ICAR-National Agricultural Higher Education Project

Center for Advanced Agricultural Science and Technology on
Skill Development to use Spatial Data for National Resource Management in Agriculture

Annual Progress Report
2021-2022

Jawaharlal Nehru Krishi Vishwavidyalaya
College of Agricultural Engineering Jabalpur
M.P. 482 004

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कृषि नगर, आधारताल, जबलपुर ४८२ ००४ (म.प्र.)
Jawaharlal Nehru Krishi Vishwa Vidyalaya
Krishi Nagar, Adhartal, Jabalpur 482 004 (M.P.)

FOREWORD

Indian Council of Agricultural Research (ICAR), with financial support from the World Bank (WB), launched National Agricultural Higher Education Project (NAHEP) with an aim to bring transformative reforms in agricultural higher education in the country. Since its inception, a collaborative and directional efforts are being made by NAHEP stakeholders to achieve improvement of faculty competence, student development, attracting talented students, IT support and upgration of infrastructure and facilities enabling the university system to catch up national and internationally.

Centre of Advanced Agricultural Science & Technology (CAAST) established at JNKVV, Jabalpur has made significant efforts towards Skill Development to Use Spatial data in Agriculture. Geospatial data is required for all the development works in all sectors. Agriculture sector, is one of the central sectors, which is going to enormously benefit from it. Spatio-temporal satellite images play a great role in precision agriculture. They provide information regarding land type and vegetation including biomass and water stress in crops. Precision agriculture is a crop management concept, field-specific, which uses real-time data gained by employing wireless sensors, RS & GIS to make smarter decisions for better productivity. We are self-reliant in space technology. From day to day, the use of remote sensing data for management of natural resources is increasing worldwide. The use of remote sensing data requires special skill and training to interpret & analyze the images. It is expensive method that required software's, hardware's, skilled person and training.

Therefore, there is need of sufficient number of trained manpower for harnessing the benefits of remote sensing technology. ICAR-NAHEP project provided an opportunity, to unlock the immense potential of students and faculty for use remote sense data in agricultural application. Through this project, various capacity building and awareness programmes were arranged for skill development of students and faculty. Due to this project, the university upskilled in the field of research and education. Students and faculty are able to use various equipment's, computers in Remote Sensing & GIS and ARIS laboratories upgraded through CAAST- CSDA project.

The progress of the project has been closely monitored discussed and received by project monitoring cell, (PMC) at JNKVV. I am happy that continuous feedback and suggestion made during these meetings have better equipped the project to meet the desired outcomes.

I appreciate the efforts by PI, NAHEP, JNKVV and the entire team for their constant efforts in improving quality and relevance of Agriculture Higher Education and contributed to fulfil the objectives of the project.

(P. K. Bisen)

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देश में सर्वश्रेष्ठ - सरदार पटेल उत्कृष्ट भारतीय कृषि अनुसंधान परिषद् संस्थान अवार्ड-2018 से सम्मानित

ICAR-National Agricultural Higher Education Project
Centre for Advanced Agricultural Science and Technology
on
Skill Development to Use Spatial Data for
Natural Resources Management in Agriculture
College of Agricultural Engineering
Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.)
Quality and relevance in Agricultural Education

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PREFACE

ICAR and world Bank, NAHEP aims to support the Agricultural Universities and ICAR for enhancing the quality of agricultural higher education, making it more suitable for the market demand and develop skilled resources for the agriculture and allied sectors. This ensures quality education by extending support to interested Agriculture Universities in enhancing faculty performance, attracting better students, improving student learning outcomes and raising their prospects for future employability, particularly in the private sector.

The Centre of Advanced Agricultural Science & Technology (CAAST) have been awarded to JNKVV on Skill Development to Use Spatial data for Natural Resources Management in Agriculture. Financial Management Committee, Procurement Committee, Project Monitoring Cell and a three-tier grievance redressal mechanism were framed to ensure a fair and transparent system for executing the program.

The Annual Report of ICAR-NAHEP-CAAST-JNKVV, Jabalpur for 2021-2022 is a compilation of the activities and programmes in the fields of Capacity building, Education, Research, Environmental Sustainability, Social Safeguard, Equity Action Plan, Extension, financial and physical achievements as well as research initiatives.

In respect of capacity building, ICAR-NAHEP-CAAST at JNKVV conducted more than 38 programmes under various heads as awareness programmes, capacity building, vocational courses, environmental safeguards and for social safeguards with total participation of 6017 including 64.46 % male and around 35.54 % female have benefited. In overall participation there was a share of about 22% for schedule tribes and schedule caste category. Through Hands-on training programs, students and faculty of the University are encouraged to undertake PG/Ph.D. research topics related to RS and GIS. 29 students have been involved to undertake research project work on different problems relevant to various departments.

In respect of research, various research initiatives have been taken to identify appropriate techniques for integration of spatial and ground data to realize problems related to land, water and vegetation. It includes research initiative for River revival, RS based crop classification, Interactive visualization of remote sensing processed data (web and mobile application) and development of user-friendly spatial data product.

During the project period a constant encouragement guidance and support extended by Dr. R.C. Agrawal, National Director, NAHEP, Dr. P.K. Bisen, VC, JNKVV, Dr. Prabhat Kumar, NC-CAAST & Component 2: Dr. P.K. Ghosh, Former NC-CAAST, Dr. Hema Tripathi, NC-M&E, SS and ESS, Mr. Dilip Roy, Deputy Secretary & Procurement Officer, Mr. Nilesh Deshmukh, M&E consultants has been immense help to entire project team in building momentum for project implementation.

I take this opportunity to acknowledge the support and guidance provided by Dr. Dhirendra Kumar Khare, Dean Faculty of Agriculture, Dr. G.K. Koutu, Director Research Services, Dr. Dinkar Sharma, Director Extension Services, Dr Abhishek Shukla, Director Instructions, Dr. D.K. Pahalwan, Director Farms, Dr. Amit Sharma, Dean Student Welfare, Dr. A.K. Shrivastava, Dean, Agricultural Engineering and Dr. Sharad Tiwari, Dean Agriculture, Jabalpur for organizing the NAHEP programmes successfully.

I appreciate the constant efforts made by Dr. S.B. Nahatkar, Co-PI International Training, Dr. M.K. Awasthi, Co-PI National Training, Dr. S.K. Sharma, Co-PI Research, Dr. A.K. Rai, Co-PI Product Development, Dr. Y.K. Tiwari, Co-PI, Procurement & Finance, Dr. S.B. Das, Nodal Officer (ESP), Dr. Deepak Rathi, Nodal Officer (EAP), Dr. Ajay Khare, Nodal Officer (Finance), Associated Scientists and staff working for NAHEP-CAAST, Jabalpur for success of the project.

(R.K. Nema)

Contents

1. Executive Summary

1.1 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 program will promote efficiency and competiveness 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), Centers 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 AU sunder 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 2020 to March 2021 has been captured herewith.

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

In order to improve standard and quality of agricultural higher education, the investments under CAAST component contribute 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.

1.2 Broad Activities during year 2021-22

Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur has been awarded with CAAST on Skill Development to Use Spatial Data for Natural Resources Management in Agriculture with the main objectives of:

1. To build basic capacity for using RS & GIS techniques applied for betterment of Natural Resource Management particularly in Agriculture and allied sectors.
2. To identify appropriate techniques for integration of spatial and ground data to realize problems related to land, water and vegetation.
3. To develop user friendly spatial data products using identified technologies for policy makers, researchers, field workers and farmers.

Activities

- Awareness program for Students
- Introductory program for administrators
- Educative learning for executives
- Capacity building for Scientists, Teachers, officials, students and young professionals
- National and international Training of faculty for knowledge upgradation
- Problem identification in realizing process with satellite and ground data with techniques available.
- Making the spatial data maps more precise and accurate using fine resolution data available with present satellite systems.
- Providing research fellowship to the students undergoing master and doctoral degree involved to undertake research project on related aspects.
- Preparation of Theme based maps
- Preparation of Integrated maps for decision making
- To develop user friendly spatial data products using identified technologies for policy makers, researchers, field workers and farmers.

Summary of work done

The project addressed the various research areas as well as training requirements of university teachers, postgraduate and doctorate students with applied geospatial techniques to meet the objective of natural resource management in agriculture. Faculty, Scientists, KVK line staff, and PG students have been trained under 21 days hands-on program for the processing of spatial data applications in agriculture. Also, agriculture executives/officers from various districts of Madhya Pradesh have trained on various spatially classified information that are readily available or may become available in the future. They have been trained on to get the various source of information, their procurement and download the spatial data from online platforms and way to utilize them effectively for various planning purposes. In addition, students from various schools have been educated about the prospects for agriculture higher education in the future.

As per the second objective of CAAST, there are number of problems related to

field have been identified. These problems were addressed through approach of spatial and ground data integration. Groundwater potential zoning, Identification of irrigated area, River revival, Water resources, Identification of insect/pest infected area, Crop characterization and biotic/abiotic stress, Carbon sequestration, Characterization of Mango orchards, Evapotranspiration and Rainfall variability, Dynamics of surface water area, Non-Availability of spatial crop area are some of them. The Spatio-temporal dynamics of ET has been studied for entire Madhya Pradesh. The Web application for visualizing the rainfall trends for entire Madhya Pradesh has been developed. The LULC change detection have been assessed over the years. Groundwater data has been processed to identify crucial places where substantial groundwater declining trends have been observed. Students pursuing master's and doctorate degrees have also conducted substantial research. There are research fellowships available for students focused on important research topics related to this objective. These activities will continue, with substantially increased the value addition for students as well as faculties.

As per the third objective of the NAHEP-CAAST-CSDA, various thematic maps have been prepared based on information available on GIS platform with fine resolution data for Drainage, Slope, LULC of different years and from different satellites. Rainfall, Soil, Crop, Lineament, Geology, Geomorphology maps are prepared to address field problems and were validated with field data. Such maps have been used to derive useful information e.g. Seasonal and permanent surface water body map of Madhya Pradesh for 7 years since year 2014, Monthly, seasonal and annual potential evapotranspiration of Madhya Pradesh for 21 years, Long term monthly, seasonal and annual rainfall and drought of Madhya Pradesh for 119 years and Ground water status of Tons basin. Integrated maps were used to demarcate groundwater potential zones, to identify suitable locations for water harvesting structures for Kanari watershed, to prioritize soil conservation works in Banjar river watersheds, to estimate crop area in different districts, and to evaluate decadal land use land cover change of Jabalpur district.

NAHEP-CAAST-CSDA started preparing the thematic maps of other problems area of agriculture and such data will be integrated with ground data to analyze the problem. Remedial measures for identified problems will be addressed by preparing spatial products for end users. These activities will be continued.

1.3 Major achievements

1.3.1 Capacity Building

To enhance the understanding and utilization of spatial data using remote sensing (RS) and geographic information systems (GIS) for applied research in various domains of Agriculture, 4 awareness program for students, 9 skill development training program for both students and faculty, and 3 Educative Learning for Agriculture Executives/officers were successfully conducted. Using the cloud-based geospatial techniques, innovative

online applications for long-term rainfall patterns, temporal changes in land surface temperature, and water body identification were developed for the entire Madhya Pradesh. Under the framework of the Environmental Safeguard Plan, 14 skill development and awareness program for students have been conducted to focus on various aspects of environmental challenges and their remediation. In addition, the center has conducted 6 awareness program and 2 capacity-building program that focus on social themes and equity concerns, respectively, and involve students from diverse backgrounds in order to solve social and equity challenges. There were a total of 6017 participants, including students and staff, who benefited from the project.

1.3.2 Problem Identification through RS and GIS

The problems related to land, water and vegetation were identified in realizing process with satellite and ground data. The particular problems includes, Priority of watershed, Groundwater potential zoning, Identification of irrigated area, River revival, Water resources depletion, Identification of insect/pest infected area, Crop characterization and biotic/abiotic stress, Carbon sequestration, Characterization of Mango orchard, Evapotranspiration and Rainfall variability, Dynamics of surface water area, Non-Availability of spatial crop area maps etc. Twenty eight students undergoing master and doctoral degree program have been involved and started research project on related aspects. The spatial data analysis laboratory is established through NAHEP-CAAST to provide research facilities and equipment's to students and faculty to carry out research work.

1.3.3 Development of Application Products

Two web application namely MP Rain (1901-2019) and MP ETp (2000-2020) are developed for interactive visualization of spatial and temporal variation of rainfall, drought, dry/wet spell and potential evapotranspiration at district level for entire Madhya Pradesh state. These web applications provide all the information at the user fingertips. The end users of these web applications are State agricultural department, Water resource department, Disaster management agencies, Academician, Students and Researchers.

One mobile application "जवाहर गन्ना मित्र'' is developed for sugarcane farmers and millers. This application provides an online platform to both the sugarcane mill owner and the farmer to easily sell their sugarcane in the mill and the sugarcane mill owner shall be able to provide time allocation and buy their products.

1.3.4 Out of box research initiatives

The use of earth observing satellite data play an important role for monitoring and managing natural resources on the earth. The huge amount of free earth observing data are available on various online platforms for society and researchers. Advanced digital technology and internet allows easy handling, storage, processing and visualization of big data. There is a need to aware and motivate the users about the use of advanced digital

techniques for accessing, handling, processing and analysing huge amount of freely available satellite data for the betterment of natural resource management particularly in agriculture and allied sectors. Based on this concept, NAHEP-CAAST-CSDA undertaken various out of box initiatives such as: Big data analysis through cloud computing, Interactive visualization of large spatial data and Development of time-lapse animation of historical satellite data. Below are the digital technologies developed under NAHEP-CAAST-CSDA:

a. Big data analysis through cloud computing

- Identification and monitoring of surface waterbodies through cloud computing.
- Spatio-temporal dynamics of potential evapotranspiration of Madhya Pradesh (all 52 districts for 2000 to 2020)

b. Development of time-lapse animation of historical satellite data

- Use of time-lapse animation as a tool to visualize changes in natural resources. As initiative, time-lapse of NDVI, Net evapotranspiration, land surface temperature and water bodies of Madhya Pradesh have been prepared.

c. Interactive visualization of large spatial data

- Open source programming languages such as Python and R programming languages have been used to develop interactive digital maps. Interactive maps of rainfall, drought, dry/wet spell and potential evapotranspiration are developed and published online through web application for effortlessly conveying the large amount of information to users.

1.3.5 Knowledge Destination

The post graduate and Doctoral students were made aware of the techniques of RS and GIS applicable for their respective fields and the same has been incorporated in the research projects planned by them on Heat stress in crop and planning solution, Contribution of orchard in Carbon sequestration, Spatial Mapping of Orchards , Insect infestation in maize crop, Revival of River, Imbalance in Ground water Utilization, Depleting Ground water availability, Fixing Priority of Watershed development Works, Monitoring Irrigated command, Spatial Monitoring of field Crops and Assessment of Carbon foot prints of various cropping Systems.

2. Output Outcome monitoring

ID	Indicator category	Indicator Title	Plan	Achievement	Remark
1	PDO 1	% increase in number of technologies commercialized	-	-	Technology/special products are being developed.
2	PDO 2	% increase in faculty research effectiveness	2	7.84	
3	IRC 1	Number of technologies transferred to industry/ private sector/national/ international organizations	-	-	MP Rain, MP ETp, Jawahar Ganna Mitra and different thematic maps was developed, now we are in process to copyright of the developed Product.
4	IRC 2	% increase in JRF/ SRF/ ARS	-	9.09	Special Training/Workshop on Competitive Examinations for the PG students will be organized by inviting subject expert and excel the student capability of these examinations will be developed.
5	IRC 3	% increase in number of students who were admitted in foreign universities	-	-	Collaboration with the foreign Universities through CAAST will be initiated for higher enrollment of the students in Foreign Universities. The process of signing MoUs with the International Universities/ Organizations will be speed up for this Purpose

ID	Indicator category	Indicator Title	Plan	Achievement	Remark
6	IRC 4	% increase (with previous year) in PG students placements	2	3.22	
(i)	IRC 5	% in PG student placement (male)	-	3.96	
(ii)	IRC 6	% increase (with previous year) in PG student placement (female)	-	221	
(iii)	IRC 7	% increase (with previous year) in PG student placement (SC/ST)	-	2.82	We have planned to increase the placement percentage up to 10% by organizing industry-Academia workshops for the students
7	IRC 8	% increase in students received National Young Scientist Award	-	-	
8	IRC 9	% increase in students received ICAR's Jawaharlal Nehru thesis Award	-	-	Organizing workshop for Technical writing skills and research methodology
9	IRC 10	% increase in students awarded at Agri-unifest	-	-	Identification, Counseling and guidance to students by experts and professionals in different fields for better performance at Agri-university festival.
10	IRC 11	% increase in students awarded at Agriuni sports meet	-	-	Identification, Counseling and guidance to students by experts and professionals in different fields for better

ID	Indicator category	Indicator Title	Plan	Achievement	Remark
					performance at Agri-Sports.
11	IRC 12	Number of industry-sponsored projects and positions in cutting-edge areas of agri-science	-	-	Young faculties will be exposed to new cutting-edge research areas. The collaboration with the industries is being developed through CAAST-CSDA for this purpose, and more number of faculties will be encouraged to earn the industry sponsored projects.
12	IRC 13	% increase in number of competitive grants from a national/international funding agency			
13	IRC 14	Faculty exchange program			
14	IRC 15	Student exchange program			
15	PDO 3	Direct Project beneficiaries	3000	6017	
16	PDO 4	Female beneficiaries %	33	35.55	
17	IR	National and international trainings undertaken for faculty upgradation	23	14	International training to the faculty are being planned.
18	IR	Number of training undertaken (both national and international) by students	12	36	The training Conducted online and offline training planned in future.
19	IE 1	Goods and equipment's	379	107	Purchased process is in progress.
20	IE 2	Civil works	90	60	Remaining civil works is in progress.
21	IE 3	Human capacity building	76	00	National and International

ID	Indicator category	Indicator Title	Plan	Achievement	Remark
					trainings and participation in workshop is planned.
22	IE 4	Consultancy	25	00	Under process
23	IE 5	Recurrent cost	427	122	Expenditure on offline program will start this year.
24	ESI 1	Number of pilot courses introduced/ upgraded with focus on integrated environmental / Green themes / concept in curriculum	-	-	
25	ESI 2	Number of faculties being sent for training on environmental aspects within or outside the country	-	-	
26	ESI 3	Number of guest faculties delivering lectures or lessons on environmental aspects	-	8	-
27	ESI 4	Number of courses/seminars/workshops/lectures/on environmental aspects	-	14	
28	ESI 5	Number of on-going research projects in AUs involving environmental and sustainable aspects	-	5	
29	ESI 6	ESP (Environmental Sustainability Plan) prepared and implemented	-	Yes	
30	ESI 7	Number of risk mitigation measures adopted for upgradation of Laboratories as per EA and EMF of NAHEP	-	1	
31	ESI 8	Number of risk mitigation measures adopted for civil work as per EA and EMF of NAHEP	-	4	

ID	Indicator category	Indicator Title	Plan	Achievement	Remark
32	SSI 1	Number of pilot courses introduced / upgraded with focus on social themes/ concepts in the curriculum	-	-	
33	SSI 2	Number of faculties being sent for training on social/ equity aspects within or outside the country	-	-	
34	SSI 3	Number of guest faculties delivering lectures or lessons on social/ equity aspects	-	10	
35	SSI 4	Number of seminars conducted on social/ equity themes and concepts		8	
36	SSI 5	Number of research projects taken up with focus on social aspects		5	
37	SSI 6	EAP (Equity Action Plan) prepared and implemented		Yes	
38	SSI 7	Social Management plan / Labour management plan prepared and adopted		Yes	
39	SSI 8	SC / ST beneficiaries	1080	1123	
40	SSM	Social Management Plan / Labor Management Plan prepared and adopted			
41	SSM	SC / ST beneficiaries			
42	AWP	Goods and equipment (Data field with elaboration field)	402	402	
43	AWP	Civil works (Data fields with elaboration field)	2	2	
44	AWP	Human capacity building (Data filed with elaboration field)	35	50	
45	AWP	Consultancy (Data field with elaboration field)	-	-	
46	AWP	Miscellaneous (Data field with elaboration field)		63	

3. Input and activity monitoring

SNo	Funds received/spent (INR Lakhs)	2020-21	2021-22
1	Total funds received during year from PIU	327.00	770.50
2	Total funds received till year (Cumulative)	407.00	1177.50
3	Total expenditure during the year	226.46	180.63
4	Total expenditure till year (Cumulative)	226.46	407.09

Outcome –output

Expenditure

Input / Activity indicator	Sub- head / category	April 2020 to March 2021		April 2021 to March 2022	
		Planned 2020-21	Utilization 2020-21	Planned 2021-22	Utilization 2021-22
Goods and equipment	Equipment, Plant & Machinery	90	49.39	175	0
	Office equipment	4.5	3.02	2	0
	Laboratory equipment	64	62.01	231	33.16
	Furniture & fixtures	9	15.25	13	0.68
	Computers and Peripherals	8	6.99	10	2.08
	Books and Journals	4	0	4	4.13
Civil works	Minor repair and renovation works	40	41.64	50	18.48
Human capacity building	National level training	5	0	11	0
	International level training	0	0	30	0
	Short visit/ seminars	5	0	5	0
	Meetings and workshops	3	0.47	4	0
Consultancy	National level consultancies	10	0	20	0
Recurrent	Travel	6	0.05	5	0.39
cost	Contractual services	73.5	26.28	100.5	82.16
	Operational costs	65	13.43	100	27.2
	Institutional charges	20	7.93	10	12.35
Total		**407**	**226.46**	**770.5**	**180.63**

4. MoU/ Project Sanction/Media Coverage

4.1 MoUs signed: Educational Institute, Research Institute State Organization and Private Institute

Detail of MoU signed during 2020-21 & 2021-22

Category	2020-21	2021-22	Purpose	Status
1. Education Institute	1	-	Research collaboration	5 years
2. Research Institute	3	8	Research collaboration	5 years
3. State Institute	-	1	Research collaboration	5 years
4. Private Institute	1	1	Research collaboration	5 years
5. International	1	-	Research collaboration	5 years
Total	**6**	**10**		

List of Institutes

SN	Name of Institute	Date	Purpose of MoU	Likely benefits
With International Institutes				
1.	Agreement between JNKVV,. Jabalpur -IRRI, Philippines, Jabalpur	01.10.2020	Research collaboration	Training in Crop & Seed development of field and horticulture crops
With ICAR Institutes				
2.	JNKVV-ICAR, New Delhi (Umbrella MoU of AICRPS)	21.09.2020	Research collaboration	Training in Crop & Seed development of field and horticulture crops
3.	DBT-ICAR-NBPGR-JNKVV, JABALPUR (Dr D. K. Payai Project)	27.07.2021	Research collaboration	Training in Crop & Seed development of field and horticulture crops
4.	JNKVV-CPRI (ICAR), Shimla	27.10.2021	Research collaboration	Training in potato Crop & Seed Development
5.	JNKVV-ICAR-IIWBR, Karnal	28.02.2022	Research collaboration	Training in Wheat Crop &

SN	Name of Institute	Date	Purpose of MoU	Likely benefits
				Seed development
Govt. of India and its agencies				
6.	JNKVV-Department of Bio-technology (DBT) Govt. of India	07.07.2020	Research collaboration	Training in Biotechnology of crops
7.	JNKVV-Indian Meteorological Department IMD, MoES, Pune	07.09.2020	Research collaboration	Training in Meteorology
8.	JNKVV- Indian Meteorological Dept. Ministry of Earth Science, New Delhi	18.01.2021	Research collaboration	Training in Meteorology
9.	JNKVV-Dept. of Biotechnology (Govt. of India) Dr. Anita Babbar	01.07.2021	Research collaboration	Training in Biotechnology of crops
10.	JNKVV-Ministry of Agriculture & FW, Govt. of India, New Delhi (CCS)	29.07.2021	Research collaboration	Training in Crop & Seed development of field and horticulture crops
11.	JNKVV-Dept. of Bio-technology (DBT)-ICAR NBPGR	11.08.2021	Research collaboration	Training in Biotechnology of crops
12.	JNKVV-APEDA, New Delhi (Ministry of Commerce & Industry GoI)	17.12.2021	Research collaboration	Training in Crop & Seed development of field and horticulture crops
JNKVV with other UNIVERSITIES				
13.	IABM-JNKVV-IUM-(RDVV, Jabalpur)	11.02.2021	Research collaboration	Training in Crop & Seed development of field and horticulture crops
Govt. of MP and its agencies				
14.	JNKVV-Atal Bihari Bajai Institute of Good Governance and Policy Analysis, Bhopal MP.	14.08.2021	Research collaboration	Training in Crop & Seed development of field and horticulture crops

SN	Name of Institute	Date	Purpose of MoU	Likely benefits
With Private Agencies				
15.	JNKVV, Jabalpur-Bayer Bio-Science Private Limited, Thane (MS)	20.12.2020	Research collaboration	Training in Crop & Seed development of field and horticulture crops
16.	JNKVV-Ok Food Private Limited, Industrial Area Richai, Jabalpur	08.02.2022	Research collaboration	Training in Crop & Seed development of field and horticulture crops

4.2 Details of the *Ad-hoc* Projects Sanctioned During 2021-22
(1.4.2021 to 31.03.2022)

(Rs. in Lakhs)

S.No.	Title	Amount	Name of PI	Funding agency
1	Sustentation of climate Resilient Small Millets Through Crop Management and Women Agri-Entrepreneurship Development in Rewa District of Madhya Pradesh	19.96 3 years	Dr. R.P. Joshi	Dr. Namita Gupta Advisor/Scientist-G, KIRAN Division Dept. of Science &Technology, New Mehrauli Road New Delhi
2	Development of short duration, high Yielding, Disease Resistant Green Gram (*Vigna radiate* Wilczek L.) Geotype Suitable for Rice (*Oryza satva* L.) Wheat (*Triticum estivum* L.) cropping system in Madhya Pradesh Ref. 2691/CST/R&D (Bio Sci.)2022 dated 25-01-2022	9.88 2 years	Dr. Stuti Sharma	Director General, MPSCT, Bhopal
3	"Germplasm collection, bio-molecular characterization and development of in vitro mass multiplication protocol of Black Turmeric (*Curcuma caesia* Roxb.)"	42.22 2 years	Radhe shyam Sharma	NMPB, Ministry of AYUSH, GoI

S.No.	Title	Amount	Name of PI	Funding agency
4	Strengthening of Instructional Dairy Unit of College of Agriculture, Jabalpur	95.20 1 years	Dr. L.S. Sekhawat Scientist (LMP)	Director, Dept. of FW&AD, Govt. of MP, Bhopal
	Total	**167.26**		

4.3 Media coverage of project activities and Achievements

S. No.	Name of Newspaper	Activities Published Under CAAST-CSDA	
		2020-21	2021-22
1	Dainik bhaskar	5	7
2	Patrika	2	1
3	Hitvada	1	5
4	Nai Duniya	1	5
5	Agniban	1	-
6	Haribhumi	2	8
7	Navbharat	1	7
8	Raj Express	3	6
9	JNKVV News	1	-
10	Peoples Samachar	2	6
11	Yash Bharat	1	-
12	Tripuri Times	1	-
13	See Times	3	-
14	Swatantra mat	3	5
15	Deshbandhu	-	6

जल संचयन संरचना का दिया प्रशिक्षण

जबलपुर देशबन्धु। जवाहरलाल नेहरु कृषि विश्वविद्यालय स्थित कृषि अभियांत्रिकी महाविद्यालय में भारत सरकार की नेशनल एग्रीकल्चर हायर एजुकेशन प्रोजेक्ट (एनएएचईपी) परियोजना द्वारा विभिन्न प्रदेशों के विश्वविद्यालयों- कृषि विश्वविद्यालय जैसे आचार्य एन.जी.रंगा. आनंद, महात्माफूले, परभणी, नवसारी, भारतीय कृषि अनुसंधान परिषद तथा बनारस हिंदू विश्वविद्यालय के वैज्ञानिकों, शिक्षकों व विद्यार्थियों के लिए रिमोट सेंसिंग और जीआईएस का ऑनलाइन व्यावहारिक एवं क्रियाशील प्रशिक्षण परियोजना के मुख्य अन्वेषक डॉ. आर.के. नेमा, डॉ. मनोज कुमार अवस्थी (प्रिंसिपल साईंटिस्ट) के निर्देशन तथा डॉ. एस.के. शर्मा के संयोजन में हुआ।

जनेकृविवि में भाषा की दक्षता पर 10 दिनी प्रशिक्षण संपन्न

नेशनल एग्रीकल्चर एजूकेशन प्रोजेक्ट के तहत विद्यार्थियों के लिए उपयोगी

पीपुल्स संवाददाता ● जबलपुर
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जवाहरलाल नेहरू कृषि विश्वविद्यालय के अंतर्गत कृषि अभियांत्रिकी महाविद्यालय में भारत सरकार एवं विश्व बैंक से प्राप्त परियोजना नेशनल एग्रीकल्चर एजुकेशन प्रोजेक्ट एनएएचईपी के अंतर्गत विश्वविद्यालय के विभिन्न विभागों के स्नातक, स्नातकोत्तर एवं पीएचडी विद्यार्थियों के लिए मौखिक अंग्रिजी और लेखन कौशल की क्षमता निर्माण के माध्यम से भाषा दक्षता में सुधार का ऑनलाइन प्रशिक्षण आयोजित किया गया।

यह प्रशिक्षण मुख्य अन्वेषक डॉ. आरके नेमा, डॉ. मनोज कुमार अवस्थी प्रिंसिपल साइंटिस्ट के निर्देशन तथा डॉ. दीपक राठी के संयोजन में स्ट्राइड सेंटर फॉर यूथ एंपावरमेंट जबलपुर के निदेशक प्रशांत दुबे द्वारा प्रशिक्षण दिया गया। इसमें 63 विद्यार्थी उपस्थित रहे। यह प्रशिक्षण विद्यार्थियों के मौखिक और लेखन क्षमता में सुधार रचनात्मक सोच क्षमता में वृद्धि, लक्षित भाषा और संस्कृति के प्रति बेहतर दृष्टिकोण, देशी वक्ताओं के साथ संवाद, अपने उच्चारण में सुधार तथा साक्षात्कार कैसे दें आदि विषयों के लिए लाभप्रद साबित होगा।

प्रशिक्षण में भाषण के कुछ हिस्सों संज्ञा, सर्वनाम और क्रिया वाक्य संरचना और वाक्य रचना, विभिन्न काल वर्तमान, अतीत, भविष्य शब्दों का उच्चारण, एपॉस्ट्रॉफी और प्रश्न टैग का सही उपयोग कैसे करें आदि विषयों में जानकारी प्रदान की गई। ओमप्रकाश प्रजापति, सुमित काकडे, डॉ. मीनाक्षी मेश्राम, डॉ. अपर्णा वाजपेयी, इंजी. कृष्णा सिंह, इंजी. रचित नेमा एवं इंजी. अंजली पटेल ने तकनीकी सहयोग दिया।

कार्यक्रम

जेएनकृवि में रिमोट सेंसिंग और जीआईएस पर 21 दिवसीय प्रशिक्षण संपन्न

भूजल क्षमता का आंकलन, मिला जल संचयन का प्रशिक्षण

जबलपुर ■ राज न्यूज नेटवर्क

जवाहरलाल नेहरू कृषि यूनिवर्सिटी स्थित कृषि अभियांत्रिकी कॉलेज में 21 दिवसीय रिमोट सेंसिंग और जीआईएस का ऑनलाइन व्यावहारिक एवं क्रियाशील प्रशिक्षण कार्यक्रम सम्पन्न हुआ।

विषयों की दी जानकारी

प्रशिक्षण में रिमोट सेसिंग और जीआईएस की बुनियादी जानकारी तथा इनका कृषि के विभिन्न क्षेत्रों में अनुप्रयोग जैसे भूजैल की क्षमता का आकलन, जल संचयन संरचना के लिये स्थल का चुनाव, मृदा-अपरदन का आंकलन आदि के साथ साथ क्यूजीआईएस सॉफ्टवेयर की कार्य प्रणाली के विषयों मे भी जानकारी प्रदान की गई।

इनको दिया प्रशिक्षण

भारत सरकार की नेशनल एग्रीकल्चर हायर एजुकेशन प्रोजेक्ट (एनएएचईपी) परियोजना द्वारा विभिन्न प्रदेशों के यूनिवर्सिटीज-कृषि यूनिवर्सिटी जैसे आचार्य एन.जी.रंगा. आनंद, महात्मा फूले, परभणी, नवसारी, भारतीय कृषि अनुसंधान परिषद तथा बनारस हिंदू यूनिवर्सिटी के वैज्ञानिकों, शिक्षकों व विद्यार्थियों के लिए रिमोट सेंसिंग और जीआईएस का ऑनलाइन व्यावहारिक एवं क्रियाशील प्रशिक्षण परियोजना के मुख्य अन्वेषक डॉ. आर.के. नेमा, डॉ. मनोज कुमार अवस्थी (प्रिंसिपल साईंटिस्ट) के निर्देशन तथा डॉ. एस.के. शर्मा के संयोजन में सम्पन्न हुआ।

इस प्रशिक्षण में भारतीय सुदूर संवैदन संस्थान देहरादून के वैज्ञानिक डॉ. सुरेश कुमार, डॉ. एन.आर. पटेल, डॉ. पुनम तिवारी, डॉ. दिपांविता हलदार तथा नाहेप प्रोजेक्ट से डॉ. अपर्णा वाजपेयी, इजी. अंजली पटेल, डॉ. उमाकांत रावत और डॉ. देवेन्द्र वास्ट ने प्रशिक्षण दिया। डॉ. मीनाक्षी मेश्राम, ओमप्रकाश प्रजापति, सुमित काकडे एवं इजी. कृष्णा सिंह आदि का तकनीकी सहयोग रहा।

30-day online training event on remote sensing, GSI commences

A THIRTY-DAY online training programme on 'Use of Basic Principles of Remote Sensing and GIS' was initiated under the aegis of National Agriculture Higher Education Project (NAHEP) run jointly under Government of India and World Bank, at College of Agricultural Engineering, Jawaharlal Nehru Agriculture University (JNAU) on Tuesday.

The training programme is being conducted for the professors and students associated with agriculture colleges located in different States including Jodhpur, Akola, Orissa, Assam, Tamil Nadu, Junagarh, Raipur, Dharwad, Hisar, Delhi, Samastipur Bihar, Udaipur Rajasthan, Indian Council of Agricultural Research and Banares Hindu University.

Around 74 candidates registered themselves to attend the programme. Significant information concerned with basic details of Remote Sensing and GIS and their uses in various sectors of agriculture including evaluation of ground water efficiency, selection of spot for water conservation structure, evaluation of soil erosion and working system of QGIS Software.

Chief Researcher Dr R K Nema and Dr Manoj Awasthi informed that scientists from Indian Institute of Remote Sensing, Dehradun including Dr Suresh Kumar, Dr Poonam Mahajan, Dr V K Sehgal, IARI, New Delhi and Dr Aparna Vajpayee, Dr Saurabh Nema, Krishna Singh, Rachit Nema, Dr P S Pawar, Dr Devendra Vast, Sumit Kakde, Dr Meenakshi and others from NAHEP Project will impart training during the programme.


कृषि वैज्ञानिकों ने प्राप्त किया प्रशिक्षण

21 दिवसीय ऑनलाईन प्रशिक्षण व


कृषि अधिकारियों को दिया जीआइएस का ऑनलाइन प्रशिक्षण


जनेकृविवि में 6 दिवसीय प्रशिक्षण

कृषि अधिकारी होंगे प्रशिक्षित


सुदूर संवेदन और भौगोलिक सूचना प्रणाली की दी गई बुनियादी जानकारी


जनेकृविवि में 6 दिवसीय कृषि प्रशिक्षण


JNAU, World Bank's NAHEP hold online practical, experimental training on Remote Sensing


प्रशिक्षण एवं कार्यशाला का शुभारंभ

जनेकृविवि में 6 दिवसीय कृषि प्रशिक्षण

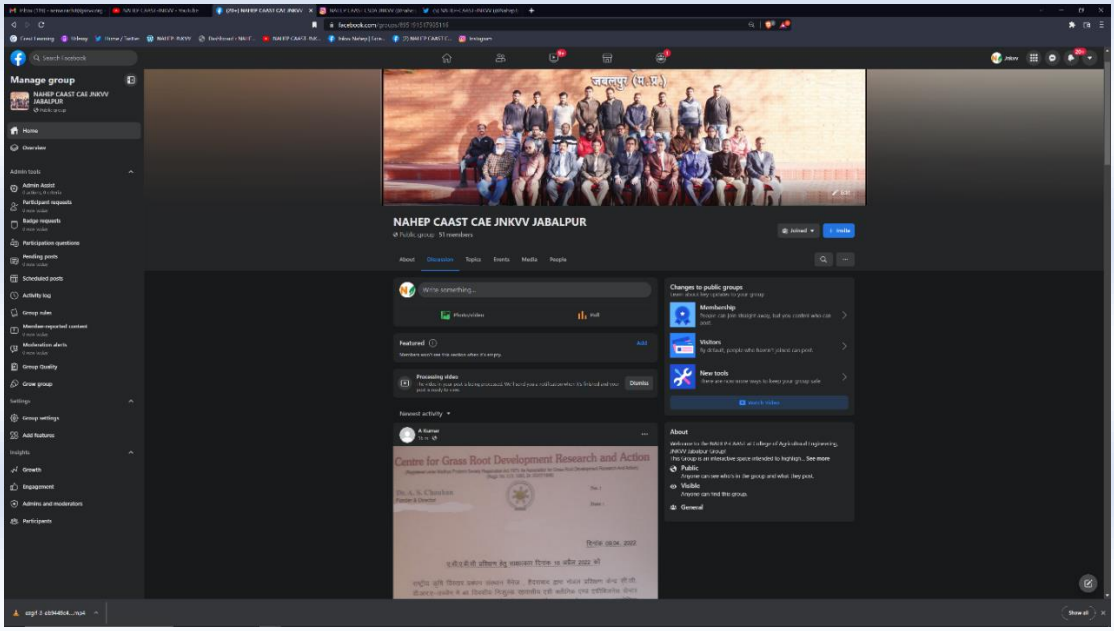
जबलपुर, देशबन्धु। जवाहरलाल नेहरू कृषि विश्वविद्यालय स्थित कृषि अभियांत्रिकी महाविद्यालय में भारत सरकार एवं विश्व बैंक से प्राप्त परियोजना नेशनल एग्रीकल्चर हायर एजुकेशन प्रोजेक्ट (एनएएचइपी) के अंतर्गत प्रदेश के विभिन्न जिलों (जबलपुर, कटनी, सागर, शिवपुरी, सिंगरोली, वारासिवनी, छतरपुर, उज्जैन, विदिशा, बुरहानपुर, पन्ना, रीवा, सीढ़ी मंडला, गुना, रतलाम, धार उमरिया) के कृषि अधिकारी जैसे कृषि विकास अधिकारी, सहायक निर्देशक, सहायक सांख्यिकी अधिकारी, सहायक प्रौद्योगिकी प्रबंधक, वरिष्ठ कृषि विकास अधिकारी एवं ग्रामीण कृषि विस्तार अधिकारी के लिए रिमोट सेसिंग और जीआईएस की बुनियादी मूलभूत सिद्धान्तों का अनुप्रयोग हेतु ऑनलाइन 6 दिनी प्रशिक्षण प्रोजेक्ट के मुख्य अन्वेषक डॉ. आर.के. नेमा एवं प्रिंसिपल साइंटिस्ट डॉ. मनोज कुमार अवस्थी के निर्देशन तथा संयोजन में दिया जा रहा है। प्रशिक्षण में भारतीय सुदूर संवेदन संस्थान देहरादून के वैज्ञानिक डॉ. पूनम एस तिवारी, एनआईएच रुड़की से डॉ. मनीष नेमा तथा आईएआरआई नईदिल्ली के डॉ. वी.के. सहगल तथा नाहेप प्रोजेक्ट से डॉ. अर्पणा वाजपेयी, डॉ. उमाकांत रावत, डॉ. सौरभ नेमा, डॉ. पी.एस. पवार और इजी. अंजली पटेल के द्वारा प्रशिक्षण तथा तकनीकी सहयोग ओमप्रकाश प्रजापति, सुमित काकडे, इजी. कृष्णा सिंह, इजी. रचित नेमा और इजी. अलोक राजपूत दे रहे हैं।

- **Social media coverage**: Activities of CAAST-CSDA were covered on different social media platforms, like Facebook, Twitter, Instagram and Youtube.

The links of CAAST-CSDA on different social media platforms as follows:

Website	https://nahep-jnkvv.org/
Facebook:	https://www.facebook.com/groups/895191517935116
Twitter	https:// twitter.com/NahepJ
Youtube	https://www.youtube.com/channel/UCKuNaqP1wIoAOsh0OL4jFDQ/featured
Instagram	https://www.instagram.com/nahepjnkvv/

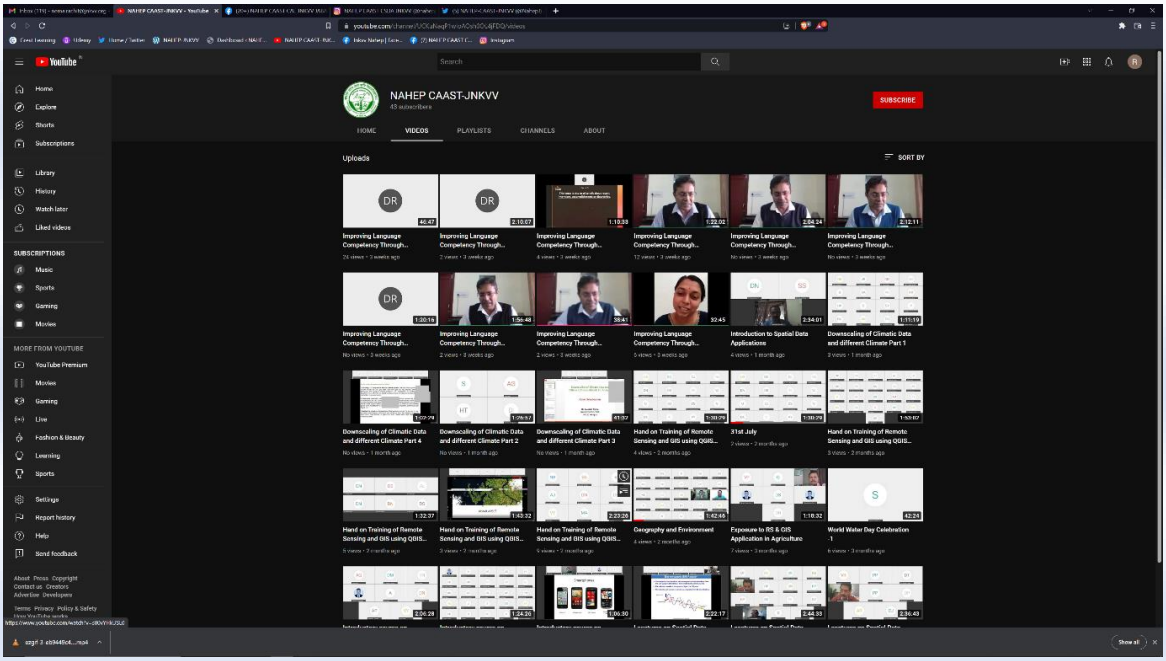
- In Facebook account, There are more than 50 subscriber.



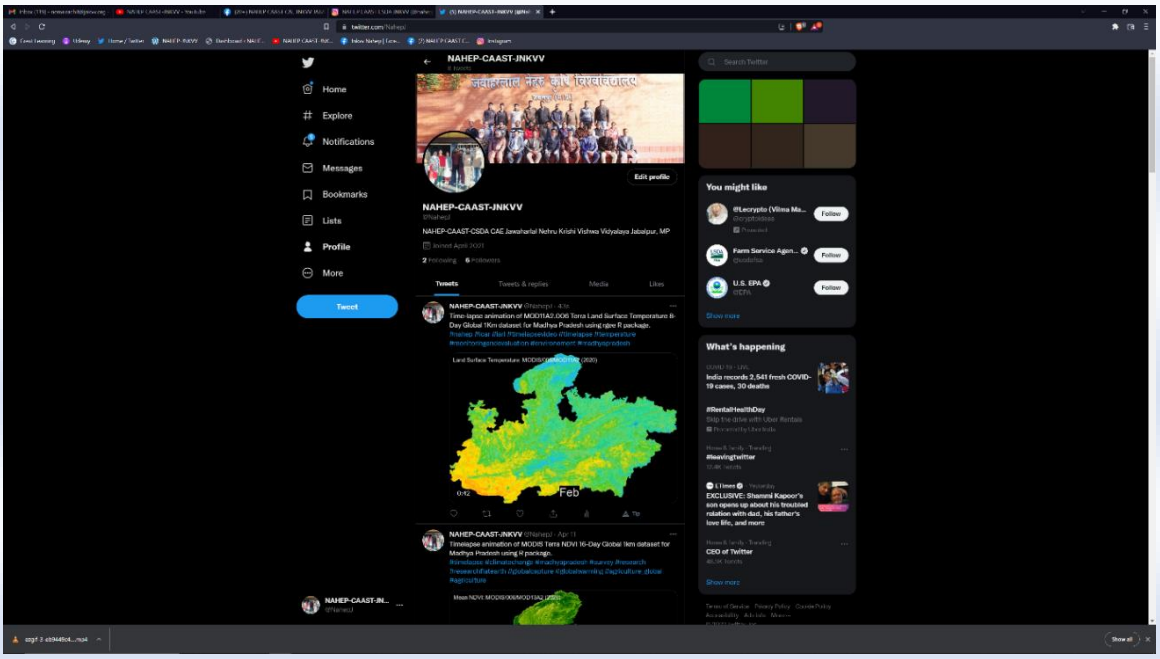
- In YouTube channel, All the capacity-building training videos have been uploaded in having 50 subscribers. So far 58 Video Recordings are available for students and faculties with video sessions on the following subjects:

SNo	Training Recordings
1.	Geography and Environment
2.	World Water Day Celebration Program
3.	Exposure to RS & GIS Application in Agriculture
4.	Introductory course on Mobile based app
5.	Lectures on Spatial Data use in Agriculture
6.	Online Awareness Program on Grievance Redress Mechanism
7.	Awareness program on RS & GIS
8.	Fundamentals of Artificial Intelligence and Machine Learning
9.	Training – Image Processing using Python
10.	Hands-on -Training on Geo-informatics

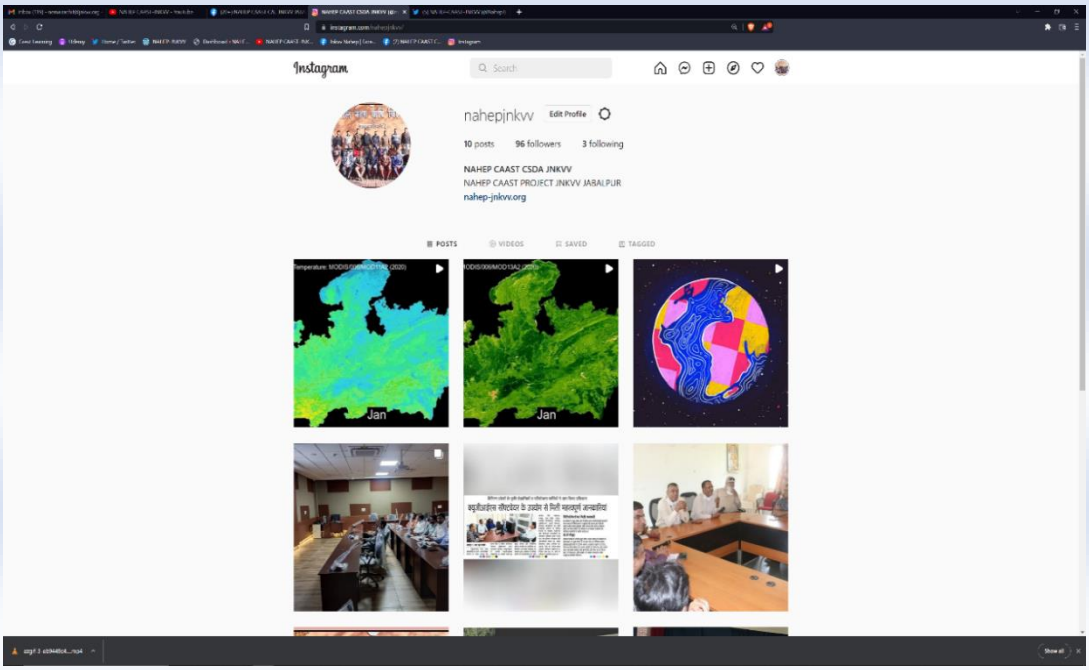
SNo	Training Recordings
11.	Training cum orientation program on Geo-informatics
12.	Training – Python Training Program
13.	Online program “Introduction to Spatial Data Applications
14.	Downscale of Climate Data & different Climate Model for Analysis
15.	Path Finding Workshop for Students Research
16.	Improving Language Competency Through Capacity Building in Spoken English & Writing Skills
17.	Hands-on training of RS & GIS using QGIS



- NAHEP Twitter handle having 6 followers



- NAHEP CAAST Instagram Page with 96 followers



4.4 Digital initiative undertaken

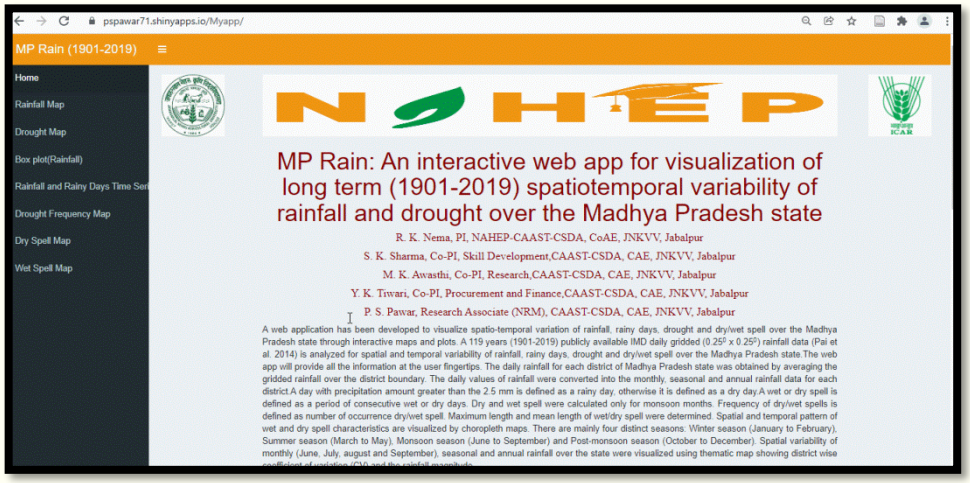
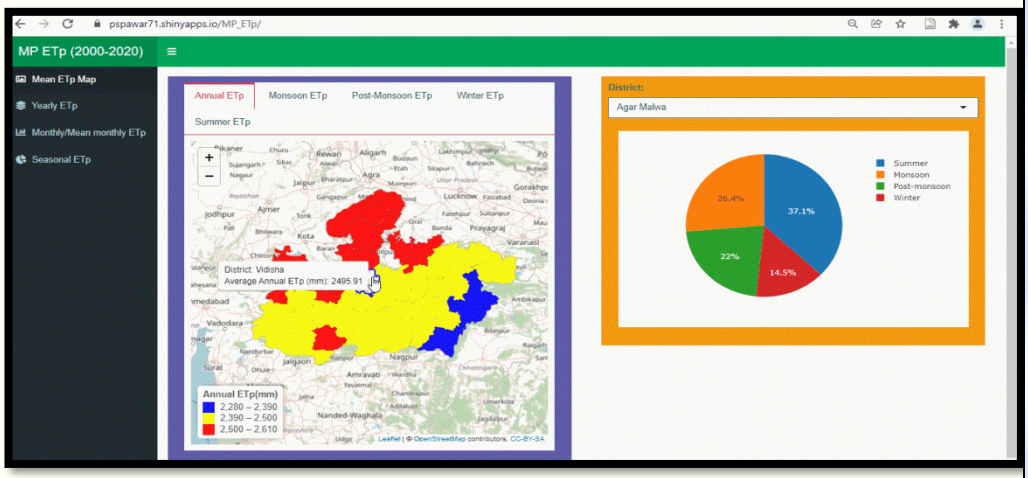
a. Interactive visualization of spatial data

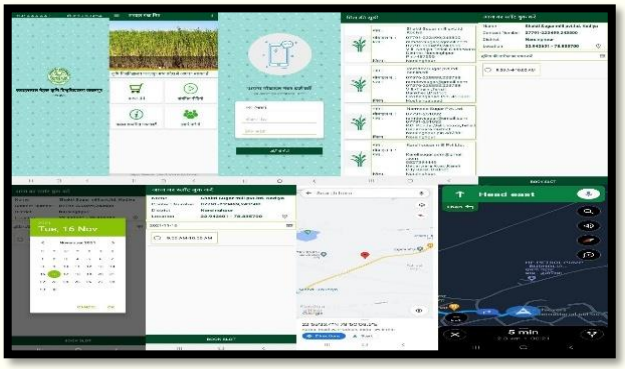
The visualization of a large amount of spatial data is a challenging task in terms of representing and effortlessly conveying the information to users. The traditional method of representing the spatial data is using static maps. The paper map has several limitations such as lacking interactivity, limited options for visualization, lacking in editing, retrieving, zoom in & zoom out, filter, search, overlay functionality etc.

Advanced digital technology and the internet allows to develop interactive digital maps that can serve the purpose of representing a large amount of data and effortlessly conveying the information to users. An interactive map provides the user interface that allow user to pan, zoom, retrieve, filter, search, and overlay the map. By developing interactive maps, the target audience can be encouraging to use spatial data more effectively and encompassing more general users in the sphere of the complex spatial data world.

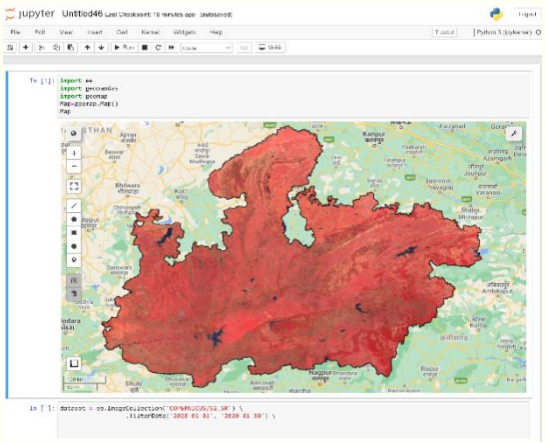
Under this objective, the initiatives have been taken to develop user friendly spatial data product as:

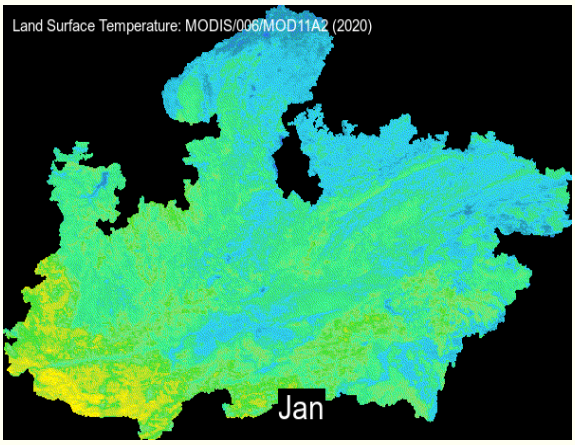
S.N.	Name	Year	Objective	Users	Platform
1	MP Rain (1901-2019)	2021	To interactively visualized the long term (1901-2019) spatiotemporal variability of rainfall and drought over the Madhya Pradesh state. https://pspawar71.shinyapps.io/Myapp	Field functionaries and Policy makers	Web application

	 **Framework of MP Rain (1901-2019) Web App**				
2	MP ETp (2000-2020)	2022	To interactively visualize spatial and temporal characteristics of potential evapotranspiration over the Madhya Pradesh. https://pspawar71.shinyapps.io/MP_ETp/	Field functionaries and Policy makers	Web application
	 **Framework of MP ETp (2000-2020) Web App**				
3	Jawahar Ganna Mitra	2022	To provide an online platform to both the sugarcane mill owner and the farmer to easily sell sugarcane in the mill and the sugarcane mill owner to buy it. http://sugarcanejnkvv.com	Farmers, Sugar mill owner & student	Android based mobile application

	 **User interface Jawahar Ganna Mitra**				
4	MP SW (2014-2021)	Under process	To interactively visualize spatial and temporal pattern of seasonal and yearlong surface water bodies over the Madhya Pradesh.	Field functionaries and Policy makers	Web application

4.5 Innovations and out of box initiatives undertaken

Use of cloud computing techniques for analysing big earth observation satellite data: In recent years, there is quite increase in free availability of earth observation data for society and researchers. This big data pose severe challenges such as large memory storage, handling of big data, processing capacities of personal computer etc. Cloud Computing is the answer to big data analysis. Cloud can help us to process and analyse big data faster. The open source programming languages like R, python and JavaScript have been used for dealing with big data.	 Assessing Sentinel-2a images for Madhya Pradesh state using Google Earth Engine Python API.

Development of time-lapse animation of historical satellite dataset: Historical satellite images of any place on earth are freely available on internet and one can accessed those images to see how a site has changed over time. The time-lapse animation tool transforms earth observation images into animated GIFs or videos using Google Earth Engine API. The time-lapse animation can help researchers to understand the changes of natural resources over the time dramatically. It would also help in introducing users to complex Earth science topics, improve understanding and develop insight.	 Created time-lapse animation of MODIS Terra land surface temperature data at 1km spatial scale using "rgee" R package for visualizing the spatio-temporal pattern of land surface temperature over the Madhya Pradesh.

5 Skill Development Program

For enhancing the awareness and knowledge of RS & GIS applications for Natural Resource Management among the students and faculty, twenty programs were conducted that includes four awareness programs, three educative learning for agricultural executives, eight capacity building training program and five student development programs (Table 5.1).

Table- 5.1 Training Programs under skill development

Program	Number
Awareness program on use of RS and GIS for students	2
Awareness program on use of RS and GIS for student and faculty	2
Hands-on training on Remote Sensing & GIS using QGIS. (For student)	2
Hands-on training on Remote Sensing & GIS using QGIS. (For faculty)	4
Hands-on training on Remote Sensing & GIS using QGIS. (For Faculty & students)	2
Educative learning for agricultural Executives	3
Student development programs	5

5.1 Awareness Program

Awareness programs were conducted to enhance the awareness of RS and GIS techniques in field of Agriculture. Details of total fifteen skill development programs are shown in section 5 and Table 5.1. Out of twenty, detail of participation and impact of four awareness programs are shown in Table 5.2. In these programs 747 students and Faculty from native and other universities have participated in these programs out of which 59.6% were male and 40.4% female. They belong to UR-35.2 %, SC-26.1%, ST-15.7% and OBC-23.0% categories. Details of the distribution of participants in different individual programs are appended in 11.1.

Table 5.1 Participation and Impact of Awareness Programs

S.N.	Topics	Date	Number of Participants		Impact
			S	F	
1	Awareness program on NRM	30/04/2021	258	42	Students and faculty were inspired to act towards the protection of earth and focus on the need for its conservation.
2	Introduction to Spatial Data Applications	26/06/2021	13	33	Scientists/Professors/Research Scholars of different agriculture disciplines were encouraged to highlight issues and gaps such that Identification of organic farming areas, Biodiversity conservation, Locust (TIDDY) attack and Mango orchard wilting issues in relevance to

					the spatial data application and explored the possible solutions.
3	Awareness program on Remote Sensing & GIS Application in student Research	29/06/2021	109	-	Agriculture/Agricultural Engineering students made aware to apply RS and GIS techniques in field of Agriculture and preparation of integrated maps for decision making.
4	Awareness program on the use of RS and GIS	03/01/2021	292	-	Students gained the basic information about types of satellite, sensors, its functioning and remote sensing applications in agriculture. Students were enlightened to opt agriculture field in their further education.

S- Students, F-Faculty

5.2 Capacity Building Training Programs:

Capacity building programs were conducted to enhance knowledge of students and faculty regarding open source GIS Software along with downloading satellite imagery from an open-source platform, image interpretation elements and basic processing of satellite image for NRM Applications. Out of twenty skill development programs mentioned in section 5, eight capacity building programs were organized. Participation and impact of capacity building programs are shown in Table 5.2. Total 329 students and Faculty from JNKVV and other universities have participated in these programs out of which 71.1% were male and 28.9% female. They belong to UR-46 %, SC-19.4%, ST- 10.2% and OBC-24.4% categories. Details of the distribution of participants in different individual Programs are appended in 11.2.

Table 5.2 Participation and Impact of Capacity Building Programs

S.N.	Topics	Date	Number of Participants		Impact
			S	F	
1	Hands on training of Remote Sensing and GIS using QGIS & Saga GIS	03/06/2021 to 23/06/2021	17	-	Students learnt about the working of QGIS software. They were motivated for preparing an exhaustive map for predicting the post-harvest processing needs by accurately predicting the crop grown and thereby planning for processing and storage of the field crops and apply acquired knowledge and skill to creates a wide variety of

S.N.	Topics	Date	Number of Participants		Impact
			S	F	
					maps at block, district and state level for research analysis and information sharing. Overall 25 to 41% improvement was seen in performance of participants.
2	Application of RS & GIS in NRM for Outgoing Students	02/06/2021 to 12/07/2021	84	-	Agricultural Engineering students gained knowledge about useful apps prevailing in NRM domain, open source GIS software and use of thematic maps. They developed their interest to use remote sensing software in their upcoming research work to prepare thematic maps in field of physical geography, landforms, land use and land cover (LULC), soil, slope, drainage and temperature map.
3	Faculty training on Remote Sensing &GIS using QGIS	29/07/2021 to 19/08/2021	-	43	Faculty of JNKVV were prepared to handle spatial data and QGIS and willing to incorporate these techniques in various field of agriculture research like disease and pest, management, crop and LU/LC map preparation and crop yield forecasting etc.
4	Faculty training on Remote Sensing &GIS using QGIS	25/08/2021 to 15/09/2021	-	40	Participants were made familiar to different open data sources to download the satellite image, preprocessing the image LU/LC map preparation. They were excited to adopt these technologies in crop monitoring through NDVI, crop stress assessment and other agriculture research application. Overall 30 to 42% improvement was seen in performance of

S.N.	Topics	Date	Number of Participants		Impact
			S	F	
					participants.
5	Hands-on training on Remote Sensing &GIS using QGIS for Faculty	21/09/2021 to 11/10/2021	-	48	Scientist/teachers and technical staff were prepared to operate QGIS software in terms of image processing, bands information, band combination, FCC formation and defining area of interest as well as methods of satellite image classification. Overall 25 to 45% improvement was seen in performance of participants.
6	Hands-on training on Remote Sensing &GIS using QGIS for Faculty &Students	09/11/2021 to 29/11/2021	14	24	Faculty and Students were developed their capabilities to geo reference the maps, vector data creation, supervised classification, LU/LC area calculation and map layout creation.
7	Basic fundamental applications of RS and GIS.	16/12/2021 to 13/01/2022	32	2	Faculty and Students were prepared to visually interpret ate the objects such as vegetation's, forest, water body, urban area etc. They were excited to adopt these technologies in soil moisture assessment, Crop nutrient deficiency detection, Crop acreage estimation and crop condition assessment. Overall 24 to 56% improvement was seen in performance of participants.
8	Hands on training on RS & GIS using QGIS (for faculty)	14/02/2022 to 16/03/2022	-	25	Faculty gained knowledge of different open data sources, useful apps prevailing in NRM domain along with satellite image and DEM data processing using QGIS software. They were encouraged to adopt these technologies in their respective field.

S.N.	Topics	Date	Number of Participants		Impact
			S	F	
9	NRM through RS and GIS applications	22/03/2022 to 23/04/2022	93	-	Students practiced to use open source GIS software QGIS for development of spatial maps required for decision making in natural resources management.

5.3 Educative Learning for Executives

Three Educative Learning Trainings of six days duration were organized for Agriculture Executives. In these programs KVK staff, Scientists and Faculty have participated and gained knowledge about RS & GIS applications and extraction of the information from different spatial products for better and efficient decision making. They were also made familiar with the use of different open data portals and their incorporation in various domains of agriculture.

Total 75 Executives from different departments have participated in these programs out of which 89.3% were male and10.7% female. They belong to UR-30.7%, SC-22.7%, ST-20.0% and OBC-26.7% categories. Details of the distribution of participants in different individual Programs is appended in 11.3.

Table: 5.3 Participation and Impact of Educative Learning for Executives

S.N.	Date	No. of Participants	Impact
1	31/01/2022 to 05/02/2022	25	Executives officers were trained about applications of remote sensing in agriculture planning, execution, and monitoring tasks. They were made aware about different classified maps which are readily available or likely to be available in future like LULC, Crop map, Soil map, lineament map, ground water potential zone maps and free data resources availability in relevance to the agriculture monitoring and planning purpose. Also, they felt motivated to use spatial technologies in their respective field i.e. crop area estimation, crop yield monitoring, Water resources mapping and pest management. They were shown their interest to attend upcoming offline trainings based on the applications part of remote sensing.
2	14/02/2022 to 19/02/2022	26	
3	28/02/2022 to 05/03/2022	24	

5.4 Student Development Program

For the development of the knowledge of students about Entrepreneurship Development, Sports and Physical Education, Cultural Events and National Competition and Holistic development, five student development programs were conducted which include 1, 7, 9, 10 and 21 days program/workshops (Table 5.4).

Total 2266 students have participated in these programs out of which 64.8% were male and 35.2% female. They belong to UR-27.9%, SC-14.5%, ST-17.1% and OBC - 40.6% categories. Details of the distribution of participants in different individual Programs is appended in 11.4.

Table 5.4 Student Development Program

S.N.	Topics	Date	Number of Participants	Impact
1	Entrepreneurship Development for Agriculture Graduates:	16/05/2021 to 306/06/2021	529	Students made aware about employment and entrepre-neurship opportunities related to the specialized areas.
2	Awareness program on plagiarism for master & Ph.D. Degree students	28/06/2021	96	Students of Master & Ph.D. degree program made aware about Plagiarism checking, software's to check it, and necessity to reduce plagiarism for qualitative improvement in academics and research.
3	7 Days workshop on Sports and Physical Education	02/01/2022 to 09/01/2022	221	Students learnt about various sports activities, their rules and regulations, and the factor that helps in performing well in any such activities.
4	9 Days Preparation of Cultural Events and National Competition	02/02/2022 to 10/02/2022	317	Students learnt about preparation of various cultural events and shown interest in participation in upcoming events.
5	21 Days workshop on Holistic development of students	28/02/2022 to 28/03/2022	1103	Students have developed an understanding about the various skills that are important along with education to cope up the challenges in life and develop leadership qualities.

5.5 Participants under skill development training program

5.5.1 Department wise distribution of participants under Capacity Building

Overall department wise distribution of participants from JNKVV and other organizations under Capacity Building Program are given in Table 5.5.1 There were total 435 participants, out of which 359 and 63 participants were from JNKVV followed by other organizations belonging to different departments like i.e. Computer science, Electronics and communication, Livestock and Poultry Management etc. have participated in these programs. Maximum Participants belongs from Soil and Water Engineering, Extension Education and Horticulture departments.

Table 5.5.1 Overall department wise distribution of participants from JNKVV in Capacity Building Program

Participants	Number of Participants in Departments of																	
	AEF	AGR	ENT	AEE	FST	AGF	HOR	AST	MTR	PBG	PPT	PPH	SAC	FMP	SWE	PHP	OTH	TOTAL
Students and Faculty from JNKVV																		
UG																		**177**
PG	-	1	-	1	-	-	-	-	-	-	-	1	-	-	5	-	-	**8**
PhD	-	-	1	2	-	2	1	-	-	2	-	1	-	-	7	-	1	**17**
Subtotal (A)	-	1	1	3	-	2	1	-	-	2	-	2	-	-	12	-	1	**202**
Faculty	4	13	10	16	2	6	11	2	1	10	10	-	6	2	8	2	5	**108**
Scientist	5	3	1	4	-	-	8	3	-	5	1	1	4	-	6	1	8	**50**
Subtotal (B)	9	16	11	20	2	6	19	5	1	15	11	1	10	2	14	3	13	**158**
Students and Faculty from Other Organizations																		
UG																		**-**
PG	-	-	1	-	-	-	-	1	-	-	-	-	-	-	20	-	-	**22**
PhD	-	1	1	1	-	-	1	-	-	-	-	-	-	1	11	-	-	**16**
Subtotal (C)	-	1	2	1	-	-	1	1	-	-	-	-	-	1	31	-	-	**38**
Faculty	-	1	-	1	-	-	1	-	-	1	1	-	2	1	15	-	-	**23**
Scientist	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	**1**
Subtotal (D)	-	1	-	1	-	-	1	-	-	1	1	-	2	1	16	-	-	**24**
Total (A+B+C+D)	9	19	14	25	2	8	22	6	1	18	12	3	12	4	73	3	14	**422**

AEF: Agriculture Economics & Farm Management, AGR: Agronomy, ENT: Entomology, AEE: Agriculture Extension Education, FST: Food Science and Technology, AGF: Agroforestry, HOR: Horticulture, AST: Agricultural Statistics, MTR: Meteorology, PBG: Plant Breeding & Genetics, PPT: Plant Pathology, PPH: Plant Physiology, SAC: Soil Science & Agricultural Chemistry, FMP.: Farm Machinery and Power Engineering, SWE: Soil and Water Engineering, PHP: Post Harvest Process & Food Engineering.

5.5.2 Distribution of participants under Awareness Program

Distribution of participants under Awareness Program from JNKVV and under other Agricultural Universities ae shown in Table 5.5.2 Total 435 Agriculture/ Agriculture Engineering students (366) and Agriculture/Agriculture Engineering Faculty (69) from JNKVV, Agriculture/ Agriculture Engineering students (14) and Agriculture/Agriculture Engineering Faculty (6) from other university and 292 school students have participated in these programs.

Table 5.5.2 Distribution of participants under Awareness Program from JNKVV and under other Agricultural Universities

Category	Participants from JNKVV		Participants from other Agricultural Universities excluding JNKVV		Others (School students)	Grand Total
	AG	AE	AG	AE		
UG	71	239	1	4	-	**315**
PG	0	21	0	2	-	**23**
PhD	2	33	0	7	-	**42**
Faculty	0	46	0	4	-	**50**
Research Staff	0	23	0	2	-	**25**
Others (School students)	-	-	-	-	292	**292**
Grand total	**73**	**362**	**1**	**19**	**292**	**747**

5.6: Overall Statistics of Participation under skill development program

For enhancing the awareness and knowledge of RS & GIS applications for Natural Resource Management among the students and faculty, seventeen programs were conducted that includes four awareness programs, three educative learning for agricultural executives, eight capacity building training program and three workshops for students. In these programs total participants were 3510 out of which 35.2% were female and 64.8% were male as well as 68.3% of participants were from Scheduled Castes, Tribes and Other Backward Caste. In academic session 2021-22, total 264 Man days were involved out of 189-man days from capacity building program of 21-days. 75 Agriculture officers/Executives belonging to different districts of Madhya Pradesh were trained to use the classified spatial information available in agriculture domain and subsequently it will help them to plan for Agriculture resource management (Table 5.6).

Table 5.6: Overall Statistics of Participation

Type of Program	No of programs	No of Days	No of Man Days	Male					Female					Total	Percentage				% Male	% Female
				UR	SC	ST	OBC	Total	UR	SC	ST	OBC	Total		UR	SC	ST	OBC		
Awareness Program	4	1	4	146	131	65	103	445	117	64	52	69	302	747	35.2	26.1	15.7	23.0	59.6	40.4
Capacity Building Program	9	21	189	124	66	26	78	294	70	16	17	25	128	422	46.0	19.4	10.2	24.4	69.7	30.3
Educative learning Program	3	6	18	19	17	13	18	67	4	0	2	2	8	75	30.7	22.7	20.0	26.7	89.3	10.7
Workshop	5	1,7,9, 15,21	53	311	206	238	713	1468	321	122	149	206	798	2266	27.9	14.5	17.1	40.6	64.8	35.2
Grand Total	**20**		**264**	**600**	**420**	**342**	**912**	**2274**	**512**	**202**	**220**	**302**	**1236**	**3510**	**31.7**	**17.7**	**16.0**	**34.6**	**64.8**	**35.2**

5.7 Impact of Capacity Building Program on students and faculty

An online survey has been conducted for 245 participants (Students/Faculty) to seeing the efficacy of 21 days capacity building program. We have received the response of 52 participates out of 56% were started to work on RS/GIS i.e. Classification of Agricultural Crops using indices, Land use planning, Agricultural Market Intelligence, Soil science soil fertility mapping, Thematic map preparation, snow pack computation, Selection of soil and water conservation structures, Watershed Management, LULC classification, Crop assessment on field level for crop management, Identification , acreage estimation and estimation of crop water requirement for Rabi season chickpea, Agricultural meteorology, Weather advisory preparation, Satellite data for NDVI assessment, Agriculture and allied fields, morphometry and land use change analysis, Characterization of different insect through proximal RS & GIS, Water Resources Management, Ground Water, watershed development plan and Water logging Assessment. In addition to this 13 % participants were likely to start their work on application of RS and GIS in Agriculture field (Fig 5.7)

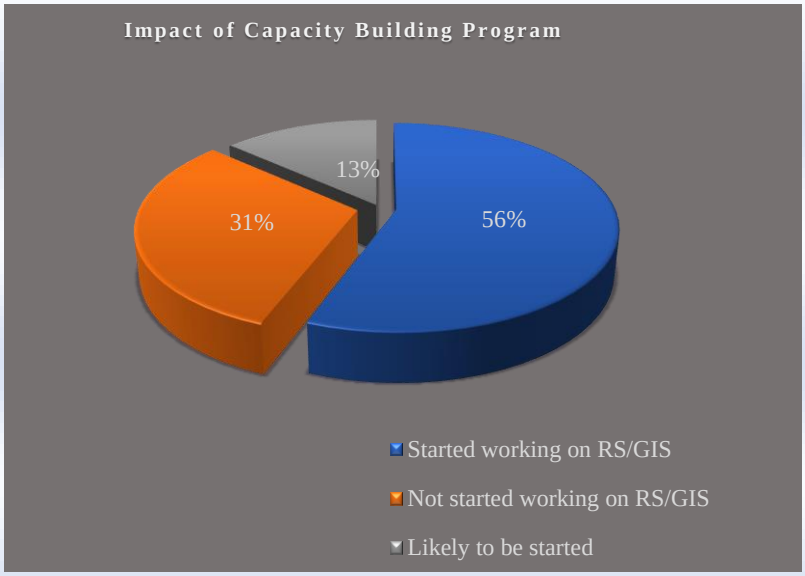


Fig 5.7 Impact of capacity building program

5.8 Training Programs under Equity Action Plan (EAP)

Program	Number
Capacity Building Training Programs EAP	2
Awareness Program for Equity Action Plan (EAP)	6

5.8.1 Capacity Building Training Programs EAP:

Capacity building programs were conducted to enhance knowledge of students regarding improving language competency in spoken English, writing skills, personality development and soft skills for social safeguard. Out of eight equity action programs, there

were two capacity building programs have been organized. Participation and impact of capacity building programs are shown in Table 5.8.1. Total 435 students from JNKVV and other universities have participated in these EAP programs, out of which 65.75% were male and 34.25% were female participants. The category wise distribution among participants were found as OBC 43.22%, UR-29.66%, SC-16.78%, and ST 10.34%. Details of the distribution of participants in different individual Programs are listed below.

Table 5.8.1. Participation and Impact of Capacity Building Programs for EAP

SN	Topics	Date	No. of Participants	Impact
1	Improving Language Competency through Capacity Building in Spoken English & Writing Skills	22/11/2021 to 01/12/2021	190	Students were enriched with various strategies of oral communication and enhanced confidence and ability to communicate effectively and the competency among participants to improve the articulation of English in their writing
2	Personality Development & Soft Skills	06/12/2021 to 15/12/2021	245	Students were enriched with various strategies of formal written communication and enhance learners' confidence and ability to communicate effectively in terms of written or oral communication in a variety of situations.

5.8.2 Awareness Program for Equity Action Plan (EAP)

Awareness programs were conducted to enhance the awareness of social safeguard in field of Agriculture and allied fields. Total eight programs were conducted under EAP theme, in which six were the awareness program and rest comes under capacity building program. This section briefs about the awareness program conducted under EAP as shown in Table 5.8.2. In these programs, 1434 participants including students and Faculty from native and other universities have been participated. Gender wise distribution shows that 60.32% male and 39.68% female were participated in these programs. They belong to OBC-34.38 %, UR-31.94%, SC-17.85%, and ST-15.83% categories. Details of the distribution of participants in different individual programs are appended.

Table 5.8.2 Participation and Impact of Awareness Programs

SN	Topics	Date	No. of Participants	Impact
1	Awareness on usefulness of Yoga in COVID 19 Environment	21/06/ 2021	Students - 527 Faculty - 110	Participants learned yoga practices specifically pranayama to overcome the mental stress due to COVID-19 environment.
2	Awareness Program on Grievance Redressal Mechanism	29/07/ 2021	Students - 124 Faculty - 77	Participants were aware about the process and functioning of Grievance Redressal Mechanism at JNKVV under NAHEP project.
3	Online Quiz Competition for students on occasion of National Unity Day	31/10/ 2021	Students - 287	Students gained the knowledge about Sardar Vallabhbhai Patel and his work on unity of nation.
4	Workshop on excel the ICAR-ARS main exams	20/11/ 2021	Students - 87	Students were exposed to ARS examination by the expert, who provided guidance for competitive examination in agriculture research system and personal development.
5	Special lecture for the ICAR-ARS main exams	26/11/ 2011	Students - 94	Mostly students qualified ARS Pre examination but in mains they face lack of preparation and planning but in the session, they got information regarding three stages of selection and other queries to do better performance in students.
6	Orientation Program on Career Opportunities for Agricultural Students in India	07/12/ 2021	Students - 128	Students gained information about preparation of different competitive examination through capacity building and awareness programs. Total 192 students were honored on their success in NET, ARS, GATE, CAT and other national level competitions

5.9 Over all departments wise distribution of participation from JNKVV and other organization in Capacity Building Program under Equity Action Plan (EAP)

A comprehensive report has been prepared (Table 5.9) to show the overall department wise distribution of participants from JNKVV. There were total 435 participants, out of which 425 and 10 participants were from JNKVV followed by other organizations belonging to different departments like Horticulture/ Plant Breeding & Genetics/Entomology/ Agriculture Economics & Farm Management / Soil and Water Engineering etc., who have attended the capacity building program conducted under EAP theme

Table 5.9 Department wise distribution of participants in Capacity Building Programs.

	Number of Participants in Departments of																	
Participants	**AEF**	**ABM**	**AGR**	**ENT**	**AEE**	**FST**	**AGF**	**HOR**	**AST**	**PBG**	**PPT**	**PPH**	**SAC**	**FMP**	**SWE**	**PHP**	**Oth**	**Total**
Students and Faculty from JNKVV																		
UG																		215
PG	18	3	7	12	11	3	5	19	1	13	10	-	8	1	5	3	3	122
PhD	5	-	5	14	10	8	1	9	-	11	5	3	4	2	7	2	2	88
Sub-total (A)	23	3	12	26	21	11	6	28	1	24	15	3	12	3	12	5	5	**425**
Students and Faculty from Other Organizations																		
UG																		4
PG	-	-	-	-	-	1	-	-	-	2	-	-	-	-	-	-	2	5
PhD	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1
Sub-total (B)	-	-	-	-	-	2	-	-	-	2	-	-	-	-	-	-	2	**10**
Total (A+B)	**23**	**3**	**12**	**26**	**21**	**13**	**6**	**28**	**1**	**26**	**15**	**3**	**12**	**3**	**12**	**5**	**7**	**435**

AEF: Agriculture Economics & Farm Management, ABM: Agribusiness Management, AGR: Agronomy, ENT: Entomology, AEE: Agriculture Extension Education, FST: Food Science and Technology, AGF: Agroforestry, HOR: Horticulture, MTR: Meteorology, AST: Agricultural Statistics, PBG: Plant Breeding & Genetics, PPT: Plant Pathology, PPH: Plant Physiology, SAC: Soil Science & Agricultural Chemistry, FMP.: Farm Machinery and Power Engineering, SWE: Soil and Water Engineering, PHP: Post Harvest Process & Food Engineering, OTH: Other.

5.10. Overall departments wise distribution of participation from JNKVV and Other Organizations in Awareness Program under Equity Action Plan (EAP)

A comprehensive report has been prepared (Table 5.6) to show the overall department wise distribution of participants from JNKVV and other organizations. There were total 1434 participants, out of which 1368 and 66 participants were from JNKVV followed by other organizations belonging to different departments like Agronomy/Horticulture/Entomology/ Plant Breeding & Genetics/Entomology /Soil and Water Engineering etc., who have attended the awareness program conducted under EAP theme.

Table 5.6 Departments wise distribution of participation in Awareness Programs.

Participants	Number of Participants in Departments of																		
	AEF	ABM	AGR	ENT	AEE	FST	AGF	HOR	MTR	AST	PBG	PPT	PPH	SAC	FMP	SWE	PHP	OTH	TOTAL
Students and Faculty from JNKVV																			
UG																			712
PG	6	3	57	35	28	5	11	48	1	1	28	15	4	21	1	10	2	3	279
PhD	20	1	32	36	20	8	11	27	-	2	35	5	1	12	2	8	3	1	224
Sub-total (A)	26	4	89	71	48	13	22	75	1	3	63	20	5	33	3	18	5	4	**1215**
Faculty	6	2	7	7	10	3	2	9	1	1	9	4	7	6	2	6	4	17	103
Scientist	3	1	4	4	4	-	-	4	-	-	6	4	1	1	-	3	1	14	50
Sub-total (B)	9	3	11	11	14	3	2	13	1	1	15	8	8	7	2	9	5	31	**153**
Students and Faculty from Other Organizations																			
UG																			6
PG	-	1	1	1	-	-	-	1	-	-	-	1	-	-	-	3	-	3	11
PhD	-	-	2	-	-	-	-	3	-	-	-	1	-	-	-	1	-	8	15
Sub-total (C)	-	1	3	1	-	-	-	4	-	-	-	2	-	-	-	4	-	11	**32**
Faculty	-	-	-	2	3	1	-	1	-	-	1	-	1	3	1	-	-	5	18
Scientist	-	-	3	1	2	1	-	3	-	-	1	-	-	1	-	1	-	3	16
Sub-total (D)	-	-	3	3	5	2	-	4	-	-	2	-	1	4	1	1	-	8	**34**
Total (A+B+C+D)	**35**	**8**	**106**	**86**	**67**	**18**	**24**	**96**	**2**	**4**	**80**	**30**	**14**	**44**	**6**	**32**	**10**	**54**	**1434**

5.11 Overall Distribution of Participants 2020-21

NAHEP-CAAST at JNKVV conducted 8 programs under various heads as awareness program, capacity building, and for social safeguards with total participation of 1869 including 61.58% male and around 38.42% female. In overall participation there was a share of about 32.16% for schedule tribes and schedule caste category.

Table 5.11 Distribution of Participants

Type of Program	No	Male					Female					Total					Percentage				Male %	Female %
		SC	ST	OBC	UR	Total	SC	ST	OBC	UR	Total	SC	ST	OBC	UR	Total	SC	ST	OBC	UR		
Awareness Program	6	158	137	337	233	865	98	90	156	225	569	256	227	493	458	**1434**	17.85	15.83	34.38	31.94	60.32	39.68
Capacity Building Program	2	47	32	139	68	286	26	13	49	61	149	73	45	188	129	**435**	16.78	10.34	43.22	29.66	65.75	34.25
Grand Total	**8**	**205**	**169**	**476**	**301**	**1151**	**124**	**103**	**205**	**286**	**718**	**329**	**272**	**681**	**587**	**1869**	**17.60**	**14.55**	**36.44**	**31.41**	**61.58**	**38.42**

5.12 Training Programs under Environmental Sustainability Plan

Program	Number
Capacity Building & Training Program conducted for PG students under ESP	12
Awareness programs conducted under Environment sustainability plan (ESP)	2

5.12.1 Capacity Building & Training Program conducted for PG students under ESP

S. N.	Topic	Date	No. of participants	Impact
1	Agro forestry- Sustainable and greener approach to farmers	5/06/2021	81	Students learnt about agroforestry for improving greenness and sustainable availability
2	Biosafety and waste disposal	26/6/2021	43	Participants learned about biosafety and waste disposal, including regulations and guidelines, as well as biosafety levels.
3	Food Safety- a Shared Responsibility	24/7/2021	128	Participants learned about Food Safety and aware various food fraud activities, importance of food safety and how it can be ensured using different laws and regulations of FSSAI.
4	Impact of Climate change on Insect Pests	25/7/2021	39	To understand about the many aspects affecting insect pests as a result of climate change, be aware that a rise in temperature increases physiological activity and, as a result, metabolic rates. Certain insects' population growth rates will increase as a result of this.
5	Good Laboratory practices for safety & estimation procedure of pesticides residues, nutrients in soil & plants	26/7/2021	28	To learned about various Participants learned about laboratory practices for safety and inform about to estimation procedure of pesticides residues
6	Management in Organic farming	11/8/2021	51	Participants gained the knowledge about complete process and nutrient management practices in organic farming of different crops

S. N.	Topic	Date	No. of partici pants	Impact
7	Integrated Disease management	29/9/2021	19	Improved understanding of integrated management of diseases with different practices
8	Safe uses of Pesticides	13/11/2021	36	To learned safe application of pesticides and aware about its toxic effect on environment, because they can have adverse effects on humans and non-target animal species if safeguards are not taken.
9	Removal pesticides from vegetables	13/11/2021	36	Pesticide residues on vegetables can endanger public health and the economy, students learned about different methods for removal of pesticides residues from vegetables.
10	Fasal Suraksha: Paudh Surksha Upakaran	4/12/2021	36	Farmers learned about different plant protections equipment's and how it is use in their farming
11	Ekikrut Kit Prabandhan (Integrated Pest Management (IPM))	15/12/2021	37	Farmers learned about integrated management of insect pest & diseases using different component of integrated pest management.
12	Integrated nutrient management for sustainable agriculture & ecosystem	17/12/2021	37	Students aware about, how integrated farming enhancing productivity, profitability, proper nutrient management, weed management and livelihood improvement

5.12.2 Awareness programs conducted under Environment sustainability plan (ESP)

S. N.	Topics	Date	Partici pants	Impact
1	Bio pesticides and their use	27/11/2021	37	Farmers commonly use chemical pesticides, which have negative environmental consequences. In session, they learned about bio pesticides and where to get availability of those products.
2	Safe uses of Pesticides	21/12/2021	30	Student learned to standard dose of pesticides including safe application of pesticides without harming, because they can have adverse effects on humans and non-target animal species if safeguards are not taken.

5.13 Overall departments wise distribution of participants from JNKVV under Capacity Building Program (ESP)

A comprehensive report has been prepared to show the overall department wise distribution of participants from JNKVV. There were total 571 participants, out of which 555 and 16 participants were from JNKVV followed by Other Organizations belonging to different departments like Agronomy/Entomology/Forestry/Soil and Water Engineering etc., who have attended the capacity building program conducted under ESP theme**.**

Table 5.13 Overall department wise distribution of participants in Capacity Building Program.

Participants	Number of Participants in Departments of																
	ABM	**AGR**	**ENT**	**AEE**	**FST**	**AGF**	**HOR**	**PBG**	**PPT**	**PPH**	**SAC**	**FMP**	**SWE**	**PHP**	**OTH**	**Farmers (D)**	**TOTAL**
Students and Faculty from JNKVV																	
UG																	158
PG	3	18	36	6	9	8	-	5	15	-	12	9	10	1	2		134
PhD	-	3	12	4	7	4	2	2	3	1	1	-	3	-	-		42
Sub-total (A)	3	21	48	10	16	12	2	7	18	1	13	9	13	1	2		**334**
Faculty	-	-	5	-	-	-	-	1	-	-	2	1	7	-	23		39
Scientist	-	-	-	-	-	-	-	-	-	-	3	-	3	-	31		37
Sub-total (B)	-	-	5	-	-	-	-	1	-	-	5	1	10	-	54	**145**	**76**
Students and Faculty from Other Organizations																	
UG																	10
PG	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-		5
PhD	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-		1
Sub-total (C)	-	-	-	-	-	6	-	-	-	-	-	-	-	-	-		**16**
Total (A+B+C)	**3**	**21**	**53**	**10**	**16**	**18**	**2**	**8**	**18**	**1**	**18**	**10**	**23**	**1**	**56**		**571**

ABM: Agribusiness Management, AGR: Agronomy, ENT: Entomology, AEE: Agriculture Extension Education, FST: Food Science and Technology, AGF: Agroforestry, HOR: Horticulture, PBG: Plant Breeding & Genetics, PPT: Plant Pathology, PPH: Plant Physiology, SAC: Soil Science & Agricultural Chemistry, FMP.: Farm Machinery and Power Engineering, SWE: Soil and Water Engineering, PHP: Post Harvest Process & Food Engineering, OTH: Other

5.14 Participants in Awareness Program under ESP

Table 5.14 Participants in Awareness Program (ESP)

Participants	Participants from JNKVV		
	Agriculture	Farmers	Total Participants
Students	30	37	67

5.15 Overall Distribution of Participants 2020-21

NAHEP-CAAST at JNKVV conducted 14 program under various heads as awareness program, capacity building, and for environmental sustainability framework with total participation of 638 including 71.16% male and 28.84% female. In overall participation there was a share of about 15.67% for schedule tribes and schedule caste category.

Table 5.15Distribution of Participants

Type of Program	No. of Programs	Male					Female					Total					Percentage				Male %	Female %
		SC	ST	OBC	UR	Total	SC	ST	OBC	UR	Total	SC	ST	OBC	UR	Total	SC	ST	OBC	UR		
Awareness program	2	2	5	24	15	46	1	2	7	11	21	3	7	31	26	67	4.48	10.45	46.27	38.81	68.66	31.34
Capacity Building	12	39	30	211	128	408	12	9	61	81	163	51	39	272	209	571	8.93	6.83	47.64	36.60	71.45	28.55
Grand Total	**14**	**41**	**35**	**235**	**143**	**454**	**13**	**11**	**68**	**92**	**184**	**54**	**46**	**303**	**235**	**638**	**8.46**	**7.21**	**47.49**	**36.83**	**71.16**	**28.84**

Total Beneficiaries

Type of Program	No. of Programs	Male					Female					Total					Percentage				Male %	Female %
		SC	ST	OBC	UR	Total	SC	ST	OBC	UR	Total	SC	ST	OBC	UR	Total	SC	ST	OBC	UR		
Skill Dev. Prog-ramme	20	420	342	912	600	2274	202	220	302	512	1236	622	562	1214	1112	**3510**	71.7	16.0	34.6	31.7	64.8	35.2
EAP	8	205	169	476	301	1151	124	103	205	286	718	329	272	681	587	**1869**	17.60	14.55	36.44	31.41	61.58	38.42
ESP	14	41	35	235	143	454	13	11	68	92	184	54	46	303	235	**638**	8.46	7.21	47.49	36.83	71.16	28.84
Total	**42**	**666**	**546**	**1623**	**1044**	**3879**	**339**	**334**	**575**	**890**	**2138**	**1005**	**880**	**2198**	**1934**	**6017**	**16.70**	**14.63**	**36.53**	**32.14**	**64.46**	**35.54**

5.16 Awareness advisory

S.N	Date	Work plan	Action taken by	Impact
1	13th Sept. 2021	Approved uses of registered insecticides For Major Crop Grown in M. P.	Dr. S. B. Das HoDs & Professor Entomology, JNKVV, Jabalpur	Student got useful information on registered insecticides for major crops.
2	11th Oct. 2021	Advisory on Parthenium	Dr. S. B. Das HoDs & Professor Entomology, JNKVV, Jabalpur	Advisory is very important step for successful implementation of Parthenium management.

Registered insecticides For Major Crop Grown in Madhya Pradesh

S.N.	Common name of the pest
1	Aluminum Phosphide 56% (3g Tablet,10g Pouch)
2	Aluminum Phosphide 15% (12gTablet)
3	Aluminum Phosphide 77.50% GR
4	Aluminum Phosphide 06% Tablet
5	Benfuracarb 03% GR
6	Benfuracarb 40% EC
7	Bifenthrin08.80% CS
8	Bromadiolone 00.25% CB
10	Buprofezin70% DF
11	Carbosulfan 06% Granules
12	Carbosulfan 25%EC
13	CartapHydrochloride04% Granules
14	CartapHydrochloride75 %SG
15	Chlorantraniliprole18.50%SC
16	Chlorantraniliprole 00.40% GR
17	Chlorantraniliprole 35% WG
19	Chlorfluazuron 05.40% EC
20	Chlorpyrifos 10 % Granules

Awareness advisory on Parthenium

Awareness advisory on Parthenium

Parthenium hysterophorus L., commonly known as carrot weed, white top or congress grass in India, is a herbaceous, erect and annual plant belonging to the family "Asteracae" (compositae).

How Parthenium spreads, dangerous weed, ways of management

It mainly spreads through its seeds. The weed has the potential of producing as high as 154,000 seeds/m2 and a single plant can produce about 15000 - 25,000 seeds. The seeds are very light in weight and easily carried or transported by wind, water or through various

human activities.

Parthenium management success is based on integration of all the available techniques and their implementation throughout years given below:

1. Uprooting of Parthenium
2. Mechanical management
3. Cultural management
4. Legal management
5. By use of chemicals
6. By use of biological control agent

Biological control is the intentional manipulation of natural enemies by man for the purpose of controlling harmful weeds. Biological control is inexpensive and poses no threat to non-target organisms, environment and biodiversity.

Introduction of Mexican beetle Zygogramma bicolorata

In India, more than 50 insect species have been reported on Parthenium, but none of the indigenous insects was found host-specific yet. Based on well documented success by Mexican beetle, *Zygogramma bicolorata* Pallister Mexican beetles can be multiplied and released anywhere in India for Parthenium suppression.

Economic benefits of biological control by *Z. bicoorata*

In a conservative estimate, the beetle controlled 200-hectare land infested with Parthenium within three years of its release at Jabalpur. Biological control through *Z. bicolorata* has great potential at least in higher rainfall areas to manage Parthenium.

Collection and release of the beetle

(i) Collection from established sites, Selection of release site

(ii) Time of release

(iii) Method of field releases

Mass rearing of *Z. bicolorata*

Parthenium can be grown in these cages either from the seeds or by transplanting small Parthenium plants from the infested place. After establishment of sufficient Parthenium plants in the cages, about ten pairs of beetles can be released in the space of 6x 6 feet.

Management by way of utilization

Parthenium can be most effectively used in compost making. The compost should only be prepared by pit method. In NADEP method

Integrated management

During rainy season soil remains wet so manual or mechanical removal can be done before appearance of flowering with the help of people participation.

6. Ongoing projects:

Problem Identification: The following problems were identified in realizing process with satellite and ground data with techniques available.

Sr. No.	Problem Identified	Techniques used to realize the problems
1	**Processing Big Earth Observing Data:** Processing big spatial data and subsequently produced meaningful information is essential for better understanding the current and future state of natural processes. Processing of huge amount of spatial data through traditional workflows is great challenge. The traditional method of downloading spatial data to personal storage devices and performing various processing tasks is time consuming & not feasible any more when dealing with large amounts of remote sensing data.	Due to the advancement in digital technologies such as increased computing power and storage capabilities through cloud computing, the huge spatial data can be assessed on demand & processed without the downloading the data to personal computer and no need to maintain the expensive hardware's and software's. There are various publicly available systems and solutions dealing with Big Earth data like Google Earth Engine, Amazon Web Services, Earth Server, EODC, Earth Explorer, Copernicus Open Access Hub etc. Cloud computing is the promising tool for analyzing Big Earth data with larger spatial and temporal extents.
2	**High throughput phenotyping using remote sensing:** Selection of best genotype based on a phenotypic expression under various environmental conditions is a very complex task. It involves the extensive field trials and plant observations ranging from cells to whole plant levels. Furthermore, traditional phenotypic analysis often involves destructive sampling that is time intensive and prone to measurement error.	To achieve best selection of genotype based on crop phenotyping linked to crop growth status, yield, and resilience to environmental stress, there is need to develop high-throughput crop phenol-typing platforms that are operational in the field. The high-throughput crop phenotyping platforms involves the use of remote sensed images, thermal cameras, UAVs, portable spectrometers or hyperspectral cameras, sensors, image processing and analyzing software's. Additionally, the use of machine learning algorithms helps to identify useful crop traits using image information.
3	**Addressing potential evapotranspiration variability:** Potential evapotranspiration is an important part of hydrological cycle and water resources management.	Remote sensing satellite provides land surface information from larger geographic extents and produced cost-effective, efficient, up-to-date information for retrieving ground

Sr. No.	Problem Identified	Techniques used to realize the problems
	Traditionally, ET can be measured by using land surface parameters (temperature, net land surface radiation, vegetation index, and soil moisture) at global scale, water balance, or crop growth models for crop ET. However, these conventional methods cannot represent large-scale terrestrial evapotranspiration due to heterogeneity of land surface and complexity of hydrologic processes.	parameters at global scale which can be used for evapotranspiration estimation. A variety of satellite-based products have provided valuable evapotranspiration data sources to research at different spatial scales, especially for regions with lack of and sparse observations.
4	**To plan priority of Watershed Development works:** Utilization of natural resources (i.e. soil and water) with poor management practices is a prime causative factor for the watershed deterioration that directly affects ecosystem stability. Quantitative values of soil erosion rate are the most preferred criterion for identifying the erosional status of the watershed. Although, such criteria require historical data on hydrological observations which are generally not available for smaller watershed units due to several constraints. The morphometric parameters of a watershed thus help in areas where adequate information about the hydrological observations is not available. The manual method of morphometric analysis makes use of toposheets for the extraction of morphometric parameters. It is extensively time-consuming, tedious, cumbersome that ultimately leads to boredom in the investigation and is highly susceptible to human error.	Satellite remotely sensed data of high spatial resolution provides information about the Earth's features in a more precise manner. Such data can help in identifying the utilization pattern of land resources with a greater degree of confidence with which the relative relationship of different LULC classes with soil erosion can be established more accurately. Digital Elevation Model (DEM) data provides spatial information of elevation values in raster format that aids in the extraction of morphometric parameters of the watershed in a more convenient and fast manner. The integration of morphometric and LULC factors would be used for prioritization of the watershed.
5	**Demarcation of Ground Water potential zones:** Groundwater is a precious natural resource having limited extent and volume. Unsustainable groundwater utilization is becoming an evident problem. It is happening because of the absence of updated spatial information on the quantity and distribution of groundwater resources. The effective	Remote Sensing and GIS are modern techniques that can effectively be used for groundwater management. The overlay analysis of different thematic layers, such as geology, geomorphology, drainage density, slope, soil, water table fluctuations or depth to water level, lineament density and rainfall, etc., for demarcation of different

Sr. No.	Problem Identified	Techniques used to realize the problems
	planning of groundwater requires the knowledge of groundwater resource potential assessment before using and managing it.	groundwater potential areas. A set of weights for the different themes will be decided and integrated with a GIS framework to identify suitable zones for artificial groundwater recharge.
6	**Non-Availability of spatial crop area maps:** The monitoring of agricultural areas is very important in reference to worldwide challenges such as increasing food demand, population growth and climate change. The early information on crop type and acreage are necessary to forecast crop yield. Generally, government officials provide the crop information (figure and statistics) after the end of the growing season, since data have to be collected, verified and compiled into a database. Therefore, there is a need to provide near real-time information on crop type and acreage for effective strategic planning.	Identification and mapping of the different crops have been one of the most common applications of RS and GIS. Multiple images corresponding to various cropping stages are generally used for this purpose. The different crop stages are also identified due to the utilization of frequent time interval satellite images. Different classification algorithms can be used for crop classification in a GIS environment.
7	**Lacking of Land use planning based on Natural Resources:** In recent years, land use/cover changes have become a key subject to have proper planning and utilization of natural resources and their management. Traditional methods for gathering information of LULC classes are not adequate for multicomplex environmental studies and also involve great complexity of handling the multidisciplinary data set.	Satellite remote sensing and Geographical Information Systems provide data to study and monitor the dynamics of LULC classes for natural resources management.

For addressing the identified problems effectively, advanced technologies, earth observation data, instruments, hardware's and software's have been used. It includes the following strategies:

- Development of well-equipped research laboratories.
- Hands on training on RS & GIS for encouraging the faculty and students to use spatial data for their research.
- Use of cloud computing platform for dealing with Big Earth Observation data.
- Use of data science programming languages such as Python, R, JavaScript etc.
- Use of spatial data of various kind.

6.1 Progress of ongoing research project

6.1.1 Assessment of land use /land cover classification accuracy based on Sentinel-2, Landsat-8 and LISS – III data.

Land cover and land use mapping and analysis are vital for different environmental and mapping applications. Mapping and monitoring of land cover have been widely recognized as an important scientific goal since created information could be used to support environmental and atmospheric models, decision making procedures. This study aims to compare classification accuracies of land use/cover maps created from different satellites like Sentinel-2, Resourceset-1(LISS-III) and Landsat-8 data. Jabalpur District (Fig.6.1) was selected as study area. The total geographical area of the district is 519757 ha as per APS (Area production statistics; Source: ministry of agriculture and farmers welfare government of India).

For Sentinel- 2 image analysis, 4 tiles have been selected to complete the boundary of Jabalpur district *i.e.* T44QLM, T44QLL, T44QML, and T44QMM. Similarly, for Landsat-8 image analysis, the Path-Row 144/ 44 and 143/44 were taken. Also, LISS-II image analysis, 15 tiles were taken (*i.e.* LISS-III F44B08, F44B11, F44B12, F44B14, F44B15, F44B16, F44C02, F44C03 F44C04,F44C07, F44C08, F44C11, F44C1,2 F44H09 and F44H13) to cover the entire study area.

The satellite data is classified in five classes *i.e.* Water, forest, agricultural, built-up and open area to classify the land use land cover. Three cloud free satellite images (12.02.2020; Sentinel-2, 12.03.2019 LISS-III; and 12.02.2020 for Landsat-8 images) were chosenas per the availability for comparative accuracy assessment.

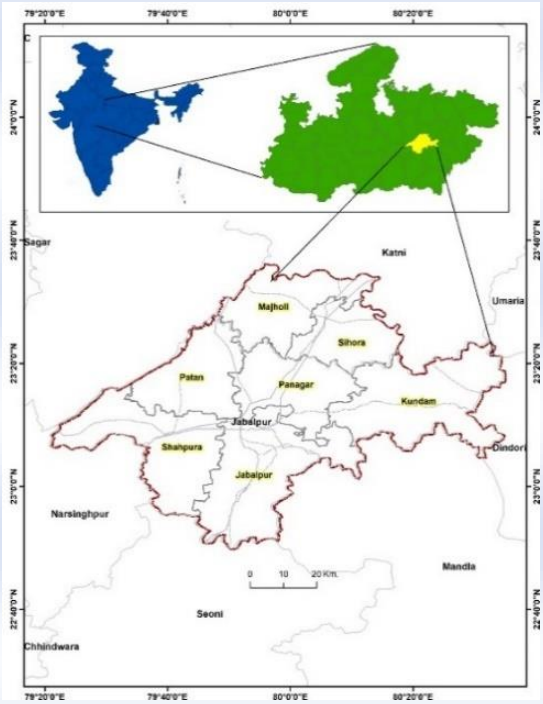


Fig. 6.1 Location map of the Study area, A) India and state boundary B) Madhya Pradesh and district boundary C) Jabalpur district boundary

Table 6.1 : Spectral bands and spatial resolution of different satellite data used

Landsat- 8 satellite			Sentinel -2 satellite			Resourceset-1 (LISS- III)		
Band	**Particular**	**Spatial Resolution, m**	**Band**	**Particular**	**Spatial Resolution, m**	**Band**	**Particular**	**Spatial Resolution, m**
1	Ultra-Blue (coastal/ aerosol)	30	1	Coastal aerosol	60			
2	Blue	30	2	Blue	10	1	Blue	23.5 m
3	Green	30	3	Green	10	2	Green	23.5 m
4	Red	30	4	Red	10	3	Red	23.5 m
5	NIR	30	5	Vegetation red edge	20	4	NIR	23.5 m
6	SWIR 1	30	6	Vegetation red edge	20			
7	SWIR 2	30	7	Vegetation red edge	20			
8	Panchromatic	15	8	NIR	10			
9	Cirrus	30	8A	Narrow NIR	20			
10	Thermal 1	100* (30)	9	Water vapour	60			
11	Thermal 2	100* (30)	10	SWIR – Cirrus	60			
			11	SWIR	20			
			12	SWIR	20			

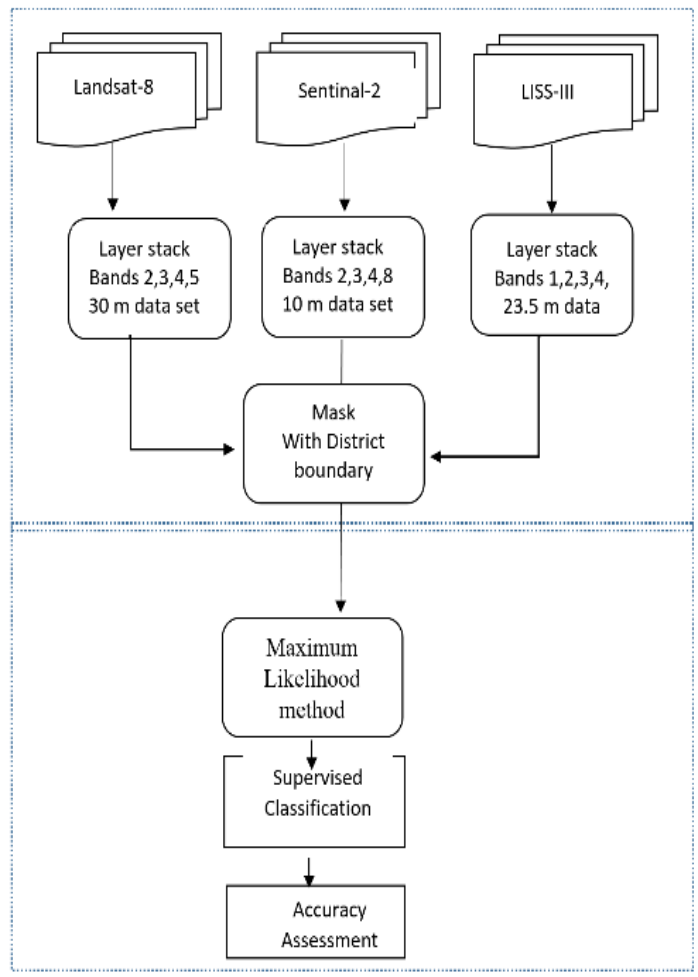


Fig. 6.2: The flow chart of methodology

Similar spectral bands of Landsat-8, Sentinel-2 and LISS-III were obtained and layers stacked. Band 2(blue) band 3(green) band 4(red) and band 5 (near infrared), having 30 m spatial resolution for Landsat-8 and band 2(blue), band 3(green), band 4 (red), and band 8 (near infrared) having 10 m spatial resolution for Sentinel-2 and band-1 (blue) band 2 (green) band 3(red) and band 4 (near infrared) for LISS- III having 23.5 m spatial resolution were stacked. Afterwards, Sentinal-2, and LISS-III spatial resolution were resampled to 30 m. Common spatial resolution data set of similar spectral band range has been created to compare the classification accuracy of results obtained from Landsat-8 Sentinel-2 and LISS-III datasets. Maximum Likelihood method was used for classification of images. Land cover map of the study area was prepared through supervised classification with five classes namely water, forest, agricultural, built up and open areas classes (Figure 6.3 and 6.4).

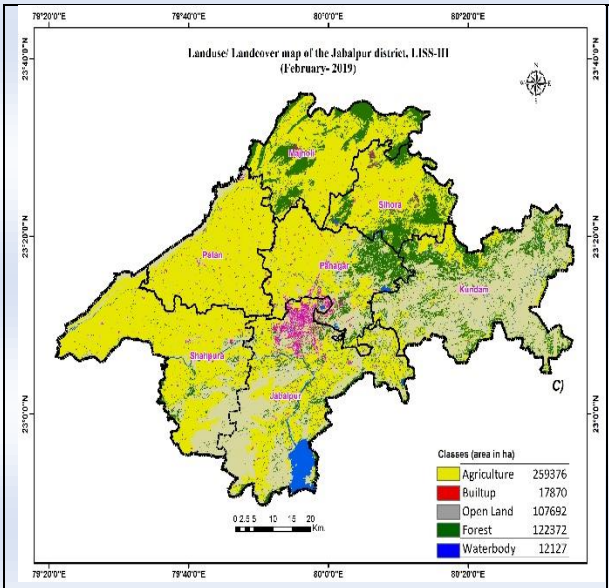


Fig. 6.3 Land use/land cover map of Jabalpur district (LISS-III), Feb 2019

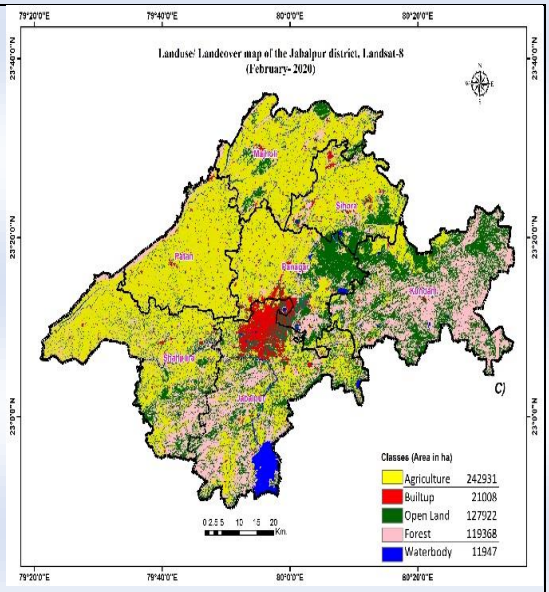


Fig. 6.4 Land use/land cover map of Jabalpur district (Lsat-8) Feb, 2020

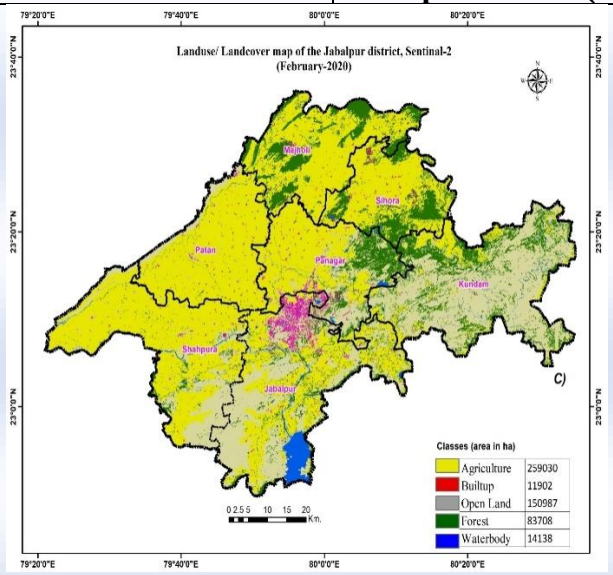


Fig. 6.5 Land use/land cover map of Jabalpur district (Sentinel-2) February, 2020

Table 6.2. Area under different classes as estimated through satellite dataset

S.No.	Classes	LISS-III		Landsat-8		Sentinal-2	
		Area in ha	%	Area in ha	%	Area in ha	%
1	Agriculture	259376.00	49.93	242930.70	46.43	259030.00	49.84
2	Built-up	17869.50	3.44	21007.50	4.02	11902.26	2.29
3	Open Land	107691.60	20.73	127922.00	24.45	150987.00	29.04
4	Forest	122372.00	23.56	119368.00	22.82	83708.40	16.10
5	Waterbody	12127.25	2.33	11947.17	2.28	14138.00	2.72
	Total	519436.35	100.00	519175.40	100.00	519765.66	100.00

Table 6.2 shows that major area of the Jabalpur district falls in agriculture followed by forest, open, built-up and waterbody in classified data using LISS-III satellite data while in the other hand Landsat -8 classified data showing that open land acquire more area than forest and this significant result also followed by Sentinal-2 satellite dataset.

Table 6.3. Land Use Land Cover classification report of Jabalpur district (Area in ha)

S.No.	Classes	Year 2020	% of district Area
1	Agriculture	250695	50%
2	Forest land	77642	15%

(Source: Directorate of Economics & Statistics Dept of Agri & Co Min of Ag GOI)

Table 6.4: Error matrix for Landsat-8 classification using MLC

SN	Class	Water body	Forest	Open	Agri-culture	Builtup	Total	U_Accuracy	Kappa
1	Waterbody	26	2	0	0	0	28	0.92	-
2	Forest	0	19	0	0	0	19	1	-
3	Open	1	0	17	1	0	20	0.85	-
4	Agriculture	0	8	5	252	0	265	0.95	-
5	Built-up	0	0	0	3	19	22	0.86	-
6	Total	27	29	22	256	19	354	0	-
7	P_Accuracy	0.96	0.65	0.77	0.98	1	0	0.940	-
8	Kappa	-	-	-	-	-	-	-	0.86

Table 6.5: Error matrix for LISS- III classification using MLC

Class	Waterbody	Agri-culture	Forest	Open	Builtup	Total	U_Accuracy	Kappa
Waterbody	26	2	0	0	0	28	0.92	-
Agriculture	0	271	0	0	0	271	1	-
Forest	4	0	12	2	0	20	0.6	-
Open	1	0	0	11	0	13	0.84	-
Built-up	0	0	0	0	19	23	0.82	-
Total	31	273	12	13	19	355	0	-
P_Accuracy	0.83	0.99	1	0.84	1	0	0.95	-
Kappa	-	-	-	-	-	-	-	**0.88**

Table 6.6: Error matrix for Sentinal 2 classification using MLC

Class	Waterbody	Forest	Open	Agri-culture	Builtup	Total	U_Accuracy	Kappa
Waterbody	26	2	0	0	0	28	0.92	-
Forest	0	19	0	0	0	19	1	-
Open	1	0	10	0	0	13	0.76	-
Agriculture	0	0	0	271	0	271	1	-
Built-up	0	0	0	0	19	24	0.90	-
Total	27	21	11	271	1	355	0	-
P_Accuracy	0.96	0.90	0.90	1	1	0	0.98	-
Kappa	-	-	-	-	-	-	-	0.94

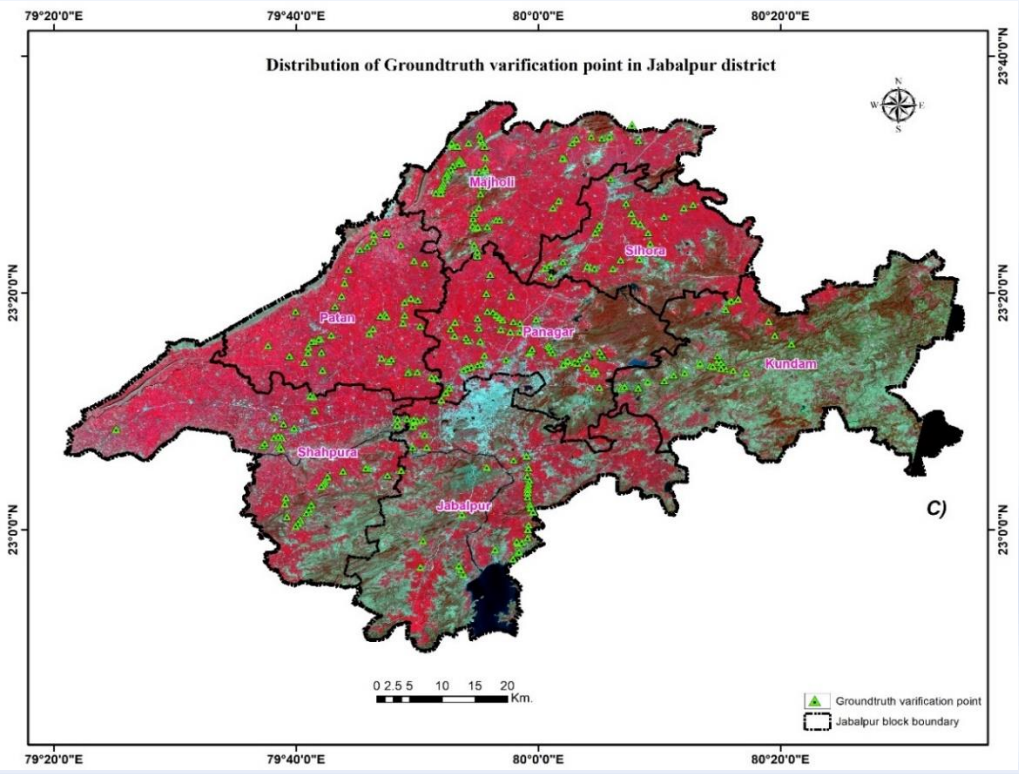


Fig. 6.6 Distribution of ground truth verification point with satellite image in Jabalpur district

The accuracy assessment was performed for each classified data and its classes. Error matrix of each classification were created and total, user's and producer's accuracy values of each class were analyzed to evaluate classification accuracies. For this purpose, total- 355 ground truth point (Fig.6.6) were used. These points were selected over different locations representing different land cover/use classes.

Overall accuracy of Maximum Likelihood Classification method for Landsat-8 data was found as 94.08 % (Table-6.4) with a kappa value of 0.86; and LISS- III overall accuracy of 95.49% (Table-6.5) with a kappa value 0.88; while, the overall accuracy was 98.19 % (Table-6.6) with a kappa value of 0.94 for Sentinel-2 data for MLC. Accuracy of MLC results obtained from Sentinel-2 data are higher than MLC results of Landsat-8 and LISS- III data.

Based on comparative evaluation of different satellite image analysis, it has been revealed that overall accuracy of Sentinel image was good as compared to the Landsat-8 and LISS-III image. In order to check the efficacy of different satellite images for individual classes, it was found that the LISS-III is equally good as Sentinel image with accuracy (i.e. 100%) while classifying agriculture area. Also, it was noticed that Landsat classified image for same agriculture area produced the accuracy of 95%, which is comparatively lower. For analysis of built-up area, Sentianal-2 image was found superior (i.e. Accuracy 90%) as compared to Landsat-8 (*i.e.* Accuracy 86%) and LISS-III image (*i.e.* 82%). It was found that for identification of water body, all the satellite images able to predict it with same accuracy (*i.e.* 92% accuracy).

As Sentinal-2 image has shown the highest accuracy when compared with other two-satellite datasets which were used in the study. Sentinal-2, & Landsat- 8 satellite images are free available in open sources, while LISS-III data is not available in open sources from year 2019. On the other hand, Setinal-2 satellite image revisit time of 5 days as compared to Landsat-8 and LISS-III images, which are having revisit of 16 days and 24 days respectively. So, it is recommended to use Sentinel images when one needs to do image classification.

6.1.2 Change detection pattern for investigating land cover dynamics using multispectral satellite data in Jabalpur district

Land use and land cover change has become a central component in current strategies for managing natural resources and monitoring environmental changes. Currently, numerous techniques are available for assessing and detecting LULC changes. Among them, remote sensing technology and GIS provide robust tools for acquiring accurate and timely information on land use patterns and their changes. To maintain the present natural resources and to understand the causes and consequences of over exploitation of soil and water resources the land use, a land cover mapping and monitoring was done in the study area *i.e.* Jabalpur District. For this analysis, Landsat-7 (29-02-2000, Path 144/ Row 044 and 25-03/2000, Path 143 / Row 044), Landsat-7 (08-03-2010, Path 144 & Row 044 and 21-03/2010, Path 143 & Row 044) and Landsat-8 (12-02-2020, Path 144 & Row 044 and 05-03/2020, Path 143 & Row 044) satellite data of different years were used to investigate the LU/LC change detection of Jabalpur district over 20 years. The

quantitative method of change detection was used in this research. In the change detection method, each satellite image was classified. The methodology adopted in this study is as follows: (1) data collection, (2) pre-processing, (3) LULC classification scheme, (4) selection of training data samples, (5) image classification, (6) accuracy assessment, and (7) change detection. Every step except the data collection step was performed using ERDAS Imagine2020 software and Arc Map 10.3. Figure 6.8 depicts the flow chart that illustrates the methodology included in this present study. Landsat satellite sensors has different spectral bands, details of these bands such as names, spatial resolution, along with their corresponding wavelength is shown in Table 6.7. Four bands (NIR, Red, Green, and Blue) of Landsat-7 and Landsat-8 at 30 m resolution have been utilized for the classification.

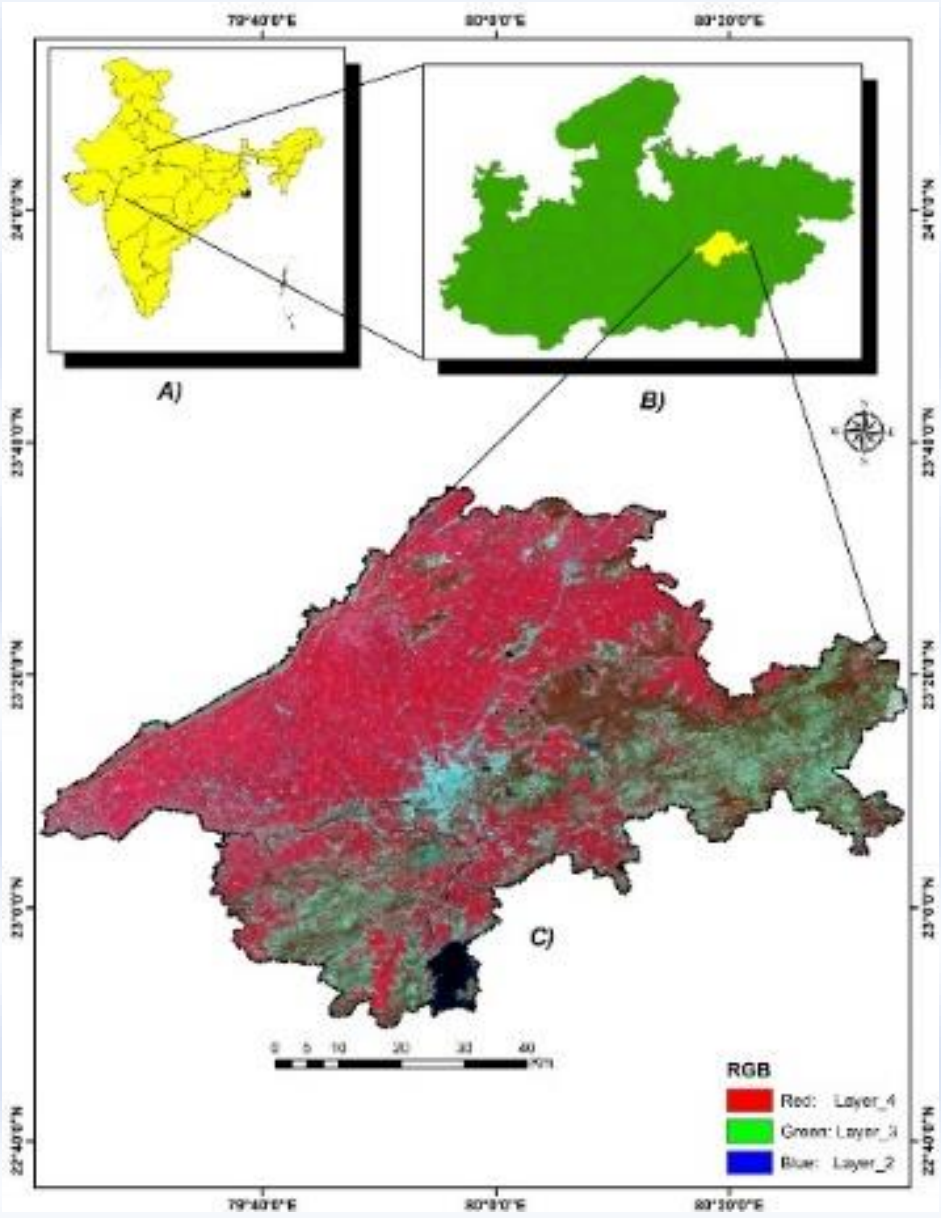


Fig. 6.7 Location map of the Study area, A) India and state boundary B) Madhya Pradesh and district boundary C) Jabalpur district boundary

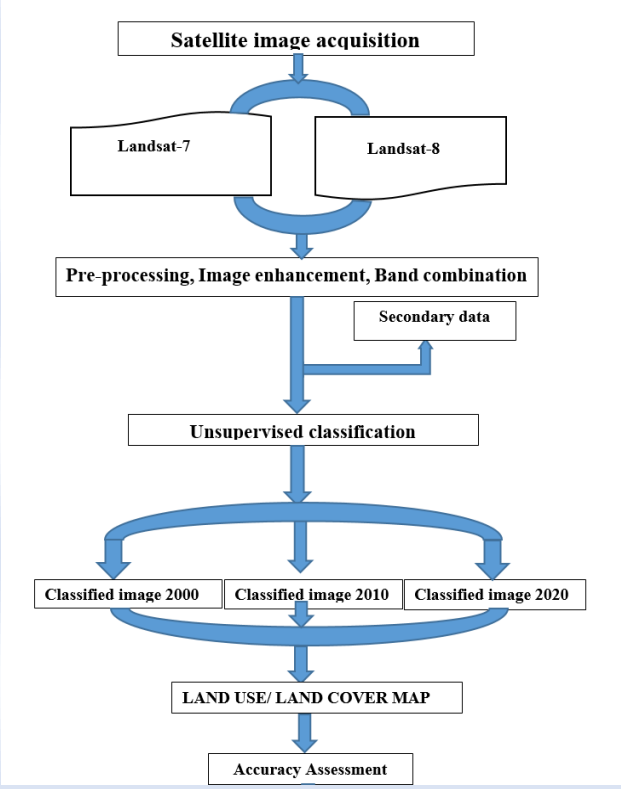


Figure 6.8 Flow chart of methodology

Table 6.7 Landsat satellite sensors specification

Landsat 7 Enhanced Thematic Mapper Plus (ETM+)			Landsat 8 Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS)		
Bands	**Wavelength (micro meters)**	**Resolution (meters)**	**Bands**	**Wavelength (micro meters)**	**Resolution (meters)**
Band 1	0.45-0.52	30	Band 1 - Coastal aerosol	0.43-0.45	30
Band 2	0.52-0.60	30	Band 2 - Blue	0.45-0.51	30
Band 3	0.63-0.69	30	Band 3 - Green	0.53-0.59	30
Band 4	0.77-0.90	30	Band 4 - Red	0.64-0.67	30
Band 5	1.55-1.75	30	Band 5 - Near Infrared (NIR)	0.85-0.88	30
Band 6	10.40-12.50	60 (30)	Band 6 - SWIR 1	1.57-1.65	30
Band 7	2.09-2.35	30	Band 7 - SWIR 2	2.11-2.29	30
Band 8	0.52-0.90	15	Band 8 - Panchromatic	0.50-0.68	15
			Band 9 - Cirrus	1.36-1.38	30
			Band 10 - Thermal Infrared (TIRS) 1	10.6-11.19	100
			Band 11 - Thermal Infrared (TIRS) 2	11.50-12.51	100

The purpose of this study is concerned with identifying the change in land use and land cover detection of the Jabalpur district. Therefore, remote sensing data, was processed for three dates of 2000, 2010 and 2020 using Landsat 7 and Landsat 8 satellite images. The land was classified into five land cover viz. water body, Agriculture, forest, open land, and residential land classes (Figure 6.9).

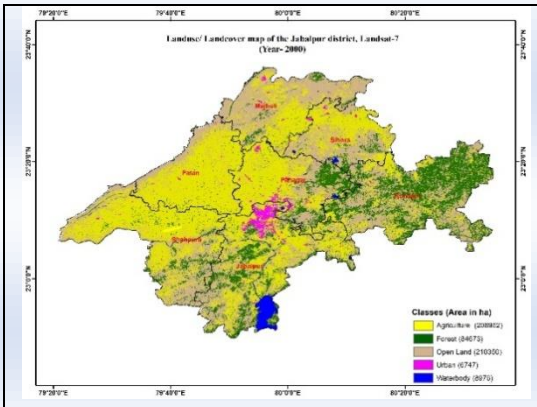


Fig 6.9.1 LU/LC map of the study area (29thFeb 2000)

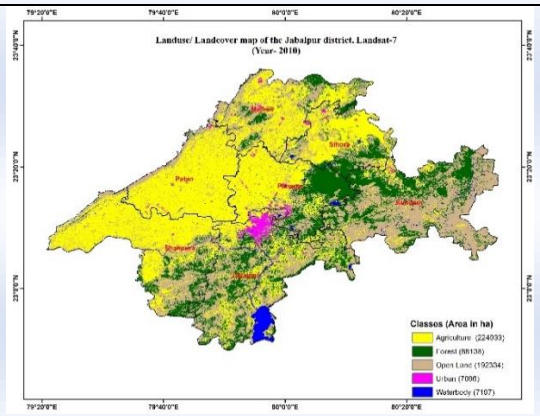


Fig 6.9.2 LU/LC map of the study area (08thMar 2010)

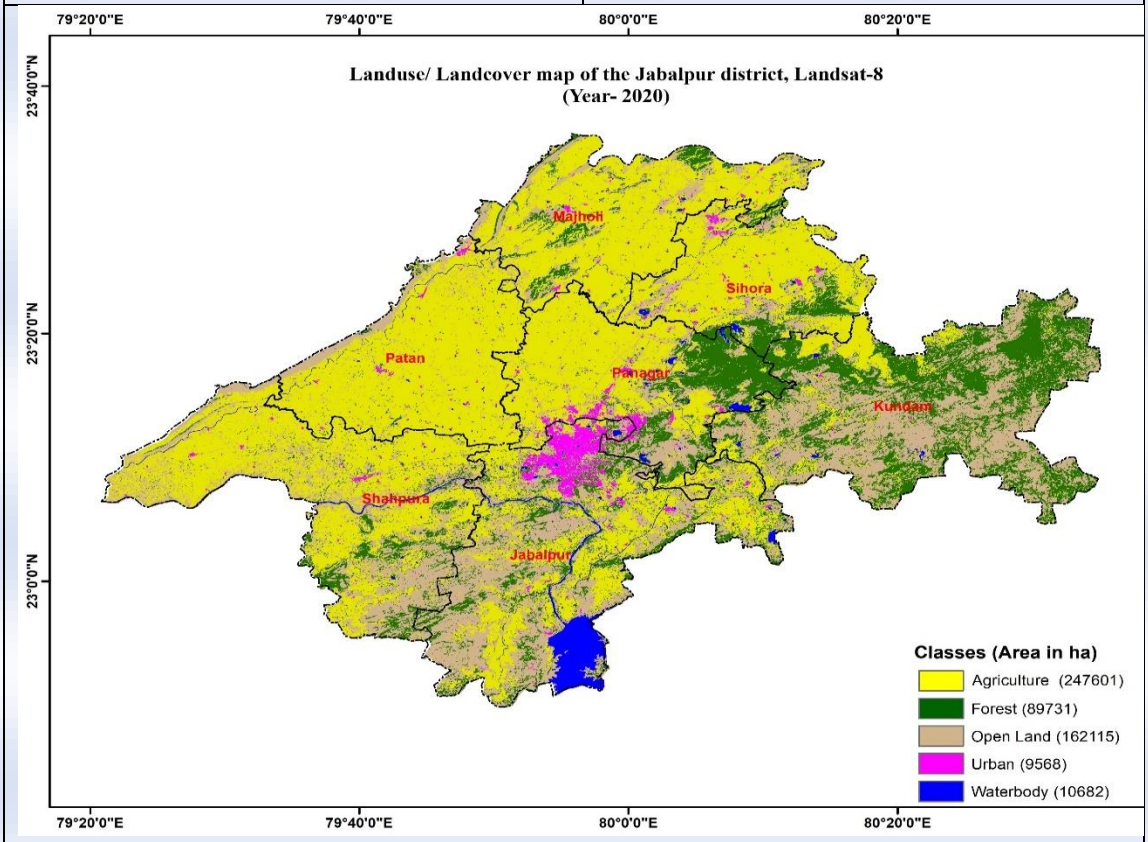


Fig 6.9.3 LU/LC map of the study area (12thFeb2020)

Table 6.8. Area under different classes in LU/LC of Jabalpur district (2000-2010-2020)

S.N.	Classes	2000		2010		2020	
		Area in ha	Area,%	Area, ha	Area,%	Area, ha	Area,%
1.	Agriculture	208952.40	40.21	224933.40	43.28	247601.60	47.64
2.	Urban Land	6747.09	1.30	7096.86	1.37	9568.98	1.84
3.	Open Land	210350.40	40.48	192334.00	37.01	162115.10	31.19
4.	Forest Land	84673.49	16.29	88138.53	16.96	89731.65	17.27
5.	Waterbody	8976.60	1.73	7197.12	1.38	10682.60	2.06
6.	Total	519699.91	100.00	519699.91	100.00	519699.93	100.00

Change detection among the three images for all the land use and land cover classes was computed. The most extensive land cover category of the District in 2000, 2010 and 2020 is agricultural land i.e. 40.21%, 43.28% and 47.64% respectively. The second most extensive land cover category is open land i.e. 40.48%, 37.01% and 31.19% in the year 2000, 2010 and 2020 respectively. Forest area shows significant difference in all three maps. The major change (+ 7.43%) identified, in the study, was in Agricultural area from 2000 to 2020 and this result also correlate with the report of area production statistics showed in Table 6.9.

Table 6.9. Land Use Land Cover classification report of Jabalpur district (Area in ha)

Classes	Area Estimated through Remote Sensing techniques			Area Estimated by Ministry of Agriculture GOV India.			Difference in area (Ministry of Agriculture GOV India- Remote		
Year	2000	2010	2020	2000	2010	2020	2000	2010	2020
Crop area (in *Rabi* session)	208952	224933	247601	215250	230061	250695	6298	5128	3094
Forest land	84673	88138	89731	74853	77655	77642	-9820	-10483	-12089

(Source: Dire. of Eco. & Stat. Dept. Ag. Coop. Min of Ag. GOI, New Delhi)

The comparative evaluation has been done for the classified image with government records and it was found that agriculture area in government record was comparatively less with respect to image classified area through remote sensing. The main reason of this difference in forest area was due to mapping of plantations and orchards as a forest by unsupervised classification. So due to this reason, the forest area has been increased little bit but it resulted a comparatively less agriculture area in classified image. Another reason of difference in forest area could be the superficial record measurement by land revenue officers which may lead the inaccuracy in government records.

The present study illustrates that remote sensing and GIS are important technologies for temporal analysis and quantification of spatial phenomena which is otherwise not possible to attempt through conventional mapping techniques. Change detection is made possible by these technologies in less time, at low cost and with better accuracy.

6.1.3 Wheat crop classification using remote sensing techniques in Jabalpur district of year 2016

Crop mapping and identification provide an important basis for many agricultural applications with various purposes such as yield estimation, crop rotation records and soil productivity. At this point, remote sensing technology helps us to derive accurate and reliable information about the crop types at the different spatial and temporal domain. Remotely sensed images at the different level of resolution from different types of sensors have been extensively and successfully used for crop mapping and identification. Mapping and classification of crop using satellite images is a challenging task that can minimize the complexities of field visits. The recently launched Sentinel-2 satellite has thirteen spectral bands, short revisit time and determination at three different resolutions (10 m, 20 m and 60 m), besides that, the free availability of the images makes it a good choice for vegetation mapping. This study aims to classify wheat crop using time series data Sentinel-2 imagery within the Jabalpur, state of Madhya Pradesh, India.

Table 6.10 Sentinel-2datausedforwheatcropacreageestimation

Bands	Band name	Spatial resolution (m)	Central wavelength (nm)
Band 1	Coastal aerosol	60	442.7
Band 2	Blue	10	492.4
Band 3	Green	10	559.8
Band 4	Red	10	664.6
Band 5	Vegetation red edge	20	704.1
Band 6	Vegetation red edge	20	740.5
Band 7	Vegetation red edge	20	782.8
Band 8	NIR	10	832.8
Band 9	Narrow NIR	20	864.7
Band 10	Water vapor	60	945.1
Band 11	SWIR – Cirrus	60	1373.5
Band 12	SWIR	20	1613.7
Band 13	SWIR	20	2202.4

This study has been carried out usingSentinel-2 satellite data acquired on December 2016, February 2017 and March 2017 for wheat growing season. Sentinel-2 satellite sensors has 13 spectral bands, details of these bands such as names, spatial resolution, along with their corresponding wavelength is shown in Table 6.10. Four bands (NIR, Red, Green, and Blue) of Sentinel-2 at 10 m resolution have been utilized for the classification. Before using unsupervised classification techniques, multi tiles of sentinel-2 imagery has been acquired in ERDAS imagine software after that individual bands of 10 m spatial resolution from NIR, Red, Green and Blue bands were stacked together to create a multispectral image cube (Figure 6.10).

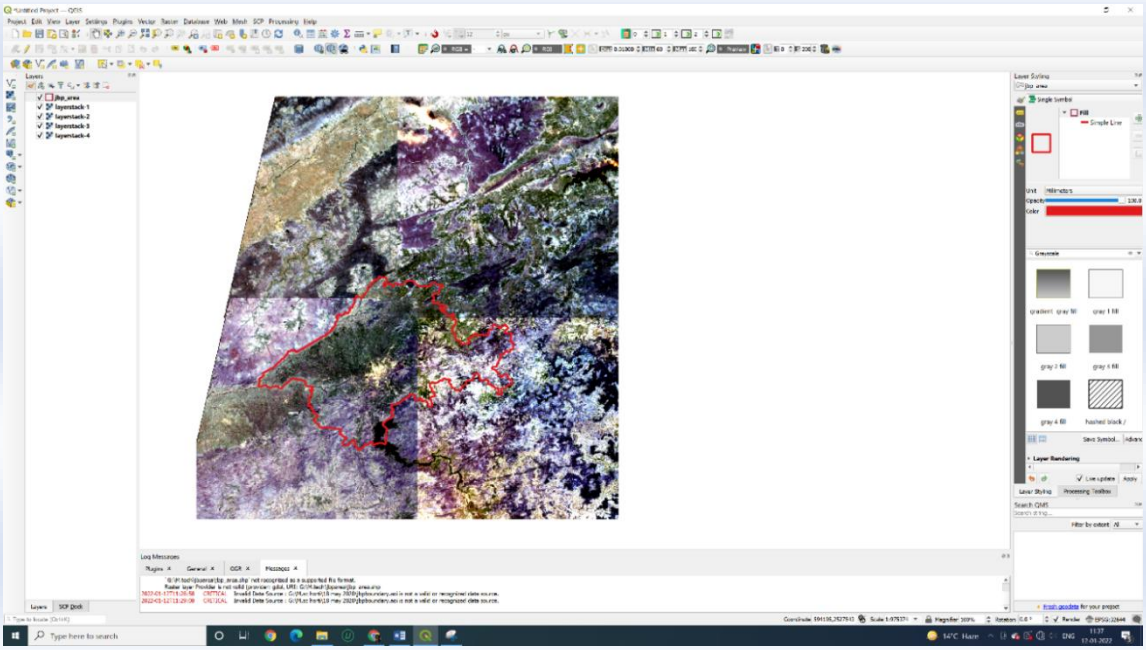


Fig. 6.10 Downloaded, Layer Stacked Sentinel-2 satellite data four tiles of the study area

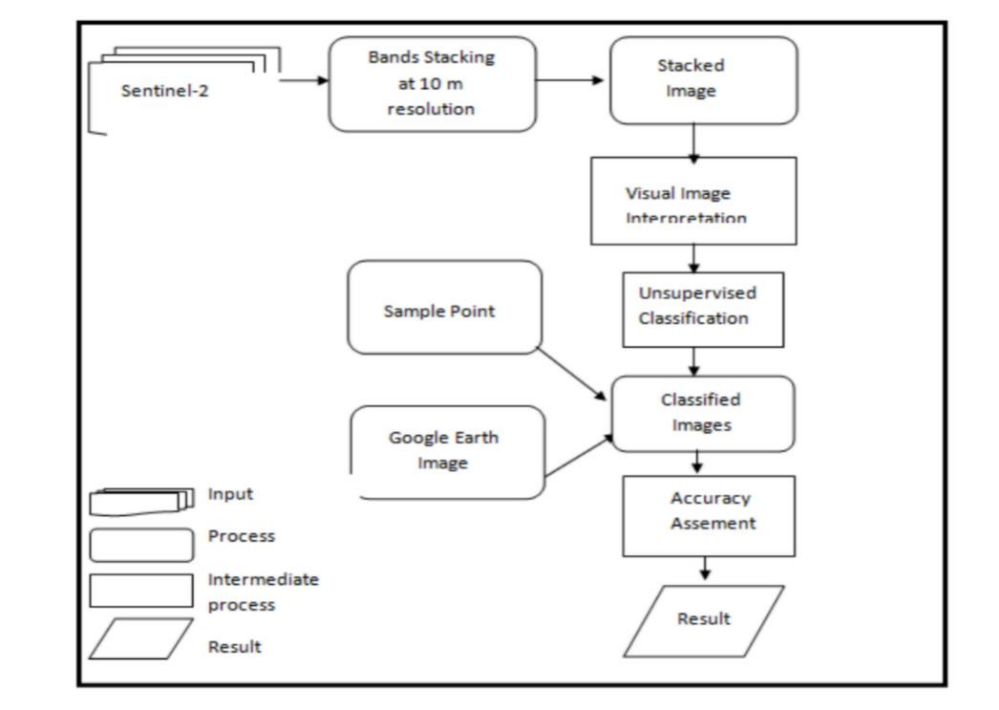


Fig. 6.11 Flow chart of methodology

The proposed methodology for crop classification is shown in Fig. 6.11. Multi DATA Sentinel-2 imagery has been taken and individual bands of 10 m spatial resolution from NIR, Red, Green and Blue bands were stacked together to create a multispectral image cube. Once the stacked image is generated, a single pixel contains a 4- dimensional vector containing spectral values corresponding the considered bands.

Sentinel-2 image acquired in the growing season, four bands at 10 m resolutions are stacked and the resultant image has been used for the crop classification. In this work, result

show that (Table 6.12.) wheat is the major crop of the study area that the wheat crop area is 128736 ha, while other crop area corresponds to 134432 ha.

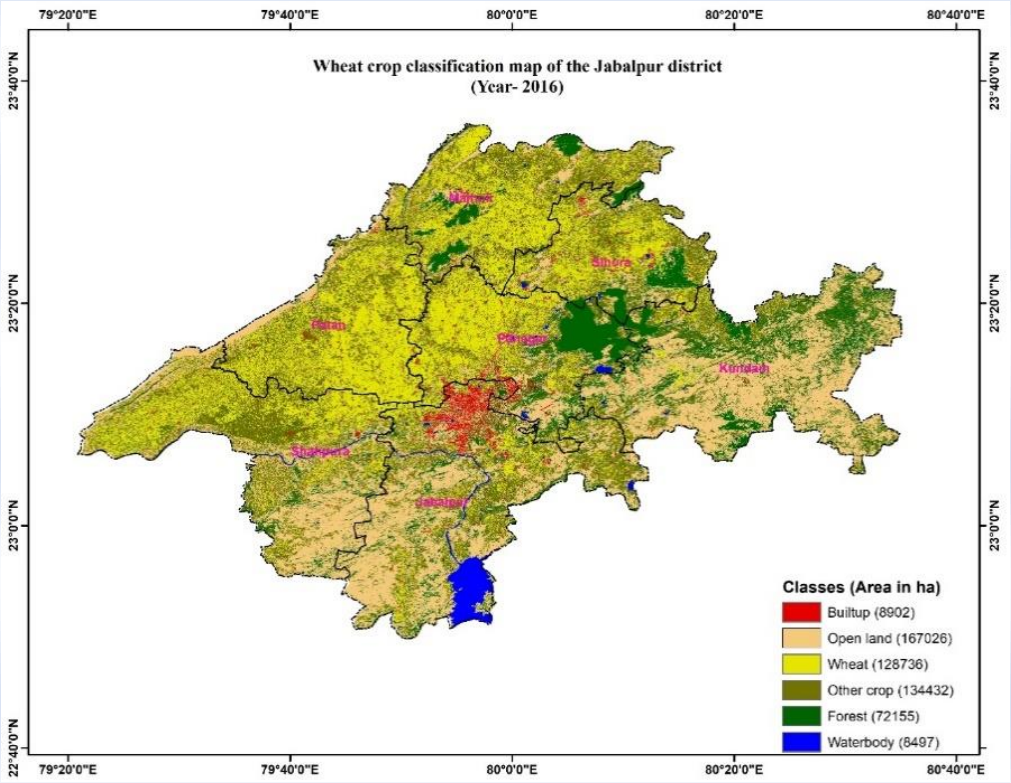


Fig. 6.12 Wheat Crop Classification Map of Jabalpur District (23February2016)

Table6.11Area under different classes in Crop map of the study area

S.No.	Classes	Area in ha	Area in %
1	Wheat	128736.00	24.12
2	Other crop area	134432.00	25.86
3	Forest	72155.50	13.88
4	Open Land	167026.62	32.14
5	Settlement	8902.03	1.71
6	Waterbody	8497.85	1.63
7	Total	519750.00	100.00

Table 6.12 Area through Remote Sensing data

Class	Area through satellite data, ha	Area as Ministry of Agriculture GOV India, ha	Difference, ha	Difference in percentage
Wheat crop	128736	131000	2264	1.72
Other crop	134432	153420	18988	12.37

Remote Sensing and GIS technology have the potential of revolutionizing the detection and characterization of agricultural productivity based on biophysical attributes of crops. Although RS cannot capture all types of agricultural information, it can reliably provide accurate and timely information to guide agronomic and economic decision-

making, if used in Jabalpur area. The study clearly demonstrated that district-level wheat acreage could be reliably estimated using multi-date vegetative growth stage Sentinel data and digital unsupervised classification. The unsupervised classification resulted in a 1.72 percent lower estimation of wheat acreage against the estimation given by the ministry of agriculture and farmer welfare GOV India, because it may be due to manual error of area estimation in a large scale.

6.1.4 Development of Ground water potential zoning map for Jabalpur district

The study is aimed to delineate groundwater potential zoning map using integrated remote sensing, Geographic information system, and Analytical Hierarchy Process (AHP) techniques for developmental blocks of Jabalpur district.

For the delineation of GWP in Jabalpur district different influencing parameters data were used and acquired from various sources. In this study area, 8 thematic maps, viz., land use land cover, soil type, geomorphology, lithology, slope, rainfall, drainage density and lineament were generated using satellite imagery and various conventional datasets in GIS environment. The complete work flow of methodology is given in Figure 6.13.

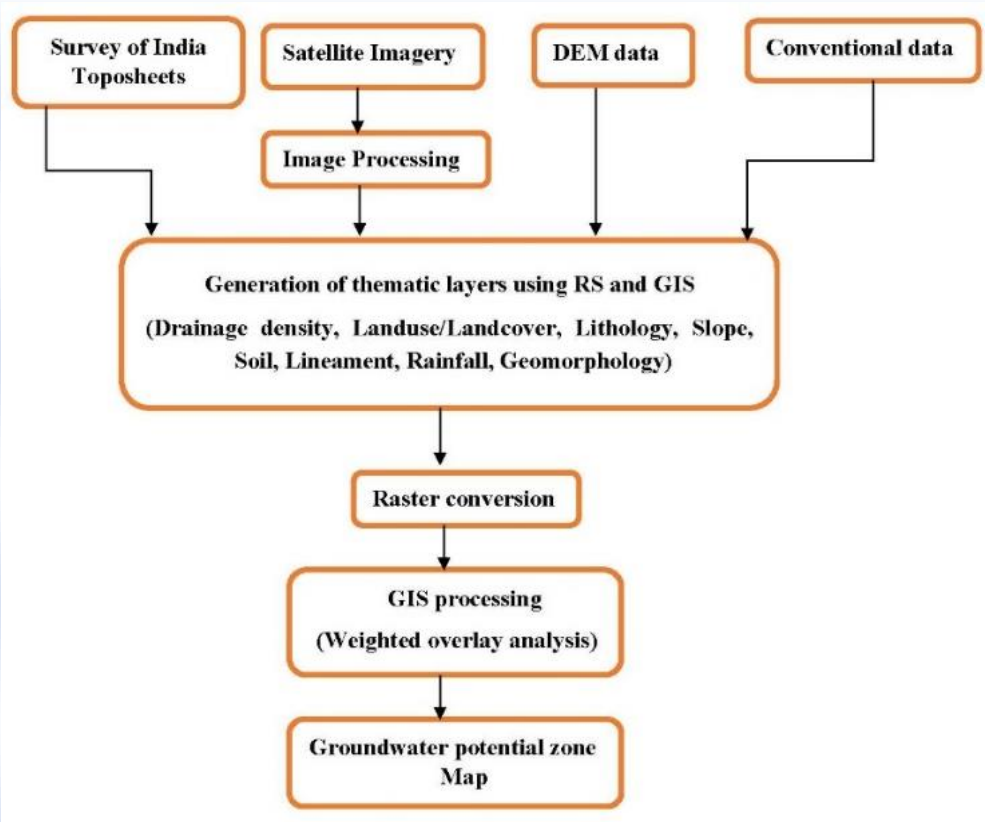


Fig. 6.13 Flowchart for delineating the groundwater potential zone

A slope map was prepared from the ALOS data using the spatial analysis tool in ArcGIS software. Figure 6.14 depicts the slope map of the Jabalpur district. The slope values were categorized into four classes namely low, moderate, high and very high. The majority area of Jabalpur district falls under low land slope category followed by moderate, high and very high slope category.

Lithology has as an important role in groundwater potential because the permeability of the rocks directly influences infiltration. In Jabalpur district various types of lithological unit are found namely Dolomite, Banded jasper fractured (BJF), Quartzite, Metalava, Phyllite, Sandstone and Orthoquartzite, Laterite, Basalt, Granite, clay with caliche concretion, Sandstone, Conglomerate, Limestone, Shale, and Amphibolite (Fig. 6.15). Mainly, about 37% of the total area in Jabalpur district, basalt is higher than another lithological unit.

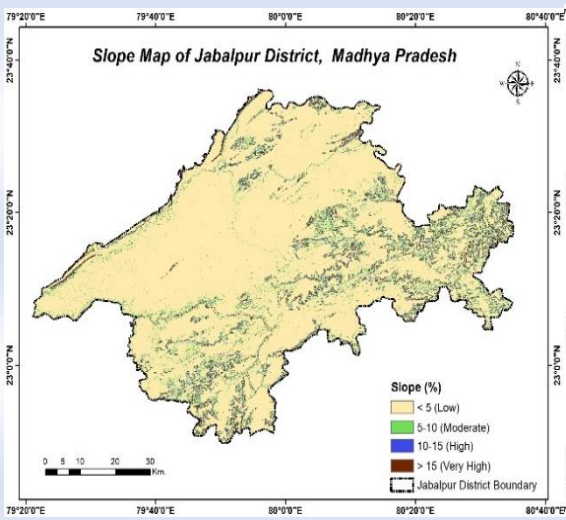


Fig. 6.14 Slope map of Jabalpur District

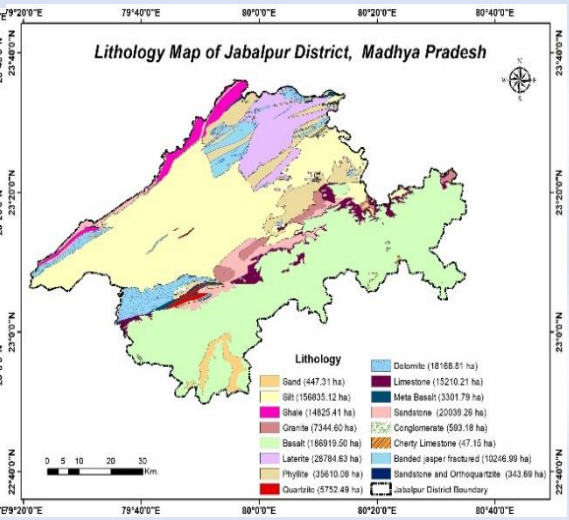


Fig. 6.15 Lithology map of Jabalpur District *(GSI)*

The Jabalpur district consists of four types of soil, i.e., loamy soil, clayey loam, loamy with clayey loam and clayey with loamy soil, as shown in Fig. 6.16. The soil texture of the area is one of the major factors that control the surface runoff and infiltration of rainwater. Loamy group soil has a low runoff rate and high groundwater potential, whereas the clayey soil group has a high runoff rate and very low groundwater potential. Table 6.13 depicts different types of soils, with a coverage percentage. The majority of study area was covered by clayey soil with a low to medium infiltration rate.

Table 6.13. Area under different soil type in Jabalpur district.

Soil Type	Area (ha)	Area, %
Clayey Soil	228002	45.10
Clayey Soil with Loamy Soil	127115	25.14
Loamy Soil	109759	21.70
Loamy Soil with Clayey Soil	40700	8.05

The identification of different landforms and the preparation of a geomorphic map are very important in evaluating the groundwater prospects. Geomorphology of the Jabalpur district is divided into various types of landforms viz., pediment–pediplain complex, low-to-high dissected hills and valleys, flood plains, Alluvial plain, Active Quarry, Dam and Reservoir, Piedmont slope, River and low to high dissected plateau. Jabalpur district is mostly covered by Alluvial plain (Fig.6.17).

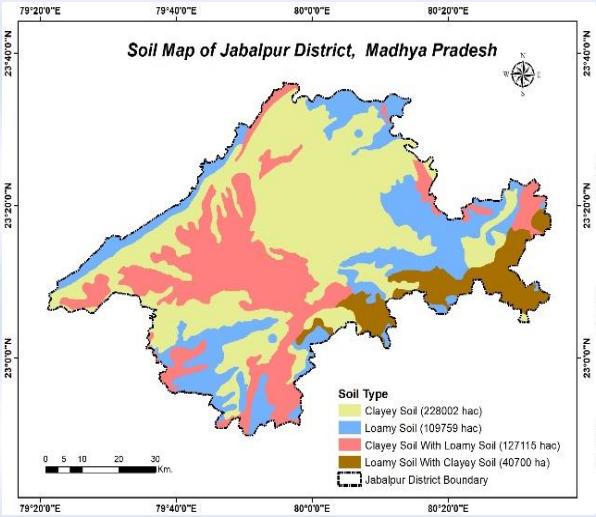


Fig. 6.16 Soil map of Jabalpur District (*NBSS&LUP*)

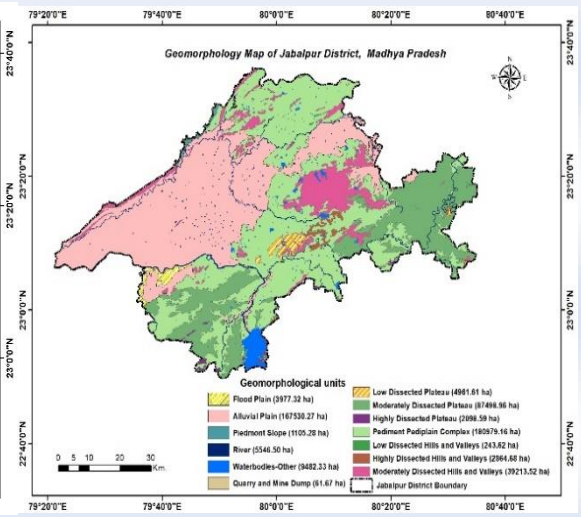


Fig. 6.17 Geomorphology map of Jabalpur District (*GSI*)

A drainage density map is prepared on the basis of closeness of spacing of stream channels. It measures the total length of the stream segment of all orders per unit area. Drainage density is an inverse function of permeability and therefore an essential parameter in assessing the groundwater potential zone. High drainage density values are favorable for runoff and hence indicate a low groundwater potential zone. The drainage density map of Jabalpur district was prepared from the digital elevation model in GIS environment (Fig. 6.18). The drainage density map classified into four categories like low, moderate, high and very high. Majority part of the Jabalpur district has low drainage density followed by moderate, high and very high.

Lineaments are structurally controlled linear or curvilinear features. Lineaments represent the zones of faulting and fracturing resulting in increased porosity and permeability. The lineament density map is depicted in Fig. 6.19. By carefully examining the values obtained, the data were reclassified into five categories - Very low (0–0.050 km/km^2), Low (0. 050–0.152 km/km^2), Moderate (0.152–0.283 km/km^2), High (0.283–0.464 km/km^2) and Very high (0.464–0.811 km/km^2). The lineament density map shows a low density in most of the area comparatively to other parts of the study area.

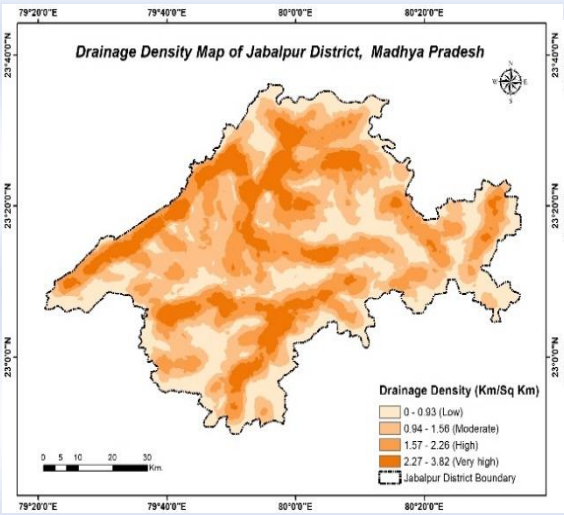


Fig. 6.18 Drainage Density map of Jabalpur District

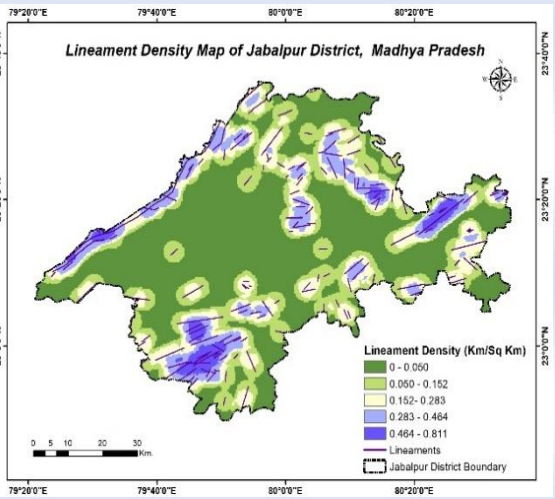


Fig. 6.19 Lineament Density map of Jabalpur district *(Bhuvan)*

Rainfall is the primary cause of groundwater recharge where water is infiltrated by fractures and soil into the subsurface, it is also essential to have other rainfall features such as duration and intensity to calculate runoff. The annual mean grid rainfall data of 21 metrological stations obtained from the Indian Meteorological Department (IMD) website and these data are interpolated spatially using the inverse distance weighting method as this approach is more appropriate for data-sparing regions. The annual average rainfall of study area was categorized into five classes which were; (i) 1086-1163 mm, (ii) 1164-1203 mm, (iii) 1204-1247 mm, (iv) 1248-1288 mm and (v) 1289-1355 mm. Fig. 6.20 depicts the rainfall regions of the study area.

Land use and land cover (LULC) is one of the vital factors which directly affect the development of groundwater recharge. Different types of land use act as differently in the runoff, infiltration and groundwater recharge. Generally, forest cover and agricultural land are most suitable for groundwater recharge. On the other hand, the built-up area is not suitable for groundwater recharge. LULC map has been classified into major six types of LULC classes namely; agricultural area, fallow area, forest, open land/barren land, settlement area, and waterbody as shown in Fig.6.21. Majority of land in this district is under the cover of agriculture and vegetation.

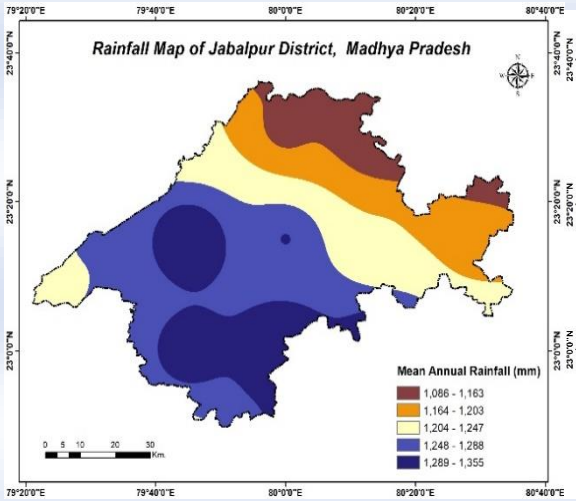


Fig. 6.20 Rainfall map of Jabalpur District

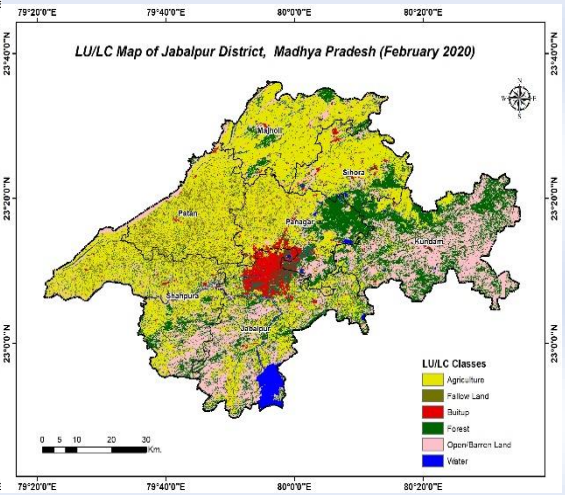


Fig. 6.21 LULC map of Jabalpur District (Sentinel-2 Data)

After assigning weights and ranks to factors and their subclasses, all the inputs were integrated through weighted overlay method using the Eq. (1):

$$GWPZ = \sum_{i}^{n} GM_x GM_y + So_x So_y + LD_x LD_y + DD_x DD_y + S_x S_y + LULC_x LULC_y + G_x G_y + R_x R_y + DL_x DL_y \quad \dots (1)$$

Where GWPZ represents the groundwater potential zone, ‘x’ and ‘y’ represents class and factor subclass, respectively, G represents Lithology, GM represents geomorphology, So is soil, LULC is land use land cover, DD is drainage density, S is slope, R is Rainfall, LD is lineament density, DL is depth to water level.

The generated groundwater potential zone of this study area was categorized into five zones, namely Very good, Good, Moderate, Poor and Very poor (Fig. 6.22). About

18.28 % of the study area has very good ground water potential zone and 21.90 % falls in the good zone category, as shown in Table 6.15. About 23.22 % of study area falls in the poor and 11.40 % in very poor ground water potential zone category. A closer analysis of the map indicates that the very Good GWPZ mapped in the northwestern and southern areas of the district are due to the favorable, geomorphology units that have good groundwater recharge capacities (Alluvial plain), prevailing that parts of the district are most likely contributing to the high groundwater potential in such part. Agricultural areas with low slope allow more infiltration due to pore spaces in the soil, which trap and hold the water in the roots, providing a pathway for water to percolate into the surface by loosening up the rock and soil. Less drainage density, Lineaments in this area do not affect groundwater potential. The lithologic unit's high permeability and porosity increase groundwater storage and groundwater yields. Water bodies (lake, pond and river) are the permanent source for groundwater recharge. Thus, these areas are the most crucial groundwater potential areas. The rainfall impact can be observed in both part which has a very high groundwater potentiality. On the other hand, very poor GWPZs mapped in scattered part of the district are due to built-up and barren lands reduce infiltration and increased runoff potential. Therefore, the areas with settlements and barren lands have poor groundwater recharge potential. Geomorphology units (Low to high dissected hill & valley, Low to high dissected Plateau, Pediment pediplain complex) and the lithologic units (Basalt, Granite, and phyllite) and high slope area that have very low groundwater recharge capacities are prevailing in that parts.

Table 6.15. Area under various groundwater potential zone in Jabalpur district

Sr. No.	Class Name	Area (km^2)	Area (%)
1	Very Good	924.36	18.28
2	Good	1107.82	21.90
3	Moderate	1274.01	25.20
4	Poor	1174.12	23.22
5	Very Poor	576.46	11.40

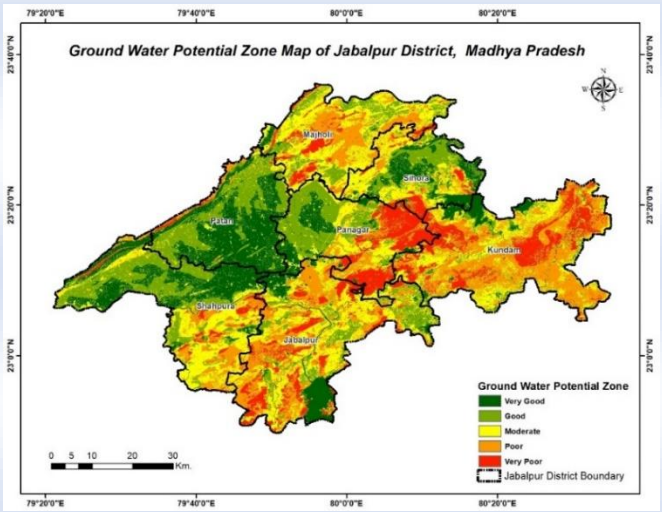


Fig. 6.22 Groundwater potential zone map of Jabalpur district

In order to validate the accuracy of the groundwater prospect map of the study area, a number of wells falling in each of these zones and the respective water level fluctuation data of observation wells were analyzed. These data are interpolated using the Inverse Distance Weighting Method, contours of one-meter interval are generated. These contours are superimposed upon GPZ map for validation. From the water level fluctuation contours, it can be observed that deep water level, high fluctuation wells indicate very poor & poor groundwater potential zones. In contrast, moderate, good, very good water potential zones are coincident with shallower water depth and low water level fluctuations. This pattern of well locations is clearly in agreement with the groundwater potential zones estimated in the study (Fig. 6.23).

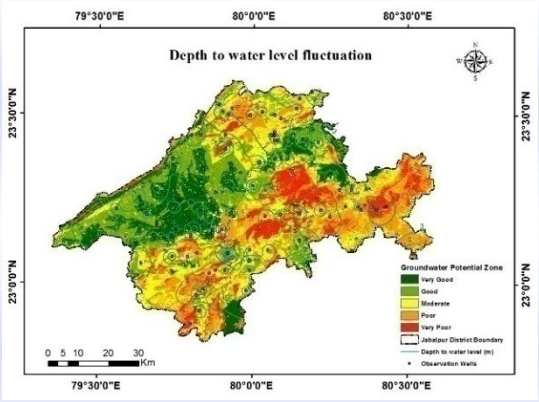


Fig. 6.23. Water level fluctuation map

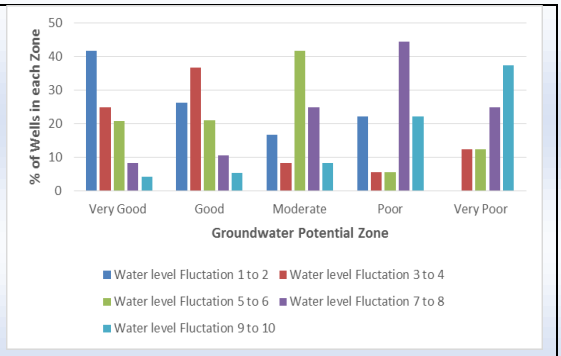


Fig. 6.24. Water level fluctuation in each groundwater potential zone

The results of the present study can serve as guidelines for planning future artificial recharge projects in the study area in order to ensure sustainable groundwater utilization. The farmers in the area will be highly benefited from such type of studies for further targeting sites under various zones for exploration of groundwater. The results will be helpful to NGO work under water conservation theme. Bore well drilling through Panchayat in remote location this result serve as base map.

6.1.5 Spatio-temporal Ground water trend analysis in Tons basin of Madhya Pradesh, India

The current study explored nonparametric statistical methods for identifying critical areas of Tons basin, which are showing significant trends in ground water depletion. To ascertain trend and its magnitude, nonparametric Mann Kendal test (*i.e.*MK test) and Sens slope estimator tests were used.

The Tons river is a tributary of the Ganga river, originating at Tamakund in the Kymore Range in Madhya Pradesh (M.P.). The Belan, Mahana, Beehar Simrawal, Karihari and Nar are some of the tributaries of the Tons. The geographical extent of the Tons sub-basin lies between 80° 18' to 83° 20' east longitudes and 23° 58' to 25° 17' north latitudes of the country with total catchment area as 17,441 km2, out of which 12,165 km2 (70%) lies in M.P., and the remaining area of 5276 km2 (30%) lies in Uttar Pradesh (U.P.).

Information from different sources have been collected to conduct and validate the study. The groundwater level data have been collected from CGWB, Bhopal for various blocks of Rewa and Satna district during the Winter (i.e., Rabi session) Pre-monsoon, Monsoon and Post-monsoon seasons for a period of 22 years from 1996-2018 have been used in the analysis.

Table 6.16. Details of Data Collected

Descriptor	Description
GWL Data	62 observation wells data collected from CGWB office, Bhopal
Rainfall Data	Monthly rainfall data from MPWRD website
Satellite Image	Sentinel 2B (10 m resolution)
DEM	SRTM (30 m resolution)
Land use	Prepared from Sentinel-2 image
Software used	ArcGIS - 10.8, ERDAS Imagine 2020

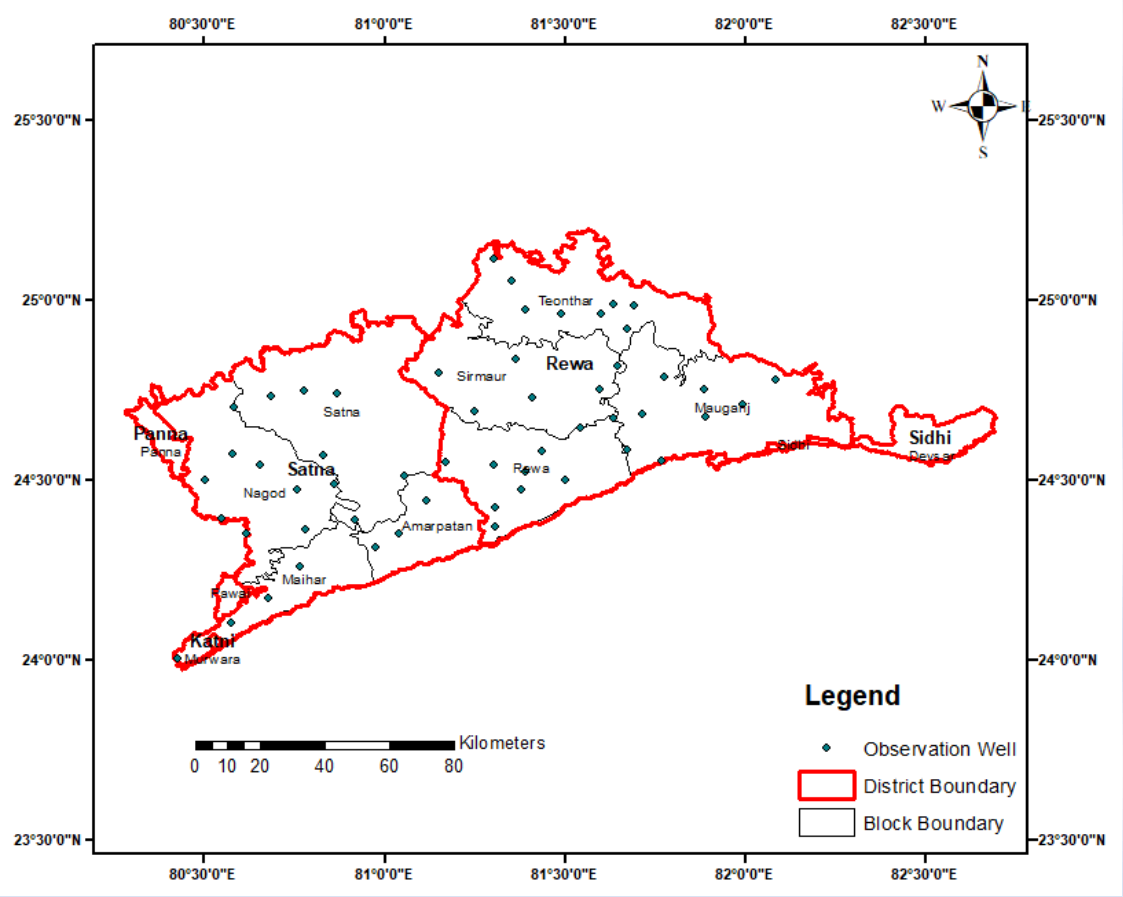


Fig.6.25 Spatial distribution of observation well in study area

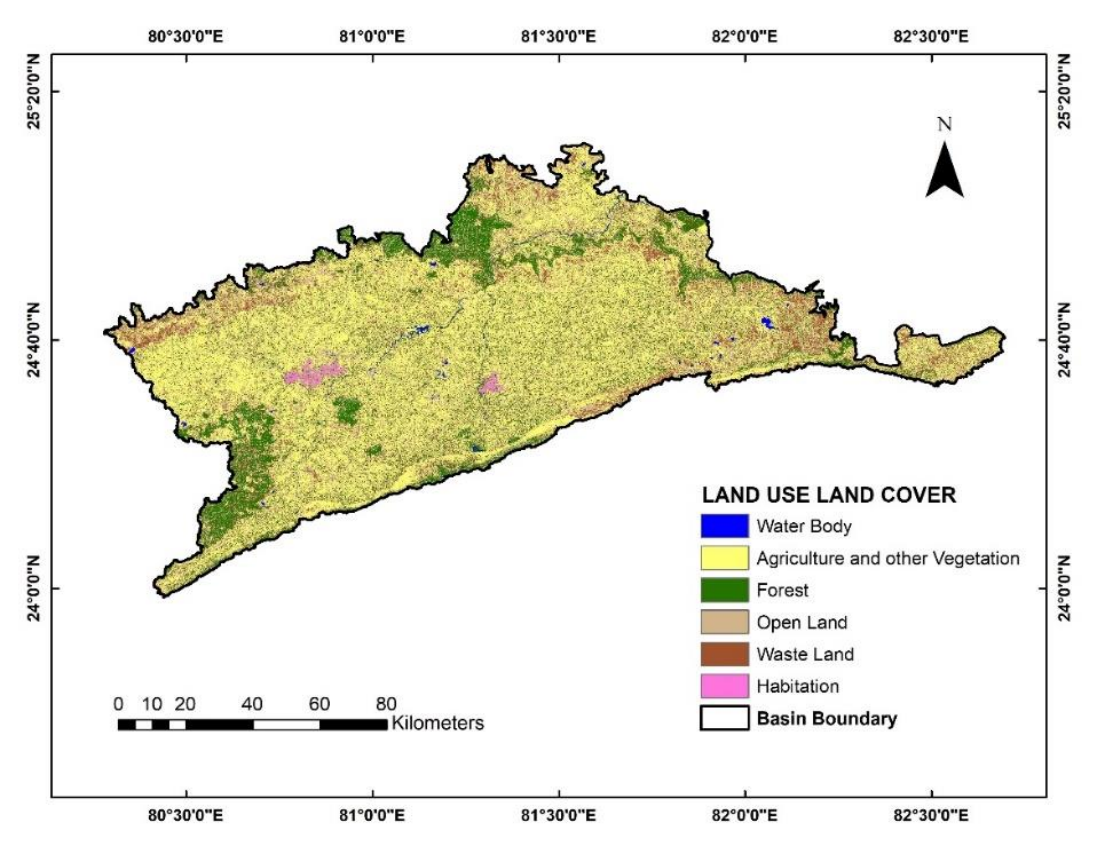


Fig.6.26 Land use land cover map of Tons Basin

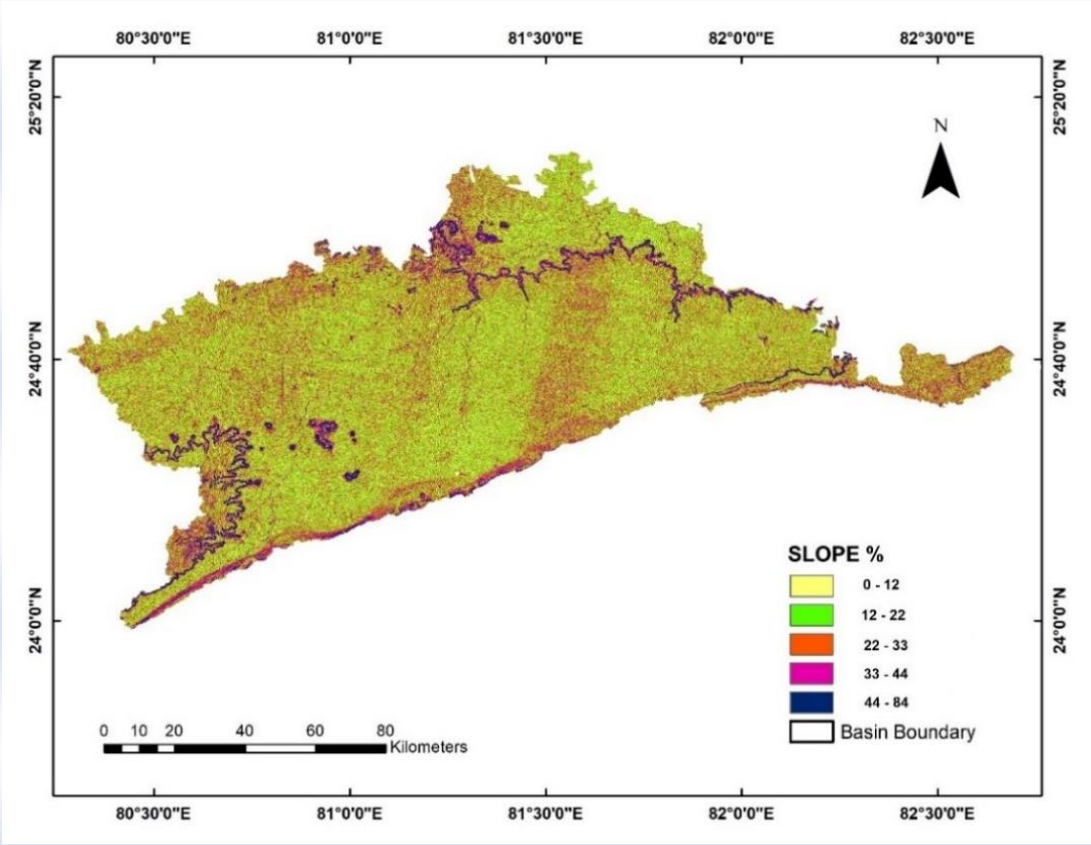


Fig. 6.27 Slope Map of study area

Spatial analysis LU/LC map has been derived from sentinel 2B image having 10m of resolution (Fig. 6.26). Also, SRTM DEM have been downloaded to derive the slope of study area (Fig. 6.27).

To determine the spatial distribution of water in the Tons basin, the average ground water level on yearly basis as well as on different seasons like Pre-Monsoon, Monsoon, Post Monsoon, Winter sessions were determined, and their spatial distribution is shown in Fig. 6.28& Fig.6.29. respectively. Considering the annual variation, it can be assessed that average yearly water level of major part of study area lies in 5-10 m. some area of Teonther blocks of Rewa district showing the depth to ground water level in the range of 15-20 m, followed by Sirmour block of Rewa having annual depth to ground water level in range of 10-15 m. rest of the other area of Tons basin lies in range of 0-10m.

Average depth to water level assessed on different seasons are shown in Fig.6.29. In pre-monsoon session, the water level range varies between 4.59 m and 18.68 m on average. More than 50% of the Tons basin area fall between 10 to 15 m which includes Blocks Teonther, Sirmour, Rewa block as well as Satna block, Amarpatan in Satna district. These blocks having few patches where water depleting by 15-20 m in Pre-Monsoon. The stations, particularly in Rewa district, indicate a higher depth to the ground water level than the stations in Satna district.

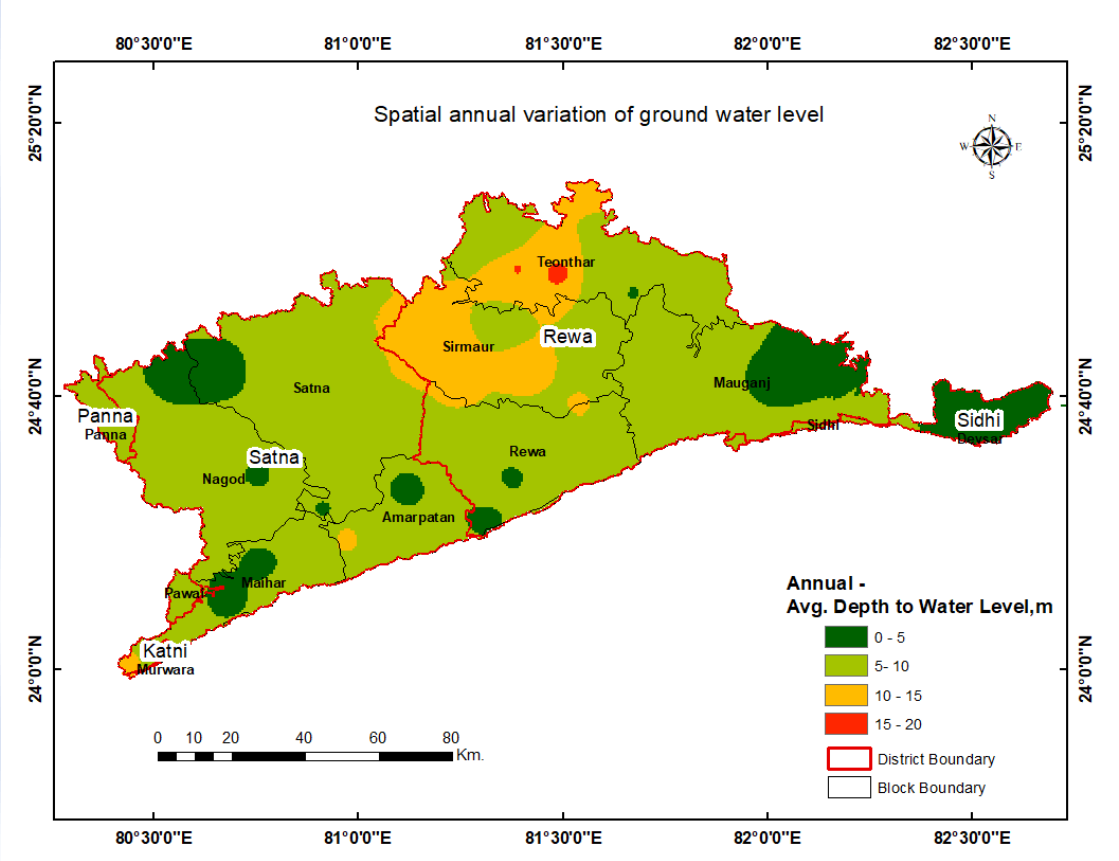
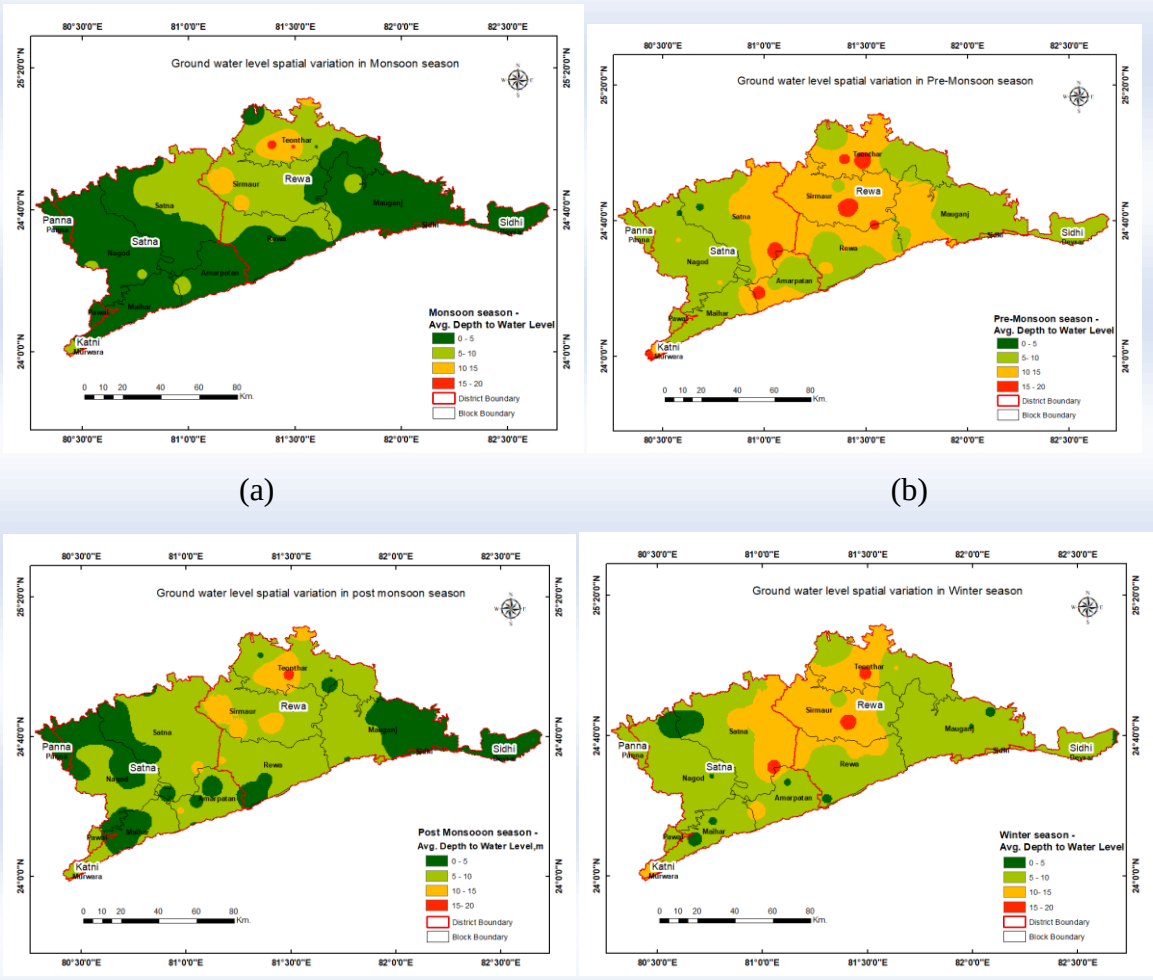


Fig. 6.28 Average Annual water Level of Tons basin



(a) (b)

(c) (d)

Fig. 6.29 (a-d) Average Ground water level of different session of study area

Table 6.17 Statistics of ground water level and their seasonal areal distribution

Depth to GWL	Area, ha			
	Pre Monsson	Monsoon	Post Monsoon	Winter
0-5	1828.23	783492	352553	38511.6
5-10	683947	383996	783086	843741
10-15	503095	46469	78203	324653
15-20	29841	4750	4869	11801

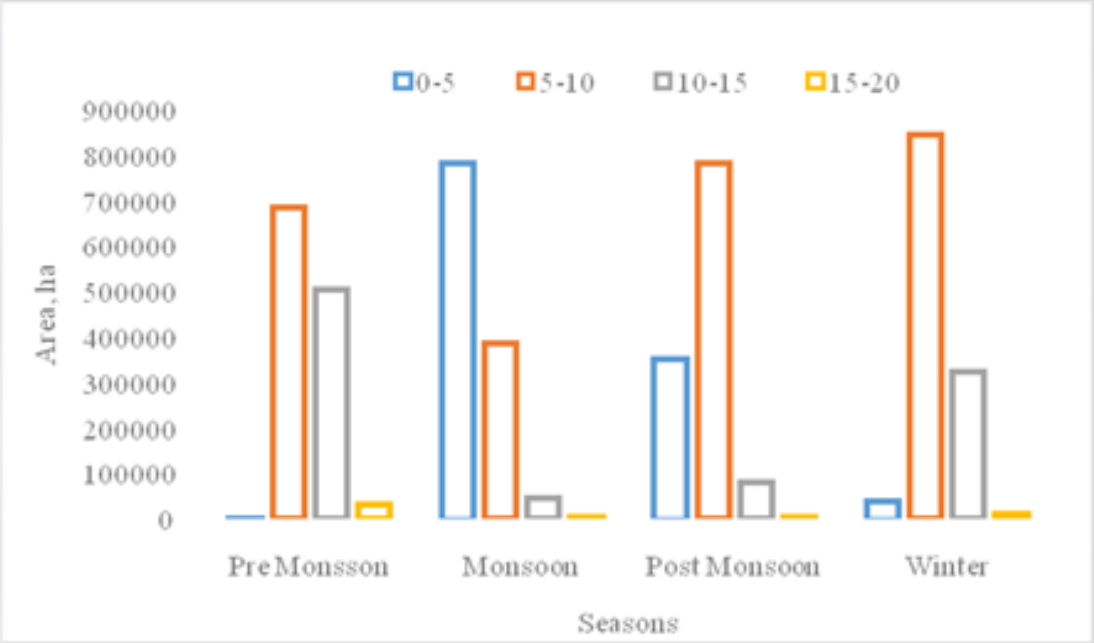


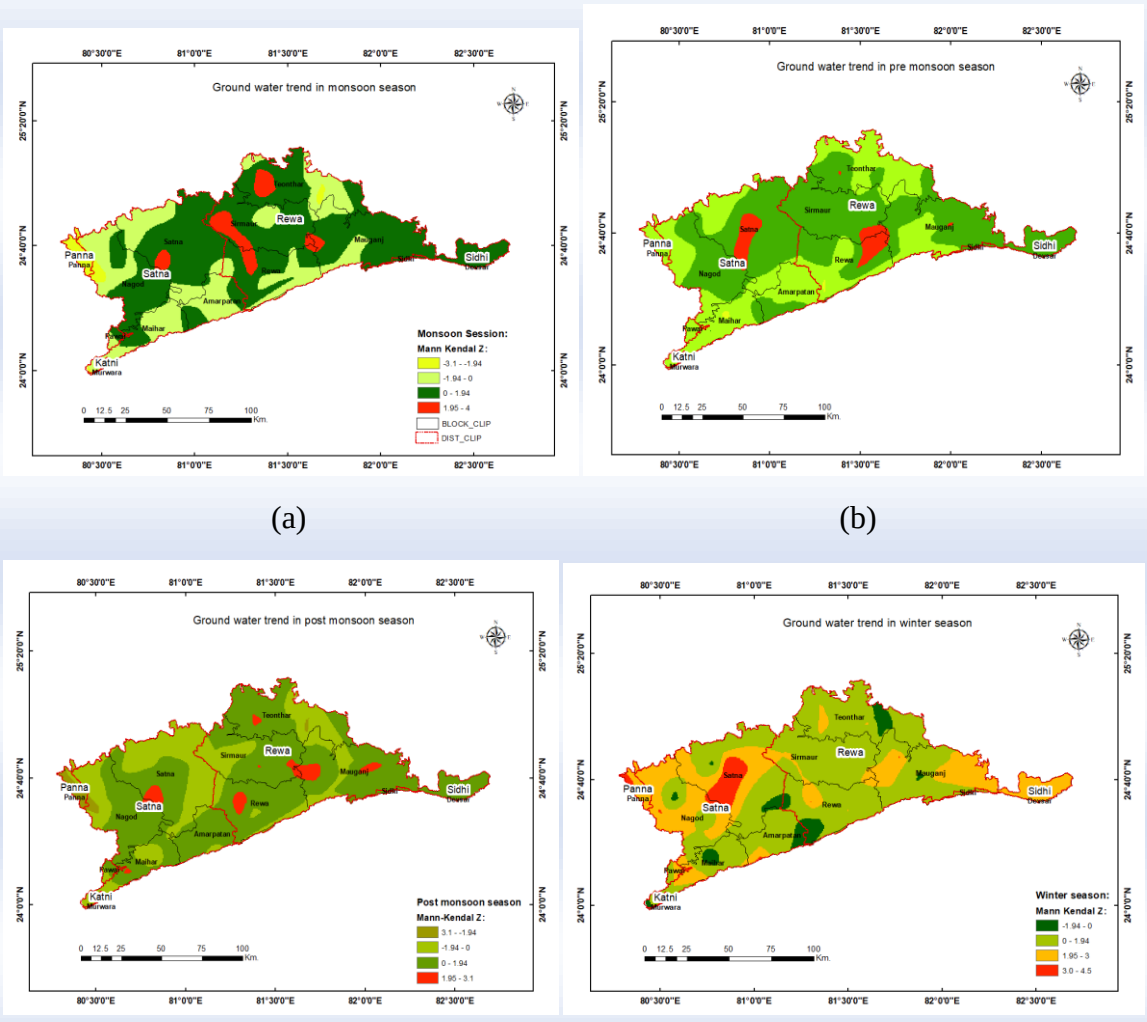
Fig.6.30 Ground water level and their seasonal areal distribution

Based on the GWL areal distribution statistics from 22 years data (i.e. 1996-2018), it can be assessed that during monsoon season, the depth to water level in 70 % of study area have been found under 0-5 m, however during post monsoon session, nearly 65% of the area lies under water table depth of 5-10 m. It can be revealed that aquifers are not retaining the received water during monsoon season and they had quickly released the water causing water scarcity in later sessions. Also, in the winter season (i.e. Rabi session), it was observed that water table getting down in nearly 27% of the area falls under 10-20 m of water table, which was earlier approx. 7% area during post monsoon season. So water table is getting depleted in high rate during winter season (i.e. Rabi session) so it is very important to identify areas where water table trend is significantly depleting so necessary action can be taken up by the decision makers.

For trend analysis, the year has been divided in to four seasons Monsoon (June-September), post monsoon (October-November), winter (December-March) and Pre-Monsoon (April-May). Analysis of the data was carried out season-wise as well as year-wise for rainfall (1996–2018). In this study, the magnitude of trend in a time series was determined using a nonparametric method known as Sen's estimator (Sen, 1968) and statistical significance of the trend in the time series was analyzed using Mann–Kendall (MK) test (Mann, 1945; Kendall, 1975). The use of the Mann-Kendall (MK) test (Mann 1945, Kendall 1975, Gilbert 1987) is to statistically measure if there is a monotonic rising or downward trend of the variable of interest over time. An upward trend means that the variable consistently increases through time and vice versa, but the trend may or may not be linear. The MK test can be applied in place of a parametric linear regression analysis, if the gradient of the linear regression is other than zero. The regression analysis requires that the residuals from the fitted regression line to be normally distributed.

Based on results, the spatial trend values have been plotted for Tons basin and it has been revealed that majority of the sites in Rewa and Satna district are showing the positive

trend (i.e. Depth to GWL increasing), However few stations showing the negative trend as well (i.e. Depth to GWL decreasing). Based on the result, it was found that there were 14 sites, showing statistically significant increasing trend changes of ground water means depth to ground water significantly increased particularly in blocks of Rewa district e.g. Gangeve, Jawa, Mauganj, Naigarhi, Rewa and Sohawal, Unchahara blocks in Satna district. The different sites which were showing the significant trend changes were highlighted in red colour for the identified blocks. On contrast, few places in Maihar and Ramnagar blocks of Satna District shown the significant decreasing ground water trend over the 22 years of selected period. It can also be revealed that there is variability of trend change in different seasons but few area's especially in Rewa district in quite prominently showing the trend change in mostly all the seasons.



(a) (b)

(c) (d)

Fig. 6.31 (a-d) Average Ground water level of different seasons of study area

Fig 6.32. The site showing Significant Ground water trend changes in all four seasons (Tikura site-Gangeve Block, Rewa)

Table 6.18 Statistics of observed ground water trend and its seasonal areal distribution

Mann-Kendal trend Z Value	Area, ha				Remark
	Pre Monsson	Monsoon	Post Monsoon	Winter	
<-1.94	2263.92	30275.3	18575.9		Statistically Significant (-ve)
-1.94-0	463868	365855	364984	57252	Not Significant
0-1.94	700155	758951	793240	763431	Not Significant
>1.94	52425.1	63631	41912.4	391930	Statistically significant (+ve)
Total Area	**1218712**				

For every season (i.e. Pre Monsson, Monsoon, Post Monsoon, Winter), the total area which is showing the statistical significant positive/negative ground water trend have been assessed for Tons basin as represented in Table 6.18.

Based on the results, it has been assessed that 61.75% of the Tons basin area in Pre-Monsoon season showing the water table depletion, however out of this area, 4.30% of area

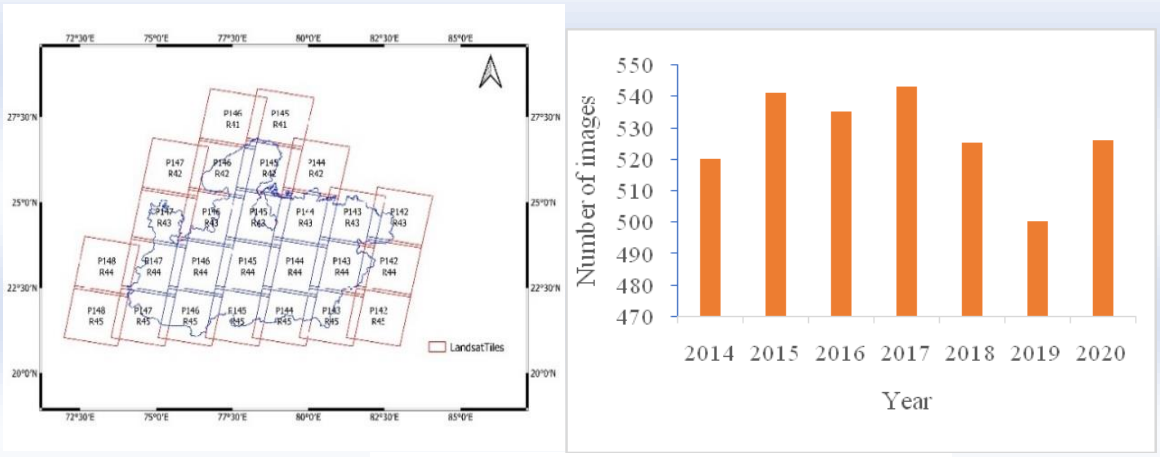
showing the statistically significant decline of ground water.

Similarly, in monsoon season, 67% area indicating the water table decline, out of which 5.22 % area is significantly declined over the year. Also in post monsoon, 68.5% area is showing a decline of ground water, out of which 3.43% of the area is statistically significant ground water decline issue.

Based on the analysis, the areas which are having significant ground water declination in different blocks of two major districts Rewa and Satna of Madhya Pradesh have been identified and suitable strategies have been planned and suggested on the demand and supply side to the policy as well as decision-makers. The areas where the significant increasing groundwater trend have been identified such as in Rewa district where Gangeve, Jawa, Mauganj, Naigarhi, Rewa and Blocks of Satna district namely Sohawal, and Unchahara blocks, the strategy of demand-side should be aimed to restrict the demand below the value which needs utilization of groundwater resources in the area having significant trend changes. Thus, the proposed strategy is to use only replenishable amounts of groundwater. Water harvesting structures need to be planned to recharge more water for the stressed areas. Rainwater harvesting through farm ponds, Nadi, anicuts, percolation tanks, surface check dams, underground check dams, and minor and major surface reservoirs. Recharging the groundwater e.g. recharge through dead wells, Nala bunding and anicuts are found to be very suitable for recharging groundwater. However, the proper location of rain harvesting structures can be decided based on the number of parameters like slope, lineament, geology, geomorphology etc, which will be done in future for the study area to propose the water harvesting structures. Efficient crop planning like wheat can be replaced in Rabi season with gram in water stressed area and cash crop like sugarcane, soyabean can be introduced in water surplus areas or area showing the significant increasing of water trend as few areas identified in the study area like Maihar block and Ramnagar block of Satna district.

6.1.6 Dynamics of Surface Water Using Landsat-8 OLI Imagery and Google Earth Engine Cloud Platform

In this study, Landsat 8 OLI imagery (2014-2020) from GEE database were used to monitor changes of surface water extent in the Madhya Pradesh state from 2014 to 2020. The Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS) are instruments onboard the Landsat-8 satellite, which was launched in February of 2013. The satellite collects images of the Earth with a 16-day repeat cycle. These two sensors provide data at a spatial resolution of 30 meters (visible, NIR, SWIR), 100 meters (thermal) and 15 meters (panchromatic). Figure 6.33a shows that the study area is completely covered with 26 tiles according to the Earth Resources Satellite Worldwide Reference System (WRS-2). All available surface reflection dataset of Landsat-8 OLI images (about 3690) was used on the GEE platform for the study area and for the period 1 January, 2014 to 31 December, 2020.



(a) (b)

Fig.6.33. (a) Spatial distribution of Landsat tiled with path and row over the study area; (b) Total number of Landsat-8 images from 2014 to 2020

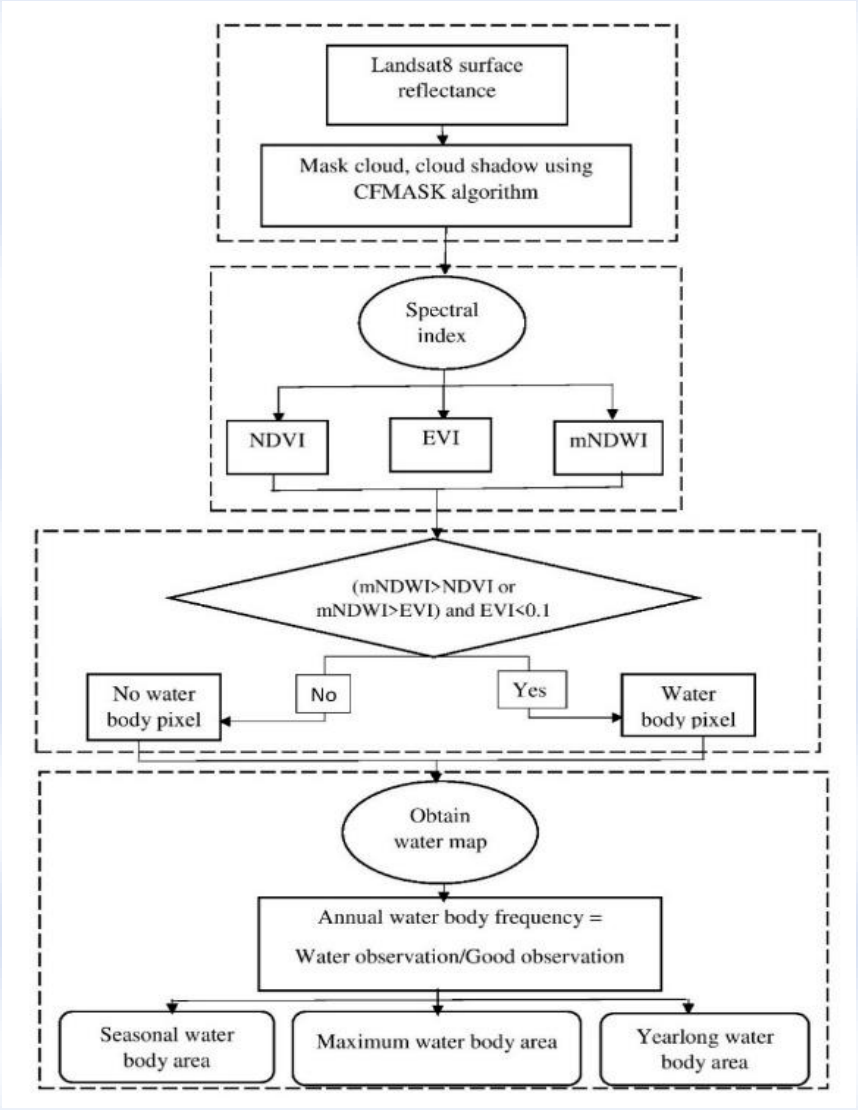


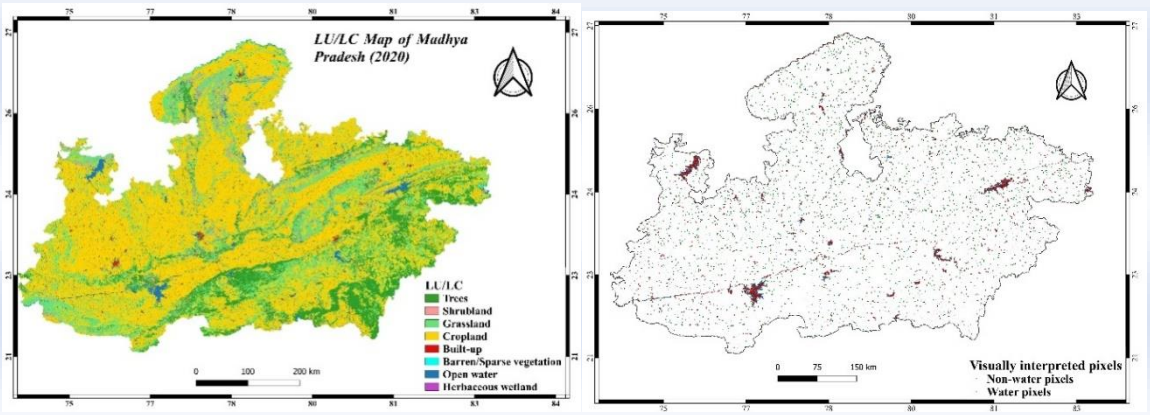
Fig. 6.34 Flowchart of the overall methodology of surface water mapping

Based on the water frequency, the maximum, seasonal and yearlong surface water area were calculated. The annual maximum surface water area is defined as the product of number of pixels having annual water frequency ≥ 0.25 and the area of a single pixel (900 m^2). The annual yearlong water body area is calculated by number of pixel having annual water frequency ≥ 0.75 multiplied by the area of a single pixel. The annual seasonal surface water extent is the difference between maximum surface water extent and yearlong surface water extent ($0.25 \leq wf < 0.75$).

$$S_a = \sum_{i=1}^{N} A \times pixelsize \times 10^{-6}$$

Here, S_a is the area of the seasonal, maximum and yearlong surface water body of different types (km^2), N is the total number of pixels, A is the number of pixels, and *pixelsize*is the pixel area (m^2).

The land use/land cover map of Madhya Pradesh for 2020 at 10 m resolution was extracted from the European Space Agency (ESA) global land cover map product (Fig. 6.35a) and used as reference data to evaluate the accuracy of the extracted open-surface water bodies in the Madhya Pradesh. The map was extracted using Python Google Earth Engine API and "geemap" Python package. In the LU/LC image, 4000 test samples, including 2000 water samples and 2000 non-water samples, were randomly generated. served as reference data. Then, 4000 points were added to a single surface water map of Madhya Pradesh for 2020, which was produced from Landsat-8 satellite images (Fig. 6.35b).



(a) (b)

Fig.6.35 (a)LU/LC map of Madhya Pradesh for 2020 at 10 m resolution (*ESA World Cover 10 m 2020 v100*); (b) Visually interpreted water and non-water pixels

Table 6.19: The confusion matrix for accuracy assessment

Verification points	Visual interpretation		Total	User's Accuracy (%)
	Water points	Non-water points		
Water points	1717	283	2000	85.85
Non-water points	09	1991	2000	99.55
Total	1726	2274	4000	OA= 92.7
Producer's accuracy (%)	99.47	87.55	Kappa coefficient = .85	

The overall accuracy and kappa coefficient was 92.7 % and 0.854, respectively (Table 6.19), which indicated that the detected surface water bodies in the Madhya Pradesh had higher accuracy and then can be used for further analysis.

The spatial distribution of water pixels in Madhya Pradesh state based on 2014 to 2020 Landsat-8 images is shown in Figure 6.36. In general, the seasonal and yearlong waterbody were 2858.2 km^2 and 2657.6 km^2, accounting 51.81% and 48.18% of the total surface water bodies in Madhya Pradesh state, respectively.

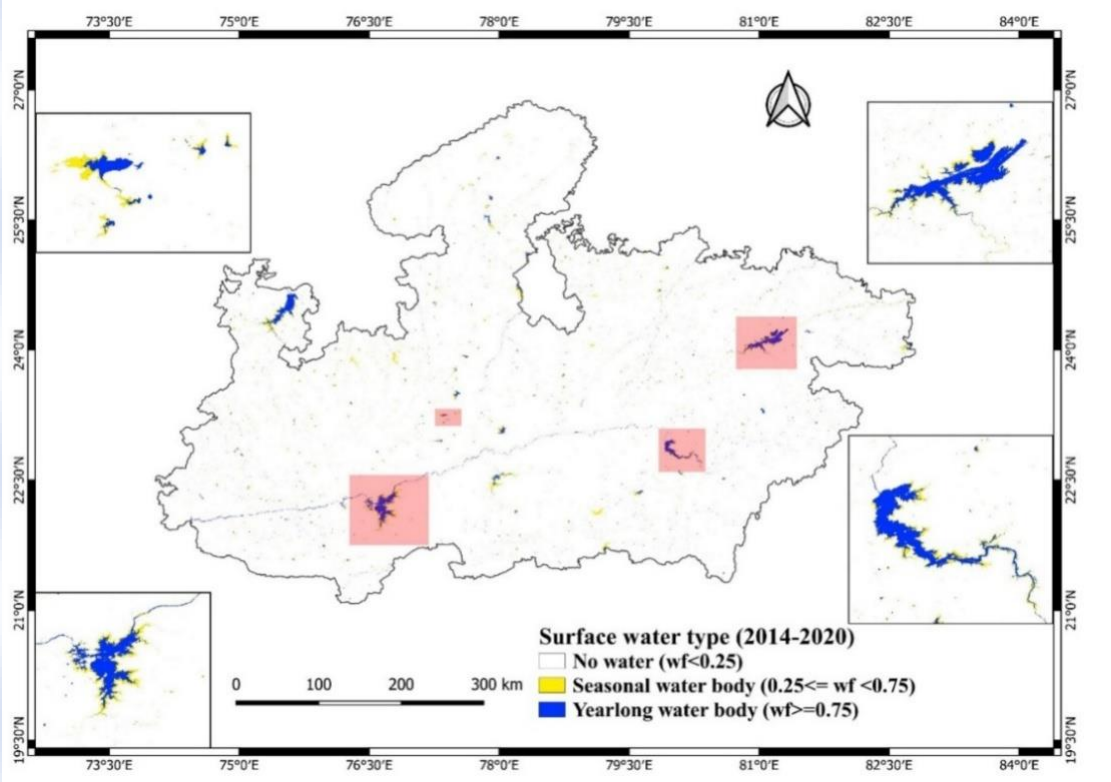
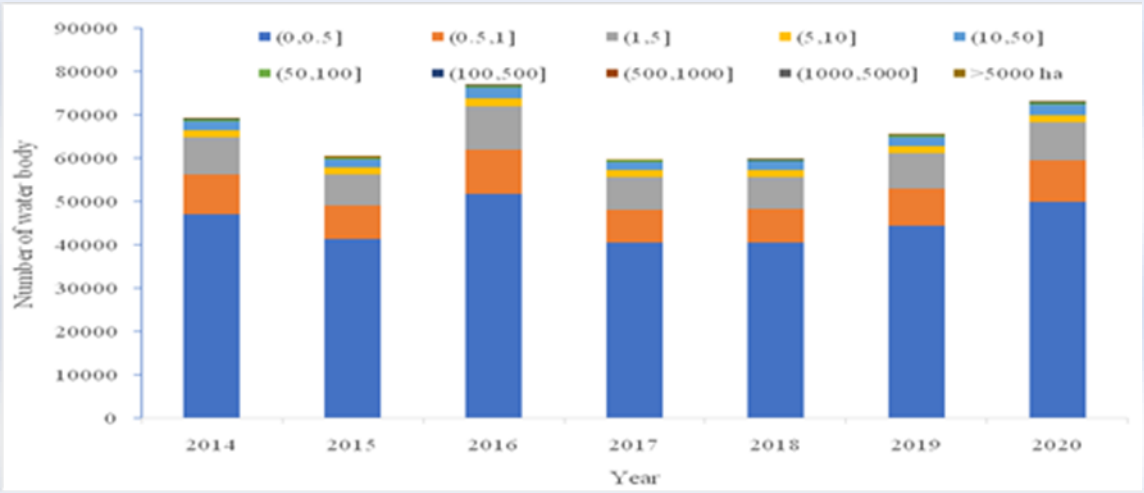
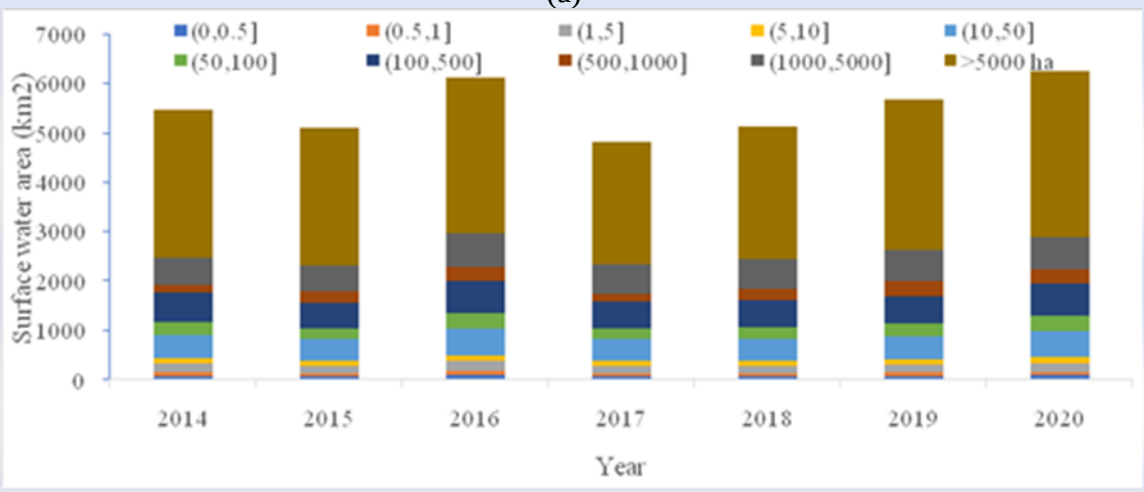


Fig.6.36 Surface waterbody map of Madhya Pradesh (2014-2020)

The number and area distribution of open surface water bodies at different size levels are shown in Figure 6.37. During 2014 to 2020, the maximum water bodies having surface area greater than 100 ha accounts 0.54% the total number of maximum water body and accounted for 73.53% of the total maximum water body area.



(a)



(b)

Fig. 6.37 The numbers and area distribution of the maximum surface water body at different size levels during 2014-2020; (a) the number of maximum surface water body, (b) the area distribution of maximum surface water body

The number of surface water bodies of surface area larger than 500 ha accounted 0.11% of the total number of surface water bodies and accounted for 60.33% of the total maximum water body area. However, the maximum water bodies which have area less than 0.5 ha accounted for 67.86% of the total number of surface water bodies and accounted for 1.34% of the total maximum water body area. These results indicated that the change of water body number in Madhya Pradesh state is mainly influenced by small water bodies, while the change of water body area is influenced by large water bodies.

The year wise surface water extent in Madhya Pradesh from 2014 to 2020 is given in Table 6.20. The highest maximum surface water area (6258.8 km^2) was observed in 2020 and lowest (4811.7 km^2) was observed in 2017. The seasonal surface water area varied from 1858.1 km^2 (2017) to 3541.7 km^2 (2016). The yearlong surface water area was found higher in the year 2020 (3984.9 km^2) and lower in 2018 (2396.8 km^2). The ratio of yearlong water body area to seasonal water area was found greater than 1 except in the year 2016, 2018 and 2019.

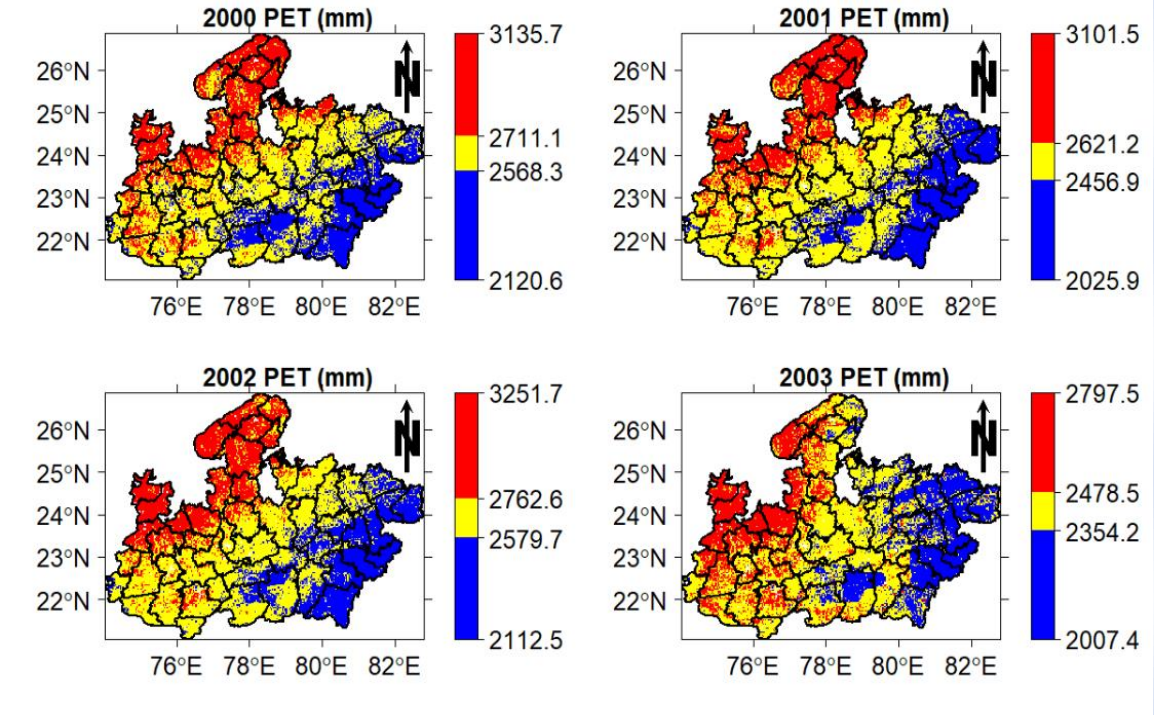
Table 6.20: The dynamics of surface water area in Madhya Pradesh from 2014 to 2020

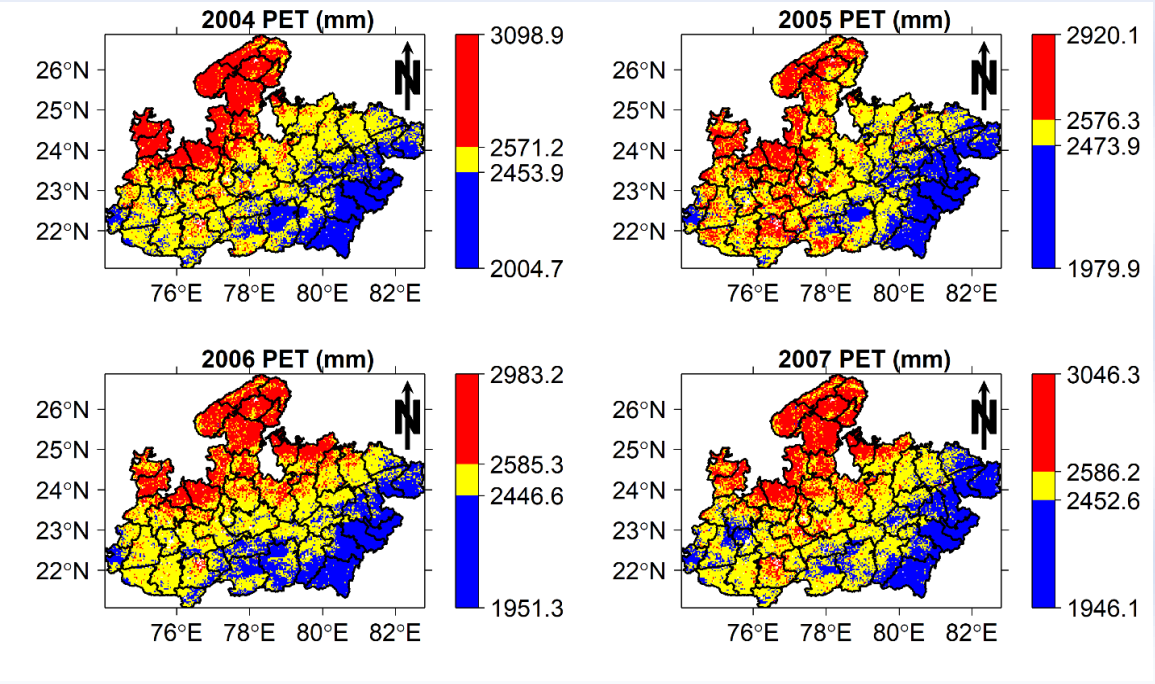
Year	Area (km^2)		
	Maximum surface water	Seasonal surface water	Yearlong surface water
2014	5465.9	2013.1	3452.8
2015	5105.0	2399.1	2705.9
2016	6108.6	3541.7	2566.9
2017	4811.7	1858.1	2953.6
2018	5134.8	2738.0	2396.8
2019	5669.7	3221.6	2448.2
2020	6258.8	2273.8	3984.9
2014-2020	5515.8	2858.2	2657.6

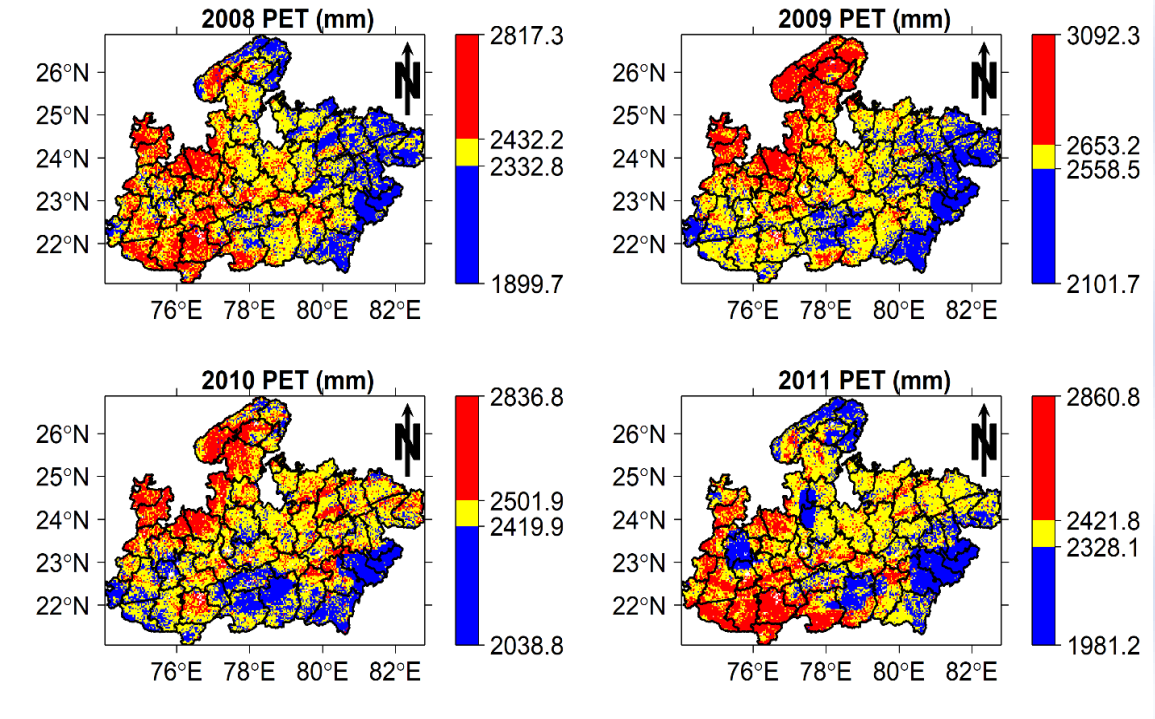
6.1.7 Dynamics of Potential Evapotranspiration over the Madhya Pradesh Based on MOD16 PET data from 2000 to 2020

In this study, the district-wise MODIS Terra MOD16A2GF 8-day composite potential evapotranspiration dataset (500m spatial resolution) from the year 2000 to 2020 for the Madhya Pradesh state was downloaded using MODIS tsp R package.

The 8-day composite potential evapotranspiration data were converted into the monthly, seasonal and annual ETp data for each district. The seasonal ETp were calculated for winter season (January to February), summer season (March to May), monsoon season (June to September) and post-monsoon season (October to December). Yearly, mean annual and season potential evapotranspiration are shown in Figure 6.38 and 6.39 respectively.




2004 PET (mm)
3098.9
2571.2
2453.9
2004.7
2005 PET (mm)
2920.1
2576.3
2473.9
1979.9
2006 PET (mm)
2983.2
2585.3
2446.6
1951.3
2007 PET (mm)
3046.3
2586.2
2452.6
1946.1
26°N
25°N
24°N
23°N
22°N
76°E
78°E
80°E
82°E


2008 PET (mm)
2817.3
2432.2
2332.8
1899.7
2009 PET (mm)
3092.3
2653.2
2558.5
2101.7
2010 PET (mm)
2836.8
2501.9
2419.9
2038.8
2011 PET (mm)
2860.8
2421.8
2328.1
1981.2
26°N
25°N
24°N
23°N
22°N
76°E
78°E
80°E
82°E

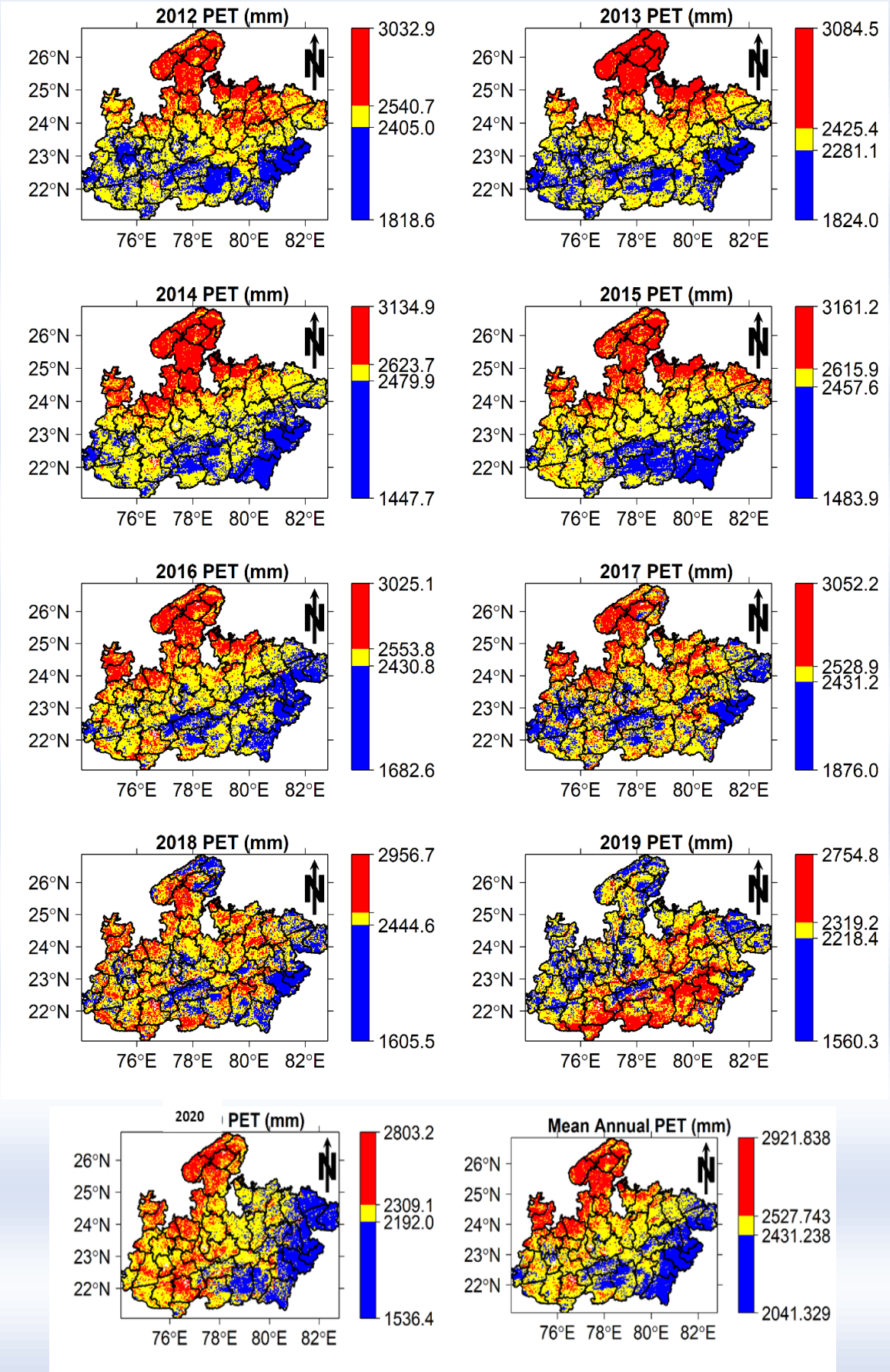


Fig.6.38: Yearly and mean annual potential evapotranspiration at pixel level for Madhya Pradesh state

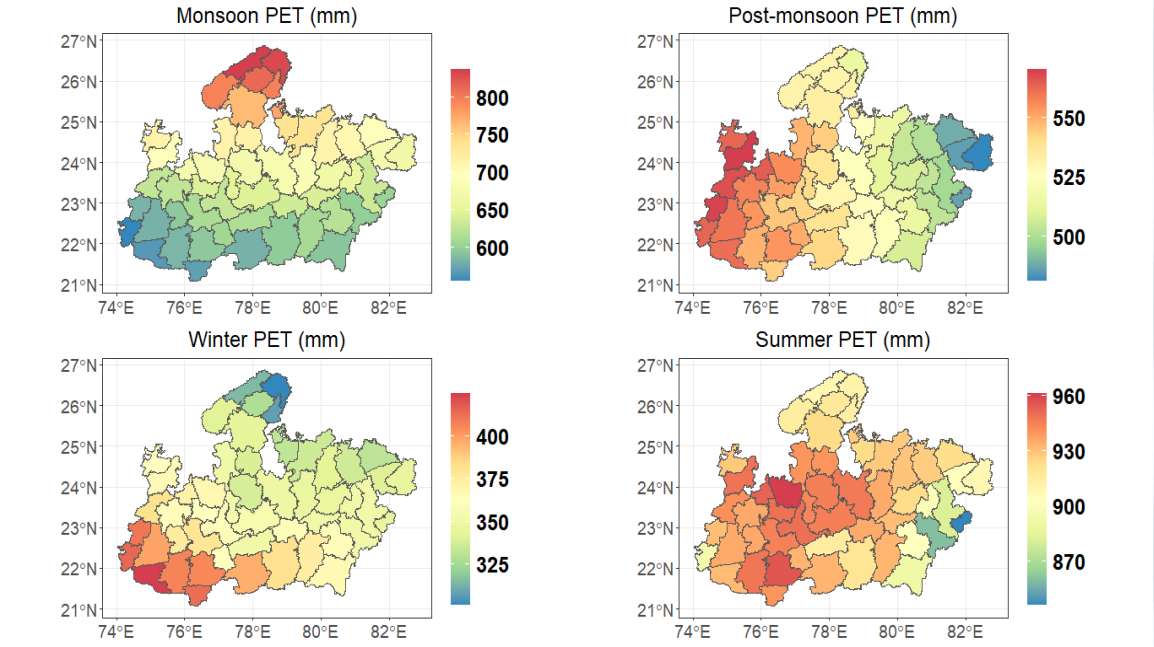


Fig.6.39: District wise mean seasonal potential evapotranspiration of Madhya Pradesh state (2001-2020)

The Mann Kendall trend analysis of yearly potential evapotranspiration raster time series (2000-2020) was carried out using "Kendall" R package. The trend analysis of yearly potential evapotranspiration showed a significant declining trend for north, east and south-east part of Madhya Pradesh over the 21 years. Whereas west and south-west part of Madhya Pradesh showed non-significant decline trend for yearly potential evapotranspiration. The rate of change of yearly potential evapotranspiration was found in the range of -30 to 20 mm per year (Fig. 6.40).

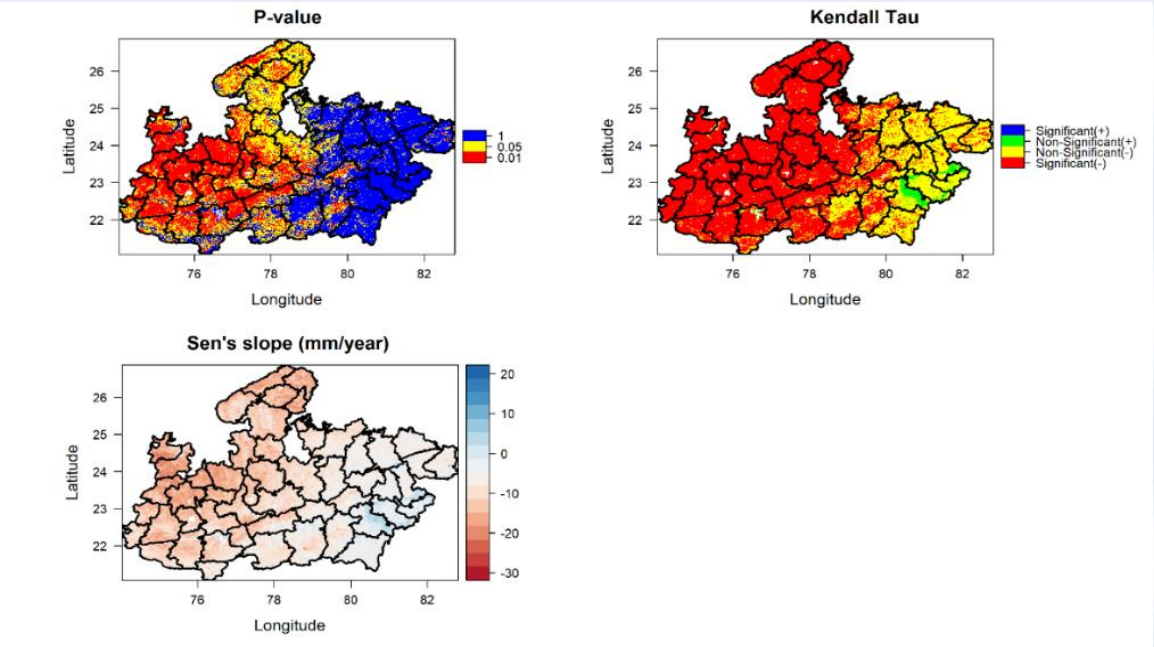


Fig.6.40: Mann Kendall trend analysis of yearly potential evapotranspiration of Madhya Pradesh over 21 years (2000-2021)

This analysis can help the users to understand spatio-temporal pattern of ETp over the Madhya Pradesh state. This data can be used for: calculating the water requirement of crops, crop and water resource management, water-balance assessment, drought related studies, climate change studies, estimating future ETp trends etc. This study would help to explore the influence of vegetation distribution, climate and water resources on potential evapotranspiration over the Madhya Pradesh state. The belief on MODIS-16 PET in regions with sparse observations is growing up, however information about its performance is limited and validation studies mostly focused in developed countries. Further studies need to be carried out to validate MOD16 ETp data in the field.

6.2 Students Research Projects:

Students of undergoing master and doctoral degree program have been involved to undertake research project on related aspects. Research fellowship have been provided for students working on relevant research problems of this particular objective. These activities will continue in the following years. The details of research topic, student involved and advisor for guidance are presented below.

Table 6.21 : Involvement of students for post graduate research under NAHEP theme

S.N.	Topics	Student	Department	Advisor	Course
1	Characterization of the efficacy of plant growth regulators for high-temperature stress mitigation in chickpea (*Cicer arietinum* L.) through ground based proximal remote sensing.	Supriya Debnath	Plant Physiology	Dr. R. Shivrama Krishnan	Ph. D.
2	Computation of carbon sequestration of mango (*Mangiferaindica* L.) orchards of Jabalpur district using geoinformatics.	Shreesty Pal	Horticulture	Dr. S. K. Pandey	Ph. D.
3	Spatial mapping and characterization of Mango *(Mangiferaindica*L.) orchards using Remote Sensing and GIS in Jabalpur District of Madhya Pradesh.	Govind Madariya	Horticulture	Dr. S. K. Pandey	M.Sc.
4	Characterization of Fall Army Worm (FAW) Infestation in Maize Crop through Ground Based Hyperspectral Remote Sensing Under Field Conditions.	Kumari Pragya	Entomology	Dr. S. B. Das	Ph. D.
5	Diagnostic Analysis and Planning of Rejuvenation of Kanari River in Jabalpur District.	Ayushi Trivedi	Soil and Water Engineering	Dr. M. K. Awasthi	Ph. D.
6	Identification of Suitable Sites for Artificial Groundwater Recharge Using Geoinformatics in Ken River Basin, India.	Deepak Patle	Soil and Water Engineering	Dr. M. K. Awasthi	Ph. D.

S.N.	Topics	Student	Department	Advisor	Course
7	Demarcation of Groundwater Potential Zones of Tons Basin using Geoinformatics.	Neelam Bunkar	Soil and Water Engineering	Dr. R. K. Nema	Ph.D.
8	Study on Prioritization of Sub-watersheds through Integration of Land Use Land Cover Factors with Morphometric Parameters.	J Himanshu Rao	Soil and Water Engineering	Dr. S.K. Sharma	Ph. D.
9	Deciphering the Mechanism of Resistance for Dry Root Rot and Terminal Heat Stress Resistance in Chickpea applying Genetic, Genomic and proximal remote sensing based phenomics approaches.	Deepak Katkani	Plant Breeding and Genetics	Dr. Anita Babbar	Ph. D.
10	Characterization of the plant growth regulators for alteration of growth, physiology and high temperature stress tolerance mechanism in wheat (*Triticumaestivum*L.) through ground based proximal remote sensing.	Rohit Kumar Kumawat	Plant physiology	Dr. Gyanendra Tiwari	Ph. D.
11	Application of proximal remote sensing elicited from plant phenomics approaches and characterization of chilli genotype for heat stress.	Ms. Shweta Tiwari	Plant Breeding and Genetics	Dr. Kanchan Bhan	Ph. D.
12	Morphometric study for prioritization of sub-watersheds using Principal Component Analysis: A Geospatial Technique based approach.	Suruchi Vishwakarma	Soil and Water Engineering	Dr. M. K. Hardaha	M.Tech
13	Land use and land cover classification of Betwa basin using spatial data	Vipin Kumar Mishra	Soil and Water Engineering	Dr. M. K. Awasthi	M.Tech
14	Characterization of yellow stem borer (YSB) infestation in rice crop through ground based hyperspectral remote sensing under field conditions.	Salil Dwivedi	Entomology	Dr. S. B. Das	Ph. D.
15	Performance of wheat varieties at different thermal & radiation environments with respect to carbon sequestration under open and agroforestry system	Makhan Singh Karada	Forestry	Dr. Rakesh Bajpai	Ph. D.
16	Spectral & physiological characterization of drought mitigation responses to plant growth regulators &nutrients in Chickpea (Cicer arietinum L.) varieties	Mandhana Keerthana S	Plant Physiology	Dr. Shiv Ramkrishanan	Ph. D.
17	Multi -variate characterization of Green gram(Vigna radiata wilczek	Sunny Thakur	Plant Breeding &	Dr. Stuti Sharma	Ph. D.

S.N.	Topics	Student	Department	Advisor	Course
	L.) Genotypes for heat Tolerance under different environments using proximal multispectral remote sensing		Genetics		
19	Identification and evaluation of Kabuli chickpea germplasm for tolerance to heat stress under late sown condition using multi spectral based remote sensing	Surbhi Pachori	Plant Breeding & Genetics	Dr. Anita Babbar	Ph. D.
20	Exploration of gene for qualitative traits and biotic stress in soybean (Glysine max.)	Akash Barela	Plant Breeding & Genetics	Dr. M. K Shrivastava	Ph. D.
21	Design, Development, & Evaluation of Engine operated by remotely controlled Sprayer-cum weeder	Yalaka Nandini	Farm machinery & Power Engineering	Dr. Atul Kumar Shrivastava	Ph. D.
22	Geospatial planning for groundwater recharge in low rainfall Chambal basin of Madhya Pradesh	Priyamvada Vaidya	Soil & Water Engineering	Dr. M. L. Sahu	Ph. D.
23	Assessment of spectral indices in relation to irrigation scheduling in wheat varieties	Megha Singh	Agronomy	Dr. Manish Bhan	M.Sc.
24	Assessment of below ground spatio temporal storage capacity of Wainganga River Basin of M.P.	Pushplata Arihwar	Soil & Water Engineering	Dr. Y. K. Tiwari	Ph. D.
25	Spatial Estimation of Greenpea crop using RS and GIS technique in Jabalpur District.	Shivam Rathore	Soil & Water Engineering	Dr. Y. K. Tiwari	M.Tech
26	Soil Loss Estimation in Shakkar watershed by USLE using RS and GIS Technique.	Sahil Singh Kaurav	Soil & Water Engineering	Dr. S.K. Sharma	M.Tech
27	Change detection of Vegetative cover of the watershed using RS and GIS technique.	Ritesh Mahto	Soil & Water Engineering	Dr. M.L. Sahu	M.Tech
28	Wetland area mapping and change detection in Tikamgarh district.	Rajnish K. Giri	Soil & Water Engineering	Dr. R.K. Nema	M.Tech
29	Identification of groundwater potential zones of Sone River basin.	Anoop Patel	Soil & Water Engineering	Dr. M. K. Awasthi	M.Tech

Outcome:

- One Ph. D. Student Ayushi Trivedi department of Soil and Water Engineering, College of Agricultural Engineering, Jabalpur submitted thesis entitled as "Diagnostic Analysis and Planning of Rejuvenation of Kanari River in Jabalpur district".
- Mr. Govind Madariya student of M.Sc. Fruit Science, Department of Horticulture, College of Agriculture, Jabalpur submitted his thesis entitled as "Spatial mapping

and characterization of Mango (MangiferaindicaL.) Orchards using Remote Sensing and GIS in Jabalpur District of Madhya Pradesh."

- Other thesis mentioned in Table 6.21 are in progress.

6.3 Glimpses of Ongoing Research Work of Students under NAHEP CAAST:

Spectral reflectance measurement of chickpea

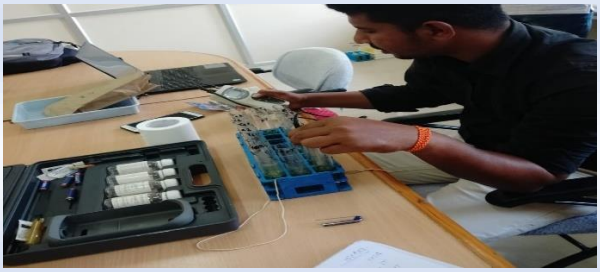
Spectral reflectance measurement of Wheat

Measurement of Plant Canopy of Soybean

Chickpea CCI Observation using SPAD Meter (MC-100)

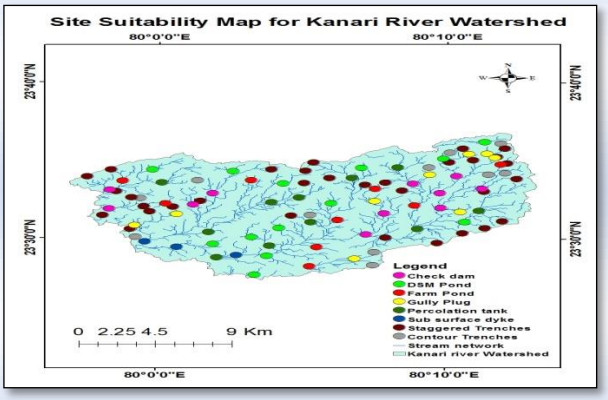
Field trial of Wheat and Chickpea

Chickpea canopy temperature observation using Infrared thermometer

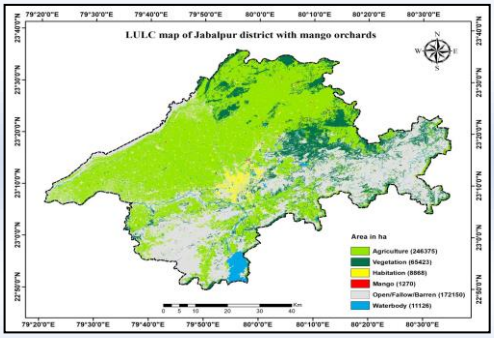


Characterization of Plant Growth Regulator in Wheat

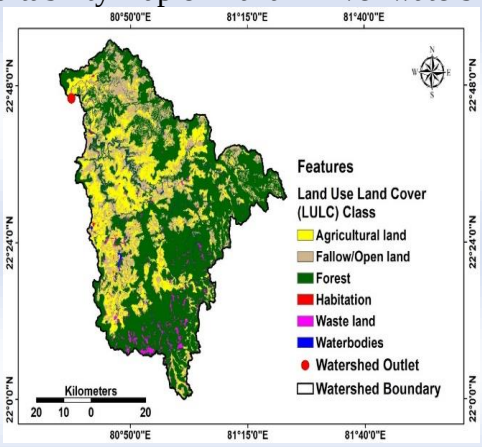
Measurement of RWC of Wheat



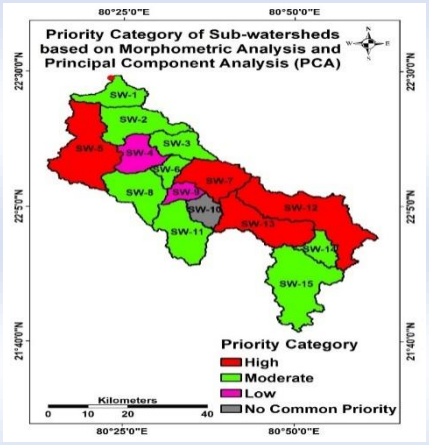
Site suitability map of Kanari River watershed



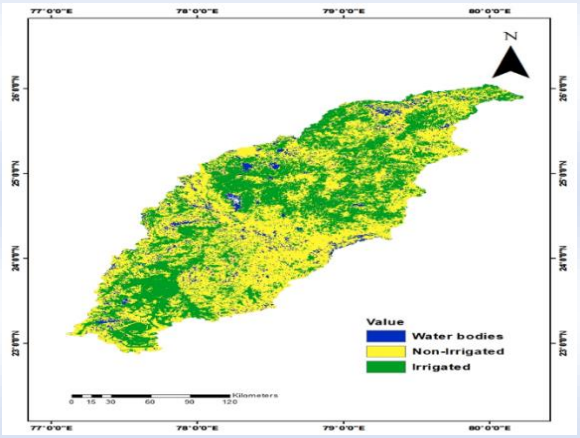
LULC map of Jabalpur district with mango orchards



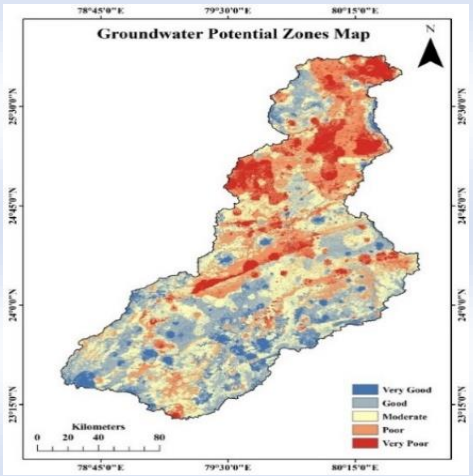
LULC map of Burhner river watershed



Prioritization of Sub-watersheds of Banjar River



Irrigated area map of Betwa river basin



Groundwater Potential Zone map of the Ken Basin

7. Development of user-friendly spatial data products

User-friendly spatial data products were developed using identified technology for policy makers, researchers, field workers and farmers.

7.1 Spatial product developed:

SN	Spatial Product	Study area	Data used	Period	Spatial resolution
1	LU/LC map	Jabalpur	Sentinel-2, Landsat-8 and Resourceset-1 data	2020 and 2019	30 m
2	LU/LC change detection map	Jabalpur	Landsat data	2000, 2010, 2020	30 m
3	Crop map	Jabalpur	Sentinel 2	2016	10 m
4	Rainfall map • Annual and seasonal rainfall map • Drought frequency map • Dry and wet spell map	Madhya Pradesh state	IMD daily gridded (0.25^0 x 0.25^0) rainfall data	1901-2019	District level
5	Potential Evapotranspiration (PET) map • Annual and seasonal PET map • Monthly PET map • PET trend map	Madhya Pradesh state	MODIS Terra MOD16A2GF 8-day composite ET dataset	2000-2020	500m
6	Surface water body map • Seasonal surface waterbody map • Yearlong surface waterbody map	Madhya Pradesh state	Landsat-8 data	2014-2020	30m
7	Seasonal groundwater level trend map	Tons River Basin	Observation well data from CGWB	1996-2018	10 m
8	Ground water potential map	Jabalpur	Rainfall, Lithology, Lineament density, Geomorphology Drainage density, Slope, Soil and LULC maps	-	10 m
9	Time-lapse animation of earth observation data using Google Earth Engine Python API	Madhya Pradesh state	Google Earth Engine datasets	Historical data	-

7.2 Web and mobile application developed:

7.2.1 MP Rain (1901-2019): An interactive web app for visualization of long term (1901-2019) spatiotemporal variability of rainfall and drought over the Madhya Pradesh state.

Spatial and temporal variability of rainfall have major consequence on agricultural production and the economy of country. Understanding of spatial and temporal behavior of rainfall has a key role for sustainable planning of agriculture and water resources. The occurrence of drought with spatio-temporal variation in frequency, severity, duration can have devastating influences on regional water resources, agriculture, industry, and other social-ecological systems. Therefore the web application has been developed to address climatic variability considering spatiotemporal pattern of rainfall and occurrence of drought for effective planning of disaster risk management strategies. In this developed application, a 119 years (1901-2019) publicly available IMD daily gridded (0.25^0 x 0.25^0) rainfall data (Pai *et al.* 2014) were analyzed for interactively visualizing the spatial and temporal variability of rainfall, rainy days, drought and dry/wet spell at district level for the Madhya Pradesh state.

The web app is developed using R software and "Shiny" web framework, it allows user to assess spatial and temporal pattern of rainfall/drought over the state in variety of interactive maps and plots which can be filtered and queried by district, season, year etc. MP Rain (1901-2019) web app is currently deployed online using the shinyapps.io platform (http://www.shinyapps.io/) at https://pspawar71.shinyapps.io/Myapp/ with free hosting plan. No specialized coding, expertise, or software are needed to utilize the MP Rain (1901-2019) web app. The App link is available on the NAHEP-JNKVV website. The web app will provide all the information at the user fingertips.

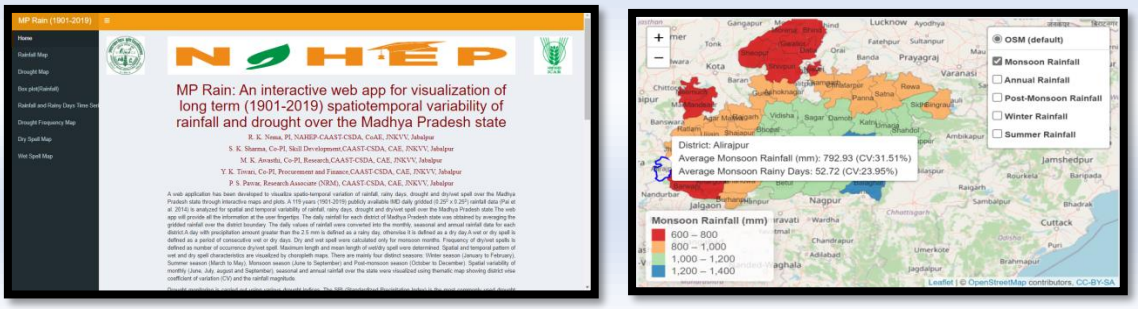


Fig. 7.1 User interface of MP Rain (1901-2019) web app

The end users for MP Rain (1901-2019) web app are State agricultural department, Water resource department, Academic researchers, Disaster management agencies and Farmers. Information on earlier drought impacts is very important for planning future drought responses. It can be used for evaluating the impact of deficient rainfall or drought on yield of cereals, horticultural crops, livestock production, loss of employment and decreased income of farmers. Based on earlier disastrous drought impacts, policymakers can formulate effective policies in advanced to deal with possible drought disasters such as drying of water resources, crop failure, increase in food prices, poor health and a decline in prices of livestock. It would help the farmers to understand the historical rainfall and

drought information of their region.

7.2.2 MP ETp (2000-2020): Dynamics of Potential Evapotranspiration over the Madhya Pradesh Based on MOD16 from 2000 to 2020

Potential evapotranspiration is an important part of hydrological cycle and water resources management. Traditionally, evapotranspiration (ET) can be measured by using land surface parameters (temperature, net land surface radiation, vegetation index and soil moisture) at global scale, water balance, or crop growth models for crop ET. However, these conventional methods cannot represent large-scale terrestrial evapotranspiration due to heterogeneity of land surface and complexity of hydrologic processes. Remote sensing satellite provides land surface information from larger geographic extents and produced cost-effective, efficient, up-to-date information for retrieving ground parameters at global scale which can be used for evapotranspiration estimation. A variety of satellite-based products have provided valuable evapotranspiration data sources at different spatial scales, especially for regions with lack of and sparse observations.

ETp (2000-2020) web application developed to visualize spatio-temporal variation of Potential Evapotranspiration (ETp) at district level for the Madhya Pradesh state through interactive maps and plots. This app provides a user-friendly interface to interact with Potential Evapotranspiration data product of MODIS satellite. The MODIS Terra (MOD16A2GF) 8-day composite potential evapotranspiration data (500m spatial resolution) of the 21 years of record (2000-2020) was used in this application. The 8-day composite potential evapotranspiration data were converted into the monthly, seasonal and annual ETp data for each district. The web app is developed using R software and “Shiny” web framework. User interface of the app allows user to pan, zoom, retrieve, filter, search, and overlay the map. This application is useful to provide data for: Calculating the water requirement of crops, Crop and water resource management, Water-balance assessment, Drought related studies, Climate change studies, Estimating future ETp trends etc. This application would help to explore the influence of vegetation distribution, climate and water resources on potential evapotranspiration over the Madhya Pradesh state.

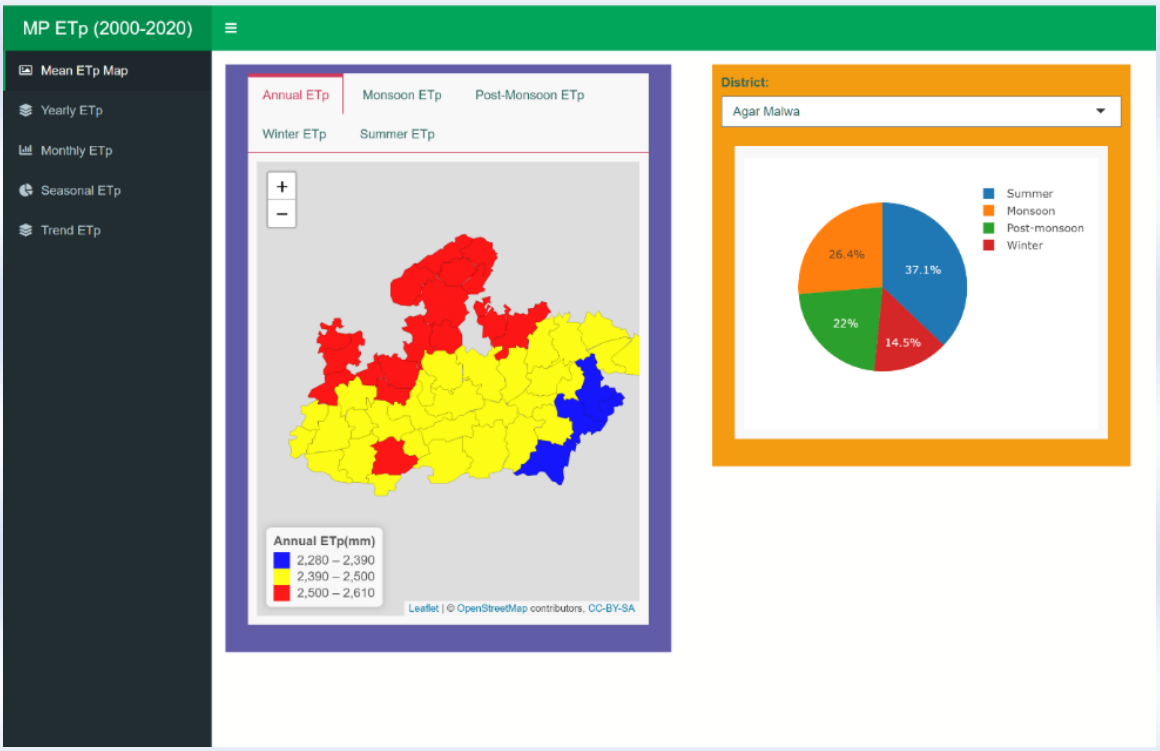


Fig.7.2: Web framework of MP ETp (2000-2020) web app

App features:

- The App link is available on the NAHEP-JNKVV website.
- The app providing user friendly interface for interacting with spatial ETp data (2000-2020) over the Madhya Pradesh state.
- No specialized coding, expertise or software are needed to utilize the MP ETp (2000-2020) web app.
- Enables the user to select a specific variable and time (year or month) to produce the choropleth map of ETp.
- Allow interactive visualization of monthly, seasonal and annual ETp (mm) at district level during 2000-2020 over the Madhya Pradesh state.
- A time slider also provided to understand temporal pattern of ETp at district level over the Madhya Pradesh state.
- Allow filter query and split-screen functionality to compare two map overlays.
- Allow interactive visualization of trend category and trend magnitude of annual and seasonal ETp at pixel level (500 m).
- Allow user to zoom in & zoom out map. It uses the open street map and Esri world Imagery tiled map in background.
- Can serve the purpose of representing a large amount of data and effortlessly conveying the information to users.

7.2.3 "जवाहर गन्ना मित्र" : (Jawahar Ganna Mitra) **Android based mobile Application for sugarcane farmers and millers**

"जवाहर गन्ना मित्र" has been developed as an initiative to provide a linkage between sugarcane farmers and their association with sugarcane industries. A survey has been conducted to know all the problems related to sugarcane farmers and the sugarcane factory located nearby. Issues identified are 1. farmers facing quite complicated process to stand in long queue to sell their sugarcane. 2. farmers are unaware about the modern practices regarding sugarcane cultivation. The mobile app "जवाहरगन्नामित्र "has been developed to relief the farmers from noted problems and also to provide video tutorials to aware them about latest advancement in sugarcane cultivation. This app provides an online platform to both the sugarcane mill owner and the farmer to easily sell their sugarcane in the mill and the sugarcane mill owner shall be able to provide time allocation and buy their products. The app consists of three components: -

1. Improved practices for higher productivity in sugarcane
2. GIS based selection of appropriate outlet by farmer
3. Video library for modern technologies of sugarcane cultivation

First component provides information related to sugarcane in regional language that will be useful for farmers and students. Second component provides registration utility for farmers to sell sugarcane and to mill owners to confirms lot for buying sugarcane. Third component provides videos related to technologies for sugarcane production. This makes the application farmers friendly.

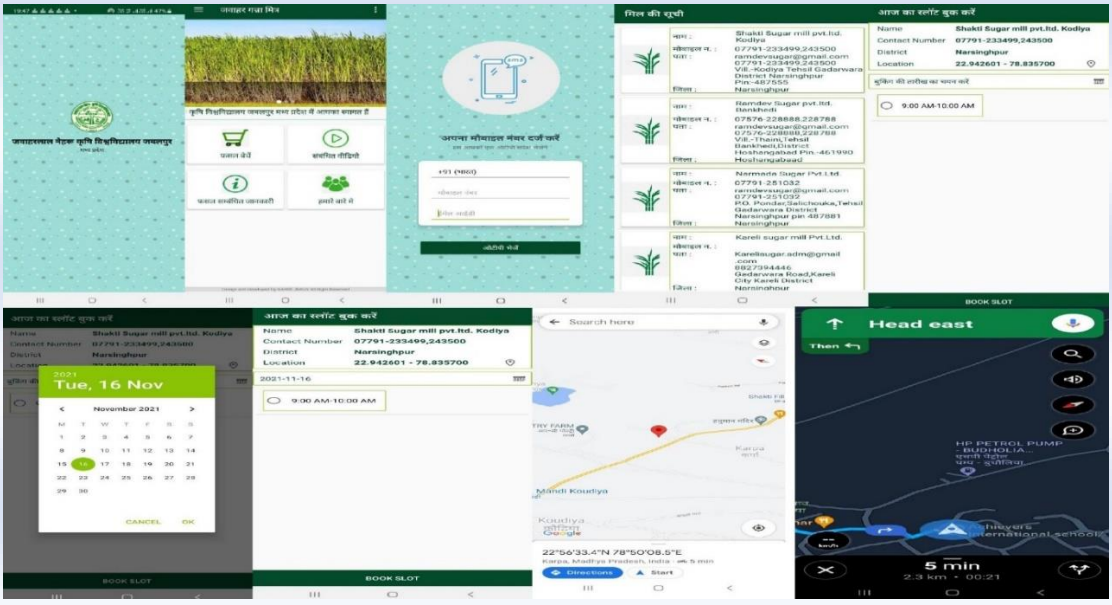


Fig. 7.3 Working with application "जवाहर गन्ना मित्र "

8. Other Activities- Best practices at JNKVV Campus.

8.1 Bio pesticides Production

Objective: Screening, bio efficacy & standardization of dose, Mass production Compatibility with additives / plant derivatives/ insecticides Storability and Efficacy of formulation

Products developed: Jawahar Bio Pesticides Produced by Bio control research centre

S.N.	Biopesticides	Entomopathogenic fungi(Formulation)	Target pests
1	Jawahar Beauveria bassi -1	*Beauveria bassiana* (Formulation-Liquid)	Larvae, beetles, sucking pests such as aphids, mites, *etc*.,
2	Jawahar Meta A-1	*Metarhizium anisopilae* (Formulation-Liquid)	Root grubs, termites, ants, beetles, mosquitoes, leaf miners, leaf hoppers and other common agricultural insect pests
3	Jawahar Lecalec -1	*Lecanicillium lecanii*(Formulation-Liquid)	Control whitefly, leaf miners, leaf hoppers and other common agricultural insect pest.

Microbial Insecticides developed in BRP Centre

Beauveria bassiana

Lecanicillium lecanii

Metarhizium anisopilae

8.2 Bio fertilizer Production

Objectives

- To commercialize the production technology of bio fertilizers and bio-control agents thus to develop entrepreneurship among the trainees
- To provide good quality of bio fertilizers as lowcost input to the farming community.
- To improve the soil health by increasing the microbial activity in soil through application of bio fertilizers

Products developed: Jawahar biofertilizers produced by Microbes research centre

S.No.	Biofertilizers (type/group)	Crop
1	Jawahar legume nitro (*Rhizobium*)	Legumes
2	Jawahar non-legume /cereal nitro	Cereals

3	Jawahar cash nitro	Cash crops
4	Jawahar BGA	Paddy
5	Jawahar phospho (PSB)	All crops
6	Jawahar mycorrhiza (VAM)	All crops
7	Jawahar potash (KSB)	All crops
8	Jawahar micro (ZSB)	All crops
9	Jawahar PGPR- *Pseudomonas*	All crops
10	Jawahar plant stimulator (Biofertisol)	All crops
11	Jawahar decomposer- *Trichoderma*	All crops
12	Jawahar biodigester (consortium)	Waste materials
13	Jawahar enriched bio-organic (MOM)- consortium	All crops


Jawahar biofertilizers Microbes research centre

8.3 Water conservation measures

a. Rainwater water harvesting structures and recharge of ground water

Objective: Conservation of water

Impact: Due to dependence on perched water, wells are characterized by very low specific yield and are unable to support continuous operation of pumps to irrigate the agricultural fields at a single stretch. This warrants water harvesting to ensure quick recharge of wells and thereby facilitate irrigation and in turn crop productivity.

S.No.	Farm Pond (m^2)	Location	Capacity (m^3)	Recharge Capacity (m^3/ hr)
1	106	Adjacent to Rajendra Prasad	143.10	1.23
2	75	Adjacent to Adhartal *Talaab*	101.25	0.96
3	75	Adjacent to Adhartal *Talaab*	101.25	0.96
4	8200	F -1	11,070	3.93
5	96	Adjacent to Girl's hostel	129.60	0.82
6	96	Adjacent to Girl's hostel	129.60	0.82
7	96	Adjacent to Girl's hostel	129.60	0.82
	8744	**-**	**11531.7**	**9.54**


Hostel ponds

b. Roof Top Rain Water Harvesting

SN	Location	Roof top area (m^2)	Capacity (m^3)	Recharge Capacity (m^3 / hr)
1	Behind *Tapti* Guest House	205	276.50	1.73
2	College of Agricultural Engineering	1505	2031.75	2.86
3	KVK , Jabalpur	85	114.75	1.02
	Total	**1795**	**2423**	**5.61**



COAE, Campus **Behind *Tapti* Guest House KVK Jabalpur**

8.4 Greenery at Campus

Objective:

Planting in construction areas, and to increase the planting along the roadside amenity areas and expressways for increasing the planting density and beautification in the university area

Impact: Greenery helped in improving our health and well-being and also in reducing the amount of noise pollution experienced by residents. It also facilitated the water management and promoted in increased biodiversity in the area.

University Entrance Gate

CoAE, Jabalpur

CoA, Jabalpur University

Guest House Complex

8.5 Energy conservation measures

Objective: Conservation of energy

Impact: Availability of solar energy system, Availability of star rated appliances and Proper ventilation and air passage

Total energy consumption of the campus in KW

S.N.	Location of feeders	Units / month
1	Registrar Feeder	61,473
2	EE Feeder	1,28,093
3	Director Farms-1	48,984
4	Director Farms-2 (Tank area)	12,369
	Total	**2,50,919**

Renewal energy generated and used:

S.N	Sources	Capacity in KW
01	**Solar panel**	
1	Solar water heater Girls Tribal Hostel 01-500lit Awanti Bai 01-500lit International Hostel 01-300lit Kalpana Chawla 02-500lit Maharani Laxmi Bai 02-500lit	10KW (Approx.)
2	Solar Water Pumps KVK Jabalpur	5 HP
3	Wood Gasifier (FRes. Lab College of Agriculture Engg.) Rice Husk Gasifier (FRes. Lab College of Agriculture Engg.)	35 KW 3.75KW

Environment Eco-friendly Infrastructure / Best Practices

S.N.	Category	Activity	Quantity(No./ area / unit)
1	Reduce the energy	Yes	Use of LED
2	Ecofriendly constructions	Yes	Sufficient ventilation, Water Harvesting units
3	Roof top solar system	Yes	Roof top solar system already installed (215 KWp, 190 KWp and 300 KWp)

Solar Power system installed in the JNKVV

8.6 Waste management measures

Objective: Management of waste

Impact: Utilization of field wastes & kitchen waste and its conversion into manure

Kitchen waste - Organic waste convertor (Compost Pit)

02 pits each of 15 x 10 x 4 ft (1200 cu ft) in 9 months obtain 90 Q compost

Kitchen waste - Bucket of Liquid Converter

08 bucket of liquid converter (15 kg waste converted to5 litre liquid fertilizer per bucket) in 4 Weeks

Compost pit- Quantity of waste converted into manure.

Kitchen waste - Bucket of Liquid


Compost pits

8.7 Plantation (Diversity of species)

Objective: Increase in plantation

Impact: Microclimate in the campus to improve the greenery and pollution free environment

List of Horticultural crop species:

S.No.	Common name	Numbers	Indigenous (I) / Exotic (E) sp.
1.	Guava	2147	E
2.	Mango	523	I
3.	Ashoka	212	I
4.	Pomegranate	60	I
5.	Bottle Palm	36	I
6.	Munga	20	I
7.	Chiku	12	E
8.	Seedless lime	12	E
9.	Jamun	05	I
10.	Bottle Brush	04	E
11.	Ber	03	I
Total species			**3034**
Total area (ha)			**2.51**

8.8 Lab Safety / Fire safety Measures

Objective: To control exposure to airborne contaminants

(Total 54 safety measures board in Universities Departmental laboratory and VV, offices)

Impact: Protection personnel, students and scientists against risks and hazards

Technical boards for safety purposes

9. Additional Social Activities

9.1 De-addiction program *(Madya Nished Saptah)*

Impact: On Madya nished saptah, organised in joint collaboration with Rashtriya Seva Yojna and NAHEP a lecture was delivered on "Increasing Tendency of Drinking Among Youth". In the program the students shared their views. Chief Guest, Dr. Sharad Tiwari, Dean Agriculture College Jabalpur and Dr. Atul Kumar Shrivastava, Faculty Agricultural Engineering highlighted that there was an increase in the consumption of alcohol among the youth. They expressed concern over the increasing trend and cautioned about the ill-effects of drinking. Dean Student Welfare, JNKVV, Dr. Amit Kumar Sharma inaugurated the drug de-addiction message rally by flagging it off. Heads of departments, faculty members, employees and students participated in the rally. Displayed meaningful message with placards, slogans and street play "Nasha Chhode Ghar Jode"

Program conducted at SV Hall

Rally with placards & slogan

9.2 Nutritional Plantation *(Poshan Vatika Vrukshropan)*

Impact: Plantation of 71 plants species and One thousand fruit plant species were distributed. During this program, speech of Hon'ble Union Agriculture Minister, Shri Narendra Singh Tomar was broadcast live through web casting for students, faculty and farmers. In another function, packets of nutritious food made from Koda, Kutki, Bajra were distributed to 71 malnourished girl children, Anganwadi workers and agricultural farm women. In another program related with this function an exhibition was organized on the theme of Poshan Mala, Poshan Vatika Abhiyan, and Cleanliness Campaign.

Poshan Vatika Abhiyan addressed by MLA, Shri Ashok Rohani Ji

9.3 World Food day

Impact: Identified as a significant day to raise awareness about healthy food habits. According to FAO, about 2 billion people in the world are obese or overweight due to poor diet and sedentary lifestyles. This day is particularly important to point out the necessity to indulge in healthy eating with the right nutrition. Dr. S. S. Shukla, HODs of Food Sc. & Technology addressed on WORLD FOOD DAY

9.4 National Service Scheme (NSS Day)

Awareness program entitled on Environmental Safeguard measures was held on 24th September 2021, under the guidance of Dr. R. N. Shrivastava on the auspicious day of NSS. Dr. P. K. Bisen enlightened about the aim of NSS that is to provide hands on experience to young students in delivering community services and the motto of NSS "NOT ME BUT YOU" and Awareness of Environmental Conservation.


Dean student welfare had shared about inception of the scheme in the year 1969 and the student's strength till date. Students also presented their presentation and shared the experience of NSS camp and distributed certificates to the students.

10. Work Plan for 2022-23

10.1. Capacity Building

Capacity building with integrating RS and GIS approaches for Natural Resource Management, particularly in agriculture and related domains, has been planned for the years 2022-23. The training activities have been organized for three separate groups, namely, school students, administrators/executives, scientists/Faculty and UG and PG students, with training days allocated for each of these activities as shown in the table below.

S. No.	Activity	III Year (2022-23) Proposed Capacity Building Plan											
		First Quarter			Second Quarter			Third Quarter			Fourth Quarter		
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
		No. of Days given as planned in each month for capacity building											
1.	Awareness program for Students			2						1	1	1	1
3.	Educative learning for executives				7		7						
4.	Capacity building for PG & PhD students, Scientists, Teachers, officials and young professionals	21	21	21		21			21		21		21

- **For Awareness program – One awareness program scheduled in each quarter:**

  The target audience will be students at schools as well as students of UG, who will be aware about modern agricultural education, contemporary agriculture facts & studies, future prospective scopes in higher studies of Agriculture education and RS/GIS applications in agriculture, in order to promote the agriculture education among students. Total 6 awareness program scheduled.

- **Educative learning program for Agriculture executives/officers – 2 seven-day training scheduled:** It is especially designed to acquit executives/officers of agriculture department/ administrators/ Line staff of KVK to give them practical application knowledge to develop skilled manpower acquainted with remote sensing and GIS capability in their area of interest

- **Capacity Building training program – Twenty-one days training in every month as per scheduled plan given below:** 21 days hands-on training have been scheduled for capacity building for Scientists, Teachers, officials, PG/PhD students and young professionals. Total seven 21-days capacity building training scheduled. The complete program has been given in below tables.

Capacity building program proposed for year 2022-23

SN	Program	Date
1	NRM through RS and GIS Applications	22nd Mar - 23rd Apr 2022
2	Hands-on training of RS-GIS using QGIS	19th May -11th Jun 2022
3	Hands-on training of RS-GIS using ERDAS Imagine	22rd Jun- 15th Jul 2022
4	Hands-on training of RS-GIS using ERDAS Imagine	9th Aug - 23th Aug 2022
5	Hands-on training of RS-GIS using ERDAS Imagine	3th Nov - 26th Nov 2022
6	Hands-on training of RS-GIS using QGIS	4thJan - 27th Jan 2023
7	Hands-on training of RS-GIS using ERDAS Imagine	7th Mar - 30th Mar 2023

Awareness program proposed for year 2022-23

SN	Event	Program	Date
1	World Environment Day	Environmental safeguard with the help of RS and GIS	Jun 5, 2022
2	International Yoga Day	Making awareness about Yoga	Jun 21,2022
3	National Agriculture Education Day	Strengthening Agriculture Education by enhancing spatial data application in research and learning.	Dec 03, 2022
4	National Youth Day	Youth Inspiration," How RS and GIS can help youth in agriculture sector''	Jan 12,2023
5	National Science Day	Application of satellite data for improving agriculture and ultimately enhancing farmers income.	Feb 28,2023
6	World Water Day	Application of spatial data in water resource management.	Mar 22,2023

Educative learning programs proposed for year 2022-23

SN	Event	Program	Date
1	Educative Learning program-I	To empower agriculture executives to know about geospatial techniques and allow them to read spatially classified data that is available or may be available in future	18-23 July 2022
2	Educative Learning program-II	To empower agriculture executives to know about geospatial techniques and allow them to read spatially classified data that is available or may be available in future	19-24Sep 2022

Note: The above dates are tentative and may be changed, if there are any limitations.

10.2 Program scheduled under Equity Action Plan: (EAP) 2022-2023

S.No	Items	Date
1.	Training of faculty in subject matter and pedagogy, particularly to improve the performance of weak students	30thMay to Jun 3rd 2022
2.	Identification of weakness in students and remedial steps	At the beginning each Semester
3.	Introduction and exposure of three tier grievance redress mechanism (GRM)	27th Jul 2022
4.	Formation of peer Learning Groups of students	Jul 2022
5.	Opportunity to upgrade the domain knowledge of young faculty	Sep 2022
6.	To improve language competency, soft skills and confidence levels.(Linguistic classes including courses on communication skill and personality development)	Oct - Nov 2022
7.	Advisory for awareness program to attract students to higher agriculture education	3rd Dec 2022
8.	Labour Management plan	17th Feb 2023
9.	Innovation and knowledge sharing workshop	20th March 2023

10.3 Procurement of Lab Equipment

Equipment, plant & Machinery	No	Total (Lakh)
Hyper Spectral Radiometer (350-2500nm) along with accessories	2	120.00
Drone with multispectral sensor and application equipment's	1	20.00
Thermal Imaging Camera	1	15.00
Server with software	2	10.00
Network Attached Storage (100 – 150 TB)	1	10.00
Stereo head phones, microphones, Patch Bay, Head phone distribution amplifier, digital portable recorder, sound proofing and control room	1	30.00
Wall mounted smart LED display TV meeting room	1	1.50
Large Format Plotter A0 Size	1	10.00
Drone Image Processing Software Pix4D	1	10.00
Geo-server software for windows with web server	1	60.00
High Power Computing (HPC) system	1	50.00
Digital Terminals	50	20.00
A0 Scanner	1	10.00
Interactive LED Display with Digital Podium 8X6 feet 120" diagonal	2	10.00
Camera 45 mega Pixel with Zooming facility and all accessories.	4	4.00
Soil moisture meter with 50 sensors	1	7.00
Digital planimeter and chartometre	30	12.00
Furnishing items	-	2.80
Other peripherals	-	2.00

10.4 Organization of Awareness advisories / Vocational Certificate Program / Capacity Building & Trainings Year 2022-2023

S.No.	Work planned	Resource person/ Course Coordinators/ Convener	Activities quarterly wise			
			Apr to Jun	Jul to Sep	Oct to Dec	Jan to Mar
1.	**Awareness advisory**					
i.	Pesticides recommend & banned by Central Insecticide Board & Registration Committee & Safe	Dr. S.B. Das	√		√	
ii.	Green technology theme-Plantation – Agroforestry	Dr. R.K. Bajpai	√		√	
iii.	Green technology theme-Plantation -Horticulture	Dr. S.K. Pandey	√		√	
iv.	Green technology theme-Plantation– Medicinal &Aromatic	Dr. Gyanendra Tiwari	√		√	
2.	**Vocational certificate program (7 days)**					
i.	Installation, maintenance & monitoring of solar power system	Dr. A.K. Rai Dr. R.N. Shrivastava		√		
ii.	Saving energy through installation, operation and maintenance of pumps	Dr. R.N. Shrivastava		√		
iii.	Assessment Methods for Soil Carbon And Greenhouse Gas Emissions In	Dr. Shiv Ramakrisna Mudaliyar		√		
iv.	Production of biofertilizers & biopesticides (7 days)	Dr. N.G. Mitra, Dr. P.B. Sharma Dr. S.B. Das		√		
3.	**Capacity building & trainings (1 day)**					
i.	Monetizing Waste from Agriculture- a road ahead	Dr. R.C. Shrivastava	√		√	
ii.	Biosafety, Wastedisposal	Dr. Kirti Tantwai	√		√	
iii.	Green technology theme-Plantation -Agroforestry	Dr. R.K. Bajpai	√		√	
iv.	Green technology theme-Plantation– Medicinal & Aromatic	Dr. Gyanendra Tiwari	√		√	
v.	Green & Efficient energy use	Dr. A.K. Rai		√	√	
vi.	Biodiversity conservation	Dr. Anita Babbar		√	√	
vii.	Energy auditing & management	Dr. A.K. Rai		√	√	
viii.	Green award implementation	Er. Gautam Aswa		√	√	
ix.	Food safety	Dr. S.S. Shukla		√	√	
x.	NABL guidelines for accreditation of laboratories	Dr. M.K. Agarwal		√		
xi.	Promotion of soil health	Dr. G.S. Tagore		√		√

S.No.	Work planned	Resource person/ Course Coordinators/ Convener	Activities quarterly wise			
			Apr to Jun	Jul to Sep	Oct to Dec	Jan to Mar
xii.	Integrated Nutrient & Weed Management	Dr. P.B. Sharma		√		√
xiii.	Integrated Disease Management	Dr. V.K. Yadav	√		√	
xiv.	Registration of Pesticides	Dr. S.B. Das	√		√	
xv.	Procedure for Organic Registration at State level	Dr. P.B. Sharma	√		√	
xvi.	Parthenium – its impact and biocontrol	Dr. Sushil Kumar		√	√	
xvii.	Apiculture for entrepreneurship development	Dr. S.B. Das		√		
viii.	Precision farming	Dr. G.S. Tagore		√		
xix.	Digital farming with reference to precision water management	Dr. R.N. Shrivastava		√		
xx.	Advances in micro irrigation	Dr. R.N. Shrivastava			√	
xxi.	Bioenergy: Present Status and Future	Dr. V.K. Gour			√	
xxii.	Environmental protection for improving animal health	Dr. Shekhawat			√	
xiii.	Impact of climate change on insect pests	Dr. S.B. Das	√			
xiv.	Groundwater monitoring & management	Dr. R.K. Nema	√			
xxv.	Impact of e- waste on environment	Dr. A.K. Rai			√	
4	**Awareness program (1 day)**					
i.	NABL guidelines for accreditation of laboratories	Outside VV		√		√
ii.	FSSAI Registration	Dr. S.S. Shukla			√	
5	**National workshop**	Dr. S.B. Das			√	

11 Publication in proposed area:

Under publication 12 Research Articles, 8 Book Chapters and 2 Review articles has been published. Out of 13 research articles, 8 papers is published in journals having NAAS rating above 5. Two students achieved best poster award in conference. Spatial product album and Basics of Remote Sensing Album were prepared for providing useful information about the basic concepts of RS & GIS to students and progress of the project.

SNo	Research Articles	NAAS Rating
1.	Patle D, Awasthi MK, Sharma SK and Tiwari YK. 2022. Application of Geoinformatics with frequency ratio (FR) model to delineate different groundwater potential zones in Ken Basin, India. Indian Journal of Ecology. 49(2):313-323.	5.79
2.	Trivedi A and Awasthi MK. 2021. Runoff estimation by integration of GIS and SCS-CN method for Kanari River Watershed. Indian Journal of Ecology 48(6): 1635-1640.	5.79
3.	Suman S, Sharma A and Trivedi A. 2020. Bioactive phytochemicals in rice bran: processing and functional properties: a review. International Journal of Current Microbiology and Applied Science Special Issue-11:2954-2960.	5.38
4.	Gautam VK, Awasthi MK. 2020. Evaluation of water resources demand and supply for the districts of central Narmada valley zone. International Journal of Current Microbiology and Applied Science. 9(2):3043-3050.	5.38
5.	Trivedi A,Pyasi SK, Galkate RV and Gautam VK. 2020. A Case Study of rainfall runoff modelling for Shipra River Basin. International Journal of Current Microbiology and Applied Science Special Issue-11:3027-3043.	5.38
6.	Singh SK, Tripathi SK, Mishra KP, Pandya AK and Awasthi MK. (2020). Water quality evaluation for drinking purpose of Rewa Block, district-Rewa, Madhya Pradesh, India. International Journal of Chemical Studies 8(2): 2473-2480	5.31
7.	Gautam VK, Awasthi MK and Trivedi A. 2020. Optimum allocation of water and land resource for maximizing farm income of Jabalpur District, Madhya Pradesh. International Journal of Environment and Climate Change 10(12):224-232.	5.29
8.	Rao JH, Sharma SK, Awasthi MK, Pyasi SK and Pandey SK. 2022. Land use land cover classification of Burhner river watershed using remote sensing and GIS technique. International Journal of Environment and Climate Change, 12(7): 119-132. DOI:	5.13

SNo	Research Articles	NAAS Rating
	10.9734/IJECC/2022/ v12i730707.	
9.	Rao JH, Sharma SK, Awasthi MK, Pyasi SK and Pandey SK. 2021. Morphometric analysis of Burhner river watershed using remote sensing and GIS technique. International Journal of Agriculture, Environment and Biotechnology, 14(04): 585-599. DOI: 10.30954/0974-1712.04.2021.13	4.54
10.	Nigam A, Awasthi MK and Bunkar N. 2020. Assessment of groundwater potential zones of tons basin using spatial data. International Journal of Agriculture, Environment and Biotechnology, 13(3):261-268.	4.69
11.	Singh BP, Srivastava P, Trivedi A, Singh D. 2021. Application of Geospatial techniques for Hydrological Modelling. International Journal of Multidisciplinary Research and Analysis: 181-192.	-
12.	Trivedi A, Singh BP and Nandeha N. 2020. Flood forecasting using the Avenue of Models. JISET - International Journal of Innovative Science, Engineering & Technology 7(12):299-311.	-

Poster Presentation	
1.	Deepak Patle has secured 1st position in poster competition on the theme 'Wetlands Action for People & Nature' held on the occasion of the World Wetlands Day on 2nd February 2022 organized by JNU ENVIS Resource Partner Centre on ‘Geodiversity & Impact on Environment’ & SCST ECOTOURISM ENVIS.
2.	Ayushi Trivedi (2020) has secured best poster award for the topic “Estimation of rainfall-runoff by integration of SCS-CN and ArcGIS Approaches” in International Conference: Global Perspective in Agricultural and Applied Sciences for Food and Environmental Security.
Book Chapter	
1.	Sharma A, Suman S and Trivedi A. 2022. Food security and nutrition and sustainable agriculture: key points for achieving SDGs. New Dimension of Agricultural Sciences: 11-21.
2.	Trivedi A, Nandeha N, Sharma A and Gautam VK. 2022. Artificial intelligence and geospatial analysis in disaster management. New Dimension of Agricultural Sciences: 62-81.
3.	Raju JT, Gautam VK and Trivedi A.2022. Role of conservation agriculture in increasing crop yields. New Dimension of Agricultural Sciences: 92-103.
4.	Patle D and Awasthi MK. 2021. Identification of drought presumable zones using

	Geographic information system: A case study of Niwari district of Bundelkhand region, Madhya Pradesh. Soil and Water Conservation &Management.1:63-68.
5.	Trivedi A and Awasthi MK. 2021. Runoff estimation by integration of GIS and SCS-CN method for Kanari River Watershed. Soil and Water Conservation & Management: 121-126.
6.	Rawat U, Yadav A, Pawar PS, Rajput A, Vasht D and Nema S. 2021. Determining wheat crop acreage based on Remote sensing & GIS technique in Jabalpur, India. Current Topics in Agricultural Sciences. B P International Publisher. 3: 63-69.
7.	Trivedi A, Awasthi MK and Singh M. 2021. Application of RS and GIS for determination of various criteria causing drying of Kanari River System.Water Resources Management and Sustainability Springer Nature. Chapter 16.
8.	Trivedi A and Nandeha N. 2020. Indigenous water conservation techniques. Organic farming in 21st century: Concept, Innovation and Perspectives. Agrobios (India):221-241.
Review Article	
1.	Katkani D, Babbar A, Mishra VK, Trivedi A, Tiwari S and Kumawat RK. 2022. A review on applications and utility of remote sensing and geographic information systems in agriculture and natural resource management. International Journal of Environment and Climate Change 12(4): 1-18
2.	Rop D, Pyasi SK, Awasthi MK, Shrivastava RN and Pandey SK. 2020. A review of the effect of deficit irrigation and mulching on yield and water productivity of drip irrigated onion. International Journal of Science and Research. 9(12):1675–1681.
Training Manual	
1	Practical Manual on “Hands on Training on Remote Sensing & GIS Using QGIS”
Spatial Product Album	
1	Spatial Product Album
2	Basics of Remote Sensing Album

Appendix A

Training schedules for Capacity Building Programs

A1:Hand on training on RS and GIS using QGIS & Saga GIS: 3rd to 23rd June 2021

SN	Topic
1	Introduction to Remote Sensing, Application of Remote Sensing in Agriculture.
2	Discuss about Satellites, Sensors, and Resolution.
3	Visual Interpretation of Satellite Imagery.
4	Details on Geo portals (Earth explorer, Bhuvan, Copernicus ESA etc.).
5	Hands on how to Sign Up of Earth Explorer and introduction about the earth explorer portal.
6	Hands on to Downloading Landsat 8 dataset and discuss about bands information.
7	Downloading and installation of QGIS open source software.
8	Hands on layer stacking of bands and subset the area using QGIS.
9	Hands on Band combinations for specific application such as FCC, true color composite etc.
10	Hands on Geo referencing of the topo sheet.
11	Generation of vector features such as Point, Line, and Polygon.
12	Features digitization, area calculation and attributes.
13	Introduction, Installing Required Plugins in QGIS and Pre-Processing of Landsat 8 using SCP.
14	Region of Interest (ROI) and Creating Training Dataset in QGIS.
15	Downloading and Installation of Saga GIS open sources software.
16	Classification using Random Forest technique.
17	Mapping Of classified data in QGIS
18	Practice test of Evaluation of the student

A2:Application of RS & GIS in NRM for Outgoing Students: 22nd Jun to 12th Jul 2021

SN	Topic
1	Common structures and load distributions and force analysis
2	Analysis of soil sample – sand, silt, clay, sieve analysis, and Hydrometry
3	Determination of soil mechanical properties.
4	Types of drippers, laterals and filters and their layout in drip design.
5	Maintenance against clogging and fertigation techniques.
6	Design, layout and evaluation of a sprinkler Irrigation system.
7	Common satellites, resolutions, supplying agencies and data acquisition.
8	Thematic maps its preparation and use.
9	Introduction to open source software
11	Useful apps prevailing in NRM domain.
12	Working out area of an irregular field
13	Levelling exercise
14	Working and use of Total station
15	Measurement and estimation of quantities of work.
16	Costing for quantities SOR for PWD and SOR for WK

A3: Faculty training on Remote Sensing & GIS using QGIS:

29th Jul to 19th Aug 2021 | 21st Sept to 11th Oct 2021 | 16th Dec to 13th Jan 2022
25th Aug to 15th Sep 2021 | 9th Nov to 29th Nov 2021 | 23rd Mar to 22 April 2022

SN	Topic
1	Inauguration, Pre-Training Test, Introduction to Remote Sensing and applications in Agriculture, Specialized learning Videos.
2	Satellites, Sensors, and Resolution, Visual Interpretation of Satellite Imagery.
3	Different Geoportals Specialized learning, Introduction to GIS, Specialized learning Videos
4	Introduction of QGIS open-source software, Downloading & Installation of QGIS Software Overview, Specialized learning Videos
5	Georeferencing of Map, Generation of vector features such as Point, Line and Polygone, Specialized learning Videos
6	Features (Point, Line and Polygon) digitization, filling data in attribute table and area calculation.
7	Downloading of Landsat-8 satellite dataset and about bands information. Specialized Learning
8	Layer stacking of different bands and clipping of Area of Interest (AOI)
9	Layer stacking of bands and clipping of Area of Interest (AOI).
10	Band combinations for agriculture applications using False Colour Composite
11	Introduction in QGIS and Pre-Processing of Landsat 8 using SCP
12	Region of Interest (ROI) and Creating Training Dataset
13	Introduction of Classification Supervised classification using Minimum distance algorithm
14	Supervised classification using Minimum distance algorithm
15	Area Calculation of LU/LC classified data
16	Map Layout Creation
17	Presentation by Participants on LU/LC (as prepared during exercise)
18	Presentation by Participants on LU/LC (as prepared during exercise)
19	Post Training Assessment & Valedictory Function

A4: Educative Learning Program for Agriculture Executives:31st Jan to 5th Feb 2022

SN	Topic	Resource Person
1	Concept of RS & GIS and Its application in Agriculture,	Dr. Suresh Kumar (Scientist, G IIRS Dehradun)
2	Classified Land use land cover maps, Classified Crop maps & Crop area identification	Dr. Poonam S Tiwari (Scientist F, IIRS Dehradun)
3	Groundwater potential zone maps, Lineament maps for Water harvesting site selection in watersheds	Dr. N. Patidar (Scientist B, NIH Roorkee)
4	Vegetation index maps for crop yield modeling, Crop condition, stress assessment using RS & GIS	Dr. V. Sahgal, Professor, IARI, New Delhi
5	RS in Crop inventory and crop resource Management	Dr. N R Patel, Scientist G, IIRS, Dehradun
6	Satellite data availability at open source, Collection of field data, and verification of satellite data	Dr. Manish Nema, Scientist D, NIH Roorkee

Appendix B

Training Schedules for Students Development Programs

B1: Entrepreneurship Development for Agriculture Graduates 16 May to 3 Jun 2022

SN	Topics	Resources person
1	Inaugural session and welcome address	Dr. R.K. Nema
	Commercial Production and Marketing of Bio-pesticide	Dr. S. B. Das
2	Commercial production and Marketing of Bio Fertilizer	Dr. NG Mitra
	Commercial production and Marketing of Vermi-based product	Dr. S. B. Agrawal
3	Commercial Production and Marketing of Bakery & Confectionary products	Dr. Sheela Pandey
	Processing & Preservation of Vegetables and fruits	Dr. S.S. Shukla
4	Commercial Production and Marketing Fruits	Dr. Rajni Sharma
	Commercial production and Marketing of Flowers under Hi-tech Horticulture	Dr. VK Singh
5	Commercial production and Marketing of Flowers under Hi-tech Horticulture	Dr. B.P. Bisen
	Mass Multiplication of citrus Sapling and its marketing	Dr. V.K. Paradkar
6	Establishment, marketing and Marketing in Commercial Nursery	Dr. R Tiwari
	Commercial Production and Marketing of Lac	Dr. Moni Thomas
7	Commercial Production and Marketing of Hybrid Seed	Dr. Uttam Bisen,
	Commercial Production and Marketing Mushroom	Dr. Vijay Yadav
8	Establishment of private Soil Testing Lab and its operation	Dr. G.D. Sharma
	Commercial Cultivation and Marketing of Pearl	Dr. Chanchal Bhargava
9	Licensing, Marketing & Export of Agri-products	Dr. Anil Mishra
	Project formulation and Financial analysis	Mrs. Laveena Sharma
10	Agri-entrepreneurship: Opportunities & Support Mechanism	Dr. S.B. Nahatkar
	Millet based products- Start-ups Experience on Business Development	Mr. Rakesh Singh
11	Mushroom Production- Start-ups Experience on Business Development	Mrs. Hiresha Verma
	Vegetable & fruit marketing- Start-ups Experience on Business Development.	Mr. Raunak Jain
12	Solar dehydrated vegetables and fruit: Start-ups Experience on Business Development	Mr.Varun Raheja
	Vegetable Production- Business Development	Mr. Swadesh Kurmi
13	Importance of forward and backward linkages in agribusiness	Dr. R Pastor
	One District one Product Policy of the State	Dr. VK Agrawal
14	Commercial processing, value addition and marketing of Herbal Medicines	Dr. Gyanendra Tiwari
	Commercial Production and Marketing of seed	Mr. Lakshya Agrawal
15	First aid & care of patients at home:	Dr. Akhiesh Gautam
	Remarks by Dean Faculty Agriculture	Dr. Dhirendra Khare,
	Remarks by Hon'ble Vice Chancellor	Prof. P. K. Bisen
	Vote of thanks	Dr. S. B. Das

B2: Seven days workshop on Sports and Physical Education: 3rd Jan to 9th Jan 2022

S.N.	Topic	Resource Person
1	Nutrition and Body physique	Dr. Kuldeep Yadav, International Body Building Trainer
2	Sports Training & Work Schedule	Dr. D. P. Chattarjee, Athletic coach, Dept of Physical Education, RDVV, Jabalpur
3	Athletics	Dr. Rakesh Yadav, Asstt. Director, JNU, New Delhi
4	Sports Training and Complementary Exercise	Dr. Shailesh Singh, Asstt. Prof LNIPE, Guwahati, Assam
5	Lecture on Volleyball	Dr. Vergese Antony, Lecturer Physical Education Department, College of Applied & Supporting studies, KFUPM, Dhahran, Saudi Arabia
6	Lecture on Javelin throw	Dr. Ajeet Yadav, Para Olympian and world champion
7	Lecture on Badminton Sports Quiz	Mr. Ashutosh Pant Badminton Coach, Indian School, Muscat.

B3: Nine days workshop on Preparation of Cultural Events and National Competition:2nd Feb to 10th Feb 2022

S.N.	Event	Resource Person
1	Folk Dance & Song	Sanjay Pandey
2	Theatre	Sandeep Pandey
3	Singing	Animesh Tiwari
4	Fine Arts	Harshit Jha
5	Literary	Sulekha Mishra
6	Fine Arts	Sharanjeet Guru
7	Literary	Hanumant Sharma
8	Rangoli, Painting	Aruna Anna
9	Theatre	Rohit Tiwar

B4: 1 Month Workshop on Holistic development of students 28 Feb to 28 Mar 2022

Training Schedule

S.N.	Topic	Resource Person
Philosophy Aspect		
1	My Teacher	Dr. D. K. Khare, DFA, JNKVV
2	Yoga life style	Dr. Ajay Bharatwaj, Gujrat
3	Know yourself & realizing your greatest strength	Dr. S. S. Sandhu, Jbp
4	Power of self confidence	Shri Kevin Pareria
Health Aspect		
5	Enhance soft skill & become presentable	Dr. Girajesh Mehra, IARI, New Delhi
6	Know your body and awareness on	Dr. Parimal Swamy, Jbp
7	Mental wellness	Dr. R. S. Dubey, Jbp
8	Nutritional aspect of human being	Dr. Rakesh Tomar, Saudi Arabia
Communication Aspect		
9	Fitness & Motor fitness	Dr. Varghese Anthony, Saudi Arabia
10	How to become presentable for private sector	Dr. Abhay Katare, Jbp
11	Soft skills	Ms. Deepa Ayachit, Bhopal
12	Orientation of artificial intelligence in	Dr. Alka Arora, New Delhi
Contemporary Agricultural Education Aspect		
13	Preparation of different Agriculture	Dr. Amit Goswami, New Delhi
14	Computer skills in Agriculture	Dr. Soumen Pal
15	Abroad opportunities for higher studies &Job	Dr. Naveen Sharma, Nerobi
16	How to write and publish research material	Dr. Vaseem, Jbp
17	Progressive farmer	Shri Rakesh Dubey, NSP
18	Agricultural entrepreneurship	Dr. Ajay Naberia, Jbp
Social Aspects		
19	Awareness program women empowerment	Dr. Sabina, Kolkota
20	Know your rights and duties	Shri Siddhart Seth, Jbp
21	Leadership quality	Capt. Sunil K. Bharadwaj

Appendix C

Capacity building Programs under EAP

C1: Improving Language Competency through Capacity Building in Spoken & Writing Skills.: 22nd Nov to 1st Dec 2021

S.N.	Topic	Resource Person
1	Intro -A talk on how English can be learned-	Mr. Prashant Kumar Dubey, Director, Institute- strides center, for youth empowerment, Jabalpur
2	Basic Structure of English - Parts of speech,	
3	Talking about the Present – Verb 'To Be'	
4	Talking about the Present – Simple Present,	
5	Talking about the Present – CAN & Have	
6	Writing Tips - Writing Task Explanation	
7	Talking about the Future- Will& Shall & Be	
8	Talking about the Past – Simple Past & Present	
9	Possessive Case of Nouns-Apostrophe	
10	Question Tags "**?**"	

C2: Personality Development & Soft Skills: 6th Dec to 15th Dec 2021

S.N.	Topic	Resource person
1	Confidence, Motivation & Attitude	Mr. Kushal Raut, Director CommuniCare Training & content solution
	SWOT Analysis	
2	Group Discussion (GD) Techniques Cont.	
	Group Discussion (GD) Techniques	
3	Personal Interview (PI) Techniques Cont.	
	Personal Interview (PI) Techniques	
4	Time Management	Mr. Sanjeev Rane, Trainer CommuniCare Training
	Stress Management	
5	Communication Skills – Session I Cont.	
	Communication Skills – Session I	
6	Communication Skills – Session II Cont.	
	Communication Skills – Session II	
7	Goal Setting	Mr. Kushal Raut, Director CommuniCare Training & content solution
	Innovation - the need of the hour	
8	Developing an Entrepreneurial Attitude,	
	Presentation Skills	
9	Email Etiquette	Mr. Sanjeev Rane, Trainer CommuniCare Training
	Self-Discipline	
10	Internet & Social Media Etiquette	
	Leadership	

Appendix D

Participants in Various programs

D1: Awareness programs

SN	Date	Awareness programs	Participants												
			Male					Female					Total	Faculty
			UR	OBC	SC	ST	Total	UR	OBC	SC	ST	Total		
1	30/04/2021	Natural Resources Management	58	65	36	23	182	56	30	14	18	118	**300**	42
2	24/06/2021	Introduction to spatial data applications	19	3	1	9	32	8	2	1	3	14	**46**	33
3	29/06/2021	Remote Sensing & GIS Application in student Research	14	37	10	11	72	14	15	6	2	37	**109**	-
4	12/03/2021	Use of RS& GIS	26	18	60	55	159	17	31	46	39	133	**292**	-
		Total	**117**	**123**	**107**	**98**	**445**	**95**	**78**	**67**	**62**	**302**	**747**	**75**

D2: Capacity Building Programs

SN	Date	Capacity Building Programs	Participants											
			Male					Female					Total	Faculty
			UR	OBC	SC	ST	Total	UR	OBC	SC	ST	Total		
1	03/06/2021 - 23/06/2021	RS and GIS using QGIS & SAGA GIS	3	1	2	4	**10**	2	2	1	2	**7**	**17**	-
2	22/06/2021 - 12/07/2021	Application of RS & GIS in NRM	7	32	5	8	**52**	12	7	5	8	**32**	**84**	-
3	29/07/2021 - 19/08/2021	Remote Sensing & GIS using QGIS	21	2	2	9	**34**	9	-	-	-	**9**	**43**	43
4	25/08/2021 - 15/09/2021		23	3	-	1	**27**	11	1	1	-	**13**	**40**	40
5	21/09/2021 - 11/10/2021		28	5	2	6	**41**	7	-	-	-	**7**	**48**	48
6	09/11/2021 - 29/11/2021		12	2	4	12	**30**	6	-	-	2	**8**	**38**	24
7	16/12/2021 - 13/01/2022		6	6	-	7	**19**	6	3	-	6	**15**	**34**	2
8	14/02/2022 - 16/03/2022		11	3	1	6	**21**	3	-	1	-	**4**	**25**	25

SN	Date	Capacity Building Programs	Participants											
			Male					Female					Total	Faculty
			UR	OBC	SC	ST	Total	UR	OBC	SC	ST	Total		
9	23/03/2022 - 22//04/2022	NRM through RS and GIS Applications	13	12	10	25	**60**	14	3	9	7	**33**	**93**	-
		Total	**124**	**66**	**26**	**78**	**294**	**70**	**16**	**17**	**25**	**128**	**422**	**182**

D3: Educative learning for Executives

SN	Date	Educative learning for Executives	Participants											
			Male					Female					Total	Faculty
			UR	OBC	SC	ST	Total	UR	OBC	SC	ST	Total		
1	31/01/2022-05/02/2022	For Agriculture Executives	7	3	5	5	20	3	-	1	1	5	**25**	25
2	14/02/2022-19/02/2022		6	8	4	6	24	1	-	1	-	2	**26**	26
3	28/02/2022-05/03/2022		6	6	4	7	23	-	-	-	1	1	**24**	24
	Total		**19**	**17**	**13**	**18**	**67**	**4**	**-**	**2**	**2**	**8**	**75**	**75**

D4: Students Development Programs

SN	Date	Students Development Programs	Participants										
			Male					Female					
			UR	OBC	SC	ST	Total	UR	OBC	SC	ST	Total	Total
1	16/05/2021 - 03/06/2021	Entrepreneurship Development for Agriculture Graduates	52	43	66	173	334	77	29	35	54	195	**529**
2	28/06/2021	Plagiarism for master & Ph.D. Degree students	11	7	7	34	59	22	5	4	6	37	**96**
3	02/01/2022 - 09/01/2022	Workshop on Sports and Physical Education	35	27	27	51	140	37	11	22	11	81	**221**
4	02/01/2022 - 10/01/2022	Preparation of Cultural Events and National Competition	44	30	31	73	178	45	27	26	41	139	**317**
5	28/02/2022 - 28/03/2022	Holistic development of students	169	99	107	382	757	140	50	62	94	346	**1103**
		Total	**311**	**206**	**238**	**713**	**1468**	**321**	**122**	**149**	**206**	**798**	**2266**

D5: Awareness Program under (EAP)

SN	Date	Awareness Program under (EAP)	Participants										
			Male					Female					Total
			UR	OBC	SC	ST	Total	UR	OBC	SC	ST	Total	
1	21/06/2021	Sustainable life style through yoga in COVID-19 Environment	93	65	69	162	389	92	39	49	68	248	**637**
2	29/07/2021	Grievance Redressal Mechanism (GRM)	44	21	13	46	124	32	9	9	27	77	**201**
3	31/10/2021	Online Quiz Competition for students on occasion of National Unity Day	45	21	21	74	161	60	15	20	31	126	**287**
4	20/11/2021	Lecture on excel the ICAR- ARS mains exam	15	13	9	16	53	12	10	3	9	34	**87**
5	26/11/2021	Special lecture for the ICAR-ARS main exams	15	12	14	16	57	8	4	12	13	37	**94**
6	07/12/2021	Orientation Program on Career Opportunities for Agricultural Students in India	23	13	25	20	81	17	5	9	16	47	**128**
		Total	**235**	**145**	**151**	**334**	**865**	**221**	**82**	**102**	**164**	**569**	**1434**

D6: Capacity building Program under (EAP)

SN	Date	Capacity building Program under (EAP)	Participants										
			Male					Female				Total	
			UR	OBC	SC	ST	Tot	UR	OBC	SC	ST	Tota	
1	22/11/2021 - 01/12/2021	Improving Language Competency through Capacity Building in Spoken English & Writing Skills.	18	12	58	34	122	12	7	25	24	68	**190**
2	06/12/2021 - 15/12/2021	Personality Development & Soft Skills	29	20	81	34	164	14	6	24	37	81	**245**
		Total	**47**	**32**	**13**	**68**	**286**	**26**	**13**	**49**	**61**	**149**	**435**

D7: Awareness Program under (ESP)

SN	Date	Awareness Program under (ESP)	Participants										
			Male					Female					Total
			UR	OBC	SC	ST	Total	UR	OBC	SC	ST	Total	
1	27/11/2021	Bio Pesticides and their use	1	3	12	10	26	1	2	2	6	11	**37**
2	21/12/2021	Safe use of Pesticides	1	2	12	5	20	-	-	5	5	10	**30**
		Total	**2**	**5**	**24**	**15**	**46**	**1**	**2**	**7**	**11**	**21**	**67**

D8: Capacity building Program under (ESP)

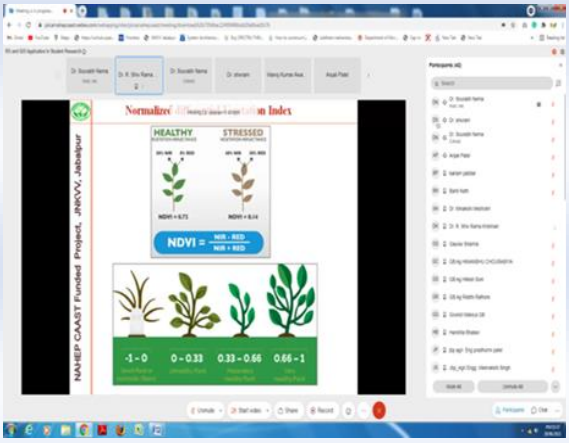
SN	Date	Capacity building Program under (ESP)	Participants										
			Male					Female					Total
			UR	OBC	SC	ST	Total	UR	OBC	SC	ST	Total	
1	05/06/2021	Agroforestry-Sustainable and greener approach to farmers	17	10	5	21	53	12	3	2	11	28	**81**
2	26/06/2021	Biosafety and waste disposal	11	3	4	12	30	4	2	-	7	13	**43**
3	24/07/2021	Food Safety a Shared Responsibility	38	11	2	27	78	32	2	1	15	50	**128**
4	25/07/2021	Impact of Climate change on Insect Pests	3	5	5	13	26	3	1	2	7	13	**39**
5	26/07/2021	Good Laboratory Practices for safety & estimation procedure of pesticides residues and nutrient in soil & plants	5	4	2	5	16	4	-	1	7	12	**28**
6	11/08/2021	Nutriment management in organic farming	9	5	5	16	35	8	2	-	6	16	**51**
7	29/09/2021	Integrated disease management	6	1	1	2	10	4	1	1	3	9	**19**
8	13/11/2021	Safe use of pesticides	-	1	25	10	36	-	-	-	-	-	**36**
9	13/11/2021	Removal of pesticides from Vegetables	-	1	25	10	36	-	-	-	-	-	**36**
10	04/12/2021	Crop Protection Equipment	-	1	25	10	36	-	-	-	-	-	**36**
11	15/12/2021	Integrated Pest Management	1	-	25	11	37	-	-	-	-	-	**37**
12	17/12/2021	Integrated Nutrient Management for Sustainable Agriculture & Ecosystem	1	3	12	10	26	1	2	2	6	11	**37**
		Total	**89**	**41**	**74**	**116**	**320**	**67**	**11**	**7**	**56**	**141**	**461**

Appendix E

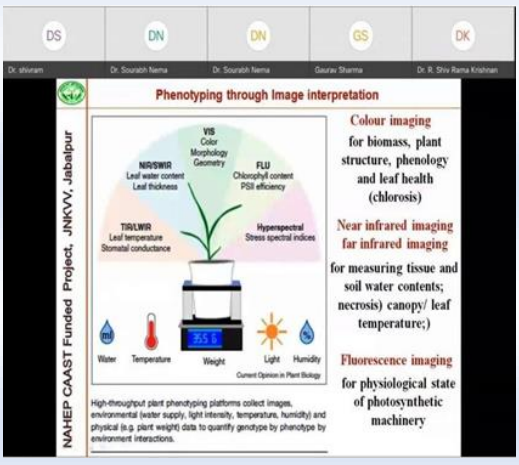
Activities at a Glance

Awareness program on NRM- 30th Apr 2021

Introduction to Spatial Data Applications -24th June 2021

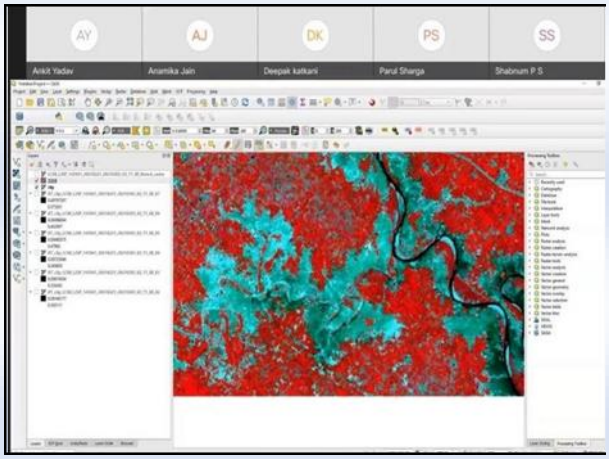


Awareness Program on Remote Sensing & GIS Application in student Research - 29th June 2021.

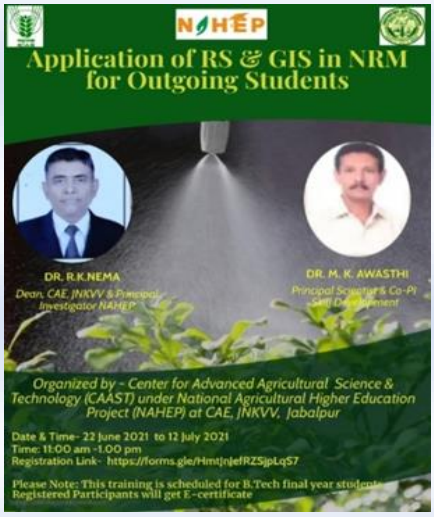


Awareness Program on the use of RS&GIS- 3rd Dec 2021

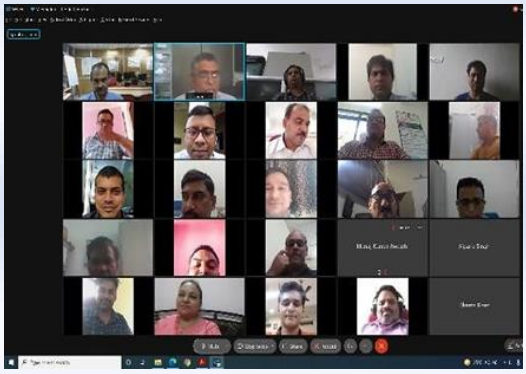
Hands-on training on Remote Sensing & GIS using QGIS for Faculty: 3rd June to 23rd June 2021



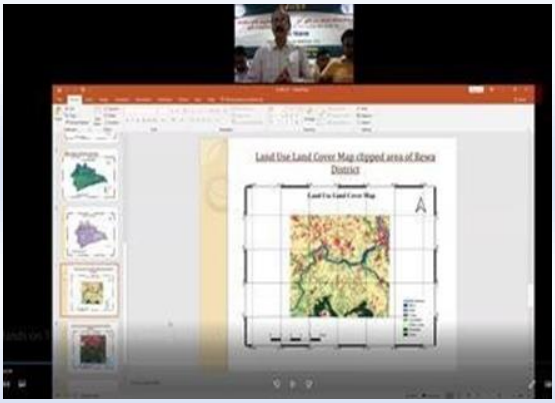
Training on Application of RS & GIS in NRM

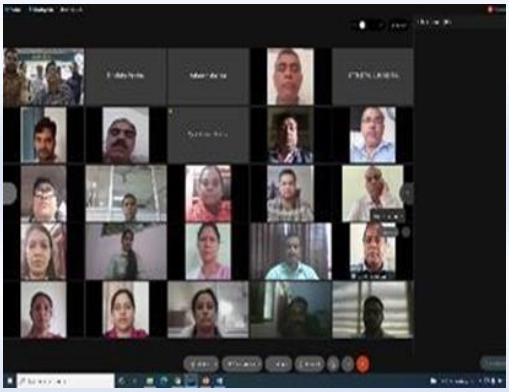


Training on Application of RS & GIS in NRM

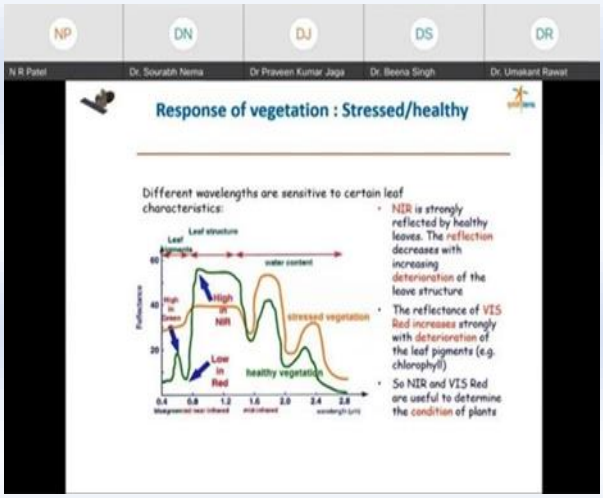


Faculty training on Remote Sensing & GIS using QGIS: 25th Aug to 15th Sept 2021

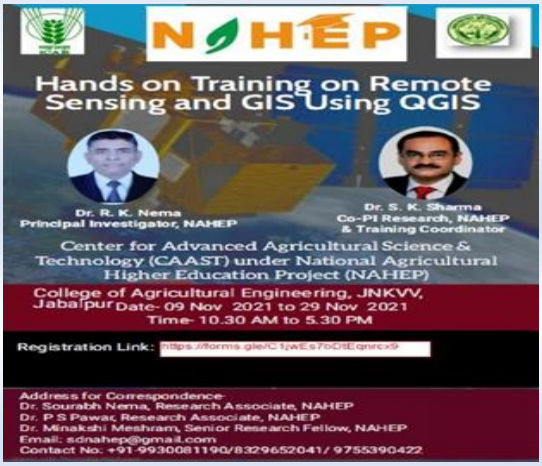


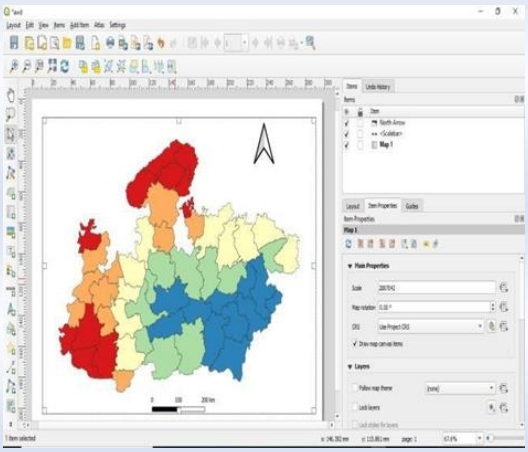


Hands-on training on Remote Sensing & GIS using QGIS for Faculty: 21st Sept to 11th Oct 2021

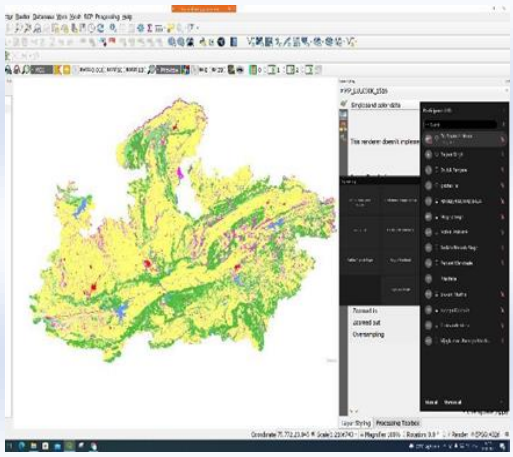


Hands-on Remote Sensing & GIS using QGIS for Faculty & Students: 9th Nov to 29th Nov 2021

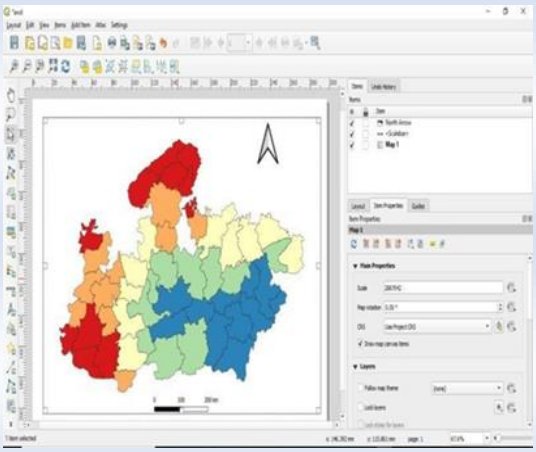




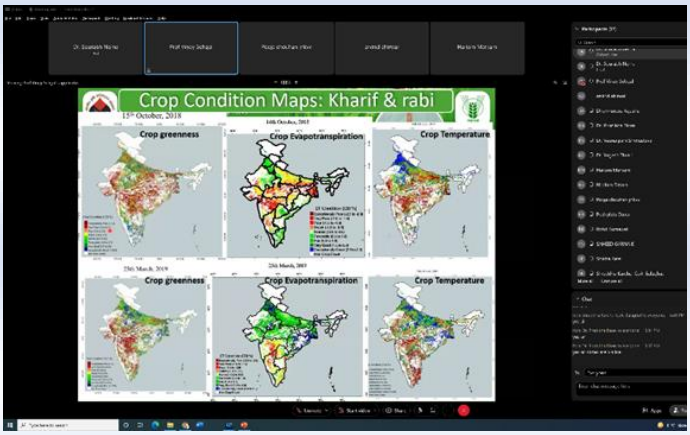
Fundamental application of Remote Sensing &GIS: 16th Dec to 13th Jan 2022



Hands on RS and GIS using QGIS (For faculty) 14th Feb to 16th Mar 2022

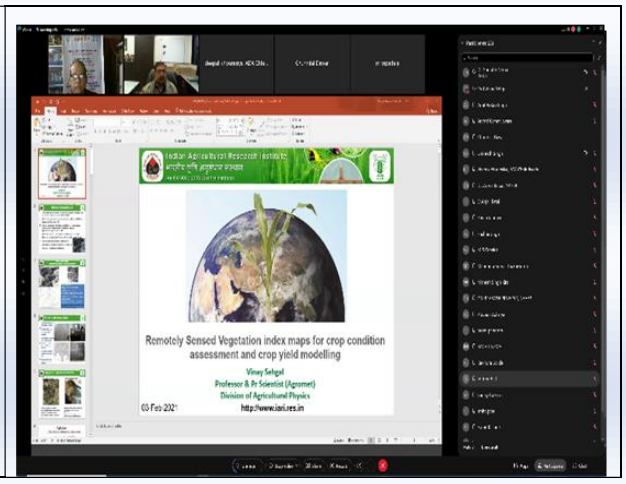


NRM through RS and GIS : 23rd Mar to 22 April 2022

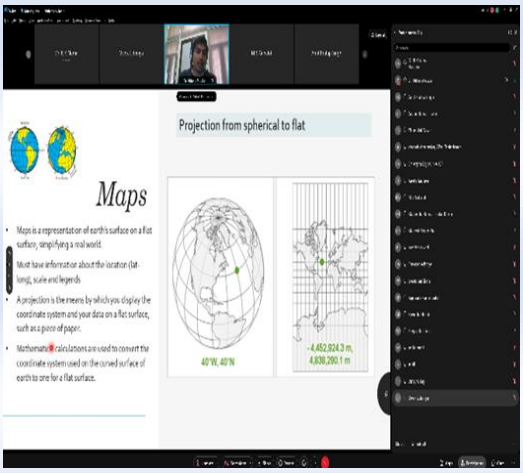


Educative learning for Executives

Batch 1: Educative Learning for Agriculture Executives: 31st Jan to 5th Feb 2022



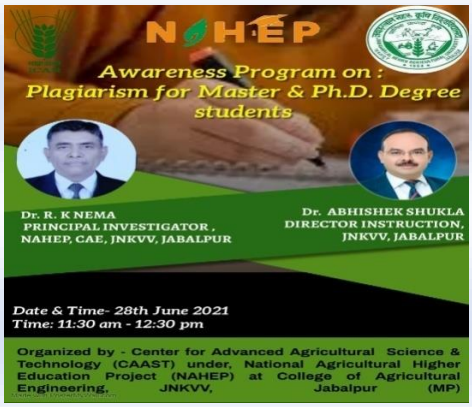
Batch :2 Educative Learning for Agriculture Executives: 14th Feb to 19th Feb 2022



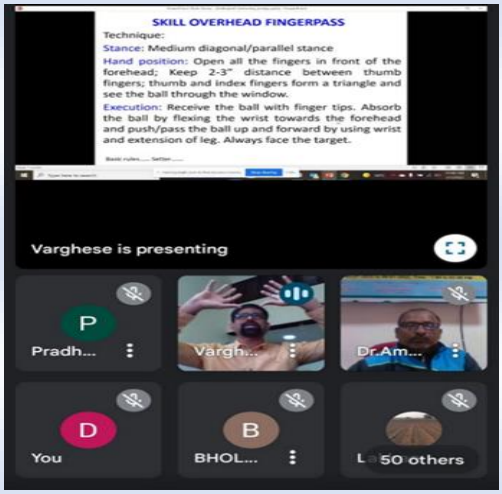
Batch: 3 Educative Learning Agriculture Executives: 28th Feb to 5th March 2022

Students Development Program

Awareness on plagiarism for master & Ph.D. Degree students: 28th June 2021



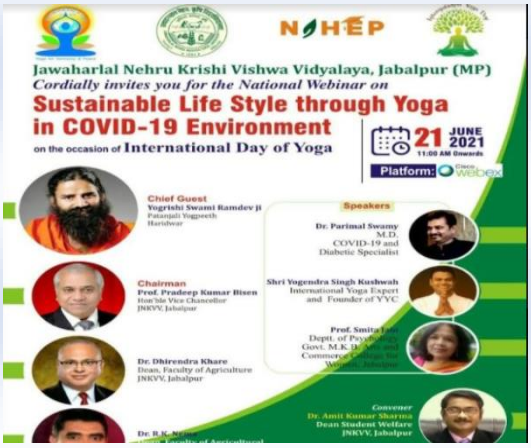
Nine days workshop on preparation of cultural Events for national competition: 15th February to 23rdFebruary 2022

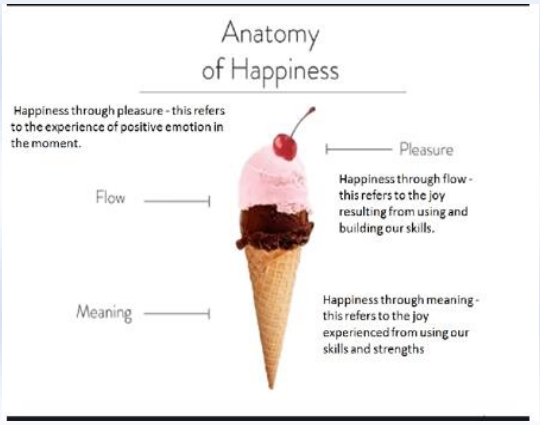


Twenty-one Days workshop on Holistic development of students: 28th Feb to 28th March 2022

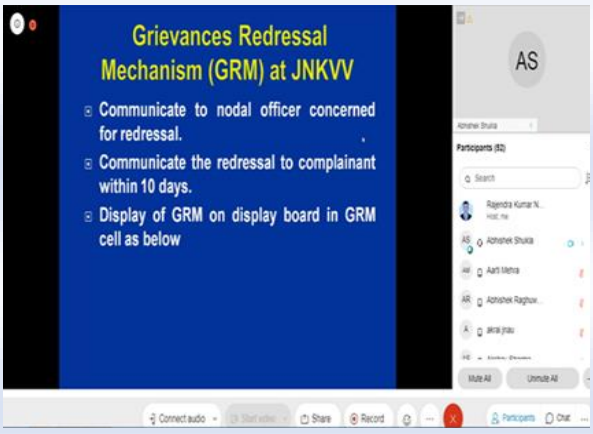
Awareness Program under EAP

Awareness on usefulness of Yoga in COVID-19 Environment: 21st June 2021

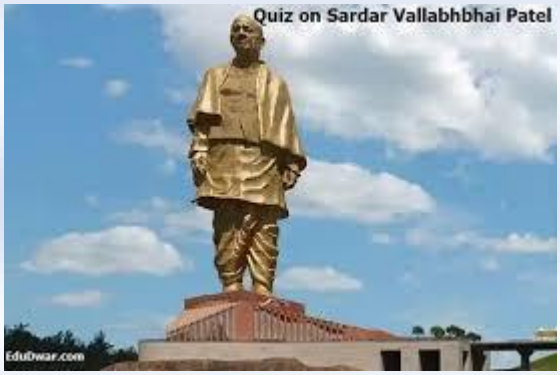




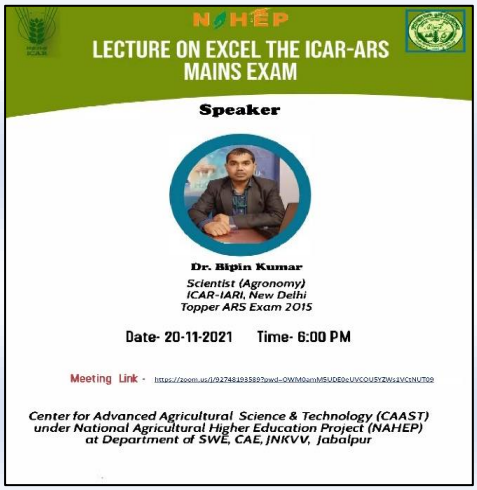
Online Awareness Program on Grievance Redressal Mechanism: 29th July 2021



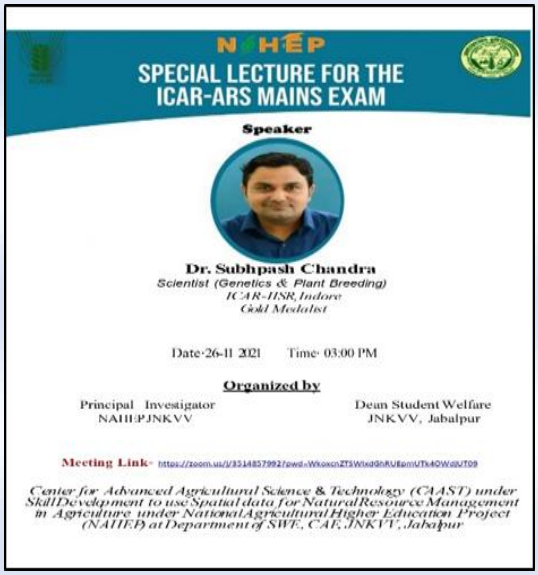
Online Quiz Competition for students onNational Unity Day: 31st Oct 2021

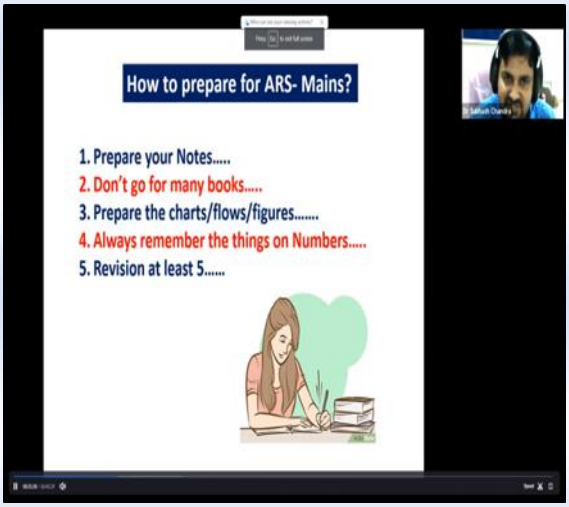


How to excel the ICAR- ARS mains exam: 20th Nov 2021



Special lecture for the ICAR-ARS main exams: 26 Nov, 2021

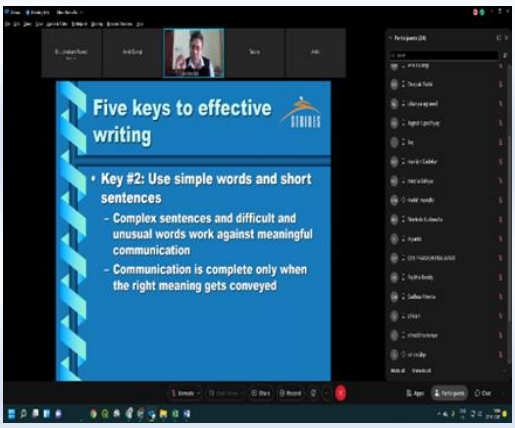




Orientation programe on Career opportunities for Agricultural Students in India and Abroad & Facilitation of students for competitive Excellence : 7th Dec 2021

Capacity building Program under EAP

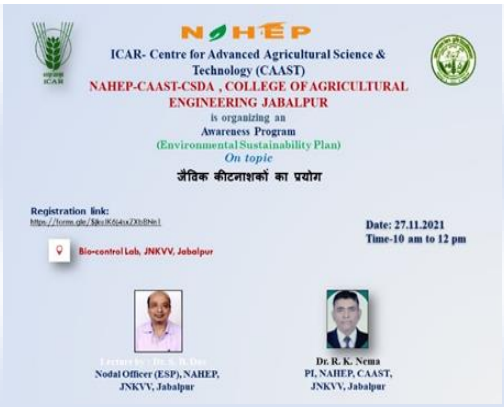
Personality Development and soft skills: 22nd Nov to 3rd Dec 2021



Personality Development & Soft Skills: 6th Dec to 15th Dec 2021

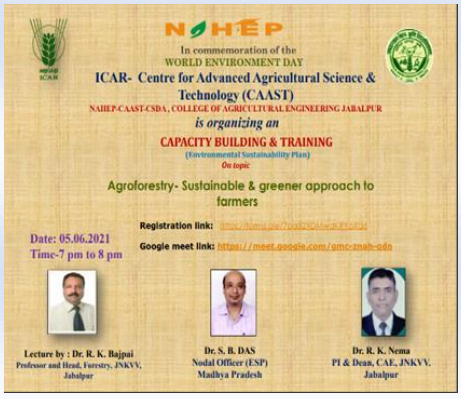
Awareness Program under ESP

Bio Pesticides and their use: 6th Dec 2021

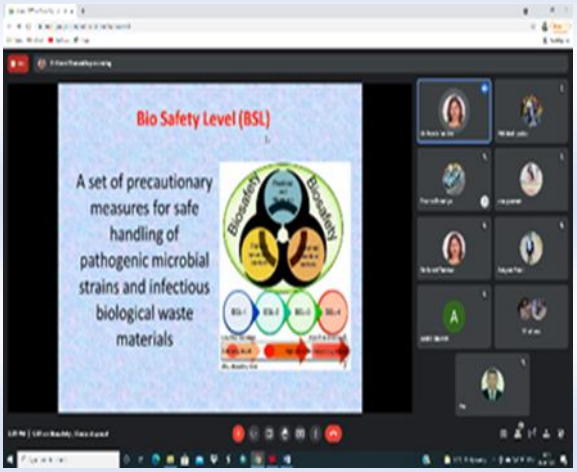


Safe use of Pesticides: 6th Dec 2021

Agroforestry- Sustainable and greener approach to farmers: 5th June 2021

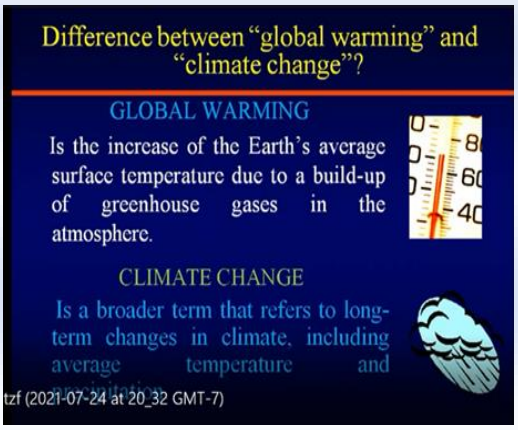


Biosafety and waste disposal: 26th June 2021

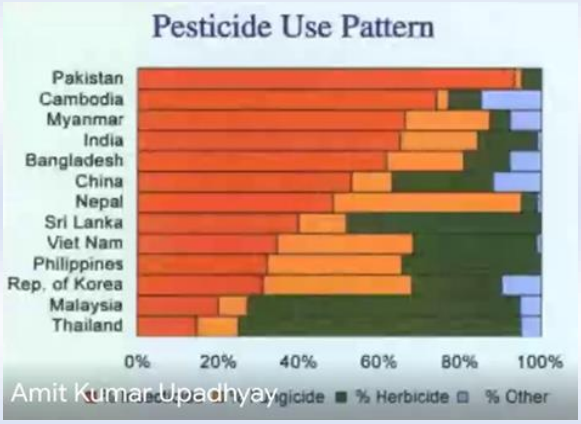


Food Safety - a Shared Responsibility: 26th June 2021

Impact of Climate change on Insect Pests: 25th July 2021



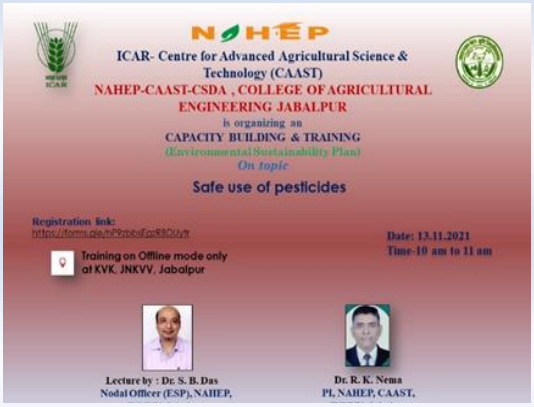
Good Laboratory Practices for safety & estimation procedure of pesticides residues and nutrient in soil & plants: 26th July 2021



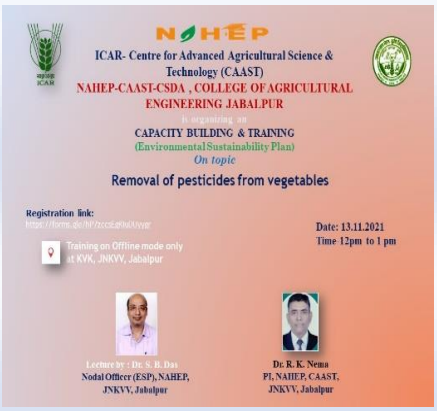
Management in organic farming : 26th July 2021

Integrated Disease Management: 26th Sept 2021

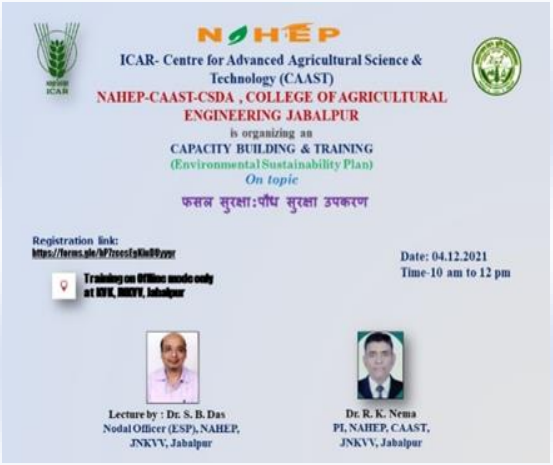
Safe use of pesticides: 13th Sept 2021



Removal of pesticides from Vegetables: 13th Sept 2021



Crop Protection Equipment: 13th Sept 2021



Integrated Pest Management: 15th Dec 2021

Integrated Nutrient Management for Sustainable Agriculture & Ecosystem: 15th Dec 2021

List of Key Personnel involved in NAHEP

S.No.	Project Monitoring and Evaluation Team		
1	Dr. P. K. Bisen Hon'ble Vice Chancellor	2	Dr. Dhirendra Khare Dean Faculty of Agriculture
3	Dr. G. K. Koutu Director Research Services	4	Dr. Abhishek Shukla Director Instructions
5	Dr. D. K. Phalwan Director Farms	6	Dr. Dinkar Sharma Director Extension Services
7	Dr. Atul Kumar Shrivastava Dean, CAE	8	Dr. Amit Sharma Dean Students Welfare
9	Shri V. N. Bajpai Comptroller, JNKVV	10	Dr. Ajay Khare Deputy Comptroller Finance
11	Er. S. K. Jain Computer & IT specialist and Incharge University, Technical Cell	12	Dr. Rakesh Bajpai Professor & Head, Agricultural Forestry, CoA,
13	Dr. Mohan Singh Professor & Head, Process & Food Engineering, CAE,	14	Dr.(Smt) Anita Babbar Principal Scientist, Department of Plant Breeding CoA,
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3	Dr. M.K. Awasthi	Co-PI, National Training	
4	Dr. S.K. Sharma	Co-PI, Research	
5	Dr. A.K. Rai	Co-PI, Product Development	
6	Dr. Y.K. Tiwari	Co-PI, Procurement &Finance	
7	Dr. S.B. Das	Nodal Officer, Environmental Safeguard	
8	Dr. Deepak Rathi	Nodal Officer, Equity Action Plan	
9	Dr. Ajay Khare	Nodal Officer, Finance	
Associated Scientists			
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5	Dr. C.M. Abroal, Associate Professor, PHPE	6	Dr. Dinkar Sharma, Director, Extension Services
7	Dr. S.K. Pandey, Professor, Horticulture	8	Dr. P. B. Sharma, Professor, Agronomy,
9	Dr. Rakesh Bajpai, Professor, Forestry	10	Dr. Gyanendra Tiwari, Associate Professor, Plant Physiology
11	Dr. Manish Bhan, Asstt. Professor, Agrometeorology	12	Dr. R. Shiv Ramakrishnan, Asstt. Professor, Plant Physiology
13	Dr. G.S. Tagore, Asstt. Professor, Soil Science and Agricultural Chemistry	14	Er Manish Patel, Asstt. Professor, FMPE
RAs/ SRFs / YPs			
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3	Dr. Umakant Rawat, RA	4	Dr. Popat Shivaji Pawar, RA
5	Er. Alok Rajpoot, RA	6	Aniket Rajput, SRF
7	Om Prakash Prajapati, SRF	8	Sumit Hiraman Kakade, SRF
9	Dr. Arpna Bajpai, SRF	10	Krishna SinghYP-II (Computer)
11	Er. Anjali Patel, YP-II (Computer)	12	Rachit Nema YP-II (Computer)
13	Pratima Pathak, (YP-I)	14	Prakash Kumar Mishra, (Accounts)
15	Mukesh Kumar Vishwakarma, (YP-I)		