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ROLE OF CHEMICAL INPUTS ON FOOD GRAIN PRODUCTION IN INDIA

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ABSTRACT

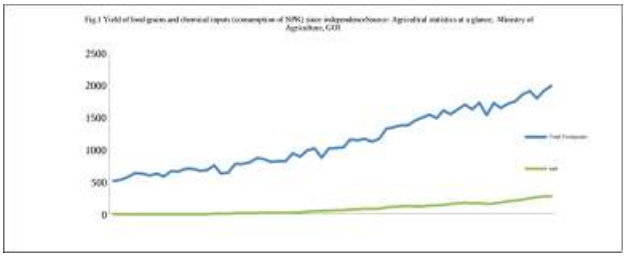
Agriculture sector is the backbone of Indian economy, employing about 52 per cent of the population. The objective of this study was to understand the effectiveness of chemical input usage food grain production, as only input, (in terms of NPK application) since independence. This study has applied ARMA (Auto-Regressive Moving Average) model to forecast the yield of food grain production. This study has found that the gap between the actual and forecasted yield has been significantly fulfilled with the application of chemical inputs in the food grain production after the Green Revolution as well as in the post reform period.

KEYWORDS: *Chemical inputs in agriculture, ARMA, Forecasting yield,JEL Classification: Q22, Q120, C530.*

INTRODUCTION :

India is largely an agrarian economy with 52 per cent of the population directly or indirectly employed in agriculture and its allied sectors but the contribution of agriculture sector to GDP has fallen from 30 per cent in 1990-91 to less than 15 per cent in 2011-12 (Economic Survey, 2012-13). Hence, Bhalla (2007) argued that the number of workers engaged in agriculture is, in turn, determined by the level of demand for food and other agricultural products, the demographic pressure on land, the extent of diversification of the economy and the capital intensity of agricultural production process.

On the basis of this argument, the role of chemical fertilizers for increased agricultural production particularly in developing country is well established during initiation of Green Revolution. Fertilizer was important seed in the Green Revolution contributing more than 50 per cent of the yield growth in Indian agriculture. Fertilizer consumption in India has been increased over the years and today India is one of the largest producer and consumer of fertilizers in the world. By 2009-10 total fertilizer consumption in the country was 25.49 million nutrient tones.



Usage of fertilizers is essential for improvement of yield, as it is understood from Figure 1[2], that with rise in NPK[3] consumption of land, the agriculture production has risen. Still, Majhi & Kumar (2012) also find the unidirectional causality from fertilizer consumption to agricultural production in India. Similarly, Birthal, et.al. (1998) have said that demand for commercial energy based inputs like fertilizers and diesel would increase, with shift in cropping pattern from course cereals to fine cereals or

commercial crops. However, in India for nearly four decades from 1950-51 to 1990-91, agricultural policy has constituted a part and parcel of overall planning of the economy. With the initiation of economic reforms in 1991, both the overall macro-economic policy framework as well as agricultural policy has undergone a significant change. These changes have had a significant impact on the growth of agriculture in the post-reform period (Bhalla, 2007). Therefore, it is important to understand the fertilizer use behavior in the country over time and its impact on agriculture yield.

Hypothesis: With the inclusion of chemical inputs (NPK) in agriculture, yield of food grain must increase. Hence, in tandem with the inclusion of that chemical input, it is necessary to forecast food grain production in Indian agriculture.

For searching the answer of this hypothesis, the objectives are as follow:

• To forecast the food grain production since independence as well as after green revolution in India along with to forecast the food grain production in post financial reform period (i.e. after 1991).

• To compare the actual production and forecasted production during these time periods (i.e. since independence, after green revolution and after financial reform period i.e. after 1991).

METHODOLOGY:

This paper is an effort to understand the effectiveness of using agriculture yields by analyzing the gap between the forecasted the food grains production and the actual since independence, period after green revolution and in the post reform period. Hence, this paper has applied the ARMA[4] (Auto-Regressive Moving Average) model to forecast the food grain production in India.

Basic model: $Y_t = \alpha + ß X_t + u_t;$

Here, Y_t = natural logarithm of yield of food grains in India and X_t = natural logarithm of chemical inputs used i.e. NPK, used in production. a and ß are parameters and ut is white noise.

Step.1 Production forecast done with the above model since independence to 2011, and found the gap between actual and forecasted yield and analysis done on the impact of chemical inputs on food grain yield in India.
Step.2 Production forecast done with the above model since Green Revolution in India to financial reform period (i.e. up to 1991). The gap between the actual and forecasted data has been analyzed for the study.
Step.3 Production forecast done since post financial reform period (i.e. after 1991). The gap between the actual and forecasted data has been analyzed for the study.

EMPIRICAL RESULTS

This paper has objective to forecast the yield of food grains production with the application of fertilizer as a chemical inputs on different time period (as shown in table.1). This table indicates the regression results by applying ARMA model to forecast the food grains production.

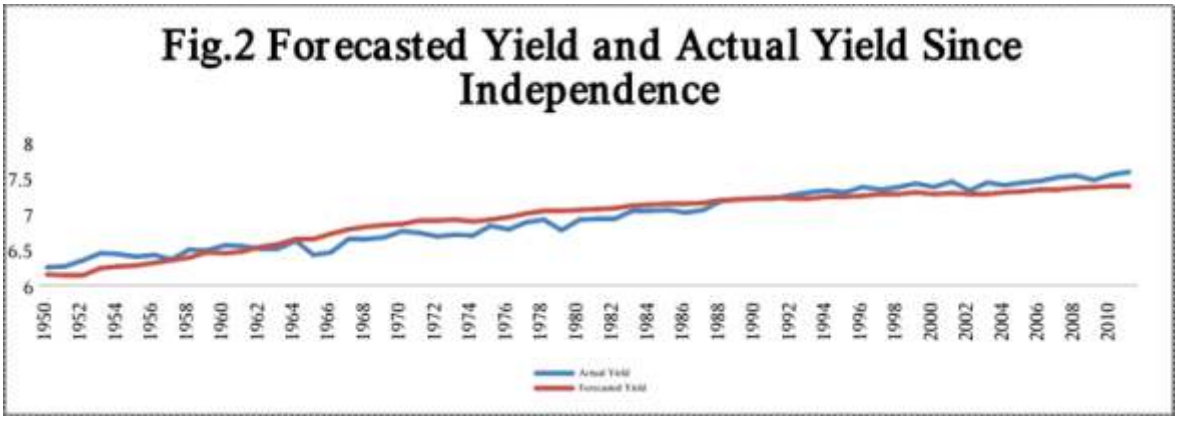
Table.1 Regression results for forecasting the yield of food grain production

Variable	1950-51 to 1965-66	1965-66 to 1991-92	1991-92 to 2011-12	1050-51 to 2011-12
constant	6.38	5.84	5.61	6.24
P-value	(0.000)	(0.000)	(0.000)	(0.000)
X_t	0.09	0.27	0.34	0.2
P-value	(0.000)	(0.000)	(0.000)	(0.000)
R^2	0.61	0.94	0.87	0.88
F	22.6	432.04	130.08	468.12
P-value	(0.000)	(0.000)	(0.000)	(0.000)
N	15	27	21	62

Dependent variable: Yt

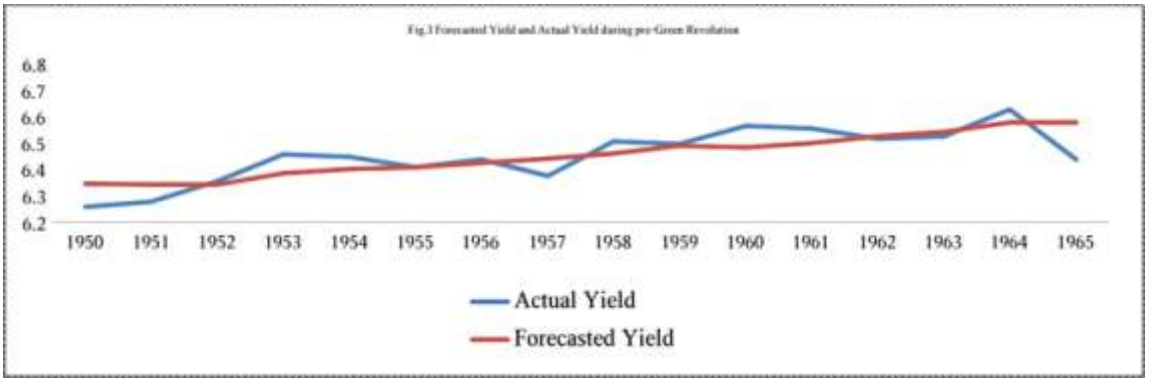
Note: *Y_t = natural logarithm of yield of food grains in India and X_t = natural logarithm of chemical inputs used i.e. NPK, used in production.*

In the above table.1,model as well as coefficient of the variables are statistically significant. Yield of food grain production is significantly positively related to fertilizer consumption in all equations. Now the forecasting of these results is shown in following figures. In these figures, red line shows the forecasted yield of food grain production while blue line shows the actual yield.



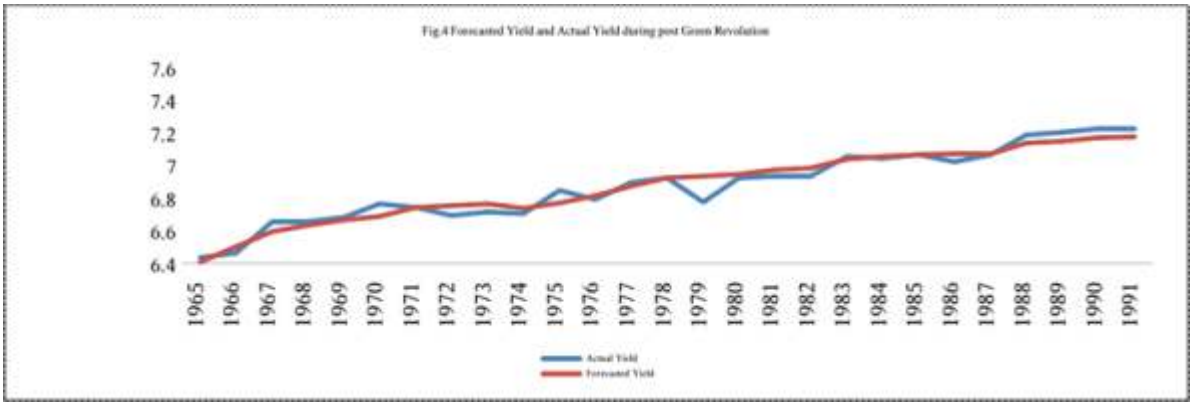
Note: *Y-axis represents forecasted yield and actual yield, calculated by above regression while on X-axis shows year i.e. from 1950-51 to 2011-12.*

Fig.2 clearly indicates the gap between actual and forecasted yield of food grain production as per only input, chemical inputs (NPK) in India since independence. In the pre-green revolution period (i.e. before mid 1960s) which could also be termed as severe food crises period (Evenson, et.al., 1998), the forecasted yield is less than the actual yield. The causation factor was being the use traditional techniques and limited use of NPK. However, during green revolution period it is clearly indicated that forecasted yield is greater than actual yield because of implication of new techniques in agriculture along with appropriate usage of chemical inputs (like NPK). On the other hand, in the post reform period, the forecasted yield is less than the actual yield because of the food surplus of early 1990s (Evenson, et.al., 1998). But in early 2000s, the growth rate of agricultural production has declined accordingly (Economic Survey, 2012-13) as Jha, et.al (2012) have also noticed that the consumption of fertilizer has declined from 56 per cent to 35 per cent during 1980-81 to 2006-07. So, it is an attempt to study the forecast yield of food grain production during pre- green revolution, post-green revolution and post-financial reform period seperately.



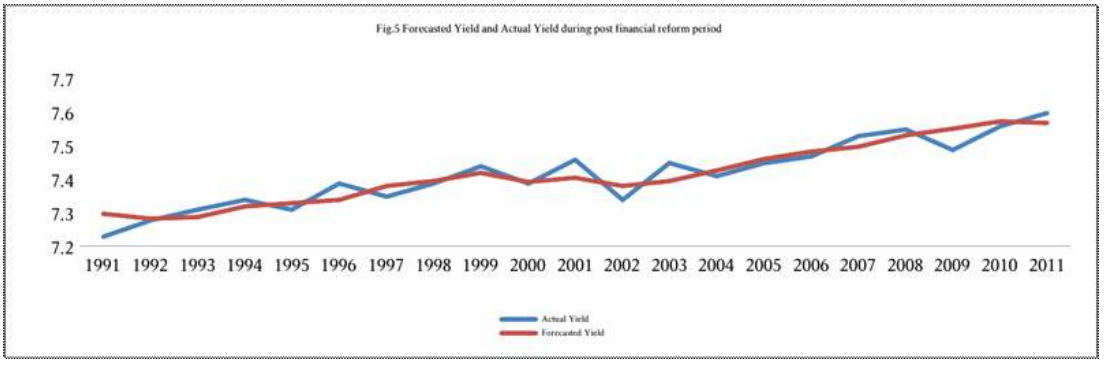
Note: *Y-axis represents forecasted yield and actual yield, calculated by above regression while on X-axis shows year i.e. from 1950-51 to 1965-66.*

The relation between forecasted yield and actual yield during pre-green revolution is shown in Fig.3. It is the period of food crises in India. So, the gap between actual and forecasted yield is significantly (as shown in table.1) fluctuated as per time because the number of time period is less.



Note: *Y-axis represents forecasted yield and actual yield, calculated by above regression while on X-axis shows year i.e. from 1950-51 to 2011-12.*

Note: *Y-axis represents forecasted yield and actual yield, calculated by above regression while on X-axis shows year i.e. from 19 to 2011-12.*



Note: *Y-axis represents forecasted yield and actual yield, calculated by above regression while on X-axis shows year i.e. from 1991- 92 to 2011-12.*

The relationship between actual and forecasted yield during post-green revolution and post-financial reform period has shown in Fig.4 and Fig.5 respectively. It is clearly indicated in both the figures, the gap between actual and forecasted yield has significantly fulfilled at most (except some time period) because of the flourishing

of the new techniques of green revolution as well as the financial reform (1991-92). Hence, it is to infer that due to green revolution (1965-66) as well as financial reform (1991-92) gap between forecasted and actual yield of food grain production has overcome.

CONCLUSION:

Agriculture sector is the backbone of Indian economy, employing about 52 per cent of the population. The objective of this study was to understand the effectiveness of chemical input usage food grain production, as only input, (in terms of NPK application) since independence. This study has applied ARMA (Auto-Regressive Moving Average) model to forecast the yield of food grain production. Since Independence, it is clearly divided into three periods of agricultural food grain production (Fig.2). This study has found that the gap between the actual and forecasted yield has been significantly fulfilled with the application of chemical inputs in the food grain production after the Green Revolution as well as in the post reform period.

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2.In Fig.1 Y-axis shows the yield of food grains in kg per hectare as well as NPK in million tons, while in X-axis it is time period since 1950-51.
3.NPK implies consumption of Nitrogen, Phosphorus and Potassium in million tones as chemical inputs.
4.It is applied here as a static forecasting.

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