SCOR Datathon

Group 8

Factors affecting Indian agriculture

Literature review of several papers focusing on the most relevant factors that have an impact on Indian agricultural output

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In the process of identifying the best additional datasets to feed to our model, we decided to perform a literature review on several articles focusing on agricultural output in order to select the most significant variables.

Among the variables described we observed:

- *Physical factors*
- *Economic factors*
- *Operational factors*
- *Institutional factors*
- *Structural factors*

Panda and Rittu [1], show that agricultural production is dependent on a number of fixed as well as variable factors. The fixed factors include access to land, availability of labor and rainfall, whereas the variable factors include agricultural credit, mechanical power, availability of seeds, fertilizers, pesticides and insecticides, natural disasters, population, and controls exercised on markets.
In the study, agricultural output has been modelled as a function of gross sown area, gross irrigated area, fertilizer usage, forest cover, development expenditure and agricultural credit on agricultural development of a state.

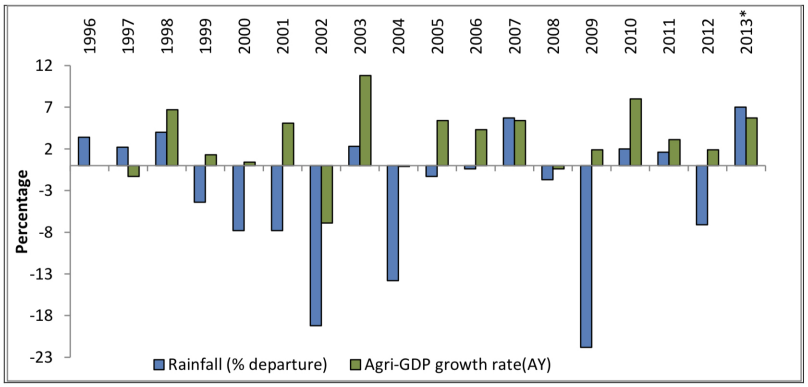
The panel framework proposed in the study considered agricultural output as a dependent variable, and gross sown area, gross irrigated area, fertilizer consumption, forest cover, and development expenditure of states as explanatory variables.
The table below shows the significance of the explanatory variables considered

Variable	Coefficient	Prob
GSA	0.4594*	0.0000
GIA	0.0008***	0.0962
FCN	0.5201*	0.0000
FC	-0.08050**	0.0122
DE	0.0436*	0.0002
AC	0.02791**	0.0115
C	8.61414*	0.0000
R Square (over all)	0.8437	
F-Stat (P Value)	134.6	0.000

Note: *, ** ,and *** indicate significance at 1%, 5% and 10% level of significance.

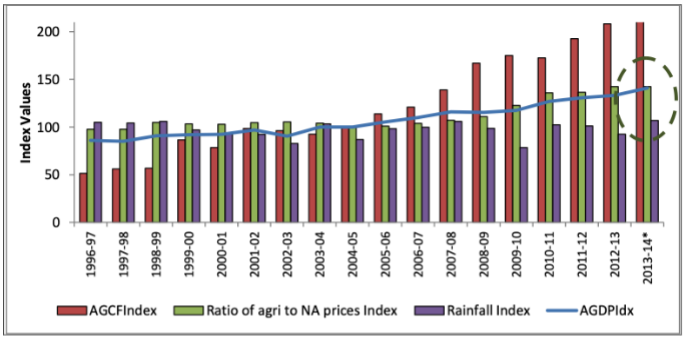
Variables such as gross sown area, gross irrigated area, fertilizer consumption, government expenditure, and agricultural credit influence agricultural output positively.

Another interesting study proposed by Gulati, Saini and Jain [2], hypothesizes that the performance of agriculture in India depends upon investments in agriculture (both private and public), agricultural price incentives, and rainfall. Almost 53 percent of Indian gross cropped area is rainfed, and even the area that is irrigated through canals, tanks, watersheds, and groundwater gets impacted when rainfall is low, and reservoir levels and ground water levels dip. Broadly, only about 35-40 precent of its areas is under assured irrigation. Results show that historically, rains and agri-GDP growth rate have been positively associated, as we can observe in the chart below.



**Rainfall %deviation as on 30 September,2013*
**Growth projections as per the Paper estimates*

The study used rainfall as the proxy for the entire amount of uncontrolled climate variables affecting production of any crop. This may appear as an over-simplification of the underlying mechanism where many uncontrolled or climatic factors (spatial spread of rainfall, temperatures, sunshine days, etc) influence agricultural productivity. However, that quantum of rainfall alone explains most of the variations in the agricultural production thus making it a preferred choice to represent the uncontrolled set of variables impacting Indian agriculture production.



**2013-14 values are based on 7% rainfall deviation for the year 2013-14*
Forecasts for AGDP(AY) and for explanatory variables are based on Model1

Details of the regression analysis, carried out at the all-India level with the data from 1996-97 through to 2012-13, yield some interesting results. The three independent variables together explain more than 94.7% variations in the Indian agricultural production for the studied period.

$$\text{Log AGDP} = 3.201 + 0.364\ \text{Log RNI} + 0.275\ \text{Log AGCF(T-1)} + 0.248\ \text{Log PR}$$
$$(3.179) \qquad (7.032) \qquad (1.796)$$

Given that the model is log-linear, the beta coefficients are the elasticity values between the respective dependent and the independent variable. Therefore, what this means is that a 1% change in the rainfall index, brings about 0.36% change in the agricultural production levels. Based on the beta values one can say, from the present analysis, that rainfall seems to have the greatest impact on the agricultural production levels, followed closely by level of investments (AGCF) and then lastly by the price incentives, which as it appears have had relatively lesser impact on the dependent variable. This study helped us identifying rainfall as a critical variable to include in our model.

Additional interesting readings were Ravi and Uthaiyasuriyan [3], as well as Gupta [4]. The paper and the article focus on demographic, economic and physical factors that play a significant role in agricultural output and gave us clues on which additional variables to include in our model. The last aspect we considered was droughts, as a study conducted by the FAO (Food and Agriculture Organisation of the UN), concludes that agriculture absorbs 80% of drought effects, and impacts are (not limited to) water availability as well as agricultural production. While we cannot prevent droughts, they can be predicted about a month in advance and therefore their effects can be mitigated. This brought us to consider whether predicting droughts could help us in predicting crop yields. An interesting study conducted by Park, Kim and Lee [5], proposes a model that look at predicting the Soil Moisture Index (SMI) to predict droughts and floods. As the thermal factor has the highest impact on SMI, we took inspiration from these results to include those factors as additional variables.

References

[1] Panda P. K., Rittu S. V. (2019) *Factors determining Agricultural output in Indian States: An Analysis*, International Journal of Applied Business and Economic Research.

[2] Gulati A., Saini S., Jain S. *Monsoon 2013: Estimating the Impact on Agriculture*, Indian Council for Research on International Economic Relations.

[3] Ravi S., Uthaiyasuriyan K. *Factors Affecting Agricultural Marketing in India: An Overview*, Indian Journal of Research.

[4] Gupta G. *What are the factors that affect agriculture in India*, www.preservarticles.com.

[5] Park H., Kim K., Lee D. *Prediction of Severe Drought Area Based on Random Forest: Using Satellite Image and Topography Data*, Multidisciplinary Digital Publishing Institute (MDPI).