

Proceedings of The Annual Review Meeting



on

FASAL

Forecasting Agricultural output using
Space, Agrometeorology and Land based observations

organized at YASHADA, Pune during 1-2 August 2011



The second “Annual Review Meeting on FASAL” was organized at YASHADA, Pune during 1-2 August 2011. Officers from SAMCs of IMD and Principal Nodal officers, Nodal officers and Technical officers from AMFUs and experts in the field of crop yield forecasting participated in the meeting. Dr.J.S.Parihar, Deputy Director (EPSA) and OS, SAC, Ahmedabad, was the Chief Guest of the inaugural session. Other dignitaries attended the meeting are Dr. Dalip Singh, Additional Statistical Advisor, NCFC, DAC, New Delhi, Dr. Ranjana Agarwal, Head, Forecasting Division, IASRI, New Delhi, Dr. A. B. Mazumdar, DDGM (WF) & LACD ADGM (R), IMD, Pune, Dr. Swati Sardesai Scientist G & DDG, NIC, Pune, Dr. R.P.Samui, Retd. DDGM (Agrimet), IMD, Pune. The programme details along with the list of participants in enclosed in the Annexures.

At the outset Dr. N.Chattopadhyay, DDGM (Agrimet) welcomed all the participants. In his address, he informed the participants the objectives of holding the Annual Review meeting and also emphasized the merit of the FASAL programme under the climate variability in recent past and projected climate change scenario in the country and mode of implementation of the same. Besides he has also outlined the theme of different technical session of the programme.

Dr. R.P.Samui, Retd. DDGM (Agrimet), IMD, Pune mentioned that the scheme is very important not only for academicians but also for the planners for taking important decision within the season and also just before the harvest of the crops. He stressed the need for developing both statistical and crop simulation models. He requested Dr. Dalip Singh to provide adequate funds for smooth functioning of the project.

Dr. Swati Sardesai, Scientist G and DDG, NIC, Pune expressed her happiness in addressing the scientists who are working both the projects of IMD i.e. IAAS and FASAL. She elaborated the importance of use of ICT in e-governance and its linkages with the FASAL project. She was of the opinion that the modern technology like ICT would be of much useful in designing a strong network among AMFUs to interact effectively with each other. Research papers / articles are required to be documented in simple languages which can be easily understood by end users. She suggested to use the open source statistical packages for easy understanding of statistical concepts for improving the skills. She assured full cooperation from NIC in implementation of the FASAL project.

Dr. Dalip Singh, Additional Statistical Advisor, NCFC, DAC, New Delhi, has informed that crop assessment and crop forecasting are two major important aspects these days. According to him kharif season is the most complicated season as crop production depends on monsoon rainfall. He said that India Meteorological Department is supposed to issue crop yield of 11 major crops in the country based on weather parameters also by giving multiforecasts within the seasons. He assured that the funds for the project would be no problem but all concerned should send the report of the utilization of funds in succession.

Dr. Ranjana Agarwal, Head, Forecasting Division, IASRI, New Delhi, in her address mentioned that the pre harvest forecasting is multidisciplinary as it involves Meteorology, Statistics, Agronomy, Remote sensing, Crop Physiology etc. According to her the use of proper statistical method and selection of parameters on the basis of correlation coefficients will be helpful for accurate yield forecasting. She added that proper planning must be done along with use of statistical softwares for yield prediction.

Dr. A. B. Mazumdar, DDGM (WF) & LACD ADGM (R), IMD, Pune said that crop acreage estimation and crop yield forecasting are crucial for planning and policy making. He mentioned about the variability of monsoon rainfall in recent past and its probable impact on crop production and hence the need to develop such technologies to predict the crop yield. He wished for the successful implementation of the project.

Dr. J.S.Parihar, Deputy Director (EPSA) and OS, SAC, Ahmedabad gave a brief account of the genesis of FASAL project including the CAPE project started at SAC, Ahmedabad. He elaborated importance and entry of different organizations in crop yield estimation. He said that great challenges are ahead for all the organizations under FASAL project to issue correct and in time yield forecast of major crops in the country. He emphasized to issue crop yield forecast based on scientific understanding in spite of criticism of wrong forecasts.

The inauguration session ended with vote of thanks by Shri R. Balasubramaniam, Scientist C, IMD, Pune.

After a short Tea-Break, first technical session started at about 11.30 A.M. under the Chairmanship of Dr. Swati Sardesai DDG, NIC, Pune assisted by Dr. N. Chattopadhyay, DDGM (Agrimet), Pune.

Technical session I

In this session five presentations were made. Dr. Dalip Singh, Additional Statistical Advisor, NCFC, DAC, New Delhi, presented the present status of FASAL project. He explained core activities planned under FASAL and constraints in the present system. He proposed some strategies for NCFC-FASAL. He focused on the role of IMD to generate multiple forecasts of crop yield of major crops during each season, coverage at district/agro climatic Zone/state/national level, development, testing and validation of crop growth simulation models, adhering to monitorable physical and financial targets each year. He also assured to provide crop production data at district level from the Agriculture Ministry.

Dr. N. Chattopadhyay, DDGM (Agrimet), IMD, Pune presented on achievements and future needs for FASAL and use of statistical techniques in crop yield forecasting. He explained about the existing system of crop estimation and its limitation. He explained the concept of FASAL is issuing multiple seasonal forecasts where the pre planting forecast is being taken care by Institute of Economic Growth, New Delhi and subsequent forecasts by IMD and SAC. He mentioned about the deadline for issue of crop yield forecast at different stages. He focused on the responsibilities and work at three tier system of FASAL i.e. at Agrimet Division, SAMCs, and AMFUs. He informed that Agrimet Division is apex body to develop national level forecast and that is given to DAC for release. Weather data of available stations under each AMFU will be provided by IMD. He explained about the Statistical methodology i.e. Regression analysis for crop yield forecast. With the available resources and funds it is also proposed to take up R & D activities like crop yield forecasting using parametric and non-parametric models, probabilistic simulations of crop yield using the seasonal hind cast ensembles. In order to develop capacity building in modeling for crop yield forecast for all the SRFs at RMCs/MCs and AMFUs, he proposed to organize 7-days training programme in two batches in the month of August-September 2011. He explained the work plan and requirement of funds for the next financial year i.e. for 2011-12.

Dr. Ranjana Agarwal, Head, Forecasting Division, IASRI, New Delhi, presented the Weather based Pre harvest Forecast of Crop Yield - IASRI Approaches. She expressed her views on forecasts of crop production before harvest which are required for various policy decisions relating to storage, distribution, pricing, marketing, import-export, etc. She discussed about the various factors affecting crop yield. She said that the distribution pattern of weather over the crop season is important and also there is a necessity of dividing the crop season into finer intervals and studying relationships in these intervals. She discussed the various crop yield forecast models which are mostly used by the crop modellers. She mentioned about the forecasts issued for Raipur and the methodology for technology trend. She also discussed about the artificial neural networks(ANN). ANNs are data driven self-adaptive methods in that there are few assumptions about the models for problems under study.

Dr. K.K.Singh Scientist F ASC, New Delhi presented on crop yield forecasting using crop simulation models under present status and future strategies. He discussed the three important crop growth simulation models which are being used primarily for crop yield forecasting. He mentioned about various data requirement for yield forecasting by simulation model. He not only explained about the field experiments proposed under FASAL project but also the various aspects of selection of the treatments. He also explained about the kharif -2011 plan for FASAL. He said that there is a need for capacity building of SRFs and evaluation mechanism at regional level. At the end he has showed some of the recommendations of the steering committee meeting on FASAL held at New Delhi in March 2011.

Through his presentation Dr. J.S.Parihar highlighted the importance of remote sensing data in crop yield forecasting. He explained the use of spectral indices in empirical models and satellite based inputs in crop simulation. He has discussed about the merits of WOFOST model including sowing date retrieval from remote sensing and also yield prediction through simulation and crop phenology. In addition to that he has showed the estimation of Wheat LAI using AWiFS and Assimilation of LAI into CSM and Spatial Wheat Yield for (5 km), He also showed the Simulated Wheat Yield: 2010-11. Besides, he explained the Crop Growth Monitoring System. He also suggested that one should go through all research and technical aspects

of the respective crop and one must have the thorough knowledge about the crop husbandry to prepare the crop growth simulation models. SRFs have to work very hard and should have accurate knowledge of all aspects of the crop husbandry.

Technical Session II

This session was chaired by Shri Dalip Singh, and he was assisted by Dr. K.Ghosh, Scientist D, IMD, Pune. In this session the In-Charges of different State Agromet Centres at Regional Meteorological Centres/Meteorological Centres of IMD briefly informed the strategies being taken to develop and issue of crop yield forecast under FASAL project. Dr. Bandopahyay, Scientist E, RMC, Kolkata said that the long period crop yield and weather data are being collected and arranged by the Senior Research Fellow (SRF) appointed under the project. He suggested that training to SRF would be useful to enhance the quality of work. Dr. S C Sahu, Scientist E, MC, Bhubaneswar has given details regarding crop coverage of different crops for 2010 and 2011 for the state of Orissa. He stated that State AAS units will consolidate the district level crop yield forecasting for generating state level crop yield forecast and ultimately the national level crop yield forecast. He also stressed for the development of infrastructure at MC and AMFUs. Ms B S Dhekale, SRF, Agrimet Division, IMD, Pune presented on behalf of MC, Chandigarh. She showed the statistical crop model already developed by Chandigarh MC for cotton crop for some districts of Punjab and Haryana. G. K. Mohanty Scientist E, MC Ranchi explained present status of FASAL project at Ranchi. Crop yield and weather data are being collected and data analysis is under process. He informed that AMFU, Ranchi has collected crop and soil data for different districts of Jharkhand, and data processing is in progress for running crop growth simulation Model. Dr. G. M. Raha Scientist C, MC, Ganagtok presented work done under FASAL. He said that SRF has collected crop and weather data from different sources. He added that rice yield forecasting model is taken up by using statistical techniques. M. L. Sahu, Scientist E, M.C. Raipur presented the progress of FASAL scheme at Chhattisgarh and Crop yield forecast model is being developed for *kharif* & *rabi* for all the districts of Chhattisgarh. Ms P K Sawant, SRF, Agrimet Division, IMD, Pune presented work done by MC, Thiruvananthapuram, Kerala on behalf of Officer Incharge, MC, Thiruvananthapuram. She informed that the centre developed crop growth simulation model for four districts namely Thrissur, Ernakulam, Thiruvananthapuram, Alappuzha. Shri. E. Kulandavelu Scientist D, AAS, RMC Chennai, has presented FASAL work status at RMC Chennai, like data collection, data analysis and statistical model. He informed difficulties faced by SRF at RMC Chennai such as statistical concept and concept on Agrometeorology as he has no agricultural and statistical background. He said that training of SRF would improve working knowledge in respect of crop yield forecasting. Shri K. Seetharam, Scientist E, MC Hyderabad, showed the statistical model developed by the centre on rabi rice and rabi groundnut for districts of East Godavari, West Godavari, Krishna, Mahabubnagar, Nizamabad, Ranga Reddy and Warangal. Shri Satish Rahatwal, SRF, Agrimet Division, IMD, Pune explained statistical model developed for *rabi* 2010-11 for sorghum and maize crops for Maharashtra state. He explained about present status of crop simulation and statistical models for kharif 2011 and rice crop regression equation for major rice growing area in Maharashtra. Dr. Geeta Agnihotri, Scientist D, MC Bangalore explained the activities under FASAL. She presented the availability of data for the selected districts of the state of Karnataka for development of crop yield forecast by statistical and crop simulation model. She said that attempts are being made to develop statistical model with the help of SRF, MC Bangalore for groundnut crop. She also highlighted some of the problems being faced for running the statistical model. Shri. C L Gautam, MC Lucknow suggested for strengthening of the weather data collection network at district levels including necessary infrastructure to SRF. He requested for suitable training programme for SRF. Dr.D.P.Dubey, Director, MC Bhopal presented the regression equation developed for Bhopal for Rice crop. First day programme ended here.

Technical session III

Next day (2-08-11) Technical session III was chaired by Dr. J.S.Parihar and he was assisted by Dr (Smt) Renga Lakshmi, PNO, Kanniwadi. In this session different experts in the field of crop yield forecasting presented their pioneering work undertaken in the field also brought out the problems and suggestions to solve the problems & the activities undertaken in the FASAL project. The speakers mentioned that they have worked on DSSAT, WOFOST, INFOCROP, EPIC and SWAT models apart from statistical correlation and regression methods. Genetic coefficients for a few crops and locations were also developed by them. All of them suggested for arranging the training for SRFs to develop the skills among them.

Dr. Raji Reddy has presented the strategies for crop yield forecasting for south region (Andhra Pradesh, Karnataka, Tamil Nadu & Kerala). He showed the crops taken for yield forecast and also added that active initiative has been taken by most of the centres in development of crop yield models by using different models. He said that field experiments have been taken up under the project and based on the current and field data the genetic coefficient would be generated. He particularly explained in detail the model development at AMFU, Hyderabad and AMFU, Bangalore. He mentioned about the work plan in 2011. 1. Monitoring the progress of sowings, 2. Mid season forecast for rice, groundnut and maize using DSSAT and for ragi using Stochastic model and 3. Development of genetic coefficients using experimental data.

Dr. Asis Mukherjee presented yield forecasting for rice and jute in New Alluvial zone of West Bengal under FASAL using the crop growth simulation models. He said that some genetic coefficients are to be developed for the important varieties of rice in West Bengal for crop growth simulation models. Dr. Manish Bhan presented crop growth simulation models used for developing the crop yield forecast in Central India (Chhattisgarh and Madhya Pradesh) and also the field experiments carried out to develop genetic coefficients

Dr. V. Geethalakshmi presented the methodology to integrate different source of information to forecast the production of selected crops at a scale of a district particularly Coimbatore, Dindigul and Tanjore for rice, groundnut and maize. She suggested for issuing experimental yield forecast of Rice and Groundnut for Coimbatore, Dindigul and Tanjore. According to her, the future plan for these three centres would be 1. Setting up of a methodology to integrate different source of information to forecast the production of selected crops at a scale of a district, 2. Issuance of experimental yield forecast of Rice and Groundnut for Coimbatore, Dindigul and Tanjore, 3. Utilization of the extended range forecast information for creating future weather file, 4. Compare the outcomes of the weather generation methodologies for best yield prediction, 5. Validation of yield prediction with observed, 6. Attempt to improve the forecast accuracy: Using TOPS information, 7. Running crop model at block level and integrating the information to District level.

Dr. (Mrs) Ananta Vashisth informed the progress of FASAL project at New Delhi, Pantnagar, Roorkee, Srinagar, Jammu, Ludhiana, Hisar, Palampur, Solan, Allahabad, Kanpur, Faizabad, Modipuram, Varanasi, Udaipur, Jodhpur, Bikaner. According to her extensive work under this project was carried out at all the centres in northern regions. Most of the centres have undertaken field experiments and both crop growth simulation models and statistical models are being tried to develop the crop yield forecast. She said that the field experiments are carried out for Maize, Wheat, Mustard and Sugarcane in Northern Region. She also presented the genetic coefficients developed for the various varieties of wheat in Northern region. Genetic Coefficients for popular Wheat variety UP-2565 have been developed and CERES Wheat model has been used to simulate wheat yield.

Dr. Vyas Pandey, has presented the strategies for crop yield forecasting for Western Region-Achievements and future planning for Kharif and Rabi seasons (FASAL). He said that following activities are being taken under this project 1. SRF has been recruited at all three AMFUs, 2. Long term weather data collected, 3. District yield data of all crops have been collected, 4. Regression models have been developed for six districts for Cotton yield prediction, 5. For other crops regression model are being developed, 6. DSSAT model validated for an and run for 30 years for all crops of a districts, 7. Experiments are being conducted for generating Genetic Coefficients for different varieties/crops

Ms B S Dhekale, SRF, Agrimet Division, IMD, Pune presented two presentations on behalf of the two centres, AMFU Basar & AMFU Barapani as the nodal officers of both the centres could not attend the meeting. It has been observed that both the centres have started appreciable work. AMFU, Basar has taken rice and maize and used remote sensing, GIS and DSSAT models for site-specific approach in crop yield forecasting. AMFU, Barapani also used the techniques of integration of the three technologies, viz., crop simulation models, Remote Sensing (RS) data and GIS which would provide an excellent solution for monitoring and modeling of crop at a range of spatial scales for maize and rice. In this station field experiments are being conducted to develop genetic coefficients of Maize and Rice.

At the end of the meeting panel discussion was held under the moderation of Dr. J.S. Parihar accompanied by Prof. S.K. Tripathi, Dr Ranjana Agarwal, Dr. Raji Reddy and Dr. K.K. Singh. All the panel experts shared

their ideas of implementation of the project under a collaboration mode. Based on the discussion during the course of the meeting recommendations of the FASAL meeting was read out by the Chairman.

Recommendations of the meeting for FASAL

1. All the meteorological data should be provided to the concerned organizations working under FASAL project for estimation of crop yield. These data will be provided matching with the available crop data mentioned in point
2. Crop data (latest up to 2009-10) required under this project should be collected from diverse sources. DAC should provide the districtwise crop yield data for last 30 years.
3. In addition to archive data, IMD should also provide current year as well as day to day meteorological data.
4. A core committee comprising the scientists of IMD, SAC and State Agricultural Universities should be constituted to explore the use of satellite derived weather parameters and subsequently other parameters in crop yield forecasting models.
5. Correct planning and correct statistical approach should be taken to develop yield forecast. IASRI may be consulted in this regard.
6. In depth hands on module training on both statistical and crop growth simulation should be provided to all concerned engaged in FASAL project. Training to the senior research fellows on statistical approval at IASRI should be explored by IMD. Besides, SRFs at RMCs/MCs may be sent to the nodal officers of AMFUs who are already trained in crop growth simulation models.
7. All the centres under this project should develop and issue crop yield forecast initially statistical model and subsequently by crop growth simulation model.
8. All the incharges at RMCs/MCs should be informed to grant the tour programme to the SRFs for visits to the State Agricultural Universities for consulting the experts as well as for collection of relevant data required for crop yield modeling.
9. All the AMFUs should send the UC/SE, demand for this year in prescribed format to ASC, IMD, New Delhi with a copy to DDGM (Grimed), IMD, Pune immediately.
10. ISARI may be requested to make available manuals and software pertaining to statistical models for crop yield forecasting.
11. All the centres should generate the crop yield forecast as per date fixed by DAC.
12. Based on the statement of actual expenditure, demand, DAC should release the fund and subsequently IMD should send the funds immediately to the different centres working under FASAL project. Special care should be taken by both DAC & IMD so that salary to SRFs can be paid without any break.
13. All the IMD centres should be given the computer at the earliest and required funds. Approval should be provided to the AMFUs to purchase the computer.
14. IMD and the AMFUs should immediate recruit the SRFs under FASAL project.
15. Efforts should be made to collaborate with NIC & CDAC for their help in both development and issue of crop yield forecast.

Programme Details

1st August 2011, Monday	
09.30 – 10.15	Inaugural Session
09.30 – 09.35	Vandana and Lighting of Lamp
09.35 – 09.40	Welcome address by Dr. N. Chattopadhyay, DDGM (Agrimet), IMD, Pune
09.40 – 09.45	Address by Dr. A.B. Mazumdar, DDGM (WF) and LACD ADGM (R), IMD, Pune
09.45 – 09.50	Address by Dr. R.P. Samui, Retd. DDGM (Agrimet), IMD, Pune
09.50 – 09.55	Address by Dr. Swati P. Sardesai, Scientist G & DDG, NIC, Pune
09.55-10.00	Address by Dr. Ranjana Agarwal, Head, Forecasting Division, IASRI, New Delhi
10.00 – 10.05	Address by Dr. Dalip Singh, Additional Statistical Advisor, NCFC, DAC, New Delhi
10.05-10.10	Inaugural address by Dr. J.S. Parihar, Deputy Director (EPSA) and OS, SAC, Ahmedabad
10.10 – 10.15	Vote of Thanks by Shri R. Balasubramanian, Scientist C, IMD, Pune
10.15-10.30	High Tea
Session I	
Chairman:	Rapporteur:
10.30 – 11.00	Presentation on present status of FASAL project by Dr. Dalip Singh, Additional Statistical Advisor, NCFC, DAC, New Delhi.
11.00 – 11.30	Achievements and future needs for FASAL - Use of Statistical techniques in crop yield forecasting by Dr. N. Chattopadhyay, DDGM (Agrimet), IMD, Pune
11.30 – 12.00	Crop simulation model - Present status and future strategies by Dr. K.K. Singh, Scientist F, IMD, New Delhi.
12.00 – 12.30	Weather based pre-harvest crop yield forecasting – IASRI approaches – Dr. Ranjana Agarwal, Head, Forecasting Division, IASRI, New Delhi
12.30 - 13.00	Use of Satellite data in FASAL for crop yield forecasting by Dr. J.S. Parihar, Deputy Director (EPSA) and OS, SAC, Ahmedabad.
13.00 -14.00	Lunch
Session II: Presentation from RMCs/MCs on Achievements and future planning for <i>kharif</i> and <i>rabi</i> seasons	
Chairman:	Rapporteur:
14.00 – 15.30	Eastern Region West Bengal by Dr. Sanjib Bandopadhyay, Scientist E Jharkhand by Shri G.K. Mohanty, Scientist E Orissa by Shri S.C. Sahu, Scientist E Sikkim by Shri G.N. Raha, Scientist C

15.30 – 15.45	Northern Region Uttar Pradesh by Shri. C.L.Gautam, Scientist D
15.45-16.00	Tea
16.00-17.00	Southern Region Andhra Pradesh by Shri K.Seetharam, Scientist E Tamil Nadu by Dr.E.Kulandaivelu, Scientist D Karnataka by Mrs Geeta Agnihotri, Scientist D
17.00 – 17.30	Central Region Madhya Pradesh by Dr. D.P. Dubey, Scientist E Chhattisgarh Shri M.L.Sahu, Scientist E
17.30 – 18.00	Western Region Gujarat by Dr.Kamaljit Ray, Scientist E Maharashtra by Dr. M. Rajavel, Scientist C
2nd August 2011, Tuesday	
Session III: Presentations by Regional Leaders on on-going R & D activities of Crop Yield forecasting, past data availability, formulation of experimental lay-out, treatments and methodology for FASAL	
Chairman:	Rapporteur:
09.00 – 09.20	Strategies for Crop yield forecasting for South region – Achievements and future planning for <i>kharif</i> and <i>rabi</i> seasons--Dr.D. Raji Reddy, Principal Scientist, Agromet Cell, ARS, Acharya N.G.Ranga Agril. Univ., Rajendranagar, Hyderabad
09.20 -09.40	Strategies for Crop yield forecasting for East region – Achievements and future planning for <i>kharif</i> and <i>rabi</i> seasons -- Dr. Ashish Mukherjee, Co - PI, Dept. of Agrometeorology, BCKV, Kalyani, West Bengal
09.40 -10.00	Strategies for Crop yield forecasting for North West region – Achievements and future planning for <i>kharif</i> and <i>rabi</i> seasons--Dr.Anantha Vashithata, Agrometeorologist & Principal Scientist, Division of Agricultural Physics Indian Agriculture Research Institute, New Delhi
10.00 – 10.20	Strategies for Crop yield forecasting for West region – Achievements and future planning for <i>kharif</i> and <i>rabi</i> seasons -- Dr. Vyas Pandey, Head, Department of Agricultural Meteorology, B.A. College of Agriculture, Anand Agricultural University, Anand
10.20 – 10.40	Strategies for Crop yield forecasting for Central region – Achievements and future planning for <i>kharif</i> and <i>rabi</i> seasons -- Dr. Manish Bhan, Jabalpur
10.40 – 11.00	Tea
11.00 – 12.30	Panel discussion and Recommendations
12.30 – 13.30	Lunch

Annexure-I
List of participants

Dr. J. S. Parihar, Deputy Director (EPSA) and OS, SAC, Ahmedabad	Dr. Dalip Singh, Additional Statistical Advisor, NCFC, DAC, New Delhi	Dr. Ranjana Agarwal, Head, Forecasting Division, IASRI, New Delhi,
Dr. Swati Sardesai, Scientist.G and DDG, NIC, Pune	Dr. K. K. Singh, IMD, New Delhi	Dr. R.P. Samui, Pune
Dr. V. H. Deshpande, NIC, Pune	Dr. A. B. Mazumdar, DDGM (WF), IMD, Pune	Ms. Akshara Kaginalkar, CDAC, Pune
Dr. U. D. Kunjir, Dept. of Agri, Pune	Shri. A. K. Bhargava, IMD, New Delhi	Dr. Kamaljit Ray, IMD Ahmedabad
Mrs. Geeta Agnihotri, IMD, Banglore	Shri D.P. Dubey, IMD, Bhopal	Shri M.L.Sahu, IMD, Chattishgarh
Shri S.C.Sahu, IMD, Orrisa	Shri. G.K.Mohanty, IMD, Ranchi	Dr. E. Kulandaivelu, IMD, Chennai
Shri K. Seetharam, IMD, Andhra Pradesh	Shri G.N.Raha, IMD, Sikkim	Dr. S. Bandhopadhyay, IMD, West Bengal
Shri C.L.Gautam, IMD, Lucknow	Dr. Raji Reddy, PNO, Hyderabad	Dr. Vyas Pandey, PNO Anand
Dr. T Ramesh, T.O, Aduthurai	Dr. T. Prathima, T.O, Tirupathi	Dr. Neeraj Kumar, NO, Navsari
Dr.D.D. Sahu, PNO, Junagad	Dr. Ram Niwas, PNO, Hissar	Dr R.S. Rana, PNO Palampur
Dr M.K. Khushu, PNO Jammu	Dr. K N Singh, Srinagar, PNO	Dr. U.V. Mummigatti, NO Dharwad
Dr. D. W. Thawal, PNO, Pune	Dr. P. Jaybhaye, NO, Parbhani	Dr Sanjay Wanjari, PNO Akola
Shri V. Chavan , T.O, Dapoli	Dr Manish Bhan, NO, Jabalpur	Dr. S. P. Singh, PNO, Ludhiana
Shir. Jajoria, T.O, Udaipur	Dr. D. V. Singh, PNO, Jodhpur	Dr. S. P. Singh, NO, Bikaner
Dr. V. Geethalakshmi, PNO Coimbatore	Dr. Renga Lakshmi, PNO, Kanniwadi	Dr U P Shahi, NO Modipuram
Dr. Biswaroop Mehra, PNO Allahabad	Prof. S.K.Tripathi, PNO Roorkee	Dr. A Mukherjee, NO Kalyani
Dr S. Banerjee, PNO Pundibari	Dr. Velmurugan, NO, Port Blair	Dr. Ananta Vashisth, PNO New Delhi
Dr.A.Kashyapai, Scientist E, IMD	Dr.K.Ghosh, Director, IMD	Shri.R.Balsubramanian, Met- I, IMD



Government of India
Ministry of Earth Sciences
India Meteorological Department
Agricultural Meteorology Division



Central India Geostationary Meteorological Satellite

