Vol 7 Issue 2 March 2017

ISSN No : 2230-7850

International Multidisciplinary Research Journal

Indian Streams Research Journal

Executive Editor
Ashok Yakkaldevi

Editor-in-Chief
H.N.Jagtap

Welcome to ISRJ

RNI MAHMUL/2011/38595 **ISSN No.2230-7850**

Indian Streams Research Journal is a multidisciplinary research journal, published monthly in English, Hindi & Marathi Language. All research papers submitted to the journal will be double - blind peer reviewed referred by members of the editorial board.Readers will include investigator in universities, research institutes government and industry with research interest in the general subjects.

Address:-Ashok Yakkaldevi 258/34, Raviwar Peth, Solapur - 413 005 Maharashtra, India
Cell : 9595 359 435, Ph No: 02172372010 Email: ayisrj@yahoo.in Website: www.oldisrj.lbp.world

INDIAN STREAMS RESEARCH JOURNAL

ISSN: 2230-7850
IMPACT FACTOR : 5.1651(UIF)
VOLUME - 7 | ISSUE - 2 | MARCH - 2017

ANALYSIS OF DIFFERENT METHODS OF CROP YIELD FORECASTING

Md. Atheeq Sultan Ghori[1] and Dr. M. Balakrishnan[2]
[1]Research Scholar, Research and Development Centre, Bharathiar University, Coimbatore .
[2]Senior Scientist, National Academy of Agricultural Research Management (NAARM), ICAR, Rajendra Nagar, Hyderabad.

ABSTRACT

Operational crop yield forecasting is mostly achieved with empirical statistical regression equations relating regional yield with predictor variables, termed "factors". Regional yield (the "dependent variable") refers to average yield over districts, provinces or, more rarely, whole countries; they are provided by national statistical services. The factors can be any combination of raw environmental variables such as weather variables or indices, satellite indices such as Normalized Difference Vegetation Indices(NDVI), farm inputs (fertilizer use) or outputs from simulation models, for instance water transpired over a given phonological phase, maximum leaf area index (LAI), average soil moisture, etc.

The approach above is termed "parametric" for two reasons:

(1) it derives or requires a number of parameters, for instance regression coefficients and the parameters characterise crop simulation models and

(2) it attempts to identify the factors that condition yields and to understand their action. The difference between

"parametric" and "non-parametric" methods is not clear-cut; it is mostly operational. Parametric forecasting approaches derive a

"Model" (through a process known as "calibration") based on historical yield and climatic data

KEYWORDS- *agriculture, monitoring, food/feed, security, biodiversity, region, climate, remote sensing.*

INTRODUCTION :

Operational crop yield forecasting is mostly done with crop simulation models and empirical statistical regression equations relating yield with predictor variables, usually termed "factors". For the purpose of this paper, crop forecasting and crop yield forecasting refer to operational within-season regional yield forecasts, i.e. forecasting of average crop yield (tons of agricultural product per ha) over large areas. The areas are administrative units, as this is the scale at which most socioeconomic data and crop statistics are available to decision makers. It is stressed that crop forecasts are eventually calibrated against crop statistics, so that, strictly speaking, crop forecasts are actually forecasts of agricultural statistics; they incorporate all the errors and biases that affect statistics. Crop forecasts are typically issued between the time of planting and the time of harvest. They use past data (data between planting or before, and the time of the forecast) and "future "data. Future data can be implicit or explicit. In the first case, the future is assumed to be "normal" whereas the second requires that numerical values be actually specified

Crop yield forecasts and crop production estimates are necessary at EU and Member State level to

VOLUME - 7 | ISSUE - 2 | MARCH - 2017

provide the EU's Common Agricultural Policy (CAP) decision makers with timely information for rapid decision-making during the growing season. Estimates of crop production are also useful in relation to trade, development policies and humanitarian assistance linked to food security.

The JRC's crop forecasting activities support the CAP by providing scientifically relevant, independent and timely crop yield forecast products and data. The JRC also supports the EU Food Security Thematic Programme and food assistance policies by providing assessments and early warnings of agricultural production in food-insecure regions of the world. In addition, the JRC works on the assessment of climate change impacts on agriculture in support to the EU climate change policy agenda and the Europe 2020 flagship initiative for a resource-efficient Europe.

The JRC provides near real-time crop growth monitoring and yield forecasting information for the EU and its neighborhood, and is extending these activities to the main producing regions of the world. It also assesses climate change impacts on agriculture through the simulation of impacts of climate change scenarios in crop models. Moreover, it provides scientific advice and early warning on agricultural production in food-insecure regions of the world. All the information the JRC gathers helps to prepare food balance sheets that are used for market analyses and decisions related to the CAP management of stocks, imports and exports, market interventions and budget preparation.

CROP YIELD FORECASTS IN EUROPE

The JRC has developed and runs a crop yield forecasting system since 1992 which provides timely forecasts of crop production, including befoul crops, for Europe and other strategic areas of the world. The MARS Crop Yield Forecasting System (MCYFS) monitors crop vegetation growth (cereal, oil seed crops, protein crops, sugar beet, potatoes, pastures, rice), including the short-term effects of meteorological events on crop production. It also provides seasonal yield forecasts of key European crops, thereby contributing to the evaluation of global production estimates (wheat, maize, etc.) in support of CAP management decisions.

VULNERABILITY ANALYSIS

The socio-economic impacts of food insecurity are explicitly linked to vulnerability. Vulnerability is defined by factors such as economic, civil or natural hazards, market prices, crop production, access to food, food consumption and livelihoods. The JRC is involved in the analysis of the reasons behind and consequences of vulnerability, and the identification of appropriate response measures. The European Commission uses these analyses to evaluate the amount of food aid and other forms of assistance that could be required in emergencies and to support longer term multi-sectoral development in developing countries.

CROP PRODUCTION UNDER CLIMATE CHANGE

Agriculture has a dual role in terms of global change - it is a big emitter of greenhouse gases, while at the same time it is one of the main sectors to be impacted by climatic change, with local, regional and global implications for the stability of and access to food supply. In view of providing support to the CAP and the climate change policy agenda, studies that assess the resilience of crop production systems under a number of climate change scenarios are being implemented by the JRC. Both current and forecasted climate conditions are analyzed, focusing on short-term and medium-term time horizons (2020, 2050) in order to evaluate different adaptation measures to mitigate the impacts identified. To simulate the impacts of climate change on agriculture and to evaluate adaptation strategies, the JRC uses its Biophysical Models Applications (BioMA) framework. A suite of model components implemented in this modeling framework help carry out simulations of various crops in agricultural systems under present and future climate change scenarios. These JRC modeling activities are being integrated with other biophysical and economic models in order to develop an integrated approach to the evaluation of climate change scenarios.

WEATHER BASED CROP FORECASTING TECHNIQUES

1 .Crop production forecast system

Crop yield is affected by technological change and weather variability. It can be assumed that the technological factors will increase yield smoothly through time and, therefore, year or some other parameter of time can be used to study the overall effect of technology on yield. Weather Variability both within and between seasons is the second and the only uncontrollable source of Variability in yields. Weather variables affect the crop differently during different stages of Development.

2 .Crop-growth simulation models

A crop growth simulation model may be defined as a simplified representation of the physical, chemical and physiological mechanisms underlying plant growth processes. If the basic plant processes - production and distribution of dry matter and water relations are properly understood and modelled, the entire response of the plant to the environmental conditions can be simulated. Therefore, there is no need to differentiate between climatic regions, since the simulation model itself will show the limiting factors for growth. In humid climates with low temperature and radiation levels, the model will generally show the greatest response of yields to increase in total radiation received.

3.Crop-weather analysis models

Crop-weather analysis models are defined here as the product of two or more factors, each representing the (simplified) functional relationship between a particular plant response (e.g. yield) and the variations in selected variables at different plant developmental phases. The overall effects, as expressed by the numerical values of the factors modify each other but are not additive as in the case of a multivariate linear regression equation. Such models do not require a formulated hypothesis of the basic plant and environmental process

4. Empirical Statistical Models

In the empirical yield. The weighting coefficients in these equations are by necessity obtained in an empirical manner using standard statistical procedures, such as multivariable regression analysis. This statistical approach does not easily lead to an explanation of the cause and effect relationships but it is a very practical approach for the assessment or prediction of yields. The coefficients in such empirical models and the validity of the estimates depend to a large extent on the design of the model, as well as on the representiveness of the input data.

DISCUSSION

From the results it is found that a reasonably good prediction can be made even with very crude and primary methods of forecasting. Data used was monthly average data, which might not be as good for large area prediction but for small area where we can assume that environment condition remain same; these methods can be effectively used. Model 2 (weather indices based MLR model) is quite efficient as it is more significant in terms of R square and more accurate

Rationale

Practical area administration for harvest creation is a chain of importance of frameworks working in—and communicating with—monetary, biological, social, and political segments of the Earth. This progression ranges from a field oversaw by a solitary agriculturist to local, national, and worldwide scales where arrangements and choices impact crop generation, asset use, financial aspects, and biological communities at different levels. Since maintainability ideas must coordinate these various issues, horticultural analysts who wish to create practical gainful frameworks and strategy creators who endeavor to impact rural generation are faced with numerous difficulties. An assortment of issues can keep creation frameworks from being manageable; then again, with adequate consideration regarding pointers of maintainability, various practices and arrangements could be executed to quicken progress.

Crop Simulation Models

Crop Simulation Models (CSM) are modernized representations of harvest development, improvement and yield, reproduced through scientific mathematical statements as elements of soil conditions, climate and administration hones (Hogenboom et al., 2004). The quality of the CSM is in their capacity to extrapolate the transient examples of product development and yield past a solitary exploratory site. Crop Simulation Models (CSM) can be utilized to increase new logical learning of product physiological procedures or to assess the effect of agronomic practices on agriculturists' salaries and situations. Crop models are just an estimation of this present reality and numerous don't represent critical elements, for example, weeds, sicknesses, creepy crawlies, culturing and phosphorus (Jones et al., 2001). By and by, CSM have assumed vital parts in the understanding of agronomic results, and their application as choice emotionally supportive networks for ranchers is expanding. Models range from easy to complex.

Remote Sensing

Remote Sensing Remote Sensing (RS) is characterized as the exploration of securing data around an item through the investigation of information acquired by a gadget that is not in contact with the article (Lillesand and Keifer, 1994). Remotely detected information can be of numerous structures, incorporating varieties in power dissemination, acoustic wave circulation or electromagnetic vitality dispersions. The information can be gotten from an assortment of stages, for example, satellite, planes, unmanned vehicles, and handheld radiometers..

Crop Yield Forecast

There are a few strategies for yield anticipating. The conventional technique for yield determining is the assessment of harvest status by specialists. Perceptions and estimations are made all through the harvest developing season, for example, tiller number, spikelet number and their ripeness rate, rate of harm from irritations and growths, rate of weeds infestation, et cetera. From the information acquired along these lines yield can be guage utilizing relapse strategies, or by the learning from nearby expertizes. Other two techniques used to conjecture crop yield are the utilization of remote detecting and harvest reproduction models. The goal of the yield conjecture is to give an exact, experimental sound and free gauges of harvests' yield as ahead of schedule as would be prudent amid the products' developing season by considering the impact of the climate and atmosphere. The contrasts amongst conjectures and last gauges are in the planning of the discharge. Gauges are made before the whole product has been gathered while evaluations are made after the yield has been collected. Signs are the consequence of applying a measurable estimator to the study information and the subsequent point appraisals are deciphered by ware analysts to make gauges and gauges. Generally, agriculturists have been continually making "gauges" with a specific end goal to arrange their agronomic practices. For instance, the planting window, the decision of a cultivar, the measure of manure to apply rely on upon the atmosphere. On the off chance that ranchers realize that the consequent week there is a decent risk for downpour, then they will race into the field to sown their seeds. Guaging crop yield implies likewise knowing or determining other critical parameters. For instance, measuring the range planted at the beginning of the developing season and evaluating the zone reaped

Remote Sensing and Precision Agriculture

The past exploration endeavors on remote detecting have given a rich foundation of potential application to site-particular administration of farming products. Regardless of the broad logical information, there couple of case of direct use of remote detecting methods to accuracy agribusiness in the writing. The reasons are for the most part because of the trouble and cost of securing of satellite pictures or airborne photography in auspicious design. With the advancement in GPS and sensor innovation direct use of remote detected information is expanding. Presently a picture can be shown on the PC screen with ongoing position superimposed on it. This takes into consideration route in the field to foreordained purposes of enthusiasm on the photo. Blackmer et al., (1995) proposed a framework for N application to corn taking into account photometric sensors mounted on the implement machine

Acknowledgements

We are grateful to Dr. Katarzyna DabrowskaZielinske and one anonymous Reviewer for their comments and suggestions, which have helped us to improve the original version of the manuscript.

CONCLUSION

Crop production environment consists of inherent sources of heterogeneity due to numerous parameters. The model discussed in the present paper reasonably minimizes inconsistency and errors in yield prediction giving high R2 -values with maximum accounting of variability in model. The model takes care of most of the parameters, which control the crop yield.

REFERENCES

1) Allen et al., 2002, R. Allen, G. Hanuschak, M. Craig Limited Use of Remotely Sensed Data for Crop Condition Monitoring and Crop Yield Forecasting in NASS (2002) http://www.usda.gov/nass/nassinfo/remoteuse.htm

2) Baruth et al., 2008,B. Baruth, A. Royer, A. Klisch, G. Genovese The use of remote sensing within the MARS crop yield monitoring system of the European commission ISPRS Arch., 36 (2008), pp. 935–959

3) Bastiaanssen and Ali, 2003,W.G.M. Bastiaanssen, S. Ali, " A new crop yield forecasting model based on satellite measurements applied across the Indus Basin, Pakistan ,Agric. Ecosyst. Environ., 94 (2003), pp. 321–340

4. Agarwal, Ranjana, Jain, R.C. and Jha, M.P. (1986) Models for studyimg rice crop-weather relationship, Mausam 37(1), 67-70.

5. Agarwal, Ranjana and Jain, R.C. (1996) Forecast of sugarcane yield using eye estimate alongwith plant characters. Biometrical Journal, 38(5), 731-39

6. Agarwal, Ranjana, Jain, R.C. and Mehta, S.C. (2001) Yield forecast based on weather variables and agricultural inputs on agro climatic zone basis. Indian Journal of Agricultural Science 71(7)

7. Agarwal, Ranjana, Ramakrishna, Y.S., Kesava Rao, A V R., Kumar Amrender, Bhar, Lal Mohan, Madan Mohan and Saksena, Asha (2005) Modeling for forecasting of crop yield using weather parameters and agricultural inputs, AP Cess Fund Project Report

8. Baier, W. (1977) Crop weather models and their use in yield assessments. Tech. Note No. 151, WMO, Geneva, 48pp

9. Chandrahas and Narain, Prem (1992) Preharvest forecasting of yield of apple. IASRI Publication.

10. Deosthali, V. and Akmanchi, Anand N. (2006) Yield estimation of summer crops grown in a mixed cropping area-a spectral growth curve profile approach, Journal of Indian Society of Remote Sensing, 34(3), 279

11. Fisher, R.A. (1924) The influence of rainfall on the yield of wheat at Rothamsted, Roy. Soc. (London) Phil. Trans. Ser. B 213, 89-142.

12. Hendrick, W.A. and Scholl, J.C. (1943) Techniques in measuring joint relationship. The joint effects of temperature and precipitation on crop yield, N. Carolina Agric. Exp. Stat. Tech. Bull. 74.

13. Jain, R.C., Agarwal, Ranjana and Jha, M.P. (1980) Effects of climatic variables on rice yield and its forecast, Mausam, 31(4), 591-96.

14. Jain, R.C.and Agarwal, Ranjana (1992) Probability model for crop yield forecasting, Biometrical Journal, 34(4) , 501-11.

15. Jain, R.C., Agarwal, Ranjana and Singh, K.N.. (1992) A within year qrowth model for crop yield forecasting, Biometrical Journal 34(7) 789-99.

16. Jain, R.C., Sridharan, H. and Agarwal, Ranjana (1984) Principal Component technique for forecasting of sorghum yield, Indian J. Agric. Sci. 54(6), 467-70.

17. Jain, R.C., Jha, M.P. and Agarwal, Ranjana (1985) Use of growth indices in yield forecast, Biometrical Journal, 27(4) 435-39.

18. Jain, R.C. and Ramasubramanium (1998) forecasting of crop yields using second order Markov Chains, Journal of Indian Society of Agricultural Statistics, Vol LI(1), 61-72.

19. Jha, M.P., Jain, R.C. and Singh, D. (1981) Pre-harvest forecasting of sugarcane yield, Indian J. Agric. Sci. 51(1), 757-61

20. Kumar, Amrender, Ramasubramanium, V. and Agarwal, Ranjana. (2010) Neural network based forecast

modeling of crops, IASRI Publication.

21. Lochan, Rajeev (2012) System of collection of Agricultural Statistics including Land Use and Area Statistics in India, Lecture Note on International Training Programme on Techniques of Estimation and Forecasting of Crop Production in India, held at IASRI, New Delhi.

22. Marwah, Shobha (2012) Recent initiatives in system of collection of Agricultural System in India, Lecture Note on International Training Programme on Techniques of Estimation and Forecasting of Crop Production in India, held at IASRI, New Delhi.

23. Matis, J.H., Gaito, T, Grant, W.E., Iwing, W.C. and Ritchie, J.T. (1985) A Markov Chain approach to crop yield forecasting, Agricultural Systems, 18, 171-87. 24. Matis, J.H., Birkett, T. and Boudreaux, D. (1989) An application of Markov Chain approach to forecasting cotton yield from surveys, Agricultural Systems, 29, 357-70.

25. Midha, Sudha (2012) System of collection of horticultural statistics in India, Lecture Note on International Training Programme on Techniques of Estimation and Forecasting of Crop Production in India, held at IASRI, New Delhi

26. Mehta, S.C. Agarwal, Ranjana and Singh, V.P.N. (2000) Strategies for composite forecast, Journal of Indian Society of Agricultural Statistics, 53(3).

27. Mehta, S.C., Satya Pal, Kumar, Vinod (2010) Weather based models for forecasting potato yield in Uttar Pradesh, IASRI Publication.

28. Rai, T. and Chandrahas (2000) Use of discriminant function of weather parameters for developing forecast model for rice crop., IASRI Publication

29. Ramakrishna, Y.S., Singh, H.P. and Rao, G. Nageswara (2003) Weather based indices for forecasting food grain production in India, Journal of Agrometeorology 5(1), 1-11.

30. Ramasubramanium, V. and Jain, R.C. (1999) Use of growth indices in Markov Chain models for crop yield forecasting, Biometrical Journal, 41(1), 99-109.

31. Ramasubramanium, V., Agarwal, Ranjana and Bhar, L.M. (2004) Forecasting sugarcane yield using multiple Markov Chains, IASRI Publication.

32. Rathi, R.P (2012) General crop estimation surveys, Lecture Note on International Training Programme on Techniques of Estimation and Forecasting of Crop Production in India, held at IASRI, New Delhi.

33. Srivastava, A.K. Agriculture Statistical System in India, Lecture Note on International Training Programme on Techniques of Estimation and Forecasting of Crop Production in India, held at IASRI, New Delhi

34. Sud, U.C. (2012) Small area estimation techniques for crop yield estimation at district level, Lecture Note on International Training Programme on Techniques of Estimation and Forecasting of Crop Production in India, held at IASRI, New Delhi.

35. Sud, U.C. (2012) Alternative techniques of crop yield estimation at lower level, Lecture Note on International Training Programme on Techniques of Estimation and Forecasting of Crop Production in India, held at IASRI, New Delhi.

36. Training Manual on International Training Programme (2012) Techniques of Estimation and Forecasting of Crop Production in India Volume I and Volume II held at IASRI, New Delhi

37.Timely and Accurate Crop Yield Forecasting and Estimation – History and Initial Gap Analysis by George A. Hanuschak Sr

38. A Literature Review on Crop Area Estimation by Michael Craig and Dale Atkinson

39. Review of Crop Yield Forecasting Methods and Early Warning Systems by Bruno Basso, Davide Cammarano and Elisabetta Carfagna.

40. Raorane A. (IJCSIT) International Journal of Computer Science and Information Technologies, Vol. 4 (2) , 2013, 270 - 272www.ijcsit.com 270