



ICAR-IASRI



NEWS

Volume 21

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January-March, 2017

- Research Activities
- Awards and Recognition
- Human Resource Development
- Panorama of Activities
- Publications
- Lectures Delivered
- Participation
- Consultancy/Advisory Services
- Personnel

From Director's desk.....

This Newsletter highlights salient research achievements, training programmers and workshop organized and other significant activities performed at the Institute during the period under report.

Under creating awareness for efficient use of ICT and MOOCs in agriculture education, a website ICTIAA (<http://ictiaa.icar.gov.in>) has been developed to provide both the services of Massive Open Online Course (MOOC) as well as impact analysis of ICT Tools. It access the response or views of faculty, students and Non teaching staff with ICTs tools used in agriculture education via online form and predict the impact of ICTs agriculture education through the response of data set of questionnaire. This can gather teaching faculty for using the MOOCs environment to develop course materials, blended learning and an online courses to engage students in learning.



Through the Hybrid ARFIMA Model for Forecasting Long Memory Time Series Data, attempts have been made to investigate the structure lone memory in daily wholesale price of mustard in Mumbai market. Forecasted values obtained from ARFIMS model and forecasts of residuals obtained from ANN are combined and forecasting accuracies one compared and the proposed hybrid model was found to be superior over ARFIMA model in terms of several measurements indices.

Under An Improved Technique for selection of Biological Informative Genes, The Boot-SVM-RFE technique has been found to be efficient and robust for selection of biological informative gene selection as compared to existing gene selection techniques. Moreover, it can be used for other case us. Control genomic studies including NGS expression study.

Many scientists of the Institute have received various awards like SESR Computational Biological 2016, Elected FELLOW Certificate, and young Scientist Award in Social Sciences, NAAS Recognition Award 2015-16, MN Das Memorial Young Scientist Award. A scientist has visited Chiba, Japan as Expert to the Regional Workshop on Training for Official Statistics.

Under the period under report, 08 new projects were initiated and 10 training programmers and workshops (5 sponsored by Education Division, ICAR and 5 by HRM Division, ICAR) were organized.

Scientists of the Institute have published 39 researches papers, 10 popular articles, 09 manuals/E-manuals and developed 04 packages.

Scientists of the Institute have provided consultancy/Advisory Services; participated in different conferences/symposia/workshop etc. in various capacities and delivered Invited Lectures/Lectures. Seminars were delved by the Scientists and students in different areas of Agricultural Statistics, Computer Applications and Bioinformatics. On Guest Seminar was delivered by Dr. A.K. Nigam. It is hoped that the contents of the document would be informative and useful to scientists in NARES. Any suggestion for improving the contents of the newsletter further would be highly appreciated. Consultant Advisor from the Institute of Applied Statistics and Development Studies, Bangalore on Global Hunger Index-How good it is?

RESEARCH ACHIEVEMENTS

Creating Awareness for Efficient Use of ICT and MOOCs in Agriculture Education

Sukanta Dash and Anil Kumar

1. Introduction

Agriculture is the backbone of the Indian economy which plays the most decisive role in the socioeconomic development of the country. Information and Communication Technologies (ICTs) are referred to as the varied collection of technological gear and resources which are made use of to communicate. They are also made use of to generate, distribute, collect and administer information. The use of ICT in education is lagging behind expectations and desired ICTs have an important role to play in changing and modernizing educational systems and ways of learning. There is, however, little scientific evidence of the concrete contributions of ICTs to the learning domain, despite the efforts of the last decades. Hence, there is a need to bring evidence together on the impact of ICT on education and training in India. Also, Massive Open Online Courses have tremendous potential to change the higher education scene by improving teaching and encouraging institutions to develop distinctive missions that will include considerations about openness and access for different groups of students. MOOCs also provide institutions with a vehicle to think creatively and innovatively and to explore new pedagogical practices, business models and flexible learning paths in their provision with the popularity of MOOCs, universities and colleges are compelled to rethink how to make their curriculum delivery models and courses truly flexible and accessible. Open courses based on new structures, ways of working, and use of technology can make higher education more cost-effective and accessible and may also contribute to balancing work, family and social life. More flexible models and open approaches will encourage more mature students to participate in higher education and gain qualifications to further their careers.

A website have been developed for accessing the responses or views of faculty, student and non-teaching staff with ICTs tools used in agriculture education via online form and predict the impact of ICTs on agriculture education through analysis the response dataset of questionnaire. This can gather teaching faculty for using the MOOCs environment to develop course materials, blended learning and an online courses to engage students in learning.

2. Development of online tools

A massive open online course (MOOC) is a category of online course where the participants are distributed and course materials also are dispersed across the web. MOOCs have tremendous potential to change the higher education scene by improving teaching and encouraging institutions to develop distinctive missions that will include considerations about openness and access for different groups of students.

2.1. Web application details

A website has been developed and named as ICTIAA (<http://ictiaa.icar.gov.in>). This website provides both the services of MOOC as well as impact analysis of ICT Tools. The details of the website are given on next pages.

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HOME PAGE

REGISTRATION PAGE

E-LEARNING TAB

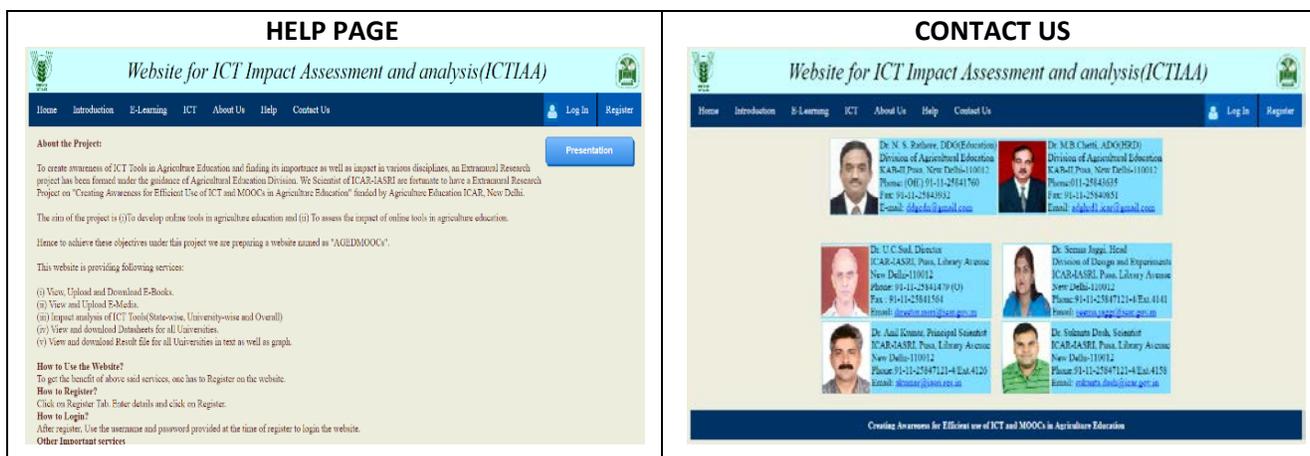
E-MEDIA CONTAINING VIDEO

SL.No.	File Name	Uploader Name	Duration	View
1	FET village Christmas	Sukarna Doshi	1:17	
2	Statistics and Agriculture	Sukarna Doshi	2:26	
3	ICAR Song	Sukarna Doshi	1:14	
4	IASRI Song	Sukarna Doshi	1:28	

E-BOOK PAGE VIEWING LIST OF BOOKS

S.No.	Title	Keywords	Institute Type	Subject of Publication	Year of Publication	Action
10	Excel	Excel	ICAR	Research Paper	2015	View
9	Genomics	Genomics	ICAR	Presentation	2015	View
8	Expt with Maturity	Expt with Maturity	ICAR	Research Paper	2015	View
7	Cluster analysis	Cluster analysis	ICAR	Presentation	2015	View
6	Cluster analysis	Cluster analysis	ICAR	Research Paper	2015	View
5	Cluster analysis using SPSS	Cluster analysis	ICAR	Research Paper	2015	View
4	ANOVA-ANCOVA	ANOVA-ANCOVA	ICAR	Presentation	2015	View
3	ANOVA-ANCOVA using spss	ANOVA-ANCOVA	ICAR	Research Paper	2015	View
2	book	book	IASRI	Sheet Note	2015	View
1	Ms Excel	Excel	IASRI	Research Paper	2015	View

E-BOOK UPLOAD



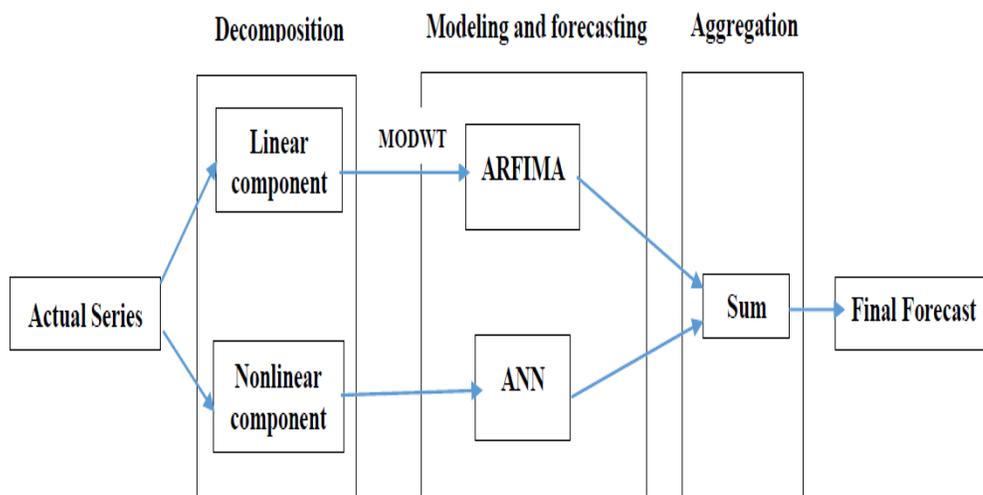
Discussion

The website contains user interactive interface including various tabs such as Home Page, Introduction, E-learning, ICT, About Us, Help, Contact Us, Registration and Login where Home page will open by default when the user opens website. Home Page contains discussion of importance of ICT and MOOCs in agriculture education along with showing video related to ICAR-IASRI and agriculture. User can know the details of this project by clicking on Introduction tab. The contribution of ICAR-IASRI, New Delhi in agricultural research and details of funding agency of this project can be accessed by clicking on About Us tab. If user faces difficulty in traversing website or any other query related to website and project he can take help from either by clicking Help tab or Contact Us tab. The E-learning and ICT tabs cannot be accessed without registration. Consequently, User can register on the website by clicking on Registration tab. Then by filling registration form user can submit the personal details as well as create username and password for further login in website. After that, user can login in website by clicking on Login tab through his/her username and password. The Registered user can access the sub tab of E-learning by clicking on E-Learning tab and explore the E-Media and E-Books tab. The video lectures of scientists and professors in different stream are available on website under the E-media sub tab of E-Learning. Registered user can simply view or download the video lecture from E-Learning tab. The website contains various types of E-books that are accessible only to the registered users. The E-Books can be uploaded or viewed or downloaded at free of cost from E-book sub tab of E-Learning. The ICT tabs of ICTIAA contain two sub tabs as such Online Questionnaire and Impact Analysis. The user can submit his/her view or details of ICT used in agriculture education followed by personal details with help of Online Questionnaire form. This form will open on clicking of Online Questionnaire sub tab of ICT. User can also view and downloads the details of ICT dataset collected by the faculty, students and non-Teaching staff of different agriculture universities with the help of Online Questionnaire sub tab of ICT. User can view and download the dataset in two ways, one is state wise and another is center /university wise. The Impact analysis tab provides various statistical interpretation results of categorical and numerical attribute of ICT in tabular as well as graphical format. User can also view and download these interpretations from Impact Analysis sub tab of ICT. These interpretations are helpful for user to understand the impact of ICT on different parameters of agriculture education. The HTML, CSS, JavaScript, Servlet and JSP technologies are used as front end and MS SQL Server is used as Back-End in development of website. This website is very fast, platform independent and secure.

Hybrid ARFIMA model for forecasting long memory time series data

Santosh Rathod, K N Singh, Ranjit K. Paul and Mrinmoy Ray

The autocorrelation among the time series is expected to disappear rapidly as the observations are distance apart in time. Some times in ARMA model the ACF exhibit short range dependence or decreases exponentially as the time lag increases and in some series the decay can occur at much slower hyperbolic rate and the correlations remain positive for long lags. Such series are said to have long memory and commonly prevail in stock market prices, economic growth rate, inflation rate, oil price and GDP figures etc. Classical time series models namely ARIMA models cannot describe such long memory phenomenon. Therefore, to overcome this difficulty set of models has been established, among which most popular one is autoregressive fractionally integrated moving average (ARFIMA) model. Sometimes the time series often contain both linear and nonlinear components, rarely they are pure linear or nonlinear. Under such conditions neither ARFIMA nor Artificial Neural Network (ANN) are adequate in modeling and forecasting of long memory time series. Artificial neural networks (ANNs) are nonlinear model that are able to capture various nonlinear structures present in the data set. ANN model specification does not require prior assumption of the data generating process, instead it is largely depending on characteristics of the data. Single hidden layer feed forward network is the most popular for time series modeling and forecasting. The ANN model is characterized by a network of three layers of simple processing units, and thus termed as multilayer ANNs. The first layer is input layer and the last layer is output layer of dependent variable. Since the ARFIMA model cannot deal with nonlinearity, while the ANNs are alone not able to capture both linear and nonlinear behavior equally. To overcome these difficulties, hybrid methods were evolved. Applications of hybrid methods in the literature shows that combining different methods can be an effective and efficient way to improve forecasts. Schematic representation of proposed methodology is expressed as follows;



Proposed methodology

In this study, attempt has been made to investigate the structure of long memory in daily wholesale price of mustard in Mumbai market, India during the period 1st January, 2009 to 31st December, 2012. The data was collected from Ministry of Consumer's Affairs, Government of India. Estimation of long memory parameter of ARFIMA model is done by wavelet method using MODWT and daily wholesale price of mustard in Mumbai market are forecasted. In the next step; the residuals obtained from ARFIMA models are tested for nonlinearity using BDS test and are found to be significant, the same residuals are modelled and forecasted using ANN. Finally, forecasted values obtained from ARFIMA model and forecasts of residuals obtained from ANN are combined and forecasting accuracies are compared between ARFIMA and hybrid model. Experimental study justified the superiority of the proposed hybrid model over ARFIMA model in terms of several measurement indices. This approach can be further extended by using some other machine learning techniques for varying autoregressive and moving average orders so that practical validity of the model can be well established.

Boot-SVM-RFE: An Improved Technique for Selection of Biological Informative Genes

Samarendra Das

With the advent of fast and cheaper genome sequencing technologies, huge genomic data is being generated and deposited in public domain databases over the years by different research organizations across the globe. Most of these datasets are related to expression of genes from various experiments conducted to understand behaviour of biological mechanism of species under biotic and abiotic stresses. In due course of time huge gene expression data is generated through microarray experiments under these stresses. Integration and analysis of data generated by microarray experiments for the same stress or related conditions is essential to enhance the sensitivity of the hypothesis under consideration for drawing valid conclusions.

Usually, microarray data are used for gene selection, which suffers from the inherent limitation of its high dimensionality, *i.e.* the number of genes is much larger than the number of subjects/samples. Therefore, it is important to select most relevant genes related to stresses/conditions from thousand(s) of genes with the help of appropriate computational approach(s). In this regard, Volcano plot method is quite popular among the researchers in which genes are selected by considering their relevance with their classes. However, such method may not be sufficient to discover some complex relationships among genes for a certain trait or condition. Besides, several statistical and machine learning methods, *viz.* t-score, F-score, Information Gain (IG) measure, Random Forest (RF) and Support Vector Machine-Recursive Feature Elimination (SVM-RFE) have also been used for gene selection. However, in these methods genes are selected by considering only their relevance with classes. In such case, there is a possibility that genes which are spuriously associated with the classes may also get selected.

Bootstrap Support Vector Machine- Recursive Feature Elimination technique (Boot-SVM-RFE)

Considering the above facts, a technique *i.e.* Boot-SVM-RFE was developed for selection of informative genes from high dimensional gene expression dataset by improvising SVM-RFE. In this approach, a Non-Parametric (NP) hypothesis testing procedure was used for the identification of informative genes based on their statistical significance. Earlier, this SVM-RFE method was used for ranking of genes from gene expression data for identification of cancer responsible genes (Das et al.,

2017). In this algorithm, genes are individually eliminated based on their least significance in classification during SVM training. The objective function, J for this classification problem is defined as:

$$J = \|w\|^2 / 2 \quad (1)$$

where, w is the kernel width computed by SVM. The Optimal Brain Damage algorithm (LeCun et al. 1990) was used to approximate the change in J , after deletion of i -th gene from each dataset. Further, expanding J with the help of Taylor series approximation (Guyon et al. 2002) (up to second order), the value of J was given by

$$\Delta J(i) = (1/2) \frac{\partial^2 J}{\partial w_i^2} (\Delta w_i)^2 \quad (2)$$

The change in weight *i.e.* Δw_i is due to removing i -th gene from existing dataset. $\Delta J(i)$ has been used as the weight pruning criterion. It may be noted here that, the cost function J is a quadratic function of w_i and both are directly proportional to each other. Hence, measurement of either w_i or J provides equivalent information. Keeping this in view w_i^2 is used as the ranking criterion for evaluating impact of i -th gene on this classification. In this process, genes are eliminated with the smallest w_i^2 iteratively in a backward elimination manner and ranked gene list is prepared at the end. Moreover, most of the gene selection methods are sensitive to small permutation of experimental conditions. The ranking of genes based on high dimensional expression data may also lead to the selection of spurious genes and make the selection process unstable. Therefore, it is essential to select genes based on statistical testing instead of ranks.

In this testing procedure bootstrap samples are selected from available M samples in a dataset. From these M samples n numbers of bootstrap samples each of size m are selected randomly with replacement to construct a training set for SVM. The SVM-RFE procedure was applied to each of these n bootstrap samples to get n list of genes along with their ranks. Therefore, each of genes will have n number of ranks (one for each bootstrap). Let a score function *i.e.* Rank Score (R_{ij}) is defined to convert these ranks of each gene into corresponding score in each bootstrap sample, as

$$R_{ij} = \frac{N + 1 - p_{ij}}{N} \quad (3)$$

where, N represents total number of genes considered in the dataset and p_{ij} ($1 \leq p_{ij} \leq N$) is the ranked position of i -th gene in j -th bootstrap sample. After getting the rank scores of all genes over n bootstrap samples, following test statistic for selection of informative genes is proposed. In this test procedure, following hypothesis needs to be tested.

H_0 : i -th gene is not informative (*i.e.* $R_i \leq Q$)

H_1 : i -th gene is informative (*i.e.* $R_i > Q$)

For i -th gene, $R_j^{(i)}$ ($N^{-1} \leq R_j^{(i)} \leq 1$) is the rank score for j -th bootstrap sample ($j= 1, 2, \dots, n$). Further, $R_j^{(i)}$ is a random variable (*rv*). Since, $R_j^{(i)}$ is a function of rank, therefore its empirical distribution is symmetric about the second quartile. Further, the distribution of the test statistic was obtained and a detail description can be found in Das et. al.(2017).Based on test statistic under H_0 , it can be tested that whether a gene is informative or not. This procedure was repeated for other genes. The implemented algorithm for Boot-SVM-RFE is shown in Figure 1.

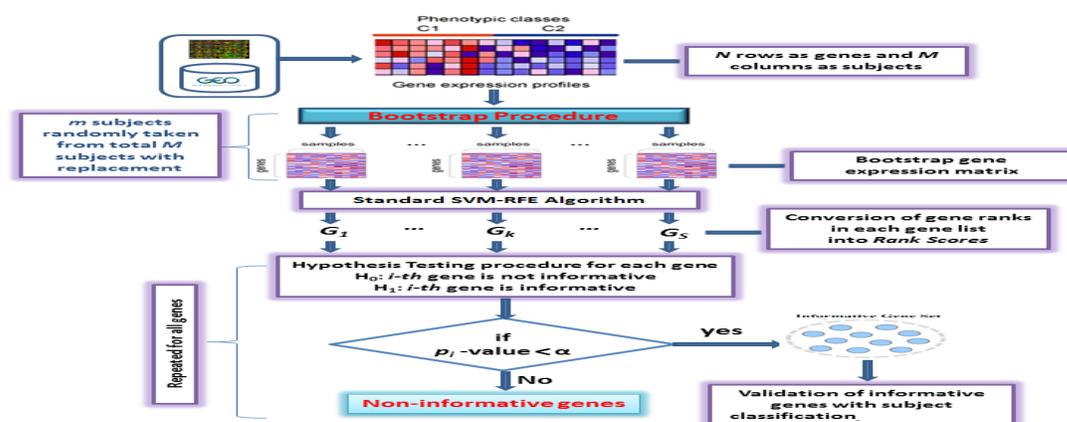


Figure 1. Outlines of Boot-SVM-RFE.

Performance analysis of Boot-SVM-RFE

Based on top 1000 ranked genes obtained from each of these gene selection techniques, the classification of crop microarray samples was made into control and stress classes by using the SVM classifier. The CAs were measured for each sliding window size over 5-fold cross validation. The CAs for different sliding window sizes are given in Table 1.

Table 1.

Comparison of Boot-SVM-RFE with other competitive algorithms for different sliding window sizes.

WS	Boot-SVM-RFE		SVM-RFE		t-Score		F-Score		IG		RF	
	CA	CV	CA	CV	CA	CV	CA	CV	CA	CV	CA	CV
Aluminum stress gene expression data in Soybean												
50	95.629	2.622	93.421	2.778	89.127	5.342	89.820	4.081	90.859	3.146	92.105	3.719
100	96.199	2.926	92.249	4.297	90.789	4.008	91.667	3.303	92.251	3.910	92.471	3.929
150	96.279	3.020	94.362	3.215	90.480	2.386	91.950	3.501	92.337	4.341	93.040	2.889
200	97.724	2.182	96.135	2.619	90.378	3.748	91.776	3.608	94.408	4.594	93.572	2.584
250	96.737	2.356	93.544	2.905	91.404	2.767	91.667	4.260	93.070	2.417	93.860	3.461
300	97.086	2.203	95.335	2.770	91.635	3.845	91.447	3.775	94.549	3.489	95.771	2.861
350	97.862	2.606	97.470	2.431	91.397	4.904	92.915	4.150	94.737	4.049	94.737	3.586

WS	Boot-SVM-RFE		SVM-RFE		t-Score		F-Score		IG		RF	
	CA	CV	CA	CV	CA	CV	CA	CV	CA	CV	CA	CV
400	97.930	1.842	97.368	1.911	92.982	2.031	93.311	2.974	94.627	3.998	95.724	2.563
450	97.249	2.599	97.129	2.332	93.062	2.009	92.943	3.541	95.096	2.239	95.813	2.934
500	97.763	2.011	97.632	2.273	93.289	3.669	93.421	3.814	94.342	4.314	96.316	3.075
Mean	97.046		95.464		91.454		92.092		93.627		94.340	

Salinity stress gene expression data in Rice

50	97.218	1.927	94.015	3.382	90.000	3.346	93.684	4.498	90.150	5.200	93.684	2.401
100	98.175	1.203	96.984	1.742	92.778	2.613	94.444	2.690	92.222	3.242	94.841	2.375
150	98.319	0.924	95.731	1.402	92.773	3.054	95.378	1.874	93.697	2.474	95.462	2.065
200	98.482	0.832	96.786	2.052	93.571	2.493	95.804	2.071	93.304	1.651	95.446	2.363
250	98.190	1.162	97.810	1.218	93.333	2.432	96.286	2.157	93.333	2.432	95.905	1.856
300	98.265	0.842	97.449	1.742	94.490	3.015	96.653	1.244	93.265	2.118	96.327	1.813
350	98.352	0.545	96.923	1.455	95.055	1.693	96.692	1.419	93.187	1.421	96.154	1.407
400	98.571	0.000	96.619	1.151	94.167	2.543	97.143	1.659	94.286	2.238	95.952	1.533
450	98.571	0.000	97.273	1.386	93.636	2.399	97.922	1.197	94.416	1.258	95.714	2.111
500	97.000	1.465	96.857	1.942	95.000	2.270	97.000	2.018	94.286	1.428	95.286	1.742
Mean	98.114		96.645		93.480		96.101		93.215		95.477	

Cold stress gene expression data in Rice

50	96.328	1.830	94.947	2.031	94.000	1.701	94.579	2.153	94.526	2.322	94.526	2.221
100	97.175	1.387	95.778	2.043	94.333	2.356	95.889	1.820	95.722	2.209	95.611	2.224
150	97.507	0.932	96.471	1.762	94.235	2.236	95.235	1.983	95.824	1.760	96.294	2.080
200	98.482	0.832	97.000	1.304	95.500	1.622	95.875	1.861	96.250	1.615	97.375	2.368

WS	Boot-SVM-RFE		SVM-RFE		t-Score		F-Score		IG		RF	
	CA	CV	CA	CV	CA	CV	CA	CV	CA	CV	CA	CV
250	98.190	1.162	96.067	1.906	95.333	1.969	95.933	1.446	96.333	1.472	96.267	2.051
300	98.265	0.842	96.000	1.634	95.786	1.487	96.014	1.935	96.143	1.255	96.643	1.855
350	96.785	0.554	96.923	1.296	95.923	1.163	96.062	1.247	96.154	1.432	97.923	1.742
400	98.881	0.687	95.567	2.027	95.667	1.433	96.667	1.273	96.000	1.740	97.333	1.752
450	98.777	0.383	95.545	1.432	95.818	1.671	95.909	1.185	97.727	1.033	97.545	1.855
500	97.679	1.454	96.700	1.545	94.500	1.433	95.100	1.353	97.300	1.078	97.300	1.594
Mean	97.807		96.100		95.110		95.726		96.197		96.681	

Boot-SVM-RFE: Bootstrap SVM-RFE; RF: Random forest; IG: Information gain measure; WS: Sliding window Sizes; CA: Classification accuracy; CV: Co-efficient of Variation in CA

For AI stress data, it is observed that the CAs of Boot-SVM-RFE are higher than that of other techniques viz. SVM-RFE, t-score, F-score, RF and IG for the sliding window sizes 50, 100, 150, 200, 250 and 300. However, for higher window sizes i.e. 350, 400, 450 and 500, the CAs for Boot-SVM-RFE are at par with that of SVM-RFE but higher than that of t-score, F-score, RF and IG (Table 1). In other words, the average performance of Boot-SVM-RFE is highest followed by SVM-RFE, RF, IG, F-score and t-score with respect to overall CA values for AI stress. In case of salinity and cold stress, the performance of Boot-SVM-RFE is observed to be better than other gene selection techniques irrespective of sizes of sliding window (Table 1). The order of the performance of different gene selection techniques in case of salinity stress is Boot-SVM-RFE > SVM-RFE > F score > RF > F score > t score > IG, whereas, in case of cold stress the order is Boot-SVM-RFE > RF > IG > SVM-RFE > F score > t score (Table 1). From this performance analysis, it was found that the performance of the Boot-SVM-RFE is consistently better over other contemporary techniques across different datasets related to abiotic stresses. Besides, it can also be observed that Boot-SVM-RFE has less CV for most of the sliding window sizes when compared to other five techniques in all these three stresses (Table 1).

The Boot-SVM-RFE technique was found to be superior for selection of informative genes from the high dimensional gene expression data. This approach is also advantageous over classical gene selection techniques like t-test and F-score, as it does not require any distributional assumptions about the data. In this technique, a *p-value* was assigned to each gene and genes with lower *p-values* were considered as informative for the particular condition/trait under investigation. The selection of informative genes based on *p-values* is scientific as well statistically meaningful to experimental biologists as compared to other techniques. Further, the bootstrap procedure used in this technique was expected to remove the spurious associations of the genes with their classes. The comparative analysis showed that the Boot-SVM-RFE performed better than existing techniques i.e. SVM-RFE, t-score, F-

score, RF and IG in terms of CA. Besides, its performance can be considered as robust due to the lower CV values in CA for all window sizes.

Application to Aluminum stress in Soybean

Boot-SVM-RFE technique was applied to Aluminum (Al) stress in soybean gene expression data, to select 981 informative genes. The Gene Ontology (GO) enrichment analysis of the selected 981 genes was performed by using *AgriGO*, a plant-specific GO term enrichment analysis tool. The GO analysis results are represented in Figure 2.

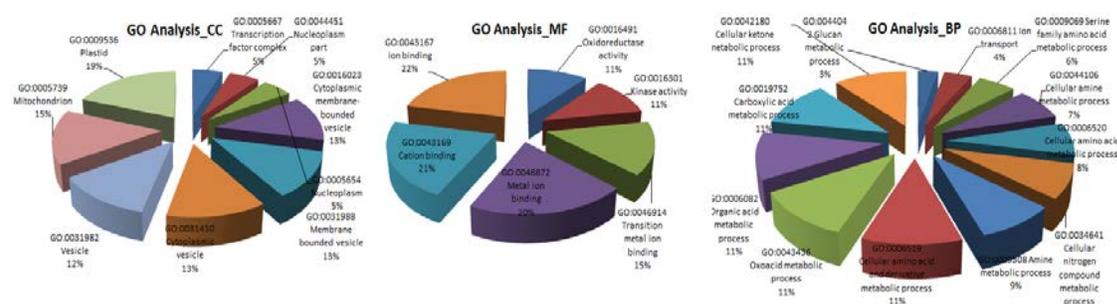


Figure 2. GO term enrichment analysis of selected 981 genes under Al stress.

The GO term enrichment analysis of hub genes for Al stress condition using *AgriGO* is shown for different gene ontology categories are Cellular Component (CC), Molecular Function (MF) and Biological Process (BP). It is observed from figure-2 that most of the selected genes are responsible for transition metal ion binding, metal ion binding, cation binding, ion binding, etc. These molecular functions (MF) might be activated due to high concentration of Al ions in water or soil. Two other MF *i.e.* oxidoreductase (redox) and kinase activities are also present in MF GO categories of these selected genes. The significant behavior of the genes in redox activity might be related to electron transport in complex chemical reactions that balances the charges during ion transport. The redox activity might also be related to Reactive Oxygen Species (ROS) that are produced in response to oxidative stress due to water deficit during abiotic stress like Al toxic stress. In biological process categories, such as cellular nitrogen compound metabolic process, amine metabolic process, cellular amino acid and derivative metabolic process, oxoacid metabolic process, organic acid metabolic process, carboxylic acid metabolic process, cellular ketone metabolic process and ion transport activity, the number of selected genes is more as compared to other biological processes. It may be inferred that some of these chosen genes are involved in ion transport activities, *i.e.* involved in transporting the ions outside the cell to maintain the proper pH in the cell. In case of cellular components, chosen genes are related to transcription factor complex, cytoplasmic membrane-bounded vesicle, membrane-bounded vesicle, cytoplasmic vesicle, vesicle and nucleoplasm part. It was found that the maximum number of the genes is related to vesicle and membrane, which is consistent with the detoxifying mechanism of metal ions available in Al stress condition, especially in sequestration by vacuole. Some of the selected genes present on membrane are found to be involved in transporting of metal ions outside the cell or to the vacuole to maintain pH and transmembrane proton gradient.

The Boot-SVM-RFE technique is efficient and robust for selection of biological informative gene selection as compared to existing gene selection techniques. Moreover, it can be used for other case vs. control genomic studies including NGS expression study. The case study of Al stress in soybean also throws some light to understand the mechanism of Al stress response in soybean and some key

important genes were reported. Moreover, functional enrichment analysis of these key genes revealed their associated intracellular functions under Al stress.

References:

Das S, Meher PK, Rai A, Bhar LM, Mandal BN (2017) Statistical Approaches for Gene Selection, Hub Gene Identification and Module Interaction in Gene Co-Expression Network Analysis: An Application to Aluminum Stress in Soybean (*Glycine max L.*). *PLoS ONE* 12(1): e0169605. <https://doi.org/10.1371/journal.pone.0169605>.

AWARDS AND RECOGNITIONS

- Dr. MA Iquebal received SESR Computational Biologist 2016 from Society for Educational and Scientific Research.
- Dr A.R. Rao received the elected FELLOW certificate in occasion of Platinum Jubilee Celebration of Indian Society of Genetics and Plant Breeding (ISGPB) and Brainstorming Session on Role of Plant Breeding and Genetics in Agricultural Development on February 11, 2017 at B.P. Pal Auditorium, I.A.R.I., New Delhi.
- Dr. Ranjit Paul received Young Scientist Award in social Sciences for the bienninun 2015- 2016 by NAAS in XIII Agricultural Science Congress held at University of Agricultural Sciences, Bengaluru during February 21-24, 2017.
- Dr. Rajender Parsad received NAAS Recognition Award 2015-16 for significant contributions to Social Sciences in XIII Agricultural Science Congress 2017 organized at University of Agricultural Sciences, GKVK, Bengaluru during February 21-24, 2017.
- Dr. Sukanta Dash received the MN Das Memorial Young Scientist Award in the 19th Annual Conference of Society of Statistics, Computer and Application organized at Sher-e-Kashmir University of Agricultural Sciences & Technology, Jammu, J&K during 06-08 March 2017.
- Dr. Rajender Parsad Chaired a Technical Session on Data Analytics and Statistical Computing during 19th Annual Conference of Society of Statistics, Computer and Application organized during March 06-08, 2017 at Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu, J&K.
- Dr. Mukesh Kumar chaired one session among Oral Presentations: Four Concurrent Sessions during the 19th Annual National Conference of Society of Statistics, Computer and Applications organized during March 06-08, 2017 at Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu, J&K.
- Dr. Hukum Chandra chaired a contributed paper session in the 19th Annual Conference of Society of Statistics, Computer & Application held at Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu, J&K during 06-08 March, 2017.

VISITS ABROADS

- Dr. U.C. Sud visited Chiba, Japan as Expert to attend the Regional Workshop on Training for Official Statistics held during March 21-24, 2017.

NEW PROJECTS INITIATED

1. Phenomics of moisture deficit stress tolerance and nitrogen use efficiency in rice and wheat – Phase II. Funded by National Agricultural Science Fund (NASF). (AGENIASRICOP201700700093)

- IARI: Viswanathan Chinnusamy; IASRI: Anil Rai, AR Rao, Sudeep, Sanjeev Kumar; Indian Institute of Technology, New Delhi: Brejesh Lall; National Rice Research Institute, Cuttack: Padmini Swain: 01.01.2017-31.03.2018.
2. Creating a fully characterized genetic resource pipeline for mustard improvement programme in India. Funded by National Agricultural Science Fund (NASF). (AGENIASRICOP201700800094)
PAU, Ludhiana: Prof. S.S.Banga, IARI: D.K. Yadav; Directorate of Rapeseed-Mustard Research, Bharatpur: K.H.Singh, GBPUAT, Pantnagar: Ram Bhajan, IASRI: A.R. Rao, Cini Varghese, PK Meher: 01.01.2017-31.12.2019.
 3. Development of an improved hybrid De-novo whole genome assembler.(AGENIASRISIL201700100087)
SB Lal, Anu Sharma, Sanjeev Kumar, DC Mishra, Neeraj Budhlakoti: 04.01.2017-03.01.2019.
 4. Management and impact assessment of farmer first project.(AGENIASRICOL201700200088)
NIAP: Shiv Kumar, Rajni Jain, Vinayak R. Nikam, Kinsly I.T., Abhimanyu Jhajhria; NAARM: P. Venkatesan, Bharat S. Sontakki, N. Sivaramane; IASRI: Mukesh Kumar, Anshu Bhardwaj, Soumen Pal; DKMA: Aruna T. Kumar, Mitali Ghosh Rai: 14.02.2017-31.03.2018.
 5. Design involving multi-way genetic crosses for agricultural and animal breeding programmes. (AGENIASRISIL201700300089)
Harun, Cini Varghese, Seema Jaggi, Anindita Datta: 09.03.2017-08.03.2020.
 6. Non-linear modeling for genomic predictions based on multiple traits. (AGENIASRISIL201700500091)
Neeraj Budhlakoti, DC Mishra, SB Lal: 31.03.2017-30.03.2019.
 7. Generalized row-column designs for cop and animal experiments. (AGENIASRISIL201700400090)
Anindita Datt, Harun, Seema Jaggi, Cini Varghese: 31.03.2017-30.03.2020.
 8. Creation of policy and strategy cell (PSC) at ICAR-NIAP for doubling farmers' income in India by 2021-22: Estimating farm income and facilitating the implementation of strategic frame work. Funded by Department of Agriculture and Cooperation, Ministry of Agriculture and Farmers Welfare, Govt. of India. (AGENIASRICOP201700600092) . NIAP: Director, Raka Saxena, Naveen P Singh, Usha R Ahuja; IASRI: Ranjit Kumar Paul: 31.03.2017-31.03.2022.

HUMAN RESOURCE DEVELOPMENT

Training Programmes Organised

S.N.	Title	Venue	Date	Sponsoring Agency	Number of participants
1.	Recent Analytical Techniques in Statistical Genetics and Genomics <i>Coordinator : Dr. L.M. Bhar</i> <i>Co-coordinator : Samarendra Das</i>	ICAR-IASRI New Delhi	January 17 to February 06, 2017	Education Division, ICAR	25
2.	Advances in Statistical Modeling and Forecasting in Agriculture <i>Coordinator : Dr. Bishal Gurung</i> <i>Co-coordinator : Dr. Mrinmoy Ray</i>	ICAR-IASRI New Delhi	December 23 to January 12, 2017	Education Division, ICAR	24

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- | | | | | | |
|----|---|-------------------------|----------------------------------|-----------------------------|----|
| 3. | Computational Approaches for Next Generation Sequencing (NGS) Data Analysis in Agriculture
<i>Coordinator : Dr. Mir Asif Iquebal</i>
<i>Co-coordinator : Dr. Sarika</i> | ICAR-IASRI
New Delhi | February 08 to February 28, 2017 | Education Division,
ICAR | 25 |
| 4. | Web-designing, Development and Maintenance using Open Source Software
<i>Coordinator : Shri Pal Singh</i>
<i>Co-coordinator : Sr. Sudeep</i> | ICAR-IASRI
New Delhi | February 18 to February 27, 2017 | HRM Division,
ICAR | 13 |
| 5. | कृषि आँकड़ों की मॉडलिंग एवं पूर्वानुमान के लिए सांख्यिकीय तकनीकें
<i>Coordinator : Rajeev Ranjan Kumar</i> | ICAR-IASRI
New Delhi | February 09 to February 14, 2017 | Education Division,
ICAR | 10 |
| 6. | Advanced Statistical Techniques in Genetics and Genomics
<i>Coordinator : Dr. A.K. Paul</i>
<i>Co-coordinator : Samarendra Das</i> | ICAR-IASRI
New Delhi | March 02 to March 22, 2017 | Education Division,
ICAR | 23 |
| 7. | A training programme on ICAR-ERP for ICAR Technical Personnel
<i>Coordinator : Dr. Anshu Bhardwaj</i>
<i>Co-coordinator : Dr. Mukesh Kumar</i> | ICAR-IASRI
New Delhi | March 20 to March 25, 2017 | HRM Division,
ICAR | 23 |
| 8. | Unit Level Data Repository
<i>Coordinator : Dr. Rajender Parsad,</i>
<i>Co-coordinator : Dr. Anil Kumar, Dr. Susheel Kumar Sarkar and Dr. Arpan Bhowmik</i> | ICAR-IASRI
New Delhi | February -28 March 01, 2017 | HRM Division,
ICAR | 20 |
| 9. | Unit Level Data from Researchers Perspective
<i>Coordinator : Dr. Rajender Parsad,</i>
<i>Co-coordinator : Dr. Anil Kumar, Dr. Susheel Kumar Sarkar and Dr. Arpan Bhowmik</i> | ICAR-IASRI
New Delhi | March 24 to March 25, 2017 | HRM Division,
ICAR | 17 |

SEMINAR DELIVERED

Seminars in different areas of Agricultural Statistics, Computer Applications and Bioinformatics were delivered by the scientists and students of the Institute. The seminars included presentations on salient findings of the completed research projects and new project proposal by the scientists, thesis/ORW/course seminars of students of M.Sc. and Ph.D. (Agricultural Statistics, Computer Applications and Bioinformatics). Apart one seminar was also delivered by a guest, Dr. A.K. Nigam,

Consultant Advisor from the Institute of Applied Statistics and Development Studies, Bengaluru on “Global Hunger Index-How Good it is ?” The detail of seminars delivered is given below.

Category	Type of seminar	Number of seminars
Student	Course	13
	ORW	15
Scientist	Project completion	02
	ORW	01
	New Project Proposal	05
Other	Guest	01
Total		37

LECTURES DELIVERED

- CAFT on Advances in Statistical Modeling and Forecasting in Agriculture at ICAR-IASRI New Delhi on January 3, 2017.
 - Rai, Anil. (i) Log linear modeling of survey data.
- Training for Scientists and Research Officers of ICFRE at Forest Research Institute (Deemed University), Dehradun on 09 January, 2017.
 - Chandra, Hukum. Development of questionnaires and data collection forms, simple random sampling, systematic and cluster sampling and determination of sample size.
- CAFT on Application of Molecular Markers in Fish Breeding held at ICAR-Central Institute of Fisheries Education, Mumbai during February 2-4, 2017.
 - Kumar, Dinesh. Basic Bioinformatics and status, miRNA identification and its target prediction, Genome wide association studies and genomic selection and Meta genome analysis.
 - Iquebal, M. A. Data cleaning and pre-processing, genome assembly, transcriptome analysis, genome annotation, allele mining and its application in fishery sciences.
- Review workshop of Network Project on Market Intelligence on February 7, 2017 at ICAR- NIAP, New Delhi.
 - Paul, R.K. Advances in time series modeling.
- National workshop on Computational Tools for Genomics and Proteomic Data Analysis held at ICAR-National Bureau of Agriculturally Important Microorganisms, Mau, Uttar Pradesh during February 14-17, 2017.
 - Kumar, Dinesh. Bioinformatics and its importance to microbiology
 - Iquebal, M. A. Data cleaning and pre-processing , genome assembly, genome annotation, allele mining and its importance in microbiology.
- Training programme on Fundamentals of Designs organized by NCIPM, New Delhi for their scientists and technical officers during Feb. 27-28, 2017.
 - Jaggi, Seema. Testing of hypothesis.
 - Varghese, Cini. Descriptive statistics.
 - Varghese, Eldho. Basic designs.
 - Dash, Sukanta. Factorial experiments.
 - Bhowmik, Arpan. Split and strip plot design.s
- Training programme for Technical Personnel organized at Division of Agronomy, IARI on 23rd March 2017.

- Bharadwaj, Anshu. Data mining for retrieval of agricultural information.
- Training programme on Layout and Maintenance of Field Experiments and Recording Observations at Division of Agronomy, ICAR-IARI, New Delhi-110012 on March 18, 2017.
 - Parsad, Rajender. Principles of field experimental designs.
- ICAR Research Data Repository for Knowledge Management to the participants of the Experts' Workshop on Geo-Portal organized at ICAR-NBSS&LUP, Nagpur on March 27, 2017.
 - Parsad, Rajender. Genesis, progress and future course of action.
- Lecture to the M.Sc. 1st year (Statistics) students of Department of Statistics, University of Calcutta, Kolkata on March 23, 2017.
 - Jaggi, Seema. Mutually orthogonal latin squares.
- National Workshop on Biostatistics organized at Zakir Husain Delhi College, on 10th March, 2017.
 - Mandal, B N, R. software.
- Training programme on Data Analysis using SAS organized at NRC Grapes, Pune during 08-09, March, 2017.
 - Varghese, Eldho. (i) Basic principle of DOE (ii) Basic designs (iii) ANOVA (iv) Multiple comparison procedures (v) Cluster analysis (vi) PCA and (vii) Response surface methodology in a.
- Winter school on "Advanced Statistical Techniques in Genetics and Genomics" organized at ICAR-IASRI during 02-22 March, 2017.
 - Dash, Sukanta. (i) Classification techniques based on SOFM (ii) JMP Genomics: An overview
- Workshop of Faculty Development Programme (FDPSCS-2017) at Department of Mathematics, Keshav Mahavidyalaya, University of Delhi, Delhi on 24 March, 2017.
 - Chandra, Hukum. Statistical computing software R.

PUBLICATIONS

Research Papers

1. Barman, D, Kundu, DK, Pal, S, Pal, S, Chakraborty, AK, Jha, AK, Mazumdar, SP, Saha, R and Bhattacharyya, P (2017). Soil temperature prediction from air temperature for alluvial soils in lower Indo-Gangetic plain. *International Agrophysics*, **31(1)**, 9-22.
2. Basak, P, Aditya, K, Chandra, H and Sud, UC (2017). Application of calibration approach for regression coefficient estimation under two-stage sampling design.
3. Bhati, J, Pandey, N, Grover, M, Nayak, NR and Mund NK (2016). In-silico characterization of EST sequences for cellulose synthase in sugarcane. *International Journal of Advanced Research*, **4(11)**, 2276-2283.
4. Chandra, MD, Shuchi, S, Indra, S, Nandhini, MD, Sanjeev, K, Farooqi MS, Chaturvedi, KK and Rai A (2017). Prediction of novel putative miRNAs and their targets in buffalo. *Indian Journal of Animal Sciences*, **87(1)**, 59-63.
5. Chandrika, KSV, P, Singh, A, Rathore, A and Kumar, A (2016). Novel cross linked guar gum-g-poly(acrylate) porous superabsorbent hydrogels: Characterization and swelling behaviour in different environments *Carbohydrate Polymers*. **149**, 175-185.
6. Das, P, Paul, AK and Paul, RK (2016). Non-linear mixed effect models for estimation of growth parameters in goats. *Journal of the Indian Society of Agricultural Statistics*, **70(3)**, 205-210.
7. Das, S, Meher, PK, Rai, A, Bhar, LM and Mandal BN (2017). Statistical approaches for gene selection, Hub gene identification and module interaction in gene co-expression network analysis: An application to aluminum stress in soybean (*Glycine max L.*). *PLoS ONE*, **12(1)**, e0169605. doi:10.1371/journal.pone.0169605.
8. Grover, M, Pandey, N and Rai, A (2016). First report on quantum computational logic in biological networks. *International Journal of Innovative Research in Technology and Science*, **4(3)**, 22-24.

9. Kour, S and Pradhan, UK (2016). Genetic variability, heritability and expected genetic advance for yield and yield components in forage sorgham [*Sorghum bicolor* (L.) Moench]. *Journal of the Society for Application of Statistics in Agriculture and Allied Sciences*, **1(2)**, 71-76.
10. Kumar, A and Panwar, S Development of Non-linear models for forecasting, *Journal of the Indian Society of Agricultural Statistics* **70(3)**, 277-285.
11. Kumar, P, Sethi, S, Sharma, RR and Varghese, E (2016). Effect of edible coatings on eating and functional quality of Japanese plum cv. Santa Rosa. *Indian Journal of Horticulture*, **73(3)**, 416-442.
12. Kumar, R, Aditya, K, Chandra, H, Basak, P and Das, S (2017). Variance estimation using quadratic programming technique. *e-paper Published in Biotech articles*.
13. Mandal, BN, Gupta, VK and Parsad, R (2017). Balanced treatment incomplete block designs through integer programming, *Communications in Statistics - Theory and Methods*, **46:8**, 3728-3737, DOI: 10.1080/03610926.2015.1071394.
14. Pal, S and Ghosh, H (2016). Web ECGR: Web solution for estimation of compound growth rates using parametric and nonparametric methodologies. *Journal of the Society for Application of Statistics in Agriculture and Allied Sciences*, **1(2)**, 7-15.
15. Parui, S, Parsad, R and Mandal, BN (2016). Construction of latin hypercube designs with two factors. *RASHI*, **1(2)**, 1-6.
16. Paul, AK, Kundu, MG, Paul, RK and Gurung, B (2016). Usefulness of growth curve parameters in early selection of pigs. *Journal of the Society for Application of Statistics in Agriculture and Allied Sciences*, **1(2)**, 27-34.
17. Paul, AK, Paul, RK, Singh, NMD, Wahi, SD and Singh, NO (2016). Genetic variability of growth curve parameters in goats: Application of bootstrap techniques. *Journal of the Indian Society of Agricultural Statistics*, **70(3)**, 211-218.
18. Paul, RK, Gurung, B, Paul, AK and Samanta, S (2016). Long memory in conditional variance. *Journal of the Indian Society of Agricultural Statistics*, **70(3)**, 243-254.
19. Pratyush D, and Bhar, LM (2016). Robustness of BIB designs for multi-response experiments against the loss of observations. *Journal of the Society for Application of Statistics in Agriculture and Allied Sciences*, **1(2)**, 64-70.
20. Sindhu, T, Venkatesan, T, Gracy, G, Jalali, SK and Rai, A (2017). Exploring the resistance-developing mutations on ryanodine receptor in diamondback moth and binding mechanism of its activators using computational study. *Biochemical Engineering Journal*.
21. Sinha, K, Paul, RK and Bhar, LM (2016). Price transmission and causality in major onion markets of India. *Journal of the Society for Application of Statistics in Agriculture and Allied Sciences*, **1(2)**, 35-40.
22. Meher, PK, Sahu, TK, Saini, V and Rao, AR (2017). Predicting antimicrobial peptides with improved accuracy by incorporating the compositional, physico-chemical and structural features into Chou's general PseAAC. *Scientific Reports* **7**, 42362; doi: 10.1038/srep42362.
23. Naveena K, Singh, S, Rathod, S and Singh, A (2017). Hybrid time series modelling for forecasting the price of washed coffee (Arabica Plantation Coffee) in India. *International Journal of Agriculture Sciences*, **9(10)**, 4004-4007.
24. Nepolean, T, Sharma, R, Singh, N, Shiriga, K, Mohan, S, Mittal, S, Mallikarjuna, MG, Rao, AR, Dash, PK, Hossain, F and Gupta, HS (2017). Genomewide expression and functional interactions of genes under drought stress in maize. *International Journal of Genomics*, 2017, Article ID 2568706, doi:10.1155/2017/2568706.
25. Panwar, S, Singh, KN, Kumar, A, Paul, RK, Sarkar, SK, Gurung, B and Rathore, A (2017). Performance evaluation of yield crop forecasting models using weather index regression analysis. *Indian Journal of Agricultural Sciences*, **87 (2)**, 270-272.
26. Pardhi, R, Singh, R, Rathod, S and Singh, PK (2016). Effect of price of other seasonal fruits on mango price in Uttar Pradesh. *Economic Affairs*, **61(4)**, 1-5.

27. Sahu, S, Sharma, JP, Burman, RR, Singh, Premlata, Kumbhare, NV and Eldho Varghese (2017). Indian socio - economic impact assessment of farms produce promotion society (FAPRO) of Punjab, *Res. J. Ext. Edu.* **17(1)**, 13-17.
28. Sharma, S, Jaiswal, Sarika, Archak and Sunil (2017). Annotation of gene sequence and protein structure of brinjal EDS1. *Bioinformatics*, **13 (3)**, 54-59.
29. Thorat, DS, Sahoo, PK, Dipankar, De and Iquebal, MA (2017). Prototype: A ridge profile mechanical power weeder. *Agricultural Mechanization in Asia, Africa and Latin America*, **48(1)**, 81-86.
30. Parihar, AK, Dixit, GP and Singh, D (2016). Gene interactions and genetics for yield and its attributes in grass pea (*Lathyrus sativus* L.). *Journal of Genetics*, **95(4)**, 947-956.
31. Parihar, AK, Basandrai, AK, Sirari, A, Dinakaran, D, Singh, D, Kannan, K, Kushawaha, KPS, Adinarayan, M, Akram, M, Latha, TKS, Paranidharan, V and Gupta, S (2017). Assessment of mungbean genotypes for durable resistance to Yellow Mosaic Disease: Genotype x Environment interactions. *Plant Breed*, **136**: 94–100. doi:10.1111/pbr.12446.
32. Kumar, P, Lal, K, Parsad, R and Gupta, VK (2017). Block designs with nested row-column for factorial experiments. *Communications in Statistics - Theory and Methods*, DOI: 10.1080/03610926.2016.1161800.
33. Nayak, AK, Kumar, P, Saxena, AK and Kumar, M (2017). Aquaculture development in Kumaon hills: A spatial decision support system approach. *Contemporary Research in India*, **7(1)**, 1-6.
34. Bhati, J, Jethra, G, Sharma, A and Rai, A (2016). In Silico prediction and characterization of micro RNAs from pigeon pea [*Cajanus cajan* (L.) Millsp.]. *Indian Journal of Biotechnology*, **15**, 477-484.
35. Verma SK, Jasrotia RS, Iquebal, MA, Jaiswal S, Angadi, UB, Rai, A, and Kumar, D (2017). Deciphering genes associated with root wilt disease of coconut and development of its transcriptomic database (CnTDB), *Physiological and Molecular Plant Pathology* doi: 10.1016/j.pmp.2017.03.011.
36. Meher, PK, Sahu, TK, Banchariya, A and Rao, AR (2017). DIRProt: A computational approach for discriminating insecticide resistant proteins from non-resistant proteins. *BMC Bioinformatics*, **18**:190, DOI: 10.1186/s12859-017-1587.
37. Mittal, S, Arora, K, Rao, AR, Mallikarjuna, M, Gupta, HS and Thirunavukkarasu, N (2017). Genomic selection for drought tolerance using genome-wide SNPs in maize. *Frontiers in Plant Science*, **8**:550. DOI: 10.3389/fpls.2017.00550.
38. Datta, A, Jaggi, S, Varghese, E and Varghese, C (2017). Generalized confounded row- column designs. *Communication in Statistics: Theory and Methods*, **46(12)**, 6213-6221.
39. Shekhawat, RS, Singh, KN, Burark, SS, Meena, GL and Shekhawat, N (2017). Agribusiness and food processing industries in Uttar Pradesh State of India. *Asian Journal of Agricultural Extension, Economics & Sociology*, **15(4)**, 1-7.

Manual/ E-manual

- कौस्तव आदित्य, हुकुम चन्द्र, शीला दास और सी पी सिंह. भारत में फसलों के बीज, चारा और अपव्यय अनुपात का आकलन, भारतीय कृषि अनुसंधान पत्रिका ।
- एल्दो वर्गीस, अर्पण भौमिक, सीमा जग्गी, सिनी वर्गीस एवं विजय बिन्दल (2016) लागत प्रभावी असममित घूर्णन योग्य अभिकल्पनाओं पर एक टिप्पणी, भारतीय कृषि अनुसंधान पत्रिका, 31 (3), 230–234 ।
- अनिंदता दत्ता, सीमा जग्गी, एल्दो वर्गीस, सिनी वर्गीस, अर्पण भौमिक, मोहम्मद हारुन, एवं बी.जे. गहलोत (2016) जनरेलाइज्ड रो-कॉलम अभिकल्पना, भारतीय कृषि अनुसंधान पत्रिका, 31 (3), 227–229 ।
- Iquebal, MA, Sarika, Kaur Manjeet, Rai Anil, and Kumar Dinesh. (2017). Computational approaches for next generation sequencing (NGS) data analysis in agriculture. Reference Manual-I, ICAR-Indian Agricultural Statistics Research Institute, New Delhi.

- Angadi UB (2017)
- PHP Language: Database connectivity with MYSQL, Protein 3D Structure Prediction, Molecular modelling and simulation and PHP Programming. Manual, ICAR-Indian Agricultural Statistics Research Institute, New Delhi.

Popular Articles

- Aarti Singh and Anu Sharma. Web Semantics for Personalized Information Retrieval. Communicated to book entitled "Web Semantics for Textual and Visual Information Retrieval" by IGI Global.
- Shashi Bhushan Lal, Anu Sharma, Krishna Kumar Chaturvedi, Mohammad Samir Farooqi, Sanjeev Kumar, Dwijesh Chandra Mishra and Mohit Jha (2017). State of the Art Information Retrieval Tools for Biological Resources. Communicated to book entitled "Web Semantics for Textual and Visual Information Retrieval" by IGI Global.
- Seema Jaggi and UC Sud (2017). Agricultural Statistics. Significant Research Achievements of Post Graduate Students (2007-2016). 548-577, Post-Graduate School, Indian Agricultural Research Institute, New Delhi.
- Sudeep Marwaha, Alka Arora and Dinesh Rajpoot. "Examining Data Trends at Post Graduate School IARI using Online Management System for Post Graduate Education" in the book by PG School, IARI.
- Sreekumar Biswas, Rajni Jain, Sudeep Marwaha and Alka Arora (2017). "Framework for Text Categorization in Agricultural Domain". Proceedings of the 11th INDIACom; INDIACom-2017, 434-437.
- Singh, A and Sharma, A (2017). Web Semantics for Personalized Information Retrieval. Web Semantics for Textual and Visual Information Retrieval. A volume in the Advances in Data Mining and Database Management (ADMDM) Book Series, IGI-Global, 166-186.
- Hanuman Singh, Ravindra Singh Shekhawat, Irfan Khan, Umesh Kumar Dhakad, and Anuj Singh (2017). White Rust [Albugo candida (PERS.) Kuntze] OF mustard [Brassica juncea (L.) Czern. & Coss.]: A Review. MARUMEGH Kisaan E- Patrika.
- Ravindra Singh Shekhawat (2017). Status of Kisan Credit Card. <http://www.biotecharticles.com/Agriculture-Article/Status-of-Kisan-Credit-Card-in-India-3833.html>.
- Ravindra Singh Shekhawat (2017). Development and Decomposition of Agricultural output in Rajasthan. <http://www.biotecharticles.com/Agriculture-Article/Development-and-Decomposition-of-Agricultural-output-in-Rajasthan-3823.html>.

Packages Developed

1. Online version of MAPI software.
2. Online data analysis software for Small Area Estimation.
3. Online prediction server *i*AMPpred for prediction of anti-microbial peptides accessible at <http://cabgrid.res.in:8080/amppred/>.
4. Transcriptomic Database and web portal for Coconut (CnTDB).

CONFERENCES/WORKSHOPS/SEMINARS/SYMPOSIA/MEETINGS ETC. ORGANISED

1. Workshop for the officials of Directorate of Statistics, Ministry of Agriculture and Farmers Welfare, and State Government Officials of various states on 17th -18th March 2017 under the project "Pilot

- Study for developing States-level estimates as per methodology recommended by Prof. Vaidyanathan Committee Report". (Dr. Anshu Bharadwaj).
- Workshop on KVK Portal and KVK Mobile App at ICAR-IASRI, New Delhi on 9th March, 2017. (Dr. Soumen Pal).
- Workshop on Standardization of sampling methodology for crop yield estimation at lower level in the context of crop insurance at ICAR-IASRI on 27 March 2017.
- Meeting with a team of scientists from ICAR-Central Institute for Research on Cattle, Meerut on "Development of Cattle Phenotype Database at CABIn, ICAR-IASRI, New Delhi on February 17, 2017. (Dr. Anil Rai, Dr. Dinesh Kumar, Dr. U.B. Angadi, Dr. Sarika and Dr. M. A. Iquebal).
- Workshop of Nodal Officers of KRISHI: Knowledge based Resources Information Systems Hub for Innovations in Agriculture (ICAR Research Data Repository for Knowledge Management) at NASC and ICAR-IASRI during January 24-25, 2017. (Dr. Mukesh Kumar and Dr. Anshu Bharadwaj)
- Workshop on IP Management jointly organized by TIFAC and DRDO at NASC Complex, ICAR, New Delhi during January 12-14, 2017. (Dr. Rajender Parsad)

PAPERS PRESENTED IN CONFERENCES

- Sahoo, PM, Ahmad, T and Rai, A (2017). Sampling Methodology for Crop Acreage and Production Estimation in Hilly Regions using Geospatial technology in 104th Indian Science Congress held at Sri Venkateswara University, Tirupati during January 03-07, 2017.
- Chandra, H, Aditya, K and Sud, UC (2017). MAPI Software for Data Collection using Smart Phones – A Way Forward for Fast, Cost Effective and Quality Data in National workshop on Improvement of Agricultural Statistics organized by Directorate of Economics & Statistics, Ministry of Agriculture and Farmers Welfare, Govt. of India during January 04-05, 2017.
- Ahmad, T, Sud, UC, Biswas, A and Sahoo, PM (2017). Alternative sampling methodology for estimation of area and production of horticultural crops under ICAR-IASRI component of CHAMAN in National Workshop on Improvement of Agricultural Statistics at Symposium Hall, Pusa Complex, New Delhi during January 04-05, 2017.
- Chandra, H, Kumar, S and Aditya, K (2017) Estimation of Small Area Proportions using Survey Data and Different Levels of Covariates. Presented in The International Conference on Computational Mathematics & Statistics organised at Banasthali University, Rajasthan, during 24-25 January, 2017.
- Lal, SB, Sharma, A, Chaturvedi, KK, Angadi, UB, Farooqi, MS and Rai, A (2017). On Internet of Things (IoT) and Agriculture: An Overview authored during Technical Session-VI: Role of Bioinformatics in Agriculture organised at SKUAST Jammu during 06-08 March, 2017.
- Bhudhlakoti, N (2017). Classification of proteins related to different stress using machine learning techniques in 19th National Annual conference of Society of Statistics, Computer and Applications organised at SKUAST Jammu during 06-08 March, 2017.
- Chaturvedi, KK (2017). on Application and Issues of Fog Computing in Agriculture in 19th National Annual conference of Society of Statistics, Computer and Applications organized at SKUAST, Jammu during 06-08th March 2017.
- Chaturvedi, KK (2017). Computational Perspectives of Bioinformatics in Agriculture in 19th National Annual conference of Society of Statistics, Computer and Applications organized at SKUAST, Jammu during 06-08th March 2017.

9. Parul, S Parsad, R and Mandal, BN (2017). Optimal completely randomized designs for incomplete factorial structure with three factors in 19th National Annual conference of Society of Statistics, Computer and Applications organized at SKUAST, Jammu during 06-08th March 2017.
10. Dash, S, Mandal, BN and Parsad, R (2017). Complete solution of Latin hypercube designs for 6 factors in 19th National Annual conference of Society of Statistics, Computer and Applications during 06-08th March 2017 at SKUAST, Jammu.
11. Sarkar, SK (2017). Database management under KRISHI at ICAR-IASRI-Data Centre- vis-a-vis ICAR KRISHI Portal in ICAR KRISHI Geo portal Workshop-Experts at ICAR-NBSS&LUP, Nagpur on March 27, 2017.
12. Ahmad, T (2017). Use of Remote sensing Technology for crop yield estimation in the context of Crop Insurance in a workshop on Standardization of sampling methodology for crop yield estimation at lower level in the context of crop insurance organized at ICAR-IASRI on 27 March 2017.
13. Chandra, H(2017). Disaggregate level crop yield estimation using small area estimation in a workshop on Standardization of sampling methodology for crop yield estimation at lower level in the context of crop insurance organized at ICAR-IASRI on 27 March 2017.
14. Aditya, K (2017). Schedules for Data Collection, Data Entry Software and MAPI Software in a Workshop under the project entitled Pilot study for developing State level estimates of crop area and production on the basis of sample sizes recommended by Professor Vaidyanathan Committee report at ICAR-IASRI during 17-18 March 2017.

PARTICIPATION

International Conference/ Workshop etc.

1. International conference on 'Innovative Approach in Applied Physical, Mathematical/Statistical, Chemical Sciences and Emerging Energy Technology for Sustainable Development (APMSCSET) to present a poster and a paper on Modified Simple Exponential Smoothing Approach for time series forecasting of crop yield during January 15, 2017 at Jawahar Lal Nehru University, New Delhi. (Dr. Wasi Alam).
2. International Conference on Computational Mathematics & Statistics held at Department of Mathematics & Statistics Banasthali University, Rajasthan, India during January 24-26, 2017. (Dr. S. B. Lal and Dr. Anu Sharma).

Conference/Workshop/Seminar/Symposia/Training/Foundation Course/ Annual Day/ Lectures etc.

1. Indian Science Congress held at Sri Venkateswara University, Tirupati during January 03-07, 2017. (Dr Prachi Misra Sahoo).
2. National workshop on Improvement of Agricultural Statistics organized by Directorate of Economics & Statistics, Ministry of Agriculture and Farmers Welfare, Govt. of India at NASC complex, Pusa, New Delhi during January 04-05, 2017. (Dr Hukum Chandra and Dr. Ankur Biswas).
3. Esri India User Conference 2017 on GIS software held at New Delhi during 19 to 20 January, 2017. (Dr. Mukesh Kumar and Dr. Anshu Bharadwaj).
4. National workshop on Improvement of Agricultural Statistics organized by Directorate of Economics & Statistics, Ministry of Agriculture and Farmers Welfare, Govt. of India during January 04-05, 2017. (D.r Hukum Chandra)

5. Agricultural Science Congress during February 21-24, 2017 at University of Agricultural Sciences-Bangalore. (Dr. Rajender Parsad and Dr. R. K. Paul)
6. Review workshop of Network Project on Market Intelligence during 7-8 February, 2017 at ICAR-NIAP, New Delhi. (Dr. R. K. Paul)
7. Thirteenth Agricultural Science Congress during February 21-24, 2017 at University of Agricultural Sciences-Bangalore. (Dr. Rajendra Prasad)
8. Platinum Jubilee Celebration of "Indian Society of Genetics and Plant Breeding (ISGPB)" and Brainstorming Session on "Role of Plant Breeding and Genetics in Agricultural Development" on February 11, 2017 at B. P. Pal, Auditorium, I. A. R. I., New Delhi-110012. (Dr. A. R. Rao)
9. Presentation of Significant Educational Achievements 2016-17 of the discipline of Agricultural Statistics was made in the Professor's presentation session on February 8, 2017 in the 55th Convocation of Post Graduate School IARI. (Dr. Seema Jaggi).
10. Annual National Conference of Society of Statistics, Computers and Applications organized at SKUAST, Jammu during 06 -08 March, 2017. (Dr. Mukesh Kumar, Dr. Soumen Pal, Dr. D. C. Misra, Neeraj Bhudhlakoti, Dr. S.B. Lal, Dr Hukum Chandra, Dr. Rajender Parsad and Dr. Sukanta Dash)
11. Presented KVK Mobile App: An ICT Tool to Empower Indian Farmers from Hill Area with Knowledge Produced at Krishi Vigyan Kendra in the Technical Session II on 'Synthesis of Statistics and Informatics in Relation to Hill Ecosystem on 6th March 2017. (Dr. Soumen Pal).
12. National Level Review-cum-Sensitization Workshop of Management and Impact Assessment of Farmer FIRST Projects during 18th -19th March, 2017 at NAARM, Hyderabad under Farmer First Programme (FFP) Component of KVK Scheme. (Dr. Mukesh Kumar, Dr. Anshu Bharadwaj and Dr. Soumen Pal)
13. Workshop on KVK Portal and Mobile App organized at ICAR-IASRI on 9th March, 2017. (Dr. Alka Arora)
14. Advanced OMICS Techniques and Tools for Crop Improvement held during March 8-28, 2017 at Division of Biochemistry, ICAR-Indian Agricultural Research Institute, New Delhi. (Dr. M. A. Iquebal)
15. Participated in 19th National Annual conference of Society of Statistics, Computer and Applications during 6-8th March 2017 at SKUAST, Jammu. (Dr. K. K. Chaturvedi)
16. STAT-QUEST-2017 workshop organized by the Department of Statistics, University of Calcutta, Kolkata on March 21, 2017 for Post Graduate students of Statistics. (Dr. Seema Jaggi)
17. Workshop for Unit Level Data Repository under KRISHI: Knowledge based Resources Information Systems Hub for Innovations in Agriculture (ICAR Research Data Repository for Knowledge Management) at ICAR-IASRI during 28 February-01March, 2017 and 24-25 March, 2017. (Dr. Rajender Parsad, Dr. Seema Jaggi, Dr. Susheel Kumar Sarkar, Dr. Arpan Bhowmik, Dr. Anshu Bhardwaj, Dr. Sukanta Dash and Sh. Raju Kumar)
18. ICAR KRISHI Geoportal Workshop- Experts at ICAR-NBSS&LUP, Nagpur during March 27, 2017. (Dr. Susheel Kumar Sarkara and Dr. Anshu Bhardwaj)
19. Agri- entrepreneurs workshop organized at KVK, Sikohpur on 27 March, 2017 and interacted with agri-entrepreneurs. (Dr. Eldho Varghese and Dr. Arpan Bhowmik)

20. Workshop under the project Pilot study for developing state level estimates of crop area and production on the basis of sample size recommended by Prof. Vaidyanathann committee report” held at ICAR-IASRI during 17-18 March, 2017. (Scientists and Technical Officers of the Division SSM)
21. Participated in a Training Programme on “Unit Level data Researchers Perspective” held during 24-25 March, 2017. (Sh Raju Kumar)
22. Workshop on “Standardization of sampling methodology for crop yield estimation at lower level in the context of crop insurance” held at ICAR-IASRI on 27 March 2017. (Scientists and Technical Officers of the Division SSM)

Participation in Meetings etc.

1. Meeting as a representative of D.G. ICAR and as a Member of National Committee on Data Analytics on January 16, 2017 at Ahmedabad, Gujrat. (Dr. Anil Rai).
2. Meeting Task Force Theoretical and Computational Biology (TCB) held on 4th January at ACTREC, Mumbai for evaluating the BTIS run network centres. (Dr. A.R. Rao).
3. Meeting on ICAR Portal on 10 January, 2017 at ICAR Headquarters for finalizing the Data Input Sheet to develop ICAR Portal. (Dr. A.K. Choubey and Dr Sudeep Marwaha)
4. Review meeting of various portals on January 5, 2017. (Dr. Soumen Pal)
5. Review meeting on 16 January, 2017 for e-Governance projects in ICAR. (Dr. A.K. Choubey, Dr. Sudeep and Dr. Soumen Pal)
6. Meeting of the National Academy of Agricultural Sciences (NAAS) at NASC Complex, New Delhi on 02 January, 2017. (Dr. Hukum Chandra)
7. Meeting of Project Monitoring Committee (PMC) the project entitled “Pilot study for Developing State Level Estimates of Crop Area and Production on the basis of Sample Sizes Recommended by Professor Vaidyanathan Committee Report”, IASRI, New Delhi on 03 January, 2017.(Dr. Hukum Chandra and Dr Kaustav Aditya)
8. Meeting of the Local Office Bearers of SSCA on 11 January, 2017. (Dr. Hukum Chandra)
9. CPC meetings held at ICAR-IASRI on January17, 2017 and January28, 2017 as member CPC. (Dr Tauqueer Ahmad and Dr. Hukum Chandra)
10. Meeting regarding implementation of developed methodology for estimation of area and production of horticultural crops under CHAMAN project in 17 states of the country held at Shastri Bhawan, New Delhi on January 17, 2017. (Dr. Tauqueer Ahmad)
11. Meeting under the Chairmanship of Director (Horticulture), Chennai, Tamil Nadu relating to the project entitled "Study to test the developed alternative methodology for estimation of area and production of horticultural crops: IASRI Component of CHAMAN Program under MIDH" held at Directorate of Horticulture and Plantation Crops, Chennai on January 21, 2017. (Dr. Tauqueer Ahmad and Dr. Ankur Biswas).
12. State High Level Coordination Committee Meeting on Agricultural Statistics on 24 January, 2017 at Bangalore, Karnataka organized by the Directorate of Economics & Statistics (DES), Karnataka. (Dr. Tauqueer Ahmad).
13. Training Functions by HRD Nodal Officers of ICAR at NAARM, Hyderabad on Competency Enhancement Programme for Effective implementation during February 23-25, 2017.(Dr. Seema Jaggi)
14. Meeting a telephonic with Dr. S S Kalamkar, Director, AERC, Gujarat regarding the field visit in the state of Gujarat. (Dr. Kaustav Aditya)
15. First meeting of the technical committee deliberated the preparation of RFP for getting the consultancy on Data Security and Disaster Management required in ICAR. (Dr. A.K. Choubey)
16. First meeting of the technical committee deliberated on the integration of e-office feature with ERP. (Dr. A.K. Choubey)

17. Meeting on 2nd February 2017, at National Bee Board, Department of Agriculture, Cooperation & Farmers Welfare, Ministry of Agriculture & Farmers Welfare. (Dr. Anshu Bharadwaj)
18. Various meetings including the Partners Meeting related to the KRISHI project and working on its various components. (Dr. Anshu Bharadwaj)
19. Meetings related to Extra Mural Project "Impact Assessment of eLearning in Agriculture Education". (Dr. Anshu Bharadwaj)
20. Meeting of the project "Impact Assessment of Framers First Project "at ICAR-NIAP. (Dr. Anshu Bharadwaj).
21. Visited IAS, BHU, Varanasi and ICAR-IIVR, Varanasi for conducting Delphi survey for the project entitled "Future perceptive of Bt technology in Indian agriculture" from 05-08 Feb, 2017. (Sh. Santosha Rathod)
22. visited Delhi university, Biotech Centre (Dr. Akshay Pradhan Lab), South Campus, New Delhi for conducting Delphi survey for the project entitled "Future perceptive of Bt technology in Indian agriculture" on 23rd February 2017 at 1.00 PM. (Santosha Rathod)
23. Visited RCA, MPUAT, Udaipur for conducting Delphi survey for the project entitled "Future perceptive of Bt technology in Indian agriculture" from 17.02.2017 to 26.02.2017. (Dr. Ravindra Singh Shekhawat)
24. Visited ICAR-NAARM, ICAR-IIRR, ICAR-IIOR, ICAR-IIMR, Institute of biotechnology and ICRISAT for conducting Delphi survey for the project entitled "Future perceptive of Bt technology in Indian agriculture" from 23.02.2017 to 28.02.2017. (Dr. Mrinmoy Ray)
25. Meeting of monitoring e-governance activities and related issues held on 10.02.2017. (Dr. Rajender Parsad)
26. Meeting of the Academic Council of PG School, ICAR-IARI held on February 8, 2017(Dr. A. R. Rao).
27. Meeting of Technical Specifications and Evaluation committee as Chairman, evaluated the technical Bids for Blade Servers, GIS software, PostgreSQL Database on 15 February, Mobile workstation, SAN Switch on 16 February and Componnets of EMS on 17 February under Krishi Project. (Dr. KK Chaturvedi).
28. Meeting to assess the loss due to fire in genome informatics lab, ICAR-NRCPB, New Delhi on February 3, 2017. (Dr. KK Chaturvedi)

Technology Assessed/Transferred

- Implementation of MIS/FMS in all ICAR Institutes.
- CBP Vortal.
- Agridaksh on maize, mushroom.
- Expert system on wheat and seed spices.
- Implementation of MIS/FMS in all ICAR institutes
- HYPM
- KRISHI

Consultancy/Advisory Services Provided

1. Consultancy service to Mr. Pawan Jeet Ph.D.and Mr. Vikram Yogi, Ph.D. Student, Division of Ag. Engineering, IARI, New Delhi. (Dr. Rajeev Ranjan Kumar).
2. Consultancy service to carried out correspondence analysis to Dr. Madhusudan Bhattarai, IFPRI, New Delhi. (Ravindra Singh Shekhawat)
3. Consultancy service to Dr. Prolay Kumar Bhowmick, Scientist, Division of Genetics, ICAR-IARI about analysis of data in Lattice design. (Dr. Kaustav Aditya).
4. Consultancy work to analyze Multifactor response surface design of data provided by Ph. D. student Manjit Lad, PHT, IARI, New Delhi. (Sh. Prakash Kumar)

5. Dr. V. Santhy, Principal Scientist, Crop Improvement (CICR), Nagpur was advised on the use of R software for working out the Cophenetic correlation of marker data and also provided modified syntax for working out the same.
6. Mr. Debasis Guloi, Scientist, Division of SSAC, IARI was advised on the use of PCA for selecting minimum data set (MDS) for constructing soil quality index.
7. Dr. Supradip Saha, Senior Scientist, Division of Agricultural Chemicals, IARI on RSM for the optimization of four responses viz., Curcumin yield, Ar, Alpha, Beta using Design Expert software. The input variables taken for the study were time and temperature.
8. The technical guidances in terms of providing a copy of SAS Depot was provided to Nodal officer from ICAR-CITH, Srinagar. (Dr. Rajender Parsad)
9. Consultancy services for work to Statistical analysis of nitrogenase activity of plant data provided by Ph. D. student Anupama Priyadarshini, in the Division of Biotechnology, BHU, Varanasi. (Sh. Prakash Kumar).
10. Consultancy services for analyzed Path analysis and cluster analysis data of Mrs. Madhuri Arya, Jr. Scientist – cum – Assistant Prof., Tirhut College of Agriculture, Dholi, Bihar in R software on 22 February, 2017. (Sh. Santosha Rathod)
11. A Ph.D. Student, Sukanya Som of P.G. School, ICAR-IARI was advised to do Wilcoxon signed rank test to find out whether significant difference existed between knowledge scores of farmers before and after experiencing the e-module or not. (Dr. Anindita Datta).
12. Consultancy service to Dr. Muraleedhar S. Aski, Scientist, Pulses Lab, Division of Genetics, Indian Institute of Agricultural Research (IARI) to estimates genetic parameters of Pulses data. (Sh. Prakash Kumar).
13. Advisory service to Jitendra Kumar, a Ph.D. student at CCSU, Meerut, UP. Performed genome wide association mapping analysis in wheat crop, using multivariate linear mixed model method. (Sh. P. K. Meher).
14. Guided two scholars of STAR COLLEGE SKUAST Kashmir about the use of SAS software for Genetics and Breeding for their research work. (Dr. AK Paul)
15. Consultancy service project proposal with International Livestock Research Institute (ILRI) has been prepared and submitted to office for approval of competent authority. (Dr. UB Angadi).
16. Dr. Naga Mani, Assistant Professor at Agricultural College, ANGRAU, Hyderabad was advised to use CRD for different combination of bioagents(treatments) tested against soil borne pathogen and RBD for per cent inhibition of Aspergillus,R.bataticola and S.rolfsii pathogens inhibited by different bacteria. (Dr. Anindita Datta)
17. Dr. RichaVarshney, Scientist (Insect Ecology) at National Bureau of Agricultural Insect Resources, Bengaluru has been guided regarding the analysis of the fitting of nonlinear logistic model. It was based on previous studies where cubic logistic regression between proportion of prey consumed and prey density was used to determine shape. The CATMOD and NONLIN procedures of SAS was used to carry out the analysis. (Mr. Mohd. Harun)
18. Carried out data analysis of Mr. Vikram Yogi, Ph.D. Student, Division of Ag. Economics, IARI, New Delhi, on co-integration analysis. (Sh. Rajeev Ranjan Kumar)
19. Analyzed Factorial experiment in RCBD of Mr. Panduranga, Ph.D scholar, ICAR-IARI, New Delhi, on 27.03.2017 in SAS v.9.4. (Sh.Santosha Rathod)
20. Worked with Dr Madhusudan Bhattarai, IFPRI, New Delhi, on Impact of Farm mechanization on Nutritional security at National level. (Dr. Ravindra Singh Shekhawat)

PERSONNEL

Promotion

The following administrative personnel have been promoted to next higher Grades from the dates indicated against their names.

- | | |
|---------------------------|-----------------|
| 1. Smt. Sunita | From 10.01.2017 |
| 2. Shri Dharmendra Tanwar | From 13.01.2017 |
| 3. Shri Anish Wadhwa | From 16.03.2017 |

Retirement

The following personnel retired on their superannuation on the dates as shown against their respective names.

- | | |
|--------------------------|---------------|
| 1. Shri Ram Naresh | On 31.01.2017 |
| 2. Shri Kunwar Pal Singh | On 31.01.2017 |
| 3. Shri Sita Ram Singh | On 31.03.2017 |
| 4. Shri Gabbar Singh | On 28.02.2017 |

Resignation

1. Approval was accorded ex-post-facto to the technical resignation of Dr. Okendro Singh, Scientist from ICAR service by the competent authority at IAR, New Delhi and consequently the resignation of Dr. Okendro Singh tendered by him has been accepted by the Director, IASRI w.e.f. 28.02.2013 upon his absorption in the college of agriculture, Imphal.



एक कदम स्वच्छता की ओर



हर कदम, हर डगर
किसानों का हमसफर
भारतीय कृषि अनुसंधान परिषद

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