurement procedure towards the end of February and in first week of March; the venders were ready to deliver and the lockdown period started which prolonged up to March end and beyond. But now they started the process of supplying. Guidance is required on continuation of the procedure from previous year, passing the bills in current years and revalidation of grants (communicated to NAHEP).
2	Fund allotment under Human capacity building head (Seminars and Short visits sub head) is not sufficient as it is difficult to manage international short visit to USA with daily allowance of USD 100/day (existing allowance/day for USA visit).
3	There shall be provision of additional fund under Human capacity building head as some emergency situation arise (Covid-19 pandemic). During short visit of MPKV officials at WSU, Pullman, USA it was necessary to reschedule their flight for return journey to India because of Covid-19 situation. It was very difficult to manage additional amount demanded by Airline at the time of rescheduling of flight in given sanction amount.
4	Delayed start of the on-campus Certificate Courses and PG Diploma: Uncertain and dynamically changing situations; regular academic programmes are also being hampered.
5	Field experiments: Important observations could not be taken and data not recorded since the start of COVID19 lockdown
6	Climate smart villages and digital villages; and Climate Smart Blocks: Non conduct of many activities planned over three months and uncertainty over conduct of activities during the time periods ahead.

6. Plan ahead (Key activities) for next reporting period

1.	The unspent grants from 2019-20 are revalidated in year 2020-21 with permission to complete the pending activities of year 2019-20 in year 2020-21. The sanctioned activities of 2019-20 and 2020-21 will be completed by expediting the required procedures after lockdown period is over.
2.	In year 2020-21, there are 19 approved activities under goods and equipment head and its subheads. CAAST-CSAWM will try to stick to the road map approved on STEP for purchase of these goods and equipment and up to December 2020 majority of the activities will be completed amounting to Rs. 170.59 lakhs. Guidelines for procurement from the savings if any, after completion of all the approved activities are required.
3.	Formulation of framework for integrated “on-campus; on-job and distance learning” mode PG Diploma
4.	Framework for Virtual class room approach and delivery by the expert teachers to students of all campuses/colleges in University simultaneously with Teaching Assistants assisting the students on other campuses/colleges. Demonstrative implementation on provision of special grants for this purpose.
5.	Detailed research studies by the Post Doctorate Research Students (however fellowship could be a limitation)
6.	Implementation of Post-Doctoral programmes and start of education programmes such as certificate and PG Diploma (subjected to COVID19 pandemic situation) and; preparation of the course materials such as manuals and videos; establishment of smart class rooms.
7.	Dissemination of climate smart and precision farming technologies; and real time solution-based advisories at village level enabling the students to have on-

	the-job training and case study-based learning.
8.	Put together the research trials and demonstration on the 'Conservation and 'Climate-Resilient Agriculture' (CRA) and develop technologies combat against changing climatic scenario which will assist to small and marginal farmers to achieve sustainable crop production and food security.
9.	Carbon stock and carbon credits generated from horticultural orchards, agroforestry and different land use types in MPKV jurisdiction, to know the carbon sequestration potential.
10.	Demonstrate the approach of Climate Smart and Digital Villages in collaboration with different agencies and set up of the climate smart blocks.
11.	Enhancement of the business and entrepreneurship opportunities in climate smart, precision and water management as per the call of Hon' Prime Minister of India for Self-Reliant India Initiative (AatmaNirbhar Bharat Abhiyaan).
12.	Constraint analysis in adoption of automated micro irrigation technologies in Pune district and the solutions to enhance adoptability of these technologies in context of Climate Smart Agriculture and Water Management.
13.	Organization of one month international training on Precision Agriculture and water management at Washington State University, Pullman, USA for batch of seven (Four faculties from first year i.e. 2018-19 and three or more faculties from second year i.e. 2019-20) faculties/scientists of MPKV, Rahuri at suitable time in near future as this planned training was not undertaken due to COVID-19 pandemic all over the world.
14.	Signing of Memorandum of Understanding for Collaborative Research, Education, Training and Extension in IT Technologies for Precision, Climate Smart Agriculture and Water Management between MPKV, Rahuri and Partner Institutes/ Organizations
15.	Renovation of seminar hall with flooring, electrification, furnishing and audio-visual aids at CAAST-CSAWM office.
16.	All Research trails under CAAST- CSAWM will be formulated which can conserve natural resources and helps to reduce Carbon footprints.
17.	Green initiative to plant more trees in campus.
18.	Awareness lectures for faculty and students about conservation of natural resources and safe disposal waste material.
19.	<p>Faculty/ Student/ Innovative Research Projects</p> <p>a. Development of the climate smart, digital and precision farming technologies adoptable to farmers including automation and robotics, drones, geo-informatics, SDSS and climate resilient solutions through PG Student's Projects.</p> <ul style="list-style-type: none"> • Design and development of Robotic harvester for tomato and capsicum • Optimization of different parameters of spraying drone for effective operation • Development of site-specific organic slurry applicator for orchard crops • Design and development of variable rate fertilizer applicator <p>b. To develop suitable user-friendly tool such as web application, mobile application, for identification of insect pests and diseases using AI, ML and IoT based algorithms and subsequent advisory for the management of insect pests and diseases.</p> <ul style="list-style-type: none"> • Development of linear conjunctive use model for Nashik region • IoT based crop monitoring and controlling in Green house • Development of Soil Moisture App and its integration with soil moisture sensor

- Development of mobile application for Services for Agricultural Mechanization (“Phule – SAM”)
- c. To conduct experiments/ studies on hyper-spectrometer remote sensing for generating the data base for the real time and precise management of the resources.
- Estimation of leaf area index, EVI, GNDVI and NDVI values on the wheat crop by using the hyperspectral imaging camera
 - Estimation of crop growth development by using the hyperspectral imaging camera.
 - Estimation of soil mapping by using the satellite data and hyperspectral imaging camera.
 - Development spectral signature from crops by using hyperspectral imaging camera.
 - Potato crop yield estimation based on spectral reflectance at Pune farmers field using NDVI and EVI
 - Monitoring of potato crop growth stages using Spectro radiometer instruments
- d. Other
- Water budgeting of smart village Buchkewadi in context of water management
 - Study the potential of carbon sequestration and generation of carbon credits of different land use in MPKV, campus.
 - Identify the constraints in adoption of protected cultivation of vegetables and flowers in Poly house technology
 - Study of the different irrigation and fertigation levels on drip irrigated Tuberose.
 - Study the irrigation scheduling using Tensiometer for Rose crop under open field condition.