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Demand and Supply Projections of Food Grains in India

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Abstract

Demand and supply of food grain for India was projected through this study. The outcome of the study revealed that the demand of food grain will increase over time with the increase in population. In 2030, projected total demand of the food grain for entire India will be 252.05 million tonnes and 171.68 million tonnes and 80.37 million tonnes for rural and urban areas respectively. The study also revealed that in 2030, the supply projection for the entire India will be 350.42 million tonnes. Demand and supply gap showed that in 2030, India have a surplus food grain stock of 98.37 million tonnes. Assuming constant productivity in food grain sector, projected demand will be 252.05 million tonnes and supply will be 277.70. Due to the constant productivity, surplus food grain stock will decline and become 25.65 million tonnes. Assuming constant area in food grain sector, the demand and supply of food grain will be 252.05 million tonnes and 337.55 million tonnes respectively. With constant area, the surplus food grain stock will be 85.50 million tonnes.

Keywords: *Demand and supply, Foodgrains, Projections.*

JEL Classification *: Q1, Q14, E02*

Introduction

India's population in 2012 was 1.237 billion and is growing at 1.3 per cent approximately. Further, 22 per cent of the population is below the poverty line (World Bank, 2014). In 2012, India had 217 million undernourished individuals. Although, the number of undernourished has fallen by approximately 9.3 per cent over the last 20 years, still India has the largest number of people suffering from chronic hunger in the world (FAO, 2013). Compared to other countries, India faces a greater food challenge – having only 2.3 per cent share in world's total land area, it has to ensure food security to about 17.5 per cent of the world's population. (Anonymous, 2011). The current food grain demand in India, estimated at 234.26 million tonnes in 2011-12 (India Times, 2012), is projected to increase to about 291 million tonnes by 2025 and to 377 million tonnes by 2050 –putting the overall value of demand of all crops at US$ 366 billion by 2050 (Amarasinghe *et al*., 2010). According to the latest Government of India figures, the total food grain production in India in 2011-12 was 252.56 million tonnes – reaffirming India's position as a self-sufficient nation in food grains. (Press Information Bureau, 2012). India, at present, finds itself in the midst of a paradoxical situation of widespread mass-hunger coexisting with sufficient food grain stocks. The food grain stocks available with Food Corporation of India (FCI) stand at an all-time high at 38 million tonnes against an annual requirement of around 20 million tonnes for ensuring food security in 2010. Still, an estimated 200 million people are underfed and another 50 million are on the verge of starvation, resulting in starvation deaths. The paradox lies in the inherent flaws in the existing food policy and implementation bottlenecks (Lakshmanan, 2010).

The per capita net availability of food grains has increased by about 12 per cent during 1951 to 2011 from 394.9 g. per day to 462.9 g. per day. It happened due to an increase in the food grain production in India from 50.82 million tonnes in 1950-51 to 257.4 million tonnes in 2011-12 showing an annual increase of about

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2.5 per cent per annum (Anonymous, 2011).The demand for food items in India is increasing at a very high rate following a steady increase in per capita income. Higher disposable income has not only significantly increased the overall demand for agricultural commodities but also changed the pattern of consumption. Gulati and Saini (2013) have shown that the pressure on prices is more on protein foods like pulses, milk and milk products, egg, fish and meat and vegetables indicating the shift in consumption pattern from cereal based diets to protein based diets due to rise in income. As the Indian economy is opening up, the purchasing power of the people is increasing with parallel to product price. In this present changing scenario, through expenditure elasticity analysis, we can project the future demand and supply scenario of food grain. This long term projection of food grain is important to formulate governmental policy for the development of food grain crops in the long run to achieve national food security for India.

Data Sources and Methodology

Expenditure elasticity

In order to work out expenditure elasticity of demand for food grains in rural and urban India using 68th round NSSO data, various models were tried to find the best fit model. The best model is selected on the basis of highest R^2 value. The selected models were as follows,

a) Linear function: $Y = a + bX + U$
b) Logarithmic Function: $Y = log_b X + U$
c) Exponential function: $Y = ab^X$
d) Quadratic function: $Y = aX^2 + bX + U$

Where,

Y = Per capita expenditure on food grain (Rs /month) in rural/urban areas (NSSO data).

X= Per capita total consumption expenditure on all commodities (Rs /month) in rural/urban area (NSSO data).

a = Constant
b = Regression coefficient
U = Random/error term

The expenditure elasticity was worked out by the following formula,

$$e_x = \frac{b_1 - b_2}{\overline{X}}$$

Where,

e_x = Expenditure elasticity of food grain in rural/urban areas

b_1, b_2 = Regression coefficients and

$\overline{X}$ = Mean value of total consumption expenditure on all commodities in rural/urban areas (NSSO data)

Demand projection formula

Demand projection is done by the equation developed by P. Kumar,

$$D_t = D_O \; N_t \; (1 + y \; e)^t$$

Where,

D_t = Potential demand in rural/urban India in time period t

d_0 = Annual per capita consumption in base year

N_t = Rural/Urban human population in India in time period t

y = Growth rate in per capita income (in per cent)

e = Expenditure elasticity of demand for the commodity

Results and Discussion

Food grain demand and supply projections of India, 2015 to 2030

In order to find the demand projections of India, four time periods are selected. To project the demand, projected population of India given by the Planning Commission of India, and expenditure elasticity for both rural and urban area is used. Expenditure elasticity is calculated by the method given by P. Kumar. The demand projections of food grain are made for the years 2015, 2020, 2025 and 2030 for rural as well for the urban areas. Supply of food grain is worked out by Compound Annual Growth Rate of area, production and productivity. Demand and supply gaps are calculated for the years 2015, 2020, 2025 and 2030, all the Tables are presented in the following sub sections.

Table 1: Projected population and per capita Consumption of Food Grain in India

Area	Population (Million)				Consumption kg/capita/ annum
	2015	2020	2025	2030	
Rural	873.708	907.126	931.789	1000.336	171.6
Urban	395.253	432.615	468.049	523.146	153.6
Total	1268.961	1339.741	1399.838	1523.482	162.6

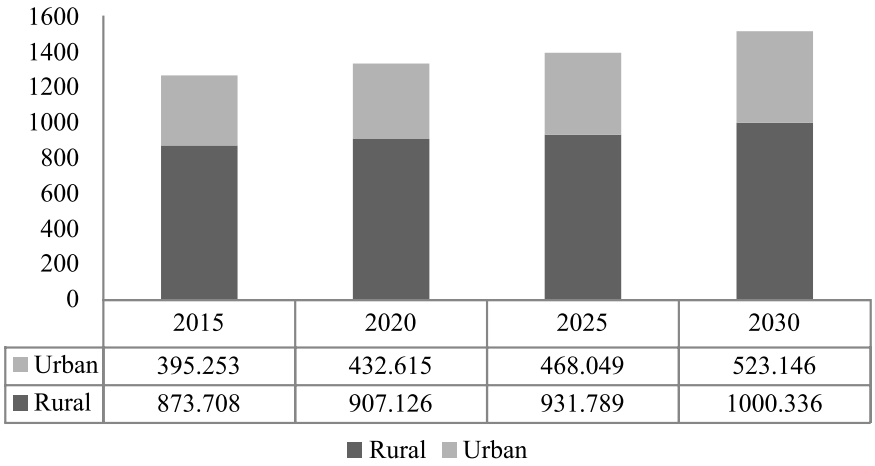

Figure 1. Projected population of India for 2015, 2020, 2025 and 2030 in million

Projected population and per capita consumption of food grain in India:

The per capita population projection and consumption of food grain (per kg) (NSSO) are presented in Table 1. According to National Sample Survey Report of 68th round (2011-12), the consumption of food grain per capita per annum was 171.6 kg and 153.6 kg for rural and urban people of India respectively and the overall consumption of food grain was 162.6 kg per capita per annum. The data presented in table1 further revealed that population of India is likely to be 1268.961 million, 1339.741 million, 1399.838 million and 1523.482 million in 2015, 2020, 2025 and 2030, respectively. The projected rural population is 873.708 million in 2015, 907.126 million in 2020, 931.789 million in 2025 and 1000.336 million in 2030. The urban population is projected 395.253, 432.615, 468.049, 523.146 million in 2015, 2020, 2025 and 2030 respectively.

Regression coefficients and R^2 using various regression models for India

The result presented in Table 2 shows regression coefficients and the R^2 value using linear, logarithmic, exponential and quadratic regression models. The R^2 values for the models in case of rural areas are 0.044, 0.014, 0.066 and 0.544 for linear, logarithmic, exponential and quadratic models respectively. In case of urban India, the values are 0.155, 0.097, 0.17 and 0.521. So it is observed from the table that R^2 value for the quadratic model is larger than other models and it is both in the case of rural and the urban India. The quadratic function was found to be best fit because the value of R^2 was the highest and regression coefficients were significant. So, the coefficient values of quadratic model are used for the data analysis. The coefficient value in quadratic model for the b_1 is 0.416 and 0.327 for rural and urban India respectively. The value of the coefficient b_2 is -0.000000042 and -0.00007105 for rural and urban India, respectively. The expenditure elasticity of food grain were found to be 0.0055 and 0.0024 for rural and urban India respectively.

Table 2. Regression coefficients and R^2 using various Regression Models For India

	Model	Linear	Logarithmic	Exponential	Quadratic
b_0	Rural	231.878	324.507	241.131	-138.12
	Urban	317.271	666.174	333.645	-112.483
b_1	Rural	-0.017^{NS}	-16.281^{NS}	0	0.416*
	Urban	-0.028^{NS}	-53.659^{NS}	0	0.327*
b_2	Rural	-	-	-	-0.000000042
	Urban	-	-	-	-0.00007105
F	Rural	1.152	0.365	1.773	14.297
	Urban	4.569	2.689	5.135	13.037
R^2	Rural	0.044	0.014	0.066	0.544
	Urban	0.155	0.097	0.17	0.521
Expenditure Elasticity	Rural	0.0055			
	Urban	0.0024			

Table 3. Demand Projections of Food Grain for India

Particulars	Demand projection (million tonnes)			
	2015	2020	2025	2030
Rural	149.98	155.70	159.93	171.69
Urban	60.72	66.47	71.91	80.37
Total	210.70	222.17	231.84	252.05

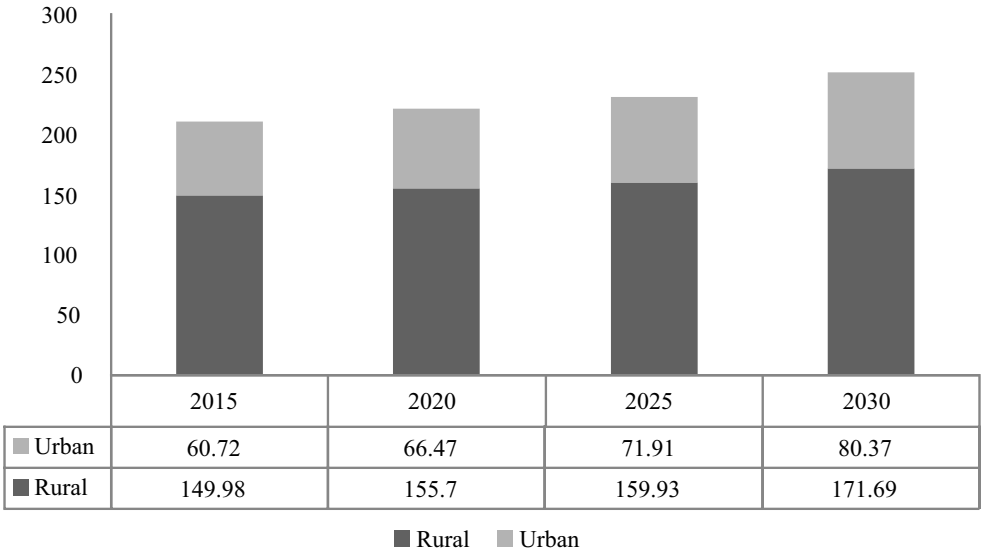

Figure 2: Projected demand of food grain for rural and urban India, 2015, 2020, 2025 and 2030

Demand projections of food grain for India

Using projected population and expenditure elasticities of rural and urban India, the demand projections for food grain were made and are presented in Table 3. The perusal of Table 3 revels that the demand of food grain will increase over time. In 2030, total demand of food grain will be 252.05 million tonnes. In 2015, it is likely to be 149.98 million tonnes in rural and 60.72 million tonnes in urban India. The total demand in 2015 will be 210.70 million tonnes. In 2020, it is likely to be 155.70 million tonnes in rural and 66.47 million tonnes in urban India. The total demand in 2020 will be 222.17 million tonnes. In 2025, it is likely to be 159.93 million tonnes in rural and 71.91 million tonnes in urban India. The total demand in 2020 will be 231.84 million tonnes and in 2030, the total demand will be 252.05 million tonnes and it will be 171.69 million tonnes and 80.37 million tonnes for rural and urban India respectively.

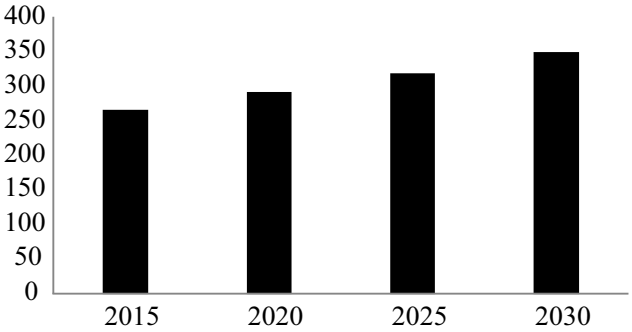

Figure 3. Projected supply of food grain for India, 2015, 2020, 2025 and 2030

Table 4. Supply Projections of Food Grain for India

Year	Supply projections		
	Area (million hectare)	Productivity (Kg/ha)	Supply (Million tonnes)
2015	128.26	2085.59	267.50
2020	129.87	2253.72	292.69
2025	131.50	2435.40	320.26
2030	133.15	2631.73	350.42
CAGR	0.25	1.56	1.81

Supply projections of food grain for India

The supply projections are made on the basis of Compound Annual Growth rate of area, production and productivity given in Table 4. The results revealed that CAGR of area, production and productivity were 0.25, 1.81 and 1.56 per cent respectively per annum over the period of 2006-10. The area under food grain was 123.71 million hectare in base year 2005-06, which was assumed to grow @ 0.25 per cent per annum. In base year 2005-06, productivity was 1756 kg per hectare which was assumed to grow @ 1.56 per cent per annum. The perusal of table 4 also revealed that the supply of food grain was projected at 267.50 million tonnes in 2015, 292.69 million tonnes in 2020, 320.26 million tonnes in 2025 and 350.42 million tonnes in 2030.

Demand and supply gap of food grain

The projected supply is compared with the

Table 5. Demand and Supply Gap of Food Grain for India

(million tonnes)

Year	Projected demand	Projected supply	Surplus
2015	210.70	267.50	56.80
2020	222.17	292.69	70.52
2025	231.84	320.26	88.42
2030	252.05	350.42	98.37

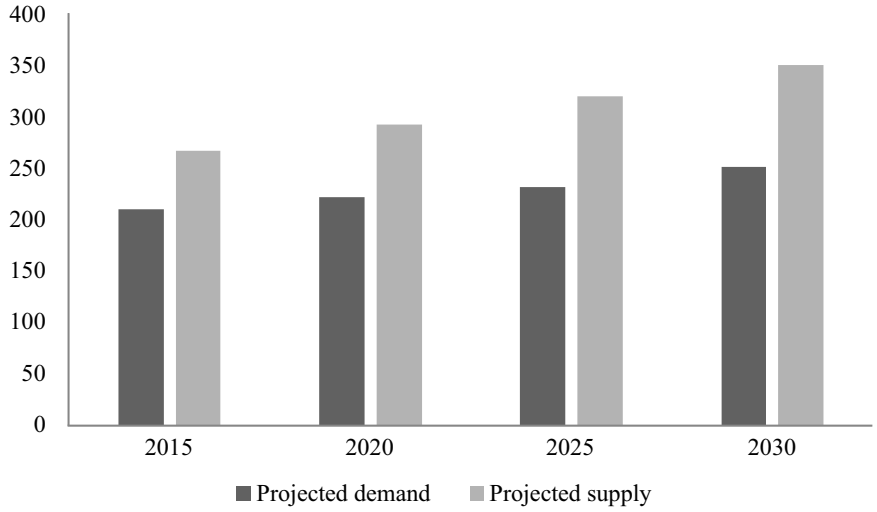

Figure 4. Demand and supply gap of food grain for India, 2015, 2020, 2025 and 2030

projected demand and the surplus is given in Table 5. The table revealed that gap between demand and supply was projected to be a surplus and the values are 56.80, 70.52, 88.42 and 98.37 million tonnes in 2015, 2020, 2025 and 2030 respectively.

Supply projections of food grain for India with constant productivity

If we assume constant productivity in recent future, than the total production will be less. In table 6, we see with constant productivity, the projected supply for the year 2015 will be 267.50 million tonnes. In the future, it will be 270.86 million tonnes, 274.26 million tonnes and 277.70 million tonnes in 2020, 2025 and 2030 respectively. We assume a 0.25 per cent annual growth rate in area, and the projected area will be 128.26, 129.87, 131.50 and 133.5 million hectares in 2015, 2020, 2025 and 2030, respectively.

Table 6. Supply Projections of Food Grain for India with Constant Productivity, 2015 to 2030

	Constant productivity		
	Area (million hectare)	Constant productivity (Kg/ha)	Projected supply (million tonnes)
2015	128.26	2085.59	267.50
2020	129.87	2085.59	270.86
2025	131.50	2085.59	274.26
2030	133.15	2085.59	277.70

Table 7. Demand and Supply Gap of Food Grain for India with Constant Productivity

(Million Tonnes)

	Projected demand	Projected supply	Gap
2015	210.75	267.50	56.75
2020	222.17	270.86	48.69
2025	231.84	274.26	42.36
2030	252.05	277.70	25.65

Demand and supply gap of food grain for India with constant productivity

The projected supply is compared with the projected demand and the surplus is given in table 7.The table revealed that gap between demand and supply was projected to be a surplus and the values are 56.75, 48.69, 42.36 and 25.65 million tonnes in 2015, 2020, 2025 and 2030, respectively.

Supply of food grain for India with constant area

If we assume constant area under food grain crops in recent future, than the total production will be less. As agricultural land is a natural resource that can't be increase infinitely. So, it is reasonable to assume a constant area under food grain crops. In Table 8, we see with constant area, the projected supply for the year 2015 will be 267.50 million tonnes. In the future year, it will be 289.06 million tonnes, 312.37 million tonnes and 337.55 million tonnes in 2020, 2025 and 2030 respectively. We assume a 1.56 per cent annual growth rate in productivity, and the projected productivity will be 2085.59, 2253.72, 2435.40 and 2631.73 kg per hectare in 2015, 2020, 2025 and 2030, respectively.

Table 8. Supply of Food Grain for India with Constant Area, 2015 To 2030

Year	Constant area (Million Hectare)	Projected productivity (Kg/ha)	Projected supply (Million tonnes)
2015	128.26	2085.59	267.50
2020	128.26	2253.72	289.06
2025	128.26	2435.40	312.37
2030	128.26	2631.73	337.55

Table 9. Demand and Supply Gap of Food Grain for India with Constant Area (Million tonnes)

Year	Projected demand	Projected supply	Gap
2015	210.70	267.50	56.80
2020	222.17	289.06	66.89
2025	231.84	312.37	80.53
2030	252.05	337.55	85.50

Demand and supply gap of food grain for India with constant area

The projected supply is compared with the projected demand and the surplus is given in Table 9 which revealed that gap between demand and supply to be a surplus with values 56.80, 66.89, 80.53 and 85.50 million tonnes in 2015, 2020, 2025 and 2030, respectively.

Conclusion and Policy Implications

Through the projected food grain demand and supply projection shows a positive indication in favour of India but without the increase in purchasing power of the poor, India cannot achieve food security as a whole. Without increase in area and productivity under food grain crops, increasing Indian population will create a detrimental effect on India's food grain self-sufficiency.

In the calculation of supply projection of food grains, it was found that the growth rate of area was 0.2499 per cent per annum and the projected area in 2030 will be 133.15 million hectare. But, we all know that area is a kind of natural resource that cannot be increased infinitely. Most of the major states in India has almost optimum area under farming and due to the development in recent future, it is fair to assume that it will be difficult to include more area under cultivation practice. We already destroyed natural resources like forests for our commercial cultivation and face its adverse effects on us. So, if we assume a constant area under farming, than the demand-supply projection is going down because though the productivity is increasing the total production will be less. So, to keep a balance between demand and supply with a constant area under farming, we have to concentrate on productivity. But, the agriculturally developed states like, Punjab, Haryana, Uttar Pradesh etc. they already have a higher productivity in their lands, so increase in productivity from those states is hard to expect because though the application of higher technology, the land has its optimum productivity. Contrast with that the agriculturally under developed states like, Assam, Bihar, Jharkhand etc. have a low productivity in their fields. If the Government of India concentrate on those states to increase the productivity, than all over production of India will increase with constant area. Effort is made to enforce the procedure to implement ever green revolution in eastern India.

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