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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.

The utility of the Differential Hub Gene Analysis (DHGA) approach in Gene Co-expression Networks (GCNs) was tested on salinity, cold stresses in rice and AI stress in soybean. Based on the developed hub gene detection and DHGA approaches, an R package i.e. dhga has been developed (available at http://cran.r-project.org/web/packages/dhga). Based on this approach a few as well as important genes were identified as hubs in the GCN as compared to existing approach, which is in accordance with the scull free property of biological networks.

A new Trend Impact Analysis (TIA) method has been developed by combining conventional TIA with time series invention model. Traditional invention model has been reoriented to incorporate three impact parameters for any number of events in order to blend it with TIA. A formula for estimating slope parameter has also been derived and a SAS micro has been developed to implement the proposed approach. An attempt is made to establish the potential performance of wavelet based combinatory model as a proficient alternative to the traditional statistical approaches. The combinatory of wavelet-GARCH hybrid model has been found to outperform the individual ARIMA and GARCH model applied to analyze and evaluate monthly potato price data of three markets Haldwani, Agra and Lucknow of Uttar Pradesh. It is observed that wavelet-GARCH produces gives the best result over the other methods in terms of RMAPE (%) and RMSPE. While standing monthly hole sale price of onion data series considering six markets, it was fund that wavelet based neural network models were preferred over most common ARIMA and ANN methodology for rending price series modeling and forecasting.

Under Impact Assessment of Agricultural Research and Development it was found that non-insured sampled household farmers had a lower education attendance rate as compared with insured farmers. Propensity Score Matching (PSM) method and Instrumental variable (IV) method have been employed to estimate the impact of crop insurance on form output which showed that crop insurance has a positive and significant effect on form output.

Many scientists of the Institute have received various awards e.g. Fellow NAAS, Krishi Vigyan Gaurav. A scientist has visited Yunnan, China, Addis Ababa, Ethiopia on various capacities. Under the period under report, 07 new projects were initiated 07 training programmers were organized (2 sponged by CSA of E thiopia, E thiopia, 3 by NSSTA, CSO, MOSPI and 2 by HRD, ICAR). Scientists of the institute have publish 24 research paper, 18 popular articles, 3 reference manuals/E-manuals/Pamphlets, 2 scientific/technical report and developed 4 packages. Scientists of the Institute have provided Consultancy/Advisory services, Participated in different conferences/symposia/workshop etc. in various capacities and also delved Invited Lectures/Lectures.

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.

UC SUD

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RESEARCH ACHIEVEMENTS

Differential Hub Gene Analysis in Gene Co-expression Networks.

-Samarendra Das

Gene expression data have been analyzed with network methods for over a decade. Gene networks are proven key tools for system biology studies. Now a days, modeling and construction of gene networks *like* Gene Co-expression Networks (GCN) are vital to understand the interrelationship among the selected genes, identification of gene modules and key genes responsible for a particular stress/condition. Weighted Gene Co-expression Network Analysis (WGCNA) (Zhang and Horvath, 2005) is a latest and popular technique used to decipher co-expression patterns among genes. The WGCNA approach typically deals with the identification of gene modules by using the gene expression levels that are highly correlated across samples. This technique has been successfully utilized to detect gene modules in Arabidopsis, rice, maize and popular for various biotic and abiotic stresses. Further, this approach also leads to construction of GCN, a scale free network, where genes are represented as nodes and edges depict associations among genes.

In gene networks, highly connected genes are called hub genes, which are expected to play an important role in understanding the biological mechanism of response under stresses/conditions. Identification of hub genes will also help in mitigating the stress in plants through genetic engineering. Further, it is proven that highly connected hub nodes are central to the network's architecture and protein knockout experiments have shown that hub proteins tend to be essential for survival in lower organisms (yeast, fly, worm), many articles have explored the role of hub genes in higher organisms (including humans and mice). While there is an ongoing debate in the literature regarding the importance of hub genes, it is unfair to say hubs are not important. The existing approaches have mainly focused on hub gene identification, based only on gene connection degrees in the GCN. Moreover, these techniques select such genes empirically without any statistical criteria. Besides, few approaches can be found in the literature for the identification of hub nodes in a scale free network.

Differential Hub Gene Analysis in GCNs

In network theory, a node is defined as hub node, if its connection degree is greater than average connection degree of the network. In the existing approach, a gene is declared as hub gene based on an indicator function, *i.e.* $Hub_i = [I(k_i > \tau)]$ and number of hub genes (*NHub*) in the genetic network is calculated as $NHub = \sum_i [I(k_i > \tau)]$, where, Hub_i: hub status of *i-th* gene (1 or 0); k_i: connection degree of *i-th* gene; τ: threshold value *i.e.* average connection degree of network. This technique selects hub genes empirically based on only observed gene connectivity without taking into account any statistical consideration. Therefore, an alternate statistical approach was

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proposed for hub gene detection in GCN for which statistical significance of gene connections was taken into account. The proposed statistical approach is described as follows:

The Weighted Gene Score (WGS) for *i-th* gene in terms of weighted gene connectivity (a_{ij}) can be written as:

$$WGS_i = \sum_j a_{ij} \qquad \forall\, i \neq j = 1, 2, \ldots, G \qquad (1)$$

where, WGS_i represents the relative importance of *i-th* gene based on its connections to the remaining genes in GCN. For the purpose of hub gene identification, following hypotheses are constructed.

$H_1 : WGS_i > \mu$ *i.e. i-th* gene in the GCN is a hub gene

$H_0 : WGS_i \leq \mu$ *i.e. i-th* gene in the GCN is not a hub gene

where, μ is average connection degree of the complete network model. Here in order to get the distribution of the test statistic under H_0, a resampling procedure was used. In this procedure, *m* microarray samples were selected randomly with equal probability from *M* microarray samples to construct one subsample (for one GCN) ($m \leq M$). Then statistical measures were applied to get WGS for each gene in that GCN. This procedure was repeated large number of times say *n* to get *S* sets of WGS. In this study, *n* = 500 was taken to get 500 random GCNs under stress and control conditions separately. For testing H_0 *vs.* H_1, a NP test statistic was proposed to test significance of the WGS for each gene, *i.e.* for testing whether WGS of a gene is greater than the average connection degree of the complete network or not. The proposed procedure for testing the hypothesis is as follows:

Let for a particular gene (*i*), $WGS_k^{(i)}$ be the WGS for *k-th* subsample (*k = 1, 2,…, n*). Here $WGS_k^{(i)}$'s are *random variables*. So, without loss of generality, another variable X_k can be defined as:

$$X_k = WGS_k^{(i)} - \mu \qquad (2)$$

To test hub gene significance for each gene, *i*, the X_k's are arranged in ascending order of their magnitude and subsequently, the ranks *1, 2, …, n* are assigned keeping in mind the original signs of X_k.

Let, S^+ = the sum of the ranks of positive X_k's

S^- = the sum of the ranks of negative X_k's

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The steps for obtaining the distribution of the test statistics can be found in Das et al., 2017. Further, the first two moments of the test statistic are given as:

$$E(S^+) = \sum_{l=1}^{n} kE(Z_{(l)}) \tag{3}$$

$$\mathrm{Var}(S^+) = \sum_{l=1}^{n} l^2 \{E(Z_{(l)})(1 - E(Z_{(l)}))\} \tag{4}$$

Under $H_0 : WGS_i = K$, the above expressions can be written as:

$$E_{H_0}(S^+) = \frac{1}{2} l = \frac{n(n+1)}{4} \tag{5}$$

$$\mathrm{Var}_{H_0}(S^+) = \frac{1}{4} \sum_{k} l^2 = \frac{n(n+1)(2n+1)}{24} \tag{6}$$

As the number of bootstrap samples are quite large (n = 500), then under Linberg's cental limit theorem, S^+ follows normal distribution asymptotically, *i.e.*

$$\frac{S^+ - E_{H_0}(S^+)}{\sqrt{\mathrm{Var}_{H_0}(S^+)}} \sim N(0,1) \tag{7}$$

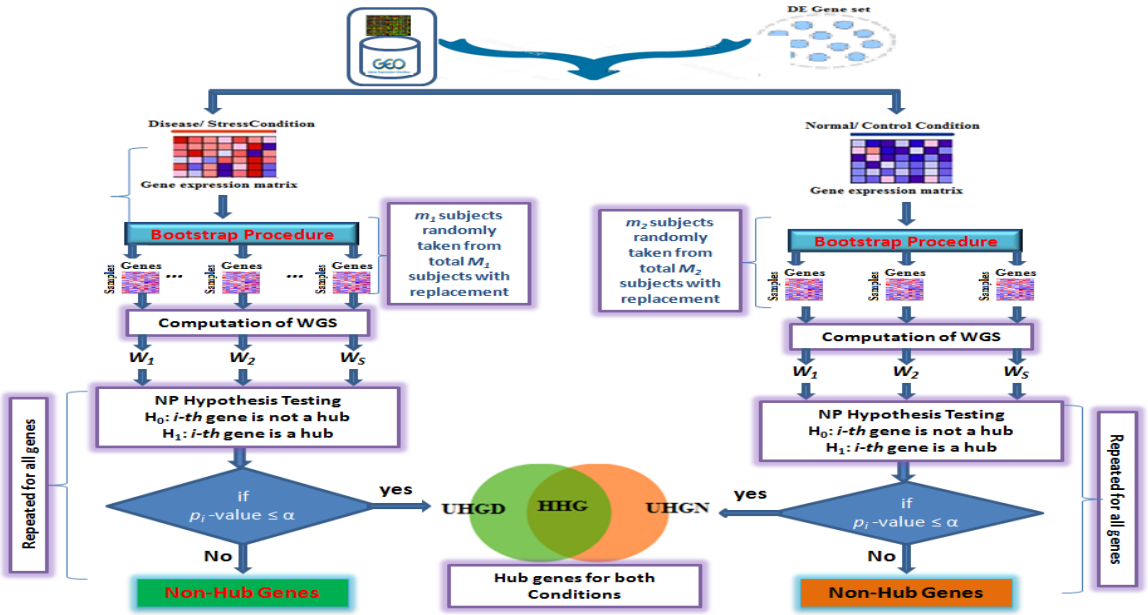

Figure 1. Outlines of the implemnted algorithm of DHGA

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The procedure was repeated for each gene in the GCN and the statistical test was applied to identify hub gene based on significance values for both control and stress conditions separately. The application of the hub gene identification approach for the gene networks constructed under two contrasting conditions (stress *vs.* control) can be called as DHGA. By this approach, the identification of hub genes is possible in both these gene networks based on statistical test of significance. On the basis of *p*-values, genes in the gene networks under either condition can be grouped into various groups, *viz.* Housekeeping Hub Genes (HHG), Unique Hub Genes (UHG) for stress, UHG for control, Non-hub genes based on a decision matrix. The algorithms of the DHGA approach are shown in pictorial form in Figure 1.

Performance analysis of DHGA approach

The utility of the DHGA approach was tested on salinity, cold stresses in rice and Al stress in soybean and the results are given in Table 1.

Based on the existing approach (*i.e.* WGS alone), 39.05% and 36.91% genes in the gene networks are detected as hub genes in soybean for stress and control conditions respectively (Table 1). Thus, large proportions of genes are identified as hub genes in the gene networks based on the existing approach, which contradicts the scale free property of biological networks (as gene networks is a scale free network. Similar findings are observed for salinity and cold stresses in rice. However, in case of proposed approach (computing *p-values*) only 19.14% and 23.24% of genes in the gene networks are found to be hub genes in soybean (for *p value* < 1E-10) for control and stress situations respectively (Table 1). Moreover, the number of hubs can be further reduced by decreasing the level of significance in the proposed approach. This indicates that the proposed approach will be able to identify relatively small subset of genes as hubs in the gene networks *i.e.* fewer WGS are statistically significant.

Table 1.

Comparison of DHGA and existing approaches in terms of predicted hub genes.

	Existing Approach		**Proposed Approach**			
			p value < 1E-5		*p* value < 1E-10	
Data sets	# HG		# HG		# HG	
Salinity stress in rice						
Rice (Salinity stress)	214	38.49	187	33.63	165	29.66

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	Existing Approach		Proposed Approach			
Rice (Control)	229	41.19	208	37.41	180	32.36
Al stress in soybean						
Soybean (Al stress)	383	39.05	331	33.74	228	23.24
Soybean (Control)	362	36.91	285	29.05	187	19.14
Cold stress in rice						
Rice (Cold stress)	301	46.3	265	40.7	234	36
Rice (Control)	242	37.23	208	32	162	24.09

HG: Number of hub genes; % HG: Percentage of hub genes in the gene co-expression network

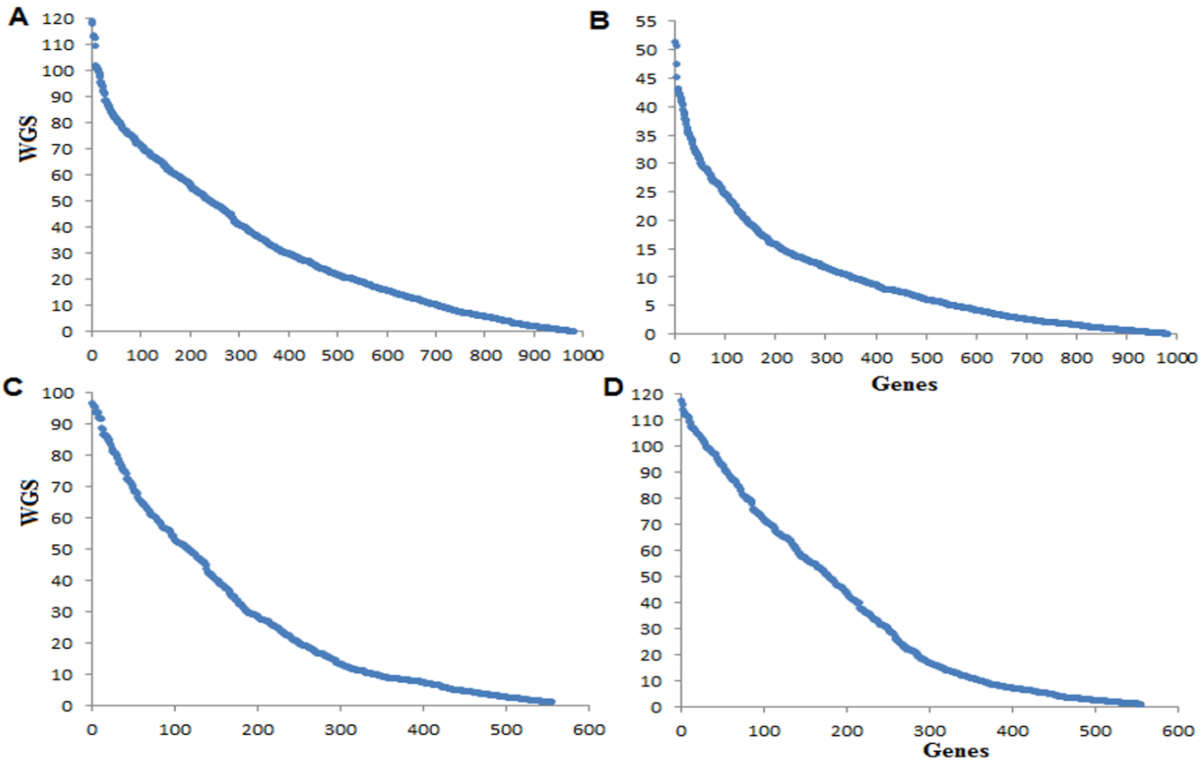

Figure 2. Distribution of WGS in complete networks under stress and control conditions.

The distributions of WGS of genes in GCNs for Al stress (A) and control (B) conditions in soybean are shown. The distributions of WGS of genes in GCNs for salinity stress (C) and control (D) conditions in rice are shown. For all these cases, the distributions are heavy tailed.

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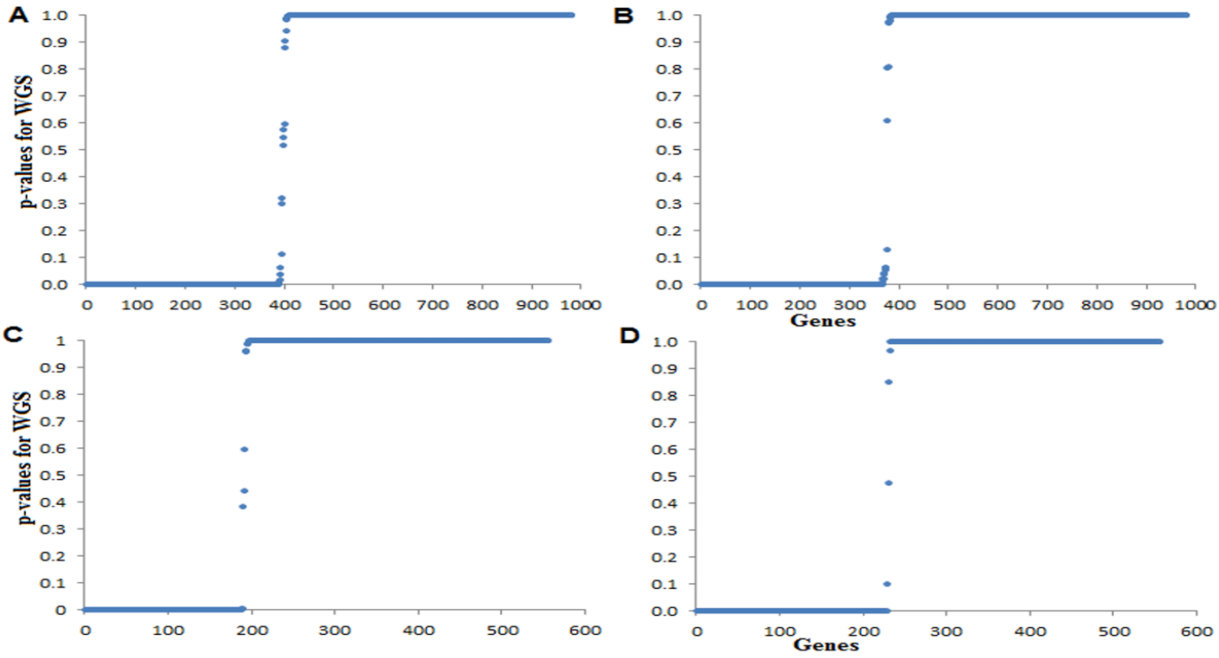

Figure 3. Distribution of *p-values* under stress and control conditions.

The distributions of *p-values* of genes in GCNs for Al stress (A) and control (B) conditions in soybean are shown. The distributions of *p-values* of genes in GCNs for salinity stress (C) and control (D) conditions in rice are shown. Genes with low *p-values* represent highly interacting genes in the gene networks.

The distributions of WGS (*i.e.* are heavy right tailed distributions) contain lower and upper values, which are not much discriminated between low and high connection degree of genes (Figure 2). On the contrary, from the distribution of *p-values*, the genes with high connection degrees are well separated from that of low connection degrees in the gene networks (Figure 3). In other words, the distinction between statistically strong and weak connected genes in the gene networks can be better seen from Figure 3 as compared to Figure 2. Based on the developed hub gene detection and DHGA approaches, an R package *i.e.* dhga has been developed for the users and available at https://cran.r-project.org/web/packages/dhga.

Application to Aluminum stress in Soybean

The DHGA approach was applied to aluminum stress in soybean and 228 and 187 genes were identified as hub genes for Al stress and control conditions of soybean respectively. From the DHGA result, it is seen that 98 hub genes are common and 130 and 89 hub genes are unique for Al stress and control conditions respectively (Figure 4). The mapping of the HHG and UHGs in soybean to *Arabidopsis* genome leads to the identification of corresponding *Arabidopsis* orthologs

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genes (Figure 4). The GCNs constructed for these two differential conditions (Al stress *vs.* control) in soybean along with the positions of hub genes and UHGs are also shown in Figure 4.

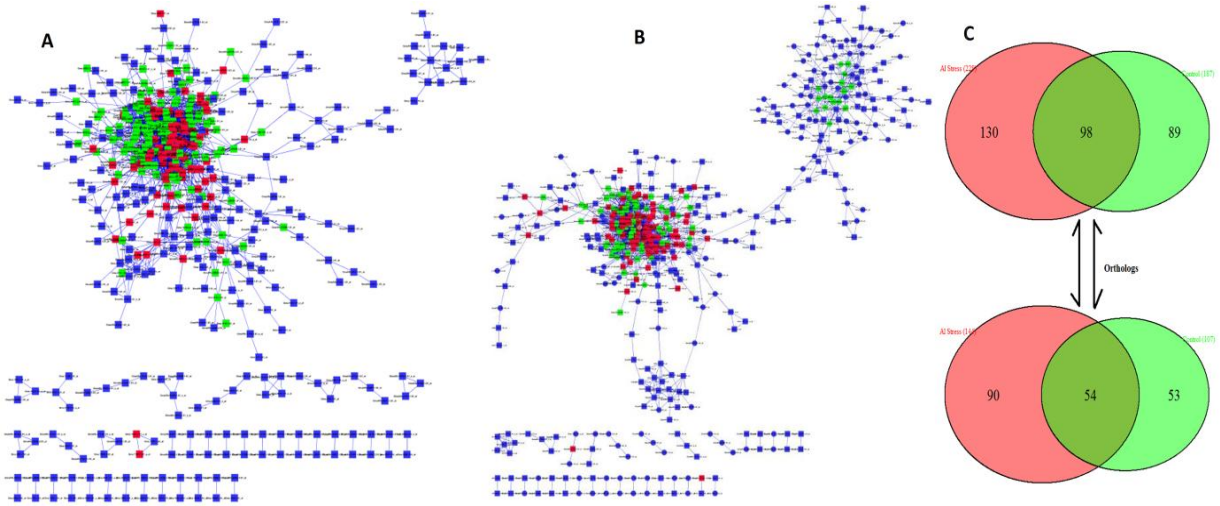

Figure 4. **Gene Co-expression Networks for two differential conditions in soybean.**

The GCNs are constructed for Al stress (A) and control (B) conditions respectively. The nodes with red colors represent the housekeeping hub genes, green color nodes represent UHG and blue color nodes represent the non-hub genes. (C) Venn diagram of hub genes in the GCNs constructed under Al stress (A) and control (B) conditions in Soybean**.** The number of orthologous genes found in *Arabidopsis* corresponding to unique and common hub genes in Soybean is also shown

The statistical approach for hub gene identification allowed the ranking and selection of candidate hub genes in the GCN, based on an assessment of the statistical significance of the gene connections. This was done with a randomized resampling based procedure where statistical significance values were calculated based on the NP test, which does not require Gaussian assumptions of data. Further, genes with lower *p-values* represent highly connected genes in the GCN and thus designated as hub genes. Moreover, the randomisation procedure used in this approach allows one to test, whether the observed gene connectivity is greater than expected gene connectivity value by chance (*i.e.* rejection of null hypothesis of random association). This was also able to remove the spurious association among genes, as these associations are measured on the basis of PCC. It seems to be more statistically convincing to select hub genes based on *p-values* rather than WGS alone, because in comparison to WGS, the *p-values* provides a reliable measure of gene connectivity (low *p-value* indicates high gene connectivity and *vice-versa*). Further, the detected hub genes tend to have higher connection degrees and are widely separated from the genes with low connection degrees in the GCN. Moreover, based on this approach a few as well as important genes were identified as hubs in the GCN as compared to existing approach, which is in accordance with the scale free property of biological networks. Using

DHGA approach, genes in the GCN were grouped into various categories *like* HHG, non-hubs, UHG for stress and control based on the computed *p-values* for these two contrasting conditions. These identified hub genes may be considered as biomarkers for further studies, including analysis of their involvement in diverse cellular mechanisms. Further, the HHG can be used for the maintenance of basal cellular functions that are essential for the existence of a cell, whereas, UHG can be used in stress response engineering in crops for developing stress tolerant cultivars.

References:

Zhang B and Horvath S. (2005). A general framework for weighted gene co-expression network analysis. Stat Appl Genet Mol Biol., 4(17).

Das S, et al. (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

Das S (2016). Dhga R package. https://CRAN.R-project.org/package=dhga

Envisioning Crop Yield Scenario using Time Series Intervention Based Trend Impact Analysis (TIA)

-Mrinmoy Ray, Anil Rai, Ramasubramanian V., K. N. Singh and Santosha Rathod.

For technology forecasting, to gainfully retain the benefits yet surpass the limitations of quantitative approaches, efforts are often made to amalgamate them with qualitative approaches to better predict the future. One such important hybrid approach is the Trend Impact Analysis (TIA). In TIA, to start with, a baseline forecast is generated using a suitable statistical model based on historical data. This is followed by identifying a set of future events and their impacts utilizing prior knowledge. Thereafter, Monte Carlo simulation in the TIA algorithm combines the so-called impact and event probability judgments with the model based forecasts to generate a fan of possible future scenarios. From these scenarios, the median, 5th and 95th percentile scenarios are taken as three divergent scenarios. In this study, envisioning wheat yield scenario at All-India level using time series intervention based Trend Impact Analysis (TIA) has been done for technology forecasting. As crop yield in any future year shall depend on future technologies (say, new variety, new cultivation procedure, better management practice etc.) and rare events (say, extreme weather conditions like drought, flood, high temperature, water logging, etc.) which can collectively be termed as 'unprecedented events', an attempt has been made to modify the conventional TIA to accommodate such dependencies. For the unprecedented future event, impact of the event is known while time at which event will occur is not known in advance. Three pre-specified events/ technology impacts have been considered, as if they were said to occur in future in the long run. The events are heat tolerant wheat variety breeding technology, rust resistant wheat variety breeding technology and an event of temperature increase each again with three degrees of severity. A new TIA method has been developed by combining conventional TIA with time series intervention model. It may be noted that instead of a single event and single impact parameter as is the case with traditional intervention modeling, TIA has three impact

parameters viz., initial impact, maximum impact and steady-state impact for each event. For this, traditional intervention model has been reoriented to incorporate three impact parameters for any number of events in order to blend it with TIA. In addition, the proposed TIA approach also requires two more parameters i.e. time to maximum impact and time to steady state impact. A formula for estimating slope parameter has also been derived. The newly proposed TIA approach has broadly three steps viz., (i) baseline forecasts are arrived at by using any time series model, say, ARIMA (ii) generation of all possible scenarios is done using intervention model with aforementioned modifications (iii) integration of baseline forecasts with the modified intervention model. A SAS macro has been developed to implement the proposed approach.

```
/* SAS Macro for employing time series
intervention based  Trend Impact Analysis
%macro m(n=,n1=,n2=,n3=,n4=,n5=);
e1={&n1};/*initial impact*/
e2={&n2};/*maximum impact*/
e3={&n3};/* steady state impact*/
t1={&n4};/* time to maximum impact*/
t2={&n5};/*time to steady state impact*/
er=e1[1]+1;
er1=e2[1]+1;
er2=e3[1]+1;
tr=t1[1];
trn=t2[1];
tr2=1/trn;
tr1=1/tr;
del1=1-(er/er1)**tr1;
del2=1-del1;
del3=1-(er1/er2)**tr2;
del4=1-del3;
%let k=tr;
delf1=j(&k,1,0);
do t=1 to &k;
delf1[t,]=del2**t;
end;
delf=delf1;
```

The chief advantages of the proposed TIA approach are that it can generate all possible scenarios, requires less data as compared to conventional TIA and also can easily be modified to predict any expected future in case some unprecedented event occurred in a particular future time period. The study reveals the advantages of proposed TIA methodology over the existing crop

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yield forecasting approach in terms of its greater utility by providing scenarios for a broader forecast horizon from which preferable futures can be chosen.

Network Project on Market Intelligence

-Ranjit Paul

Wavelet based modeling and forecasting technique to deal with volatile agricultural commodity price is elaborated as an alternative to the traditional forecasting models, such as, Autoregressive integrated moving average (ARIMA) and Generalized autoregressive conditional heteroscedastic (GARCH) model. Maximal overlap discrete wavelet transform (MODWT) is advocated to represent the series at multi-resolution level and combined with ARIMA or GARCH class of models in order to increase the forecast accuracy. An attempt is made to establish the potential performance of wavelet based combinatory model as a proficient alternative to the traditional statistical approaches. Wavelet-GARCH model offers a unique strategy for volatility forecasting through transformation and representation of original series at various scales. Decomposition makes it possible to describe the useful pattern of the series from both global and local aspects and subsequently minimizes the signal noise level making the transformed series amenable to easy analysis and evaluation. Monthly potato price data of three markets, namely Haldwani, Agra and Lucknow of Uttar Pradesh, India have been considered for the present investigation. The combinatory of Wavelet-GARCH hybrid model has been found to outperform the individual ARIMA and GARCH model. The schematic representation of hybrid model is presented in figure 1.

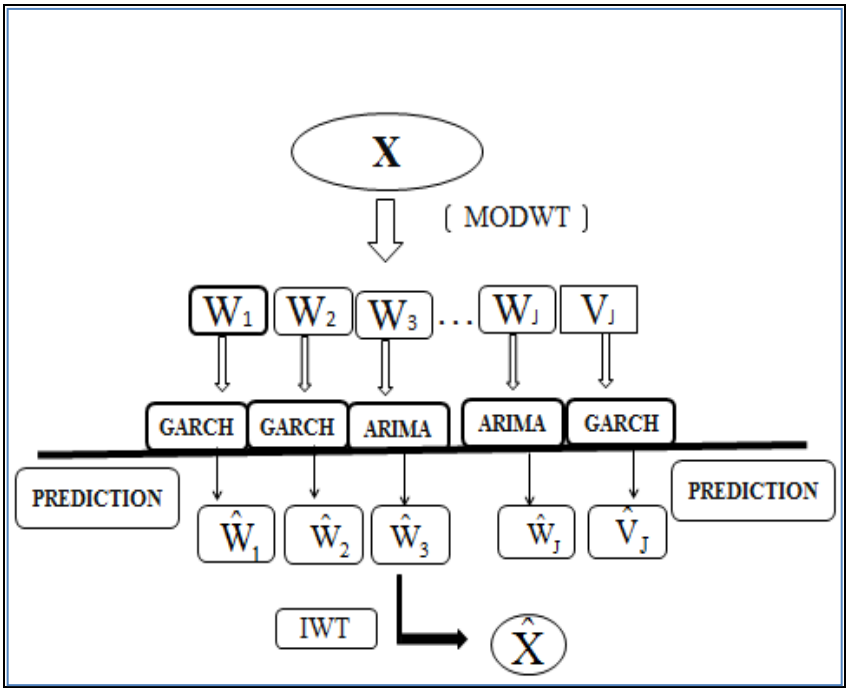

Figure-1 Structural schema of MODWT-GARCH hybrid

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The forecasting performance of all the three models has been computed for an out of-sample cross-validation period of 6 observations (i.e., 6months). Predictive abilities of different models have been compared using Relative mean absolute prediction error (RMAPE) and Root mean square prediction error (RMSPE).The corresponding results of forecast comparison have been reported in Table 1.

Table 1 Predictive Abilities for 3 different models

Market	Validation Criterion	ARIMA	ARIMA-GARCH	WAVELET-GARCH
Haldwani	RMAPE (%)	14.36	5.71	4.96
	RMSPE	102.02	43.10	43.02
Agra	RMAPE (%)	19.68	13.63	8.08
	RMSPE	179.72	110.30	66.61
Lucknow	RMAPE (%)	8.51	5.44	5.00
	RMSPE	71.74	47.97	43.13

Comparing the validation results of individuals as well as hybrid forecasting models, it is observed that Wavelet-GARCH produces gives the best result over the other methods in terms of RMAPE (%) and RMSPE. Modeling with Wavelet-GARCH hybrid yielded RMAPE(%) value as 4.96, 8.08 and 5.00 respectively which are lower than traditional parametric models. Hence, individual ARIMA or GARCH models cannot be considered at all for forecasting purpose. Prediction results clearly reflect that wavelet approach is outperforming the other models.

Another study is carried out on monthly wholesale price of onion data series obtained from AGMARKNET website from January, 2005 to February, 2016 considering six markets, namely, Delhi, Bangalore, Hubli, Lasalgaon, Pune and Solapur. Here last 12 observations i.e. from March, 2015 to February, 2016 constitute the validation set in each case. Here two wavelet based neural network approaches have been applied. The improvement upon time-delay neural network (TDNN) also is obtained up to a great extent through using wavelet based approaches as exhibited through proper empirical evidence. Hence, wavelet based neural network models can be preferred over most common ARIMA and ANN methodology for rendering price series modeling and forecasting.

Along with the above analysis, an attempt has been made to show the performance of different statistical models from simple linear time series model to complex nonlinear time series models with respect to forecast performance of potato prices in Agra market. The observations from January, 2006 to April, 2015 are used for model building and last 12 observations i.e. May

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2015 to April 2016 are used for forecast evaluation. The results (Table 2) indicate that as we go from simple ARIMA model to nonlinear ARIMAX-GARCH model the accuracy of forecasting increases a lot. Here in ARIMAX model, total arrival of potato in Agra market is considered ad exogenous variable. It is obvious form the below table that as we include the exogenous variable in the model the percentage error decreases.

Table 2: Prediction performance of different models

Model	MAPE	RMSE
ARIMA	33.3	252.65
SARIMA	18.47	167.49
ARIMA-GARCH	17.37	141.39
ARIMA-ANN	17.44	145.42
ARIMAX on Seasonally adjusted series (SAS)	15.89	138.44
ARIMAX-GARCH on Seasonally adjusted series (SAS)	14.76	137.66

Note: SARIMA stands for Seasonal ARIMA

Network Project on Impact Assessment of Agricultural Research and Development

Impact assessment of crop insurance has been estimated in Andhra Pradesh & Telangana States. The analysis reveals that at all India level only 4% of total farm households have insured their crop but in the selected states the percentage of crop insured farming households is 16.74%. Majority of insured farming households (98%) avail crop insurance were among the borrowers. The Majority (55.2%) of farmers mentioned lack of awareness as the major reason for not availing insurance. The average frequency of crop loss was observed to be 67.1 percent and the claims received are about only 1.5 percent. The majority (68.7%) of the farmer responds that the major reason for the crop loss found to be Inadequate Rainfall/Drought followed by other natural cause. The output is measured in terms of rupees per hectare. The difference in socio-economic variables like household size, education and age of the household head is not much different between the two groups. Sex as a dummy variable (it assumed the value of '1' if the household head is male and '0' for the female). The number of female respondents was only 7.15% and 92.85% respondents were males. Out of the total insured farmers only 9.23% females insured their crop. The analysis showed that 31.15% of the Insured farmers reported that they have attended at least one extension training programme whereas only 2.55% of the non-insured farmers reported that they had attended one extension training programme. About 71.23% of non-insured farming household heads had no education (illiterate) at all and only 7.35% attended primary school where as 56.92% of insured farming household heads had no education (illiterate). Overall, non-insured sampled household farmers had a lower education attendance rate compared with insured

farmers. Propensity score Matching (PSM) method and Instrumental Variable (IV) method have been employed to estimate the Impact of crop insurance on farm output. Both the method shows that crop insurance has a positive and significant effect on farm output.

RESEARCH ACTIVITIES

Awards and Recognizations

1. Dr. Hukum Chandra was appointed as the Member, Cochran and Hansen Award 2017 Committee, International Association of Survey Statisticians, The Netherlands.
2. Dr. Tauqueer Ahmad was appointed as the Programme Director and Dr. Hukum Chandra as Pogramme Co-ordinator of an International Training Programme on "Sampling Methodology, Field Organization and Data Quality" for officials of Central Statistical Agency of Ethiopia, Addis Ababa, Ethiopia during 17-21 April, 2017 and 01-05 May, 2017at ICAR-IASRI, New Delhi.
3. Dr. Anindita Datta awarded with Krishi Vigyan Gaurav (Honorary Title) by Bhartiya Krishi Anusandhan Samiti and Agricultural Research Communication Center (ARCC) for carrying out good amount of research work in official language Hindi.
4. Dr. Hukum Chandra conferred as Fellow, National Academy of Agricultural Sciences (NAAS) under section Social Science, in the AGM held on 05 June 2017 at NASC Complex, New Delhi.
5. Dr. Anil Rai was a member of School Board of Physical Sciences, North Eastern Hill University, Shillong
6. Dr. K.K. Chaturvedi received membership certificate of honours for valued reviewer from International Jounral of Bioinformatics Research on 15th June 2017.
7. Dr. Tauqueer Ahmad was nominated by Director ICAR-IASRI as Chairman, Invitation Committee and Member, Management Committee for organization of Annual Day of the Institute.

Visits Abroad

1. Dr. Hukum Chandra was the Invited speaker in an International conference on "Contemporary Theory and Practice of Survey Sampling: A Celebration of Research Contributions of J. N. K. Rao" at Yunnan, University, Kunming, Yunnan, China during May 24-27, 2017.
2. Dr. Hukum Chandra was the Expert, Ethiopia Statistics from Space project, Food and Agriculture Organization of the United Nations, Addis Ababa, Ethiopia during April 23-27, 2017.

NewProjects/Schemes/Programme/Census/Sample-Surveys/Evaluation/ Studies/ Software Developed/Initiated/ Completed

1. Study of long memory and periodicities in climate variables in different agro-climatic zones of India. (AGENIASRISIL201701000096) Ranjit Kumar Paul, LM Bhar and AK Paul:19.04.2017-18.04.2020.
2. Developments of count time-series models for predicting pest dynamics using weather variables. (AGENIASRISIL201700900095) Prawin Arya and Bishal Gurung:19.04.2017-18.10.2019.

3. Tractorization in Semi Arid Tropic (SAT) India: Determinants and Implications. (AGENIASRISIL201701100097) Ravindra Singh Shekhawat and Rajeev Ranjan Kumar:01.05.2017-01.05.2019.
4. Modelling and forecasting of drought index using machine learning techniques. (AGENIASRISIL201701200098) Rajiv Ranjan Kumar, Ravindra Singh Shekhawat, Sanjeev Panwar: 22.05.2017-21.10.2019.
5. Analytical procedure for factorial experiments with logistic and Gompertz error distributions. (AGENIASRISIL201701300099) Sunil Kumar Yadav: 25.05.2017-24.05.2019.
6. Potential gene mining form salt tolerant grasses for improvement of salt tolerance in crops. Funded by National Agricultural Sciences Fund (NASF). (AGENIASRICOP201701400100) CSSRI:Anita Mann; IASRI:Monendra Grover, Dwijesh Chandra Mishra, NRRI: Parameswaran, C: 01.06.2017-31.03.2020.
7. Modeling insect pests and diseases under climate change and development of digital tools for pest management. (NICRA Project) (AGENIASRICOP201701500101) NRCIPM: S Vennila, MN Bhat, Niranjan Singh, Heralal Yadav; IASRI, Ranjit Kumar Paul; CRIDA: MS Rao: 20.06.2017-31.03.2020.

HUMAN RESOURCE DEVELOPMENT

Training Programmes Organized

S. No.	Title	Venue	Date	Sponsored by	Number of participants
1.	Sampling Methodology, Field Organization and Data Quality *Programme Director:Dr Tauqueer Ahmad* *Programme Coordinator:Dr Hukum Chandra*	ICAR-IASRI, New Delhi	17-21 April, 2017	Central Statistical Agency (CSA) of Ethiopia, Addis Ababa, Ethiopia	14
2.	Data Analysis and Interpretation for ISS Probationers *Course Director:Dr. Seema Jaggi* *Course Co-Director:Dr. B. N. Mandal*	ICAR-IASRI, New Delhi	24 April-05 May, 2017	NSSTA, CSO. MOSPI	28
3.	Sampling Methodology, Field Organization and Data Quality *Programme Director:Dr Tauqueer Ahmad* *Coordinator:Dr Hukum Chandra*	ICAR-IASRI, New Delhi	01-05 May, 2017	Central Statistical Agency (CSA) of Ethiopia, Addis Ababa, Ethiopia	14
4.	कृषि जैव सूचना विज्ञान : एक परिचय *Course Director:Dr.D.C.Mishra* *Course Co-Director:Mr. Neeraj Budhlakoti*	ICAR-IASRI, New Delhi	24-26 May, 2017	HRD Funds of ICAR, New Delhi	13
6.	Data Analysis and Interpretation *Course Director:Dr. Rajender Parsad* *Course Co-Director:Dr. Eldho Varghese*	ICAR-IASRI, New Delhi	15-26 May, 2017	NSSTA, CSO. MOSPI	28
7.	Application of Bioinformatics in Agriculture *Course coordinator:Dr. Sarika* *Co-Course Coordinator:Dr. Mir Asif Iquebal*	ICAR-IASRI, New Delhi	27-29 May, 2017	HRD Funds of ICAR, New Delhi	10

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Seminars 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), M.Sc. (Computer Application) and M.Sc. (Bioinformatics). The detail of seminars delivered is given below.

Category	Type of seminar	Number
Student	Course	16
	Thesis	18
	ORW	05
Scientist	Project completion	02
	New Project	01
Total		**42**

Lectures Delivered

1. Three lectures on SPSS: An Overview,Testing of Hypothesis and Hands on Testing of Hypothesis in training programme on Data Analysis and Interpretation for ISS Probationers held at ICAR-IASRI, New Delhi during 24 April-05 March, 2017 (Dr. Seema Jaggi)
2. Four lectures on (i) SPSS Data and File Management, (ii) Correlation and Regression Analysis, (iii) Design Resources Server and (iv) Principal Component Analysis to the participants of the training programme on Data Analysis and Interpretation sponsored by National Statistical System and Training Academy, Central Statistical Office, Ministry of Statistics and Programme Implementation, Government of India organized at ICAR-IASRI, New Delhi during April 24-May 05, 2017 (Dr.Rajender Parsad).
3. Two lectures on MS Excel-Statistical Procedures in a training programme on Data Analysis and Interpretation for ISS Probationers held at ICAR-IASRI, New Delhi during 24 April-05 March, 2017 (Dr. Cini Varghese).
4. Three lectures on R software: an Overview, Descriptive statistics, correlation, regression and testing of hypothesis using R and Sample selection using R in a training programme on Data Analysis and Interpretation for ISS Probationers which is being held at ICAR-IASRI, New Delhi during 24 April-05 March, 2017.(Dr. B. N. Mandal)
5. Two lectures in a training programme on Data Analysis and Interpretation for ISS Probationers which is being held at ICAR-IASRI, New Delhi during 24 April-05 March, 2017: Exploratory Data Analysis,Non-parametric Tests,Discriminant Analysis and Problem solving with live data sets. (Dr. Eldho Varghese)

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6. In a training programme on Data Analysis and Interpretation for ISS Probationers organized at ICAR-IASRI, New Delhi during 24 April-05 March, 2017: SPSS: Tables and Reports and Hands on MANOVA and PCA (Dr. Arpan Bhowmik)
7. One lecture in the training on Data Analysis and Interpretation for ISS Probationers during 24th April-5th May, 2017 on SPSS Graphics (Dr. Anindita Datta).
8. One lecture in the training programme for the ISS probationers on R for Survey Data Analysis and Software for Survey Data Analysis (SSDA 2.0)" during 15-26 May, 2017, at ICAR-IASRI, New Delhi(Hukum Chandra)
9. In the training programme for the ISS probationers on “Data Analysis and Interpretation” during 15-26 May, 2017, at ICAR-IASRI, New Delhi
10. One lecture on “Cluster and Multistage sampling” in the Training Programme on “Data Analysis and Interpretation” during 15-26 May, 2017, at ICAR-IASRI, New Delhi (Dr Ankur Biswas)
11. Lecture on Log-linear models in training of ISS probationers on " Data Analysis and interpretations" from April 24-May 05, 2017 at ICAR-IASRI New Delhi(Dr. Anil Rai)
12. Lecture on Log-linear models in training of ISS probationers on " Data Analysis and interpretations" from May 15-May 16, 2017 at ICAR-IASRI New Delhi(Dr. Anil Rai)
13. On “Jaiv Suchna: Ek Parichay” on 24th May 2017 in the Hindi workshop “Krishi Jaiv Soochna: Ek Parichay” held at ICAR-IASRI during 25-7 May 2017. (Dr. Anil Rai)
14. Delivered a lecture on **“अशोका : कृषि जैव सूचना के लिए सुपरकंप्यूटिंग”** on 25th May 2017 in the Hindi workshop “Krishi Jaiv Soochna: Ek Parichay” held at ICAR-IASRI during 25-7 May 2017. (Dr. K.K. Chaturvedi)
15. One lecture and conducted practical session on **“डी.एन.ए. सिग्नेचर आधारित एस.एन.पी. एवं एस.एस.आर. मार्कर विष्लेषण”** *on May 26, 2017* in the Hindi workshop on **कृषि जैव सूचना : एक परिचय** held at ICAR-IASRI during 25-7 May 2017.(Dr. M.A. Iquebal and Dr. Sarika)
16. Three lectures entitled "जीनोम असेम्बली", "जीनोम एनोटेषन", "प्रोटीन अन्तःसम्बन्ध" in the training "कृषि जैव सूचना विज्ञान : एक परिचय" during 24-26, May, 2017 at ICAR-IASRI, New Delhi.(Dr. D.C. Mishra)
17. Two lectures on topic protein structure prediction and Statistical model for genomic selection in agriculture in a training programme entiteled ''जैव–सूचना विज्ञानः एक परिचय'' at ICAR-IASRI may 24, 2017 to May 26, 2017. (Neeraj Budhalkoti)
18. One lecture on 20th May, 2017 on time series analysis in the training programme on Data Analysis and Interpretation for the ISS probationers during 15-26 May 2017 at ICAR-IASRI, New Delhi. (R.K. Paul)
19. Delivered a lecture on 3rd May, 2017 on Non-Linear Statistical Modelling in the training programme on Data Analysis and Interpretation for the ISS probationers during 24 April 05 May 2017 at ICAR-IASRI, New Delhi. (R.K. Paul)
20. Conducted a full day session with theory and practical on time series analysis, panel data analysis, simultaneous equation modelling and two stage least squares in the Faculty Development Programme at Jagannat International Management School (JIMS), Vasant Kunj on 26th May, 2017. (R.K. Paul)
21. An invited lecture on “Exploratory Factor Analysis” in a training programme on “Data Analysis and Interpretation” which was organised at ICAR-IASRI, during 15 - 26 May, 2017 for the 38th and 39th batches of ISS probationers. (P.K.Meher)
22. Delivered three lectures on SPSS: An Overview (15-05-2017), Testing of Hypothesis and Hands on Testing of Hypothesis (16-05-2017) in training programme on Data Analysis and

Interpretation for ISS Probationers held at ICAR-IASRI, New Delhi during May 15 -26, 2017. (Dr. Seema Jaggi)

23. Four invited lectures on SPSS: An Overview, Hands on SPSS, Testing of Hypothesis, Hands on Testing of Hypothesis (23-05-2017) in a faculty refresher programme on Advanced Data Analysis using SPSS, Excel and R organized by Jagannath International Management School during May 22 – 26, 2017. (Dr. Seema Jaggi)
24. Four lectures (i) on SPSS Data and File Management and (ii) Correlation and Regression Analysis; (iii) Principal Component Analysis and (iv) Design Resources Server and Sample Survey Resources Server to the participants of the training programme on Data Analysis and Interpretation sponsored by National Statistical System and Training Academy, Central Statistical Office, Ministry of Statistics and Programme Implementation, Government of India organized at ICAR-IASRI, New Delhi during May 15-26, 2017 (Lectures were delivered on May 15, 17, 19 and 20, 2017 respectively). (Dr. Rajender Parsad)
25. Two lectures on Correlation and Regression Analysis and MANOVA and PCA in a training programme on Data Analysis and Interpretation for ISS Probationers held at ICAR-IASRI, New Delhi during 15-26 May, 2017. (Dr. Susheel Kumar Sarkar)
26. Two lectures on MS Excel-Statistical Procedures in a training programme on Data Analysis and Interpretation for ISS Probationers held at ICAR-IASRI, New Delhi during 15-26 May, 2017. (Dr. Cini Varghese)
27. Four invited lectures on Levels of measurements, Descriptive statistics, MS Excel-Statistical Procedures (2 lectures) in a faculty refresher programme on Advanced Data Analysis using SPSS, Excel and R organized by Jagannath International Management School during May 22 – 26, 2017. (Dr. Cini Varghese)
28. Four lectures on "R software: an Overview", "Descriptive statistics, correlation, regression and testing of hypothesis using R" and "Sample selection using R/SPSS" in a training programme on Data Analysis and Interpretation for ISS Probationers which was organized at ICAR-IASRI, New Delhi during 15-26 May, 2017. (Dr. B.N. Mandal)
29. Four lectures on Exploratory Data Analysis, Non-parametric Tests, Discriminant Analysis and Problem solving with live data sets in a training programme on Data Analysis and Interpretation for ISS Probationers which was organized at ICAR-IASRI, New Delhi during 15-26 May, 2017.(Dr. Eldho Varghese).
30. Four lectures on Correlation & Regression (2 lectures) and Basic Econometrics (2lectures) in a Faculty Development Programme on Advanced Data Analysis using SPSS, Excel & R which was organized at JIMS, New Delhi during 22-26 May 2017.(Dr. Eldho Varghese)
31. Two lectures on MANOVA and PCA in a training programme on Data Analysis and Interpretation for ISS Probationers which is being held at ICAR-IASRI, New Delhi during 24 April-05 May, 2017. (Dr. Arpan Bhowmik)
32. The two lectures on SPSS: Tables and Reports and Probit and Logit Analysisin a training programme on Data Analysis and Interpretation for ISS Probationers which is being held at ICAR-IASRI, New Delhi during 15-26 May, 2017. (Dr. Arpan Bhowmik)
33. Four invited lectures on Multiple Regression Analysis with Qualitative Information: Binary and Dummy variable, Logistic Regression, Multivariate Data Analysis: Cluster Analysis and Multivariate Data Analysis: Principal Component Analysis in a five days FDP programme on Advanced Data Analysis using SPSS, Excel & R from 22nd - 26th May 2017 at JIMS,Vasantkunj,New Delhi.(Dr. Arpan Bhowmik)

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34. A lecture on SPSS Graphics was delivered in the training on Data Analysis and Interpretation for ISS Probationers during 15-26th May, 2017 (Dr. Anindita Datta)
35. An invited talk on Emerging trends in Bioinformatics with special reference to Meta Genomics in International Workshop-cum-Training on "Bioinformatics in Fisheries and Aquaculture" at ICAR-CIFRI, Barrackpore during 19-21 June 2017. Besides, two practical sessions on Repeat identification and miRNA prediction have been conducted. (Dr. A.R. Rao)
36. One lecture "Application of Supercomputitng in Agriculture" and demonstrated ASHOKA to the IES (Indian Economic Services) probationers from NIAP, New Delhi on June 6, 2017.
37. Delivered a lecture on "अशोका-कृषि के लिए सुपरकंप्यूटिंग हब" on June 27, 2017 in the Hindi workshop "कृषि में जैवसूचना का उपयोग held at ICAR-IASRI during June 27-29, 2017. (Dr. K.K. Chaturvedi)
38. One lecture on "कृषि में जीव–विज्ञानी आंकड़ों के विष्लेषण के लिए बायो–कम्प्यूटिंग पोर्टल, तकनीकों एवं एल्गोरिथ्म का विकास" on June 27 2017 in the Hindi workshop "कृषि में जैवसूचना का उपयोग held at ICAR-IASRI during June 27-29, 2017 (Dr. Anil Rai)
39. Delivered a lecture and conducted practical session on "कृषि में एस.एस.आर. एवं एस.एन.पी.मार्कर का उपयोग" on June 29, 2017 in the Hindi workshop on कृषि में जैवसूचना का उपयोग held at ICAR-IASRI during June 27-29, 2017 (Dr. Dinesh Kumar)
40. Delivered one lecture and conducted practical session on "आणविक फाइलोजेनेटिक विश्लेषण on June 29, 2017 in the Hindi workshop on कृषि में जैवसूचना का उपयोग held at ICAR-IASRI during June 27-29, 2017. (Dr. Sarika)
41. A lecture and conducted practical session on "ट्रांस्क्रिप्टोम सिक्वेन्स एनालिसिस" on June 29, 2017 in the Hindi workshop on कृषि में जैवसूचना का उपयोग held at ICAR-IASRI during June 27-29, 2017.(Dr. M.A. Iquebal)
42. Prepared lecture notes and delivered two lectures entitled "जीनोम असेम्बलीष एवम् श्बेसिक लोकल एलाइन्मेन्ट सर्च टूल", in the training " कृषि में जैवसूचना का उपयोग" during June 27-29, 2017 at ICAR-IASRI, New Delhi.(Dr. D.C. Mishra)
43. Delivered two lectures in hindi on topic "प्रोटीन संरचना प्रतिरूपण and "कृषि में जीनोमिक सिलेक्शन का उपयोग in a training programme entiteled "कृषि में जैवसूचना का उपयोग at ICAR-IASRI June 27-29, 2017. (Mr. Neeraj Budhlakoti)

Research Papers Published

1. Dash, S, Meher, PK, Pradhan, UP and Paul, AK (2017). Inferring gene regulatory networks using Kendall's tau correlation coefficient and identification of salinity stress responsive genes in rice. *Current Science,* **112 (6),** *1257-1262.*
2. 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.*
3. Sinha, K, Gurung, B, Paul, RK, Kumar, A, Panwar, S, Alam, W, Ray, M and Rathod, S (2017). Volatility spillover using multivariate GARCH model: An application in futures and spot market price of black pepper. *Journal of the Indian Society of Agricultural Statistics,* **71(1)***, 21–28.*
4. Anjoy, P and Paul, RK (2016). Wavelet based hybrid approach for forecasting volatile potato price. *Journal of the Indian Society of Agricultural Statistics,* **71(1***), 7–14*
5. Ray, M, Rai, A, Singh, KN, Ramasubramanian, V, and Kumar, A (2017). Technology forecasting using time series intervention based trend impact analysis for wheat yield scenario in India. *Technological Forecasting and Social Change,* **118***, 128-133.DOI http://dx.doi.org/10.1016/j.techfore.2017.02.012.*

6. Basak, P, Sud, UC and Chandra, H (2017). Calibration estimation of regression coefficient for two-stage sampling design. *Journal of Indian Society of Agricultural Statistics,* **71(1)***, 1–6.*
7. Sarkar, KA, Jaggi, S, Bhowmik, A, Varghese, E and Varghese, C (2017). Trend resistant neighbour balanced bipartite block designs. *Journal of the Indian Society of Agricultural Statistics,* **71(1)***, 53-59.*
8. Himanshu, Chaturvedi, KK, Bandopadhyay, A and Jain, S (2017). PATRICIA Trie based time and memory optimization for fast network motif search. *Indian Journal of Animal Sciences,* **87(4)***, 512-519.*
9. Gupta, OP, Nigam, D, Dahuja, A, Kumar, S, Vinutha T, Sachdev, A and Praveen, S (2017): Regulation of isoflavone biosynthesis by mirnas in two contrasting soybean genotypes at different seed developmental stages. *Frontiers in Plant Sciences,* **8***, 567. doi: 10.3389/fpls.2017.00567.*
10. Paul, RK (2017). Modelling long memory in maximum and minimum temperature series in India. *Mausam,* **68(2)***, 317-326.*
11. Aditya, K, Biswas, A, Gupta, AK and Chandra, H (2017). District level crop yield estimation using calibration approach. *Current Science,* **112(9)***, 1927-1931*.
12. Meena, VS, Mittal, RK, Choudhury, PR, Rathod, S, Mahadevaswamy, HK and Choudhary, R (2017). Utilization of molecular and morphometric tools for assessment of genetic diversity of Rice bean [Vignaumbellata (Thunb.) Ohwi and Ohashi]. *International Journal of Current Microbiology and Applied Sciences.* **6(5)***, 2882-2892.*
13. Ranjeet, R, Kumar, Goswami, S, Shamim, M, Dubey, K, Singh, K, Singh, S, Yugal, K, Kala, Ravi, RK, Niraj, Sakhrey, A, Singh, GP, Grover, M, Singh B, Gyanendra K. Rai, AK, Viswanathan, Chinnusamy and Shelly, P. (2017). Exploring the heat-responsive chaperones and microsatellite markers associated with terminal heat stress-tolerance in developing wheat. *Funct Integr. Genomics*, DOI: 10.1007/s10142-017-0560
14. Kumar, S, Jangam, AK, Akhil, V, Rajendran, V, Katneni VK, Rajan, Sahaya JJ, Grover, M, Nagaleekar, VK, Alavandi, SV, Vijayan, KK (2017). Draft genome sequence of the luminescent strain vibrio campbellii LB102, isolated from a black tiger shrimp (Penaeus monodon) broodstock rearing system. *Genome Announc 5:e00342-17. https://doi.org/10.1128/genomeA.00342-17.*
15. Chandel, C, Dubey, M, Gupta, S, Patil, AH and Rao, AR (2017). Identification and characterization of a grain micronutrient related OsFRO2 rice gene ortholog from micronutrient-rich little millet (Panicum sumatrense), **3** *Biotech, 7:80, DOI 10.1007/s13205-017-0656-2.*
16. Saha, ND, Chaudhary, A, Singh, SD, Walia, S, Das, TK, Singh, D, Pant, B, Bhowmik, A, Gurung, B and Pathak, H (2016). Climate change variables induced soft root causing plant pathogen to produce new quorum sensing (cell to cell communication) signals for enhanced pathogenesis. *Indian Phytopathology,* **69(4)***, 260-265.*
17. Panwar, S, Singh, KN, Kumar, A, Gurung, B, Sarkar, SK, Sivaramane, N and Rathore, A (2017). Communication pre harvest forecasting of crop yield using non-linear regression modelling: A concept. *Indian Journal of Agricultural Sciences* **87(5)***, 685–689.*
18. Singh, D, Singh, CK, Tomar, KS, Singh RS, Singh, KS, Singh, R, Bahadur, R, Sarkar, SK , Pal, M (2017). Discerning morpho-anatomical, physiological and molecular multiformityin cultivated and wild genotypesof lentil with reconciliation to salinity stress. *PLoS ONE,* **12(5)***, e0177465. https://doi.org/ 10.1371/journal.pone.0177465*

19. Bhowmik, A, Jaggi, S, Varghese, E and Yadav, SK (2017). Trend free design under two-way elimination of heterogeneity. *RASHI*, **2(1)**, 34-38.
20. Krishna, DK, Kumbhare, NV, Padaria, RN, Singh, P and Bhowmik, A (2017). Socio-technological empowerment of rural households through community radio stations. *Journal of Community Mobilization and Sustainable Development,* **12(1)**, 56-60.
21. Jasna, VK, Burman, RR, Padaria, RN, Sharma, JP, Varghese, E, Chakrabarti, B and Dixit, S (2017). Impact of climate resilient technologies in rainfed agro-ecosystem. *Indian Journal of Agricultural Sciences*, **87(6)**, 816–824.
22. Noorzai, AU, Choudhary, AK, Rana, RS and Parsad, R (2017). Growth behaviour, productivity and profitability of promising mungbean varieties in semi-arid region of Afghanistan. *Annals of Agricultural Research*, **38(1)**, 78-86.
23. Grover, M, Mishra, DC, Sharma, N, Srivastava, S, Rai, A (2017). The maximum computational capacity of proteins involved in abiotic stress differs significantly from the proteins not involved in abiotic stress. *National Academy Science Letters, 1-3, 10.1007/s40009-017-0557-2.*
24. Islam, S, Sharma, RK, Chhokar, RS, Dhar, S, Sabir, N, Chaturvedi, KK, Singh, R, Farooqi, MS and Sharma, K (2017). Expert system for the identification and control of weeds in wheat crop. *Annals of Agricultural Research, New Series,* **38(2)***, 1-9.*
25. Gioi, HV, Mallikarjuna, MG, Mittal, S, Banduni, P, Jha, SK, Dash, P, Basappa, AM, Gadag, RN, Rao, AR and Thirunavukkarasu, N (2017). Variable level of dominance of candidate genes controlling drought functional traits in maize hybrids. *Frontiers in Plant Science,* **8***,940, DOI: 10.3389/fpls.2017.00940.*
26. Aravind, J, Rinku, S, Pooja, B, Shikha, M, Kaliyugam, S, Mallikarjuna, M G, Kumar, A, Rao, AR and Nepolean, T (2017). Identification, characterization, and functional validation of drought-responsive microRNAs in subtropical maize inbreds. *Frontiers in Plant Science,* **8***, 941, DOI: 10.3389/fpls.2017.00941.*
27. Iquebal, MA, Soren, KR, Gangwar, P, Shanmugavadevel, PS, Aravind K, Singla, D, Jaiswal, J, Singh R, Sarika, Chaturvedi, S, Singh K, , Varshney, NP, Rajeev, K, Rai, A and Kumar, D (2017). Discovery of herbicide resistance genes and its regulatory network in chickpea using transcriptome sequencing. *Frontiers in Plant Sciences,* **8***, 958. doi: 10.3389/fpls.2017.00958.*
28. Karak, T, Bora, K, Paul, RK, Das, S, Khare, P, Dutta, AK and Boruah, RK (2017). Paradigm shift of contamination risk of six heavy metals in tea (Camellia sinensis L.) growing soil: A new approach influenced by inorganic and organic amendments. *Journal of Hazardous Materials,* **338***, 250–264.*
29. Yashavanth, BS, Singh, KN, Paul, AK and Paul, RK (2017). Forecasting prices of coffee seeds using Vector Autoregressive Time Series Model. *Indian Journal of Agricultural Sciences,* **87(6)***, 754–758.*

30. Anjoy, P, Paul, RK, Sinha, K, Paul, AK and Ray, M (2017) A hybrid wavelet based neural networks model for predicting monthly WPI of pulses in India. *Indian Journal of Agricultural Sciences*, **87(6)**, 834–839.
31. Mitra, D, Paul, RK and Pal, S (2017). Hierarchical time-series models for forecasting oilseeds and pulses production in India. *Economic Affairs,* **62(1)***, 103-111.*
32. Kour, S, Pradhan, UK, Paul, RK and Vaishnav, PR (2017). Forecasting of Pearl millet productivity in Gujarat under time series framework. *Economic Affairs,* **62(1)***, 121-127.*
33. Kumar, P, Kaur, R, Archna S, Singh, A, and Kumar, P (2017). Nickel bioremediation by different wetland macrophytes root associated bacteria. *Chemical Science Review and Letters.* **6(22),** *987-994.*

Popular Articles Published

भा.कृ.अ.प.–भारतीय कृषि सांख्यिकी अनुसंधान संस्थान की हिन्दी पत्रिका सांख्यिकी विमर्श 2016–17, अंक 12 मे प्रकाशित।

1. संतोष राठोड़, के. ऐन .सिंह, बिशाल गुरूंग, राजीव रंजन कुमार, मृन्मय राय, प्रकाश कुमार, नीरज बुढ़लाकोटी और रविंद्र सिंह शेखावत. कर्नाटक में कृषि विविधीकरण : एक सांख्यिकीय मूल्यांकन।
2. नीरज बुढ़लाकोटी, राजीव रंजन कुमार, द्विजेश चंद्र मिश्रा, के .के .चतुर्वेदी, एस .बी .लाल, संतोष राठोड़ और सुनील कुमार यादव (2017)। कृषि में जीनोमिक सलेक्शन के सांख्यिकीय मॉडल्स।
3. राजीव रंजन कुमार, के. ऐन . सिंह, नीरज बुढ़लाकोटी, संतोष राठोड़, मृन्मय राय, बिशाल गुरुंग और सुनील कुमार यादव आकड़ों में संरचनात्मक परिवर्तन के लिए परीक्षण।
4. द्विजेश चंद्र मिश्र, नीरज बुढ़लाकोटी, संजीवकुमार, एस बी लाल और राजीव रंजन कुमार टी ए जी पी टी: जीन एक्सप्रेशन डाटा पर आधारित ट्रेट से सम्बन्धित जीन की पहचान के लिए वेब सर्वर।
5. अनु शर्मा, एस. बी. लाल, द्विजेश चंद्र मिश्र, के. के. चतुर्वेदी, संजीव कुमार एवं समीर फ़ारूक़ी। समानार्थी कोडॉन उपयोग सूचकांकों के लिये एक वेब आधारित सॉफ्टवेयर।
6. समीर फ़ारूक़ी, के. के. चतुर्वेदी, एस. बी. लाल, द्विजेश चंद्र मिश्र, अनु शर्मा, पंकज कुमार पाण्डेय एवं संजीव कुमार । हैलोफाइल प्रोटीन डाटाबेस।
7. मीर आसिफ इकवाल, सारिका, अनिल राय, दिनेश कुमार। डी.एन.ए. सिग्नेचर आधारित एस.एन.पी. एवं एस.एस.आर. मार्कर विष्लेषण। संदर्भ संहिता : कृषि जैव सूचना : एक परिचय, 56-66.
8. सुशील कुमार सरकार, सुकान्त दाश, प्रकाश कुमार एवं ओ.पी. मौर्य एस. ए. एस. द्वारा लेखाचित्र ।
9. श्वेतांक लाल, सीमा जग्गी, सिनी वरगीस, एल्दो वरगीस एवं अर्पण भौमिक। द्विचर एक्सपोनेन्सियल मॉडल हेतु डी–ऑप्टिमल संतृप्त अभिकल्पना।
10. राहुल बनर्जी, सीमा जग्गी, एल्दो वर्गीस, सिनी वर्गीस, अर्पण भौमिक एवं बी.जे. गहलोत। डिस्क्रीट चयन समुच्चय परीक्षणों के लिए अभिकल्पनायें।
11. मित्रा, डी, पॉल, आर के एवं पॉल, एस। **हिरार्चिकल** टाईम–सीरीज मॉडल फॉर फॉर्कास्टिंग ऑयल सीड्स एण्ड प्लसिस प्रोडक्शन इन इण्डिया इक्नोमिक्स अफेयरस, 62(1), 103–111।
12. कौस्तव आदित्य, हुकुम चन्द्र, श्रीला दास और सी पी सिहं - भारत में फसलों के बीज, चारा और अपव्यय अनुपात का आकलन. भारतीय कृषि अनुसंधान पत्रिका, 32(1), 31-34।
13. डी सी मिश्रा एवं नीरज बुढ़लाकोटी संदर्भ मैन्यूअल कृषि जैव सूचनाः एक परिचय।

14. सौमेन पाल, ए. के. चौबे, सुदीप मारवाहा, अलका अरोडा, पी. आदिगुरु, एस. एन. इस्लाम, सरावना कुमार, चेतना गुप्ता, विकास सुहाग, सौरभ त्यागी, प्रतिभा सिंह एवं हरिश कुमार । राष्ट्रीय कृषि शोध एवं शिक्षा प्रणाली के अंर्तगत कृषि विस्तार सेवाओं के लिए कृषि विज्ञान केन्द्र ज्ञान तंत्र।

Reference Manual/E-Manual/Panphlet

1. Neeraj Budhalkoti (2017). Introduction to Bioinformatics for training programme entiteled **जैव–सूचना विज्ञान : एक परिचय** held at ICAR-IASRI during May 24-26, 2017.
2. Ahmad, T., Sud, U.C., Biswas, A. and Singh, M. (2017). Pilot study on private food grains stock estimation at farm level aligned with Input Survey of Agriculture Census in India. Project draft report submitted to Food and Agriculture Organization of the United Nations (FAO), India.
3. Chandra, H. and Aditya, K. (2017). Development of innovative approaches for small area estimation of crop yield, socio-economic and food insecurity parameters. Project Report, Funded under ICAR's Lal Bahadur Shastri Outstanding Young Scientist Award-2012.

Packages Developed

1. GSAQ R package (available at https://CRAN.R-project.org/package=GSAQ). (Das Samarendra)
2. Transcriptomic Database and web portal for coconut (CnTDB). (MA Iquebal, Sarika, U.B. Angadi, Anil Rai and Dinesh Kumar)
3. Web server “funbarRF” for fungal species identification based on DNA barcode, accessible at http://cabgrid.res.in:8080/funbarrf/. (P. K. Meher)
4. Transcriptomic Database and web portal for small cardamom has been developed (MA Iquebal, Sarika, U.B. Angadi, Anil Rai and Dinesh Kumar)

Scientific/Technical Report Published

1. Sud, UC, Ahmad, T, Gupta, VK, Chandra, H, Sahoo, PM, Aditya, K, Singh, M and Biswas, A (2016). Measuring Crop Area and Yield under Pure Stand, Mixed and Continuous Cropping: Findings from the Field Tests in three countries under the project Research on Improving Methods for Estimating Crop Area, Yield and Production under Mixed, Repeated and Continuous Cropping. Working Paper No. 16. December 2016. Global Strategy, FAO, Rome Publication. http://gsars.org/wp-content/uploads/2017/01/WP-16.01.2017-Findings-from-the-Field-Tests-Conducted-in-Three-Countries.pdf
2. Sud, UC, Ahmad, T, Gupta, VK, Chandra, H, Sahoo, PM, Aditya, K, Singh, M and Biswas, A (2017). Methodology for Estimation of Crop Area and Crop Yield under Mixed and Continuous Cropping under the project Research on Improving Methods for Estimating Crop Area, Yield and Production under Mixed, Repeated and Continuous Cropping. Technical Report Series: GO-21-2017, March 2017. Global Strategy, FAO, Rome Publication. http://gsars.org/wp-content/uploads/2017/03/TR-15.03.2017-Methodology-for-Estimation-of-Crop-Area-and-Crop-Yield-under-Mixed-and-Continuous-Cropping.pdf

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Paper presented in Conferences

– Chandra, H, Salvati, N and Chambers, R (2017). Small area estimation of counts under aggregated level spatial model. International conference on “Contemporary Theory and Practice of Survey Sampling: A Celebration of Research Contributions of J. N. K. Rao” at Yunnan University, Kunming, Yunnan, China during May 24-27, 2017.

– Chandra, H (2017). Some innovative approaches for small area estimation of agricultural and socio-economic parameters. National Academy of Agricultural Sciences Foundation Day, 04 June, 2017 at NASC Complex, New Delhi.

Conferences/Workshops/Seminars/Symposia/Meetings Organized

The 18th meeting of the Research Advisory Committee (RAC) of ICAR-IASRI was held on 22nd April, 2017.

- Dr. Seema Jaggi made a presentation on Teaching and Training Activities of IASRI and Research Activities of Division.
- Dr. Rajender Parsad made presentations on Situation of Agricultural Statistics in the Agricultural Universities of the Country

Participation in International Conference/ Workshop etc.

- Attended International Conference on “Contemporary Theory and Practice of Survey Sampling: A Celebration of Research Contributions of J. N. K. Rao” at Yunnan, University, Kunming, Yunnan, China during 24-27 May, 2017. (Dr Hukum Chandra)

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

- Participated in the Conference of Drug Design at JNU, New Delhi during 7-9 April 2017 (Dr.U.B. Angadi).
- Participated in a राजभाषा सम्मेलन on "सरकारी कार्यो में राजभाषा का प्रभावी प्रयोग" organized by नगर राजभाषा कार्यान्वयन समिति, उत्तरी दिल्ली और भा. कृ. अ. प.- भारतीय कृषि अनुसंधान संस्थान on 12 April, 2017 at ICAR-IARI, New Delhi (Dr. Arpan Bhowmik).
- Attended a three day Hindi workshop on **कृषि में जैबसूचना का उपयोग** from 27.06.2017 to 29.06.2017 in the Divison of Bioinformatics, IASRI.(Mohd. Harun and Dr. Pradeep Basak)

Participation in Meetings etc.

i) Meeting with Secretary, ICAR related to progress in KVK Portal on 12th April, 2017 at Krishi Bhawan, New Delhi (Dr. Soumen Pal).

ii) Meeting for presenting the SRS of Institute Information Management System (ICAR portal) under the chairmanship of Secretary, ICAR on 26th April, 2017(Dr. A.K. Choubey, Dr. Mukesh Kumar and Dr. Sudeep Marwaha).

iii) Cochran and Hansen Award 2017 Committee meeting (via Skype) of International Association of Survey Statisticians on 05 April, 2017 at ICAR-IASRI, New Delhi (Dr. Hukum Chandra).

iv) The Experts Meeting on Ethiopia Statistics from Space project of the FAO of the United Nations Addis Ababa, Ethiopia during 23-27 April, 2017(Dr. Hukum Chandra).

v) Local office Bearer's meeting of Society for Statistics Computer and Application as Joint Secretary on 06 April, 2017 at ICAR-IASRI, New Delhi (Dr. Hukum Chandra).

vi) Meeting of KRISHI project team held on 06 April 2017.(Sh Raju Kumar)

vii) Meeting on monitoring of e-Governance Activities under the chairmanship of the Secretary (ICAR) on April 12, 2017.(Dr. Rajender Parsad).

viii) Meeting held with Superintending Engineer/ Executive Engineer of CPWD on April 19, 2017 to decide the further course of action in view of the report submitted by NCCBM regarding conditional Assessment of Quarters at Krishi Niketan of ICAR-IASRI, New Delhi(Dr. Rajender Parsad)

ix) 18th Research Advisory Committee Meeting organized at IASRI, New Delhi on April 22, 2017.(Dr. Rajender Parsad, Dr Tauqueer Ahmad and Dr Hukum Chandra).

x) Dr. Anil Rai participated in the following meetings:-

- As member of School Board of Physical Sciences, North Eastern Hill University, Shillong on April 10, 2017 at Shillong.
- As member of the Tender Committee related to conducting All India Examinations for admission in UG and PG in ICAR on April 17, 2017.
- As member of DPC of Scientists in ICAR Headquarter on April 18, 2017 at ICAR Headquarter.
- Institute RAC meeting as invited member on April 22, 2017.
- Meeting of RAC and made presentation on May 9, 2017 at ICAR-IASRI, New Delhi.

xi) Technical Specifications and Evaluation committee, evaluated the technical Bids for Mobile workstation under Krishi Project on 26th April 2017. Dr. K. K. Chaturvedi

xii) Meeting for preparing the Terms of Reference for ICT Roadmap for Indian Council of Agricultural Research (ICAR) on May 01, 20-17. (Dr. A.K. Choubey, Dr Sudeep Marwaha and Dr. Mukesh Kumar).

xiii) Meeting for monitoring of e-Governance activities under the chairmanship of AS (DARE) & Secretary, ICAR on May 22, 2017 (Dr. A.K. Choubey, Dr Sudeep Marwaha and Dr. Mukesh attended).

xiv) Meeting which was organized under the chairmanship of DDG (Agricultural Extension) on 15th May 2017 to present the progress of KVK Portal and KVK Mobile APP (Dr. Soumen Pal).

xv) Annual Review meeting of CHAMAN project under the Chairmanship of Additional Secretary (A&C), MoAFW, Govt. of India held at Krishi Bhawan, New Delhi on11 April, 2017 and 03 May, 2017. (Dr. Tauqueer Ahmad and Dr. Prachi Misra Sahoo)

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xvi) Meeting of DDG (Edun.) with Scientists of ICAR-IASRI on 05 May, 2017 at IASRI, New Delhi(All scientists of the Division)

xvii) Meeting to discuss the technical details about the project entitled “Pilot study for developing state level estimates of crop area and production on the basis of sample size recommended by Prof. Vaidyanathan Committee Report” on 23 May, 2017. (Dr. Tauqueer Ahmad, Dr. Hukum Chandra, Dr Kaustav Aditya, Sh Raju Kumar)

xviii) DBT project review meeting at Anand Agricultural University, Anand on May 12, 2017. (Dr. M. A. Iquebal and Dr. Dinesh Kumar)

xix) Task Force Meeting on “Aquaculture and Merine Biotechnology” on May 25, 2017 in DBT Office, CGO Complex, New Delhi. (Dr. M. A. Iquebal)

xx) Chaired the meeting of CCTV camera installation in the institute on May 29, 2017(Dr. Anil Rai)

xxi) Participated in syllabus revision committee (Computer Application) on 30th Amy 2017. (Dr. K. K. Chaturvedi)

xxii) Meeting of tender committee for on-line examination in the Education Division in the Council June 16, 2017 and June 26, 2017 at ICAR-IASRI, New Delhi. (Dr. Anil Rai)

xxiii) Annual General Body Meeting and Foundation Celebrations of National Academy of Agricultural Sciences, New Delhi on June 05, 2017. (Dr. Rajender Parsad)

xxiv) Meeting under the Chairmanship of Sh. Rajiv Lochan, ADG (Hort.) held on 20 June, 2017 at Krishi Bhawan, New Delhi regarding finalization of EFC Memo for the Scheme “Improvement on Horticulture Crops Statistics Scheme” proposed by Division of Horticulture, DACFW, MoAFW, Govt. of India under CHAMAN Phase-II. (Dr. Tauqueer Ahmad)

xxv) Review meeting of MP-CHAMAN project under the Chairmanship of Commissioner-cum-Director (Hort.), Govt. of MP State held at Bhopal on 06 June, 2017 in which the progress of the project and data entry till date was discussed. (Dr Tauqueer Ahmad)

xxvi) Review meeting of MP-CHAMAN project under the Chairmanship of Deputy Director (Hort.), Ratlam district of MP State held at Ratlam on 07.06.2017 in which the progress of the project and data entry of Ratlam district till date was discussed. (Dr Tauqueer Ahmad)

xxvii) National Academy of Agricultural Sciences (NAAS) Foundation day and Annual General Meeting of NAAS during 04-05 June, 2017 at NASC Complex, New Delhi. (Dr. Hukum Chandra)

xxviii) Fifth meeting of the Local Office Bearers of the Society of Statistics, Computer and Applications, held on 07 June, 2017 at ICAR-IASRI, New Delhi. (Dr Hukum Chandra)

xxix) Meeting as Expert Member, at Madras Institute of Development Studies, Chennai on 09 June, 2017.(Dr Hukum Chandra)

xxx) CPC meeting held on 19 June, 2017 and presented the proposal for International training programme on “Recent Advances in Agricultural Surveys: Remote Sensing and GIS Applications” for African-Asian Rural Development Organization (AARDO) during November 01-21, 2017.(Dr. Prachi Misra Sahoo)

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xxxi) Meeting with the consultants of 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” regarding finalization of the project report.(Dr. Kaustav Aditya)

xxxii) Meeting of Rajbhasha working committee held on Jun 13, 2017. (Dr. Wasi Alam)

xxxiii) Meeting a member of IJSAC committee held on 17th June 2017. (Dr. Alka Arora)

Consultancy/ Advisory services provided

i) To Dr. Vijay Gehlot, a Post-doc student at Delhi University, with regard to genome-wide association studies based on multivariate linear mixed model approach. The analysis was carried out on 300 genotypes with 4 different phenotypic traits and 1000 significant SNP markers that were obtained after performing MLMM and MTMM analysis (P.K. Meher).

ii) To Dr. S. Vennila, Principal Scientist, NCIPM for analyzing the data for forecasting pest count in different districts of Andhra Pradesh, Gujarat, Karnataka and Maharashtra (R.K. Paul).

iii) To Mr Rohit Kumar, PhD Student of BHU in Agricultural Economics for forecasting potato prices in different markets of Uttar Pradesh (R.K. Paul).

iv) On augmented design and cluster analysis to Mr.Yegappa, Ph.D scholor, ICAR-IARI, New Delhi in SAS and in R (Santosha Rathod).

v) For analysis of factorial RBD data using SAS software to Dr. Sumita Pradhan, Assistant Professor, Uttar Banga Krishi Viswavidyalaya, Pundibari, Coochbehar (Dr. Achal Lama).

vi) For analysing stability analysis in dual purpose sorghum to Rumana Khan, Ph.D. student at RCA, MPUAT, Udaipur, Rajasthan (Dr. Ravindra Singh Shekhawat).

vii) To analyse the wheat grain quality data for DMRT comparison for Mr. Raghunandan, K., Scientist, ICAR-IARI, New Delhi (Dr Pradip Basak).

viii) In developing R codes for simulation study of Ph.D. thesis problem of Sandeep Pundir, Ph.D. Student, Narendra Dev University of Agriculture and Technology, Faizabad (Dr Pradip Basak).

ix) Advised Mr. Aravind Jayaram, Scientist, NBPGR on the analysis procedure of an experiment conducted using reinforced alpha design. In each replication, the 200 accessions were in 20 incomplete blocks of size 10. But in each block, two checks were also there. So each block has 12 accessions and each replication has 200 + 40 = 240 entries. Also the genotypes were categorized as stored vs regenerated and the interest was also to test if there is any significant difference between stored and regenerated accessions for the 23 descriptors/traits (Dr. Eldho Varghese and Dr. Rajender Parsad).

x) Advised to Dr. Ajay Verma, Scientist at ICAR-Central Institute for Arid Horticulture, Bikaner to calculate the Correlation Coefficient and test the significance of Correlation Coefficient and also to calculate partial Correlation Coefficient along with the test the significance (Mr. Mohd. Harun).

xi) Consultancy service project proposal with International Livestock Research Institute (ILRI) has been prepared and submitted to office for approval of competent authority. (Dr. U.B. Angadi)

xii) To Mr. Sayak Mahato, M.Sc. Student, Department of Agricultural Meteorology, Bidhan Chandra Krishi Viswavidyslaya, Mohanpur, West Bengal (Dr. Soumen Pal)

xiii) For developing “gene co-expression network of genes responsible to multiple stress in chickpea” to Dr.Aravind Kumar, Scientist, ICAR-IIPR, Kanpur Ph.Dscholor in R and Cytoscape. (Santosha Rathod)

xiv) Advisory service about analysis of augmented design using SAS to Dr Ratna Preeti Kaur, Scientist-Genetics, ICAR- Central Potato Research Station, Jalandhar-144003, Punjab. (Dr. Wasi Alam)

xv) Advisory services for analysing CRD data using SAS software for Ms. Pritika Rai, M.Sc. student of Sikkim University. (Dr. Achal Lama)

xvi) Consultancy service project proposal with International Livestock Research Institute (ILRI) has been prepared and submitted to office for approval of competent authority. Approval of the consultancy project by Director general, ICAR, New Delhi. (Dr. U.B. Angadi)

xvii) Consultancy for Statistical analysis of data provided by Krishan Prakash and Ram Narayan singh, Ph.D and M.Sc. student IARI New Delhi-12. (Prakash Kumar)

xviii) To Dr. Vijay Gehlout, a post doc student at Delhi University. Genome-wide association mapping analysis was carried out on wheat crop with 1050 markers for 4 different economical traits in 4 different environments. The association mapping was done by taking all the four traits simultaneously, by using multivariate linear mixed effect model approach using R-software.(P.K.Meher)

xix) To Dr. Bhupender, scientist, IIMR, New Delhi to use the following four alpha design for four different trials on maize varieties,

xx) i)v=99,b=11,r=3,k=9; ii)v=39,b=13,r=3,k=3;iii)v=45,b=9,r=3,k=5iv)v=90,b=10,r=3,k=9

xxi) and also provided the randomized layout of the same. (Dr. Eldho Varghese)

xxii) To Sunita Yadav, Scientist CESCRA, ICAR-IARI, regarding analysis of data. The data was collected for the assessment of crop residues burning on soil physico-chemical and biological properties.(Mohd Harun)

xxiii) Consultancy service project proposal with International Livestock Research Institute (ILRI) and approved of the consultancy project by Director General, ICAR, New Delhi. (Dr. U.B. Angadi)

xxiv) To Dr. Shrawan Singh, Scientist, Division of Vegetable Science, ICAR-Indian Agricultural Research Institute on analysis of augmented design with 160 hybrids and 4 checks of cauliflower. (Dr. Mir Asif Iquebal)

xxv) To Dr. S.V. Sai Prasad, Head, Regional Station, ICAR-Indian Agricultural Research Institute, Indore on analysis of augmented design with 603 lines and 5 checks of wheat.(Dr. Mir Asif Iquebal)

xxvi) To Dr. Sonia Sheoran, Scientist, Plant Biotechnology, ICAR-Indian Institute of Wheat and Barley Research, Karnal on association analysis using Plink software.(Dr. Sarika)

xxvii) To Pooja Singh Patil, Ph.D. student, Anand Agricultural University, Anand on analysis of split-split plot experiment using SAS 9.3 software. (Dr. Sarika)

xxviii) To Professor R.M. Sharma, Principal Scientist, Division of Fruits & Horticultural Technology, ICAR-IARI, New Delhi on the analysis of data generated from augmented designs. (Dr. Rajender Parsad)

xxix) Analysed the data of a student (PG School IARI) Mr. Pradeep Maurya pertaining to an experiment conducted using CRD to the study of leaf curl disease susceptibility of a chilli variety 'Pusa Jwala' by introducing white fly at 4 different growth stages (Mr. Sunil Kumar Yadav)

xxx) ToSamir Barman M.Sc. (Agricultural Statistics) Student of ICAR-IASRI in developing R codes for simulation study for his thesis problem.(Dr. Pradip Basak)

xxxi) To Dr. SP Singh, Division of Genetics, IARI, New Delhi. Structure analysis was carried out using 34 individuals whose SSR markers were available for 44 loci. The analysis was conducted using STRUCTURE software, which is freely available in public domain.(P.K.Meher)

xxxii) Helped in analysis of Bayesian time-series and generalized linear model of Yogesh, Ph.D 4th year (Ag. Statistics), Banaras Hindu University, Varanasi. (Himadari Shekhar Roy)

xxxiii) Consultancy provided to statistical analysis of partial diallel cross of watermelon data provided by Kaushik, M.Sc. student division of vegetable science, IARI New Delhi. (Prakash Kumar)

xxxiv) Advised Ms. Ampee Tasung, Ph.D. Scholar (Soil Science) IARI, New Delhi on the use of Factorial Designs using SAS software. (Dr. Bishal Gurung)

xxxv) For analysing augmented design and cluster analysis for "genotypic and phenotypic traits of Soybean in western himalya" of Mr. Yegappa, Ph.D. Scholor, IARI, New Delhi on 27.06.2017 in SAS V9.4. (Santosha Rathod)

xxxvi) Provided advisory services for analysing data using cluster analysis and Response Surface Design for "drying kinetics and osmatic dehydration of pine apple" to Mr. Tayeeb, Ph.D.scholar, UHS Bagalkot, Karnataka, in R and SAS software. (Santosha Rathod).

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PERSONNEL

Promotion

i. The following Scientists have been promoted to their next respective higher Research Grades vide office order No. 17(1)/2016-Admn.-I dated 20.05.2017 from the date indicated against their names.

1.	Dr. Wasi Alam	From 10.01.2013
2.	Dr. Bishal Gurung	From 27.04.2015
3.	Dr. Kaustub Aditya	From 27.04.2015
4.	Dr. Sukant Dash	From 15.09.2015
5.	Dr. SB Lal	From 23.09.2015

ii. The following Scientists have been promoted to their next respective higher Research Grades vide office order No. 17(1)/2016-Admn.-I dated 22.06.2017 from the date indicated against their names.

1.	Dr. Anshu Bhardwaj	From 17.11.2013
2.	Dr. Sanjeev Kumar	From 21.08.2014

iii. Dr. Prachi Misra Sahu was promoted to the post of Principal Scientist from Senior Scientist w.e.f 09.08.2015 vide office order No. 17(1)/2016-Admn.-I dated 09.06.2017.

Study Leave

Shri Raju Kumar, Scientist proceeded on study leave of 18 months to pursue Ph.D. from 05.06.2017 F/N

Appointments

Shri GP Shivawamy, Scientist, Shri T. Rajesh, Scientist and Shrimati Anuja, Scientist have joined in division of the Forecasting and Agricultural System Modelling on 15.04.2017 after completing their training in the NAARM, Hyderabad.

Retirement

Dr. SP Bhardwaj, Principal Scientist retired gracefully on 30.04.2017. The IASRI family wishes him a happy retired life.

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Compiled and Edited by

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