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Demand-Supply Trends and Projections of Food in India

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Foreword

This paper draws upon some of the earlier work of the author on supply and demand projections of food groups. But the coverage of this paper is much wider as it also includes projections on demand and supply of sugar and oilseeds and not merely food grains and cereals. This is a difficult terrain, since possibilities of technological changes with significant impact on output cannot be ruled out. This paper also surveys the works of other scholars on this subject and has benefited from the insight provided by some of these scholars.

The projections made in this paper were an input into the Report of the Working Group for the Eleventh Five Year Plan (2007-12) on Crop Husbandry, Agricultural Inputs, Demand and Supply Projections and Agricultural Statistics. I am sure the wider audience will find it as useful.



Rajiv Kumar
Director & CE

March 14, 2008

Abstract

The present paper presents the supply and demand trends of rice, wheat, total cereals, pulses, edible oil/oilseeds and sugar/sugarcane. It provides the demand and supply projections for food items during 2011, 2021 and 2026. These projections have been based on change in productivity levels, changes in price, growth of population and income growth. A comparison with projections provided by other scholars has also been made in the paper. Subsequently, the future supply-demand gap has been discussed in the light of policy requirements. It is concluded that an increase in total demand is mainly due to growth in population and per capita income. A diversification in consumption basket significantly away from cereals has been observed. On the supply side, production is constrained by low yield growths. This is more specific in context of total cereals and sugarcane.

While in the short and medium term, there might be surplus of cereals in the country, these prospects are likely to diminish in the years to come. This situation is even more alarming for edible oil, sugarcane and pulses. To meet the future food requirements, the country shall have to either increase agricultural production, or depend on imports. In this light, the paper suggests that the policy focus needs to be laid, towards productivity enhancement in agriculture, through public investment in irrigation, development of roads, research and extension.

JEL Classification: Q11, Q18

Key Words: Demand Projection, Supply Projection, India, Food grains

Demand and Supply Trends and Projections of Food in India¹

1. Introduction

The Eleventh Plan aims to achieve a 9 per cent per annum economic growth, with agriculture and allied sectors growing at the rate of 4 per cent per annum. It is important to assess the feasibility of achieving this growth rate because agriculture is constrained by a number of factors of which supply and demand constraints are crucial ones. The imbalance between production and demand impacts the prices and profitability, which calls for policy interventions and planning to tackle the situation in future. Thus, the projects on demand side and supply side become very relevant to make policy interventions.

Population trends project India to emerge as the most populous country in the world in the coming decades. Demand and supply prospects of food items become important indicators to the country's food security concerns. These projections are based on growth in population and income, price change and change in productivity levels. Although, various demand and supply estimates are available for cereals with alternative assumptions in literature, not much has been said about other food items. This paper examines the past trends of demand and supply of selected food items in India. It also provides the demand and supply projections for food items under different scenarios, for 2011, 2021 and 2026. The paper covers the demand and supply estimates for food items like rice, wheat, total cereals, pulses, edible oil/oilseeds and sugar/sugarcane. A comparison of supply and demand projection done by other studies is also presented

¹ I am grateful to the Planning Commission for having given me the opportunity to do this important paper. I convey my gratitude to Prof. Praduman Kumar for his valuable suggestions. I am thankful to Gaurav Tripathi for his research assistance. The views expressed in this paper are my own and not that of ICRIER or the Planning Commission.

during the discussion. Future supply-demand gap is illustrated and discussed in the last section of the paper.

2. Past Trends in Food Consumption

The data provided by the National Sample Survey (NSS) on consumer expenditure for various rounds indicate a declining trend in the annual per capita consumption of food grains (total cereals and pulses). Consumption of per capita cereals declined from 140.3 kg per annum in 1983 to 138.2 kg per annum in 2004-05 (Table 1). This may be attributed to diversification in food consumption, easy access to supply of other high-value agricultural commodities,

Table 1: Trends in annual per capita consumption of food in India.

(Unit: Kg/annum)

Commodities	Annual per capita consumption				
	1983	1987-88	1993-94	1999-2000	2004-05
Rice	68.1	73.1	67.3	66.8	72.9
Wheat	47.9	49.1	43.8	45.6	52.7
Total Cereals	140.3	138.7	123.0	120.7	138.2
Pulses	10.1	10.3	8.1	10.6	8.5
Edible oil	4.1	4.7	4.7	8.7	-
Sugar	9.7	10.0	8.9	12.1	-

Source: Computed from consumer expenditure survey of National Sample Survey, Rounds No. 38, 43, 50, 55 and 61 pertaining to the periods 1983, 1987-88, 1993-94, 1999-2000 and 2004-05. 2004-05 figures are from the NSS report.

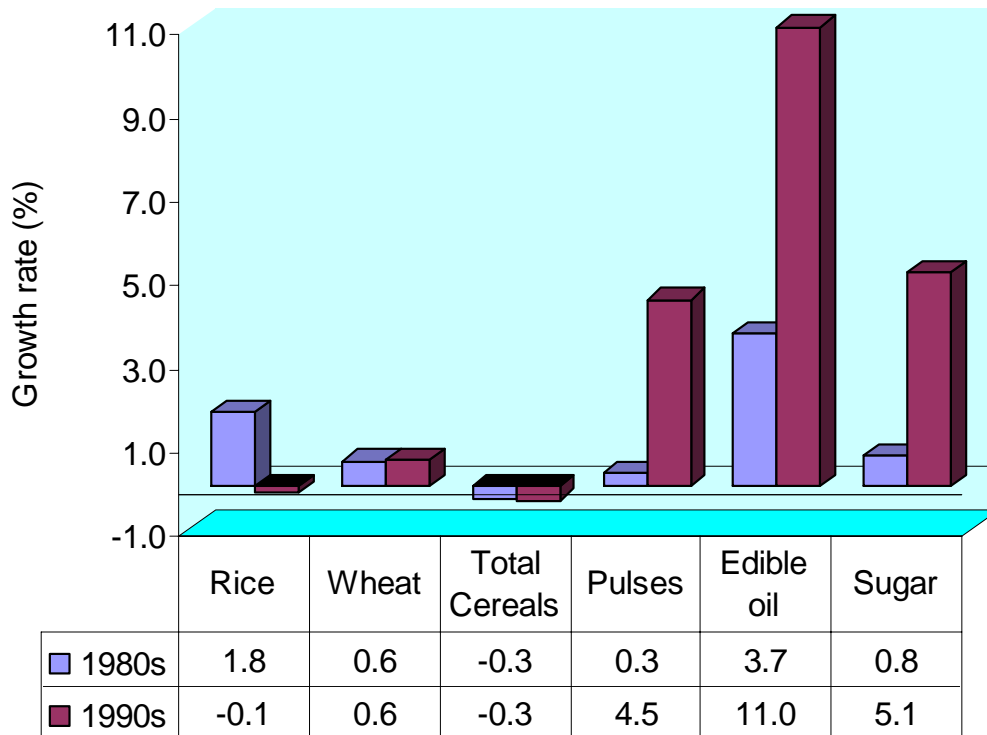
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changed tastes and preferences, as well as change in relative prices of food items (Mittal, 2006). Higher economic growth and per capita incomes have contributed to reduction in per capita demand for cereals. While the annual per capita consumption of rice, wheat and pulses changed marginally between 1983 and 2004-05, the per capita consumption of

edible oil has almost doubled. Sugar consumption also increased significantly from 9.7 kg per annum in 1983 to 12.1 kg per annum in 1999-2000.

Figure 1 below illustrates the average annual rate of growth² of per capita consumption during the 1980s and 1990s. The 1980s represent the change during 1983 to 1987, while the 1990s represent the change during 1993 to 1999. Total consumption of cereals shows a negative growth rate, both in the 1980s and 1990s. Growth in annual per capita consumption of edible oil has shown a significant increase in the two decades. Sugar also witnessed a higher rate of growth in per capita consumption in the 1990s. This is followed by significant increase in the consumption of pulses, followed by rice. According to Engel’s law, a rise in income brings about a fall in per capita consumption of staple food and this is indicative of improvement in the welfare of people.

Figure 1: Average annual growth rates for per capita consumption of selected food items



² Average annual growth rates computed in this paper are compound annual average growth rates across the time period specified.

3. Projections of Food Demand

Demand projections in general are estimated on the basis of assumptions about the base year demand, population, expenditure elasticity and economic growth. The domestic demand projections³ for rice, wheat and total cereals are arrived at by adding up the Direct Demand (human demand) and Indirect Demand (seed, feed, industrial use and wastage). It is observed that household food demand has been primarily driven by growth in population and income.

Population projections used for demand projections are given in Appendix 1. Expenditure elasticity (Appendix 2) used for demand projections are compiled from Mittal (2006)⁴. Domestic demand is projected under two scenarios of per capita income growth. The two scenarios assume that the gross domestic product (GDP) growth rates to be 8 per cent and 9 per cent. The results of food demand predictions corresponding to scenario of 9 per cent GDP is thought to be most likely in future. The growth in per capita income, under alternative scenarios, for computing demand projections is calculated by subtracting the population growth from income growth. Food demand is forecast for the years 2011, 2021 and 2026 at constant price of 1999-2000 (Table 2). Increase in the demand for total cereals and pulses are both on account of population growth and increase in demand for seed, animal feed and industrial use. The total cereal demand projected for 2011 is 187.8 million metric tonnes (mt) if the economy grows at the rate of 8 per cent per annum and 188.5 mt if the GDP is 9 per cent. The cereal demand in 2026 will be 273.5 mt and 277.2 mt in the alternative scenarios, respectively. During the same period, demand for rice, wheat and pulses is expected to be 102.1 mt, 65.9 mt and 57.7 mt, respectively, under

³ The demand projections for the commodities are obtained through

$$D_t = d_0 * N_t (1 + y * e)^t$$

where, D_t is household demand of a commodity in year t ; d_0 is per capita demand of the commodities in the base year; y is growth in per capita income; e is the expenditure elasticity of demand for the commodity; N_t is the projected population in year t .

⁴ The expenditure elasticity is computed using the two-stage Quadratic Almost Idle Demand System (QUAIDS).

Table 2: Projected domestic demand of food in India.*(Unit: Million Metric Tonnes)*

Food Items	Base year	Scenario 1			Scenario 2		
	1999-2000	2011	2021	2026	2011	2021	2026
Rice	66.0	94.5	96.9	102.2	94.4	96.8	102.1
Wheat	44.9	60.1	66.8	69.1	59.0	64.3	65.9
Total Cereals	119.0	187.8	242.8	273.5	188.5	245.1	277.2
Pulses	10.4	23.0	38.7	51.0	24.1	42.5	57.7
Edible oil	8.6	15.7	26.7	35.3	16.8	30.2	40.9
Sugar	11.9	26.7	55.0	81.1	29.3	65.7	100.7

Note: Scenario 1: GDP is 8%; Scenario 2: GDP is 9%. Domestic demand takes account of the demand for seed, feed, industrial use and wastage projected by Kumar (1998).

scenario 2. Increase in demand for pulses is quite evident as this is the major source of protein for the vegetarian population. Demand for edible oil is projected to be 40.9 mt by

Table 3: Projected annual per capita domestic demand for selected food items.*(Unit: Kg/ annum)*

Food Items	Scenario 1			Scenario 2		
	2011	2021	2026	2011	2021	2026
Rice	80.2	72.0	72.3	80.1	71.9	72.2
Wheat	51.0	49.6	48.9	50.0	47.8	46.6
Total Cereals	159.3	180.4	193.4	159.9	182.2	196.0
Pulses	19.5	28.8	36.1	20.4	31.6	40.8
Edible oil	13.3	19.8	25.0	14.2	22.4	28.9
Sugar	22.6	40.9	57.4	24.9	48.8	71.2

Note: Scenario 1: GDP is 8% per annum; Scenario 2: GDP is 9% per annum.

2026 and sugar demand is expected to increase almost nine-fold in 2026 from base year demand of 11.9 mt. By the end of the Eleventh Plan, if the economy grows at the rate of 9 per cent per annum, then the demand for pulses would be around 24.1 mt, for edible oil to be 16.8 mt and of sugar 29.3 mt.

Annual per capita domestic demand presented in Table 3 also projects an increase in demand for all the food items. The projected demand in 2026 highlights highest demand rise for oilseeds and sugar vis-à-vis total cereals in next two decades.

4. Demand Projections by Other Studies- A Comparison

Demand projections have been made in the past by different scholars under different assumptions related to population growth rates, expenditure elasticities, at different base years etc. Most of these projections are for rice, wheat, total cereals and pulses based on NSS consumer expenditure data. A comparison of the results of these studies and the present paper has been presented in Table 4 below.

Rosegrant *et al.* (1995) provided food projections for IFPRI's (International Food Policy Research Institute) 2020 vision based on the International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT). It used demand elasticity and technical coefficients synthesised from other sources, primarily from past studies. Demand for total cereals projected by this paper in 2020 is 237.3 mt. The study by Kumar (1998) used the Food Characteristic Demand System (FCDS). The total demand for cereals is projected to be 223.7 mt in 2010 and 265.7 mt in 2020 in Kumar's study. Bhalla (2001) computed demand for total cereals in 2020 as 374.7 mt. This study used new estimates on livestock growth. These estimates are based on the IMPACT model and based on the assumptions of GDP growth of 7.5-7.7 per cent. Thamarajakshi (2001) estimated the total demand for cereals to be 274 mt in 2020 under different assumptions of population and growth in urbanisation.

Table 4: Projected food demand for India, by different studies.*(Unit: Million Metric Tonnes)*

Source	Year	Rice	Wheat	Total Cereals	Pulses	Edible oil	Sugar
Mittal * under scenario 2 (9% GDP growth)	2011	94.4	59.0	188.5	24.1	16.8	29.3
	2021	96.8	64.3	245.1	42.5	30.2	65.7
	2026	102.1	65.9	277.2	57.7	40.9	100.7
Rosegrant et al. (1995)	2020	-	-	237.3	-	-	-
Kumar (1998)	2010	103.6	85.8	223.7	23.0	-	-
	2020	122.1	102.8	265.7	30.9	-	-
Bhalla (2001)	2020	-	-	374.7	-	-	-
Thamarajakshi (2001)	2020	-	-	274.0	-		
Hanchate & Dyson (2004)	2026	-	-	217.6	16.0		

*Note: * are the demand projections of the present paper.*

Hanchante and Dyson (2001) have projected the total demand for cereals at 217.6 mt in 2026. Cereal projections in this paper have been made at the state level, and subsequently aggregated at the country level. The base year considered for most of these studies is 1993-94. The present paper estimates 1999-2000 NSS rounds consumer expenditure data as the base year and also uses the expenditure elasticity computed for this year. These estimates are quite close to that of Rosegrant's study for total cereals. Estimates of Bhalla (2001) study for total cereals are observed to be quite different from that of other studies.

5. Past Trend in Production

Trends in production of selected food items and their average annual growth rates are presented in Table 5. During the period of triennium ending (TE) 1980-81, rice production was 49.9 mt which increased to 89.2 mt by TE 2006-07. Production of rice increased at a rate of 2.4 per cent per annum during this period.

Table 5: Trends in total domestic production of food in India

Food Items	Production (million metric tonnes)				Annual rate of growth (per cent)			
	TE 1980- 81	TE 1990- 91	TE 2000 -01	TE 2006- 07	1980/81- 2006-07	1980/81- 1990/91	1990/91- 2000-01	2000/01- 2006/07
Rice	49.9	72.8	86.9	89.2	2.4	3.7	1.8	0.1
Wheat	34.6	53.0	72.4	71.0	2.9	4.1	3.4	-0.5
Total Cereals	113.3	158.8	190.3	194.1	2.2	3.1	2.0	0.2
Pulses	10.5	13.7	13.1	13.6	0.7	2.2	0.3	1.4
Oilseeds	9.4	17.9	21.3	25.4	3.6	5.5	2.4	4.5
Sugarcane	144.9	223.2	294.7	287.9	2.6	3.3	2.8	-2.0

Note: All the production figures are triennium ending averages. Growth rates have been accordingly calculated after averaging out the fluctuations in production by taking triennium ending averages.
Source: Agricultural Statistics at a Glance, 2007, Directorate of Economics and Statistics, GOI

Similarly, the total domestic production of wheat nearly doubled from 34.6 mt in TE 1980-81 to 71.0 mt in TE 2006-07, at the annual rate of 2.9 per cent over these years. Total production of cereals has also grown at the rate of 2.2 per cent per annum during the 26-year period. Growth in production of rice, wheat and cereals is a cumulative effect of research efforts, area expansion, development of irrigation, enhanced use of fertilisers and plant protection measures. However, this growth has been decelerating very fast over the decades (Table 5). Growth in rice production slowed down to 1.8 per cent per annum during the 1990s and has only been growing at the annual rate of 0.1 per cent in the last six years, while the annual growth rate was 3.7 per cent in the 1980s. Overall total growth of cereals declined from 3.1 per cent per annum in the 1980s to 2.0 per cent per annum in the 1990s, and further to 0.2 per cent in the early period of the current decade, because the yield gains for cereals in the post-green revolution era have been low. For pulses and sugarcane also low yield (Appendix 3) have resulted in low production levels. However, oilseeds exhibited a high annual growth rate of 3.6 per cent in the overall period. But the oilseed sector suffers from the poor performance of the oil processing units.

6. World Trends in Food Production

Table 6 below provides an overview of the production of selected food items and world annual growth rates for these items between 1980-81 and 2005-06. World production for rice is observed to have increased from 403.5 mt in TE 1980-81 to 603.3 mt in TE 2005-06, at the rate of 1.7 per cent per annum. Total production of cereals increased at the rate of 1.2 per cent between 1980-2005. The production increased from 1591.1 mt in TE 1980-81 to 2194.7 mt in 2005-06. Wheat and pulses have been growing at a lower rate of nearly 1 per cent only in two and a half decades. Overall global production trends are quite similar to that in India. The world growth rates for total cereals and pulses have also slowed down in the second half of the period. The growth rates for all the food grains between 1990-91 and 2003-04 is nearly half or even less than that in the 1980s.

Table 6: Trends in World production of food.

Food Items	Production (million metric tonnes)				Annual rate of growth (per cent)			
	TE 1980- 81	TE 1990- 91	TE 2000- 01	TE 2005- 06	1980- 2005	1980- 90	1990- 2000	2000 -05
Rice	403.5	516.9	596.6	603.3	1.7	2.4	1.7	-0.1
Wheat	444.9	559.1	589.1	606.4	1.1	2.0	0.8	0.4
Total Cereals	1591.1	1904.0	2076.8	2194.7	1.2	1.6	1.2	1.0
Pulses	41.3	56.6	55.9	60.0	1.0	3.6	-0.1	1.5
Oil crops	51.2	75.0	107.3	131.7	4.0	4.0	4.1	4.1
Sugarcane	767.1	1053.5	1258.9	1325.7	2.2	2.9	2.3	1.3

Note: All the production figures are triennium ending averages. Growth rates have been calculated after averaging out the fluctuations in production by taking triennium ending averages.

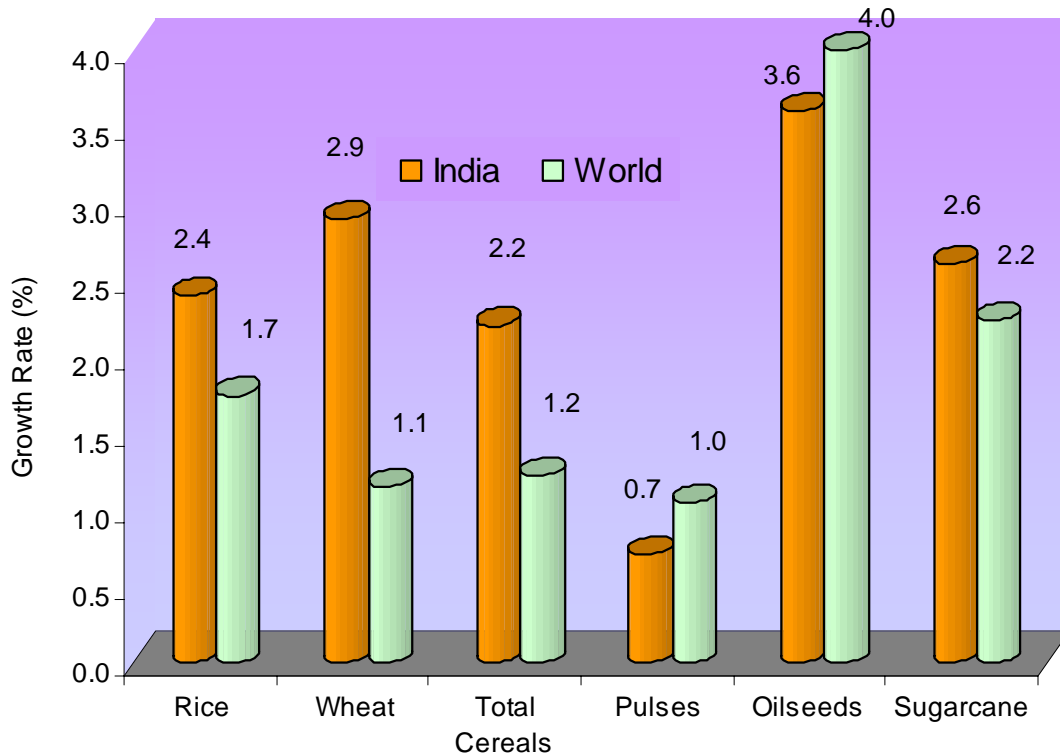
Source: FAO Statistics. <http://faostat.fao.org/>

On the other hand, global production of oil crops has shown a tremendous increase from 51.2 mt in TE 1980-81 to 131.7 mt in TE 2005-06, showing a growth rate of around 4 per

cent during this period. These growth rates have been maintained over decades. World sugarcane production also increased from 767.1 mt in TE 1980-81 to 1053.5 in TE 1990-91 and further to 1,325.7 mt in TE 2005-06 at the rate of 2.2 per cent.

Figure 2 below illustrates the production growth rates of the world and India during 1980-81 to 2003-04. For rice, wheat, total cereals and sugarcane production, growth rates in India have been higher than that of the world. For oilseeds and pulses rate of growth of World production is marginally higher than that of India.

Figure 2: Average annual growth rates of production for World and India, TE 1980-2006



7. Projections of Food Supply

Medium and long-term supply projections of food have been made using a straightforward approach. Supply projections have been calculated assuming the yield growths to be same as in the past decade (Appendix 3). It is also assumed that further

area expansion will take place. Supply prospects have accordingly been presented in Table 7 for selected food items -- rice, wheat, total cereals, pulses, oilseeds and sugarcane. Supply projections have been computed for the years 2011, 2021 and 2026, using the yield growth for the most recent period of 1993-2003 and taking 2003-04 as the base year for area and production. The projected yield figures for different crops, used in computation of future supply have been presented in appendix 4.

Table 7: Projected domestic supply of selected food items in India

(Unit: Million Metric Tonnes)

Food Items	Base Year 2003-04	Supply Projection		
		2011	2021	2026
Rice	88.3	95.7	105.8	111.2
Wheat	72.1	80.2	91.6	97.9
Total Cereals	186.9	209.7	242.2	260.2
Pulses	14.9	16.1	17.6	18.4
Edible oil	8.6 (25.3)	10.1 (29.9)	12.5 (36.9)	13.9 (41.1)
Sugar	24.2 (237.1)	25.0 (245.0)	26.0 (255.2)	26.6 (260.5)

Note: Area and yield growth rates for the period 1994/95 to 2004-05 on the base period triennium ending 1993-94 are used from Agricultural Statistics at a Glance, 2007, Directorate of Economics and Statistics, GOI.

10.2% is conversion factor of sugarcane to sugar and 33.9% is the average conversion factor of edible oilseed to edible oil. Figures in the parenthesis are the supply projections for oilseeds and sugarcane in respective columns.

If there is no area expansion and future supply is only dependent on yield growth, then total supply of cereals will be 209.7 mt in 2011, 242.2 mt in 2021 and 260.2 mt in 2026 (Table 7). The yield growth of total cereals has been 1.5 per cent in the past decade, according to government estimates. Rice and wheat production is also estimated to increase to 111.2 mt and 97.9 mt, respectively, by 2026. There has been a diversification in the cropping pattern towards high-value commodities in major rice producing regions.

Supplies of pulses are estimated to be of the tune of 16.1 mt in 2011, 17.6 mt in 2021 and 18.4 mt in 2026 under the given assumptions. Oilseed production is projected to go up to

36.9 mt in 2021 and 41.1 mt in 2026 over the base year production of 25.3 mt in 2003-04. Sugarcane has very low yield growth, thus the sugarcane production is estimated to be around 245.0 mt in 2011, 255.2 mt in 2021 and 260.5 mt in 2026. The edible oil production is estimated to be 10.1 mt in 2011 and 13.19 mt in 2026. The sugar production is likely to be 25.0 mt in 2011, 26.0 mt in 2021 and 26.6 mt in 2026.

8. Supply Projections by Other Studies- A Comparison

Some supply projections have been made under the assumptions of yield growth, cropping pattern shift, technological change, impact of input and output prices etc. A comparison of supply estimates by other studies and the present paper is shown in Table 8. Hanchante and Dyson (2001) computed supply projections using area and yield projections for total cereals and pulses for 2026. According to the paper, domestic production in 2026 will be 265.8 mt

Table 8: Projected food supply for India, by different studies

(Unit: Million Metric Tonnes)

Source	Year	Rice	Wheat	Total Cereals	Pulses	Oilseed	Sugarcane
Mittal*	2011	95.7	80.2	209.7	16.1	29.9	245.0
	2021	105.8	91.6	242.2	17.6	36.9	255.2
	2026	111.2	97.9	260.2	18.4	41.1	260.5
Kumar (1998)	2010	109.3	96.0	248.4	-	-	-
	2020	134.0	127.3	309.0	-	-	-
Mittal (2000)	2010	112.7	94.8	-	-	-	289.0
	2020	149.3	128.5	-	-	-	298.1
Kumar & Mittal (2003)	2010	107.8	95.4	236.8	13.9	-	-
	2020	127.0	111.5	274.0	15.2	-	-
Hanchate & Dyson (2004)	2026	-	-	265.8	23.7	-	-

*Note: * are the supply projections of the present paper.*

for total cereals and 23.7 mt for pulses with 1996-98 as the base year. Total estimates for cereals are quite close to the ones projected by the present paper with 2003-04 as the base

year and the assumption of only yield growth. Kumar (1998) and Kumar & Mittal (2003) study present estimates on future supply under assumptions of input and output prices, total factor productivity (TFP) growth and supply elasticity. The results in Table 8 for these studies are under the assumptions of constant TFP growth. These studies project a supply of 309 mt and 274 mt of total cereals, respectively, in 2020. Estimated supply of pulses in 2020 by Kumar & Mittal (2003) study is 15.2 mt with 2000-01 very close to the 17.6 mt estimate of pulses production by present paper for 2021. Future supply estimates for oilseeds and sugarcane have not been given by other studies except for Mittal (2000). The estimates in the present paper for sugarcane is lower than that of Mittal (2000) because sugarcane yields are showing a declining trend in present years.

9. Policy Implications

Demand and supply projections act as indicators to policy makers to formulate their medium and long-term agricultural policies. The present paper shows that the increase in total demand is mainly due to growth in population and per capita income. As far as supply is concerned, production is constrained by low yield growth.

Table 9: Supply-Demand gap for selected food items

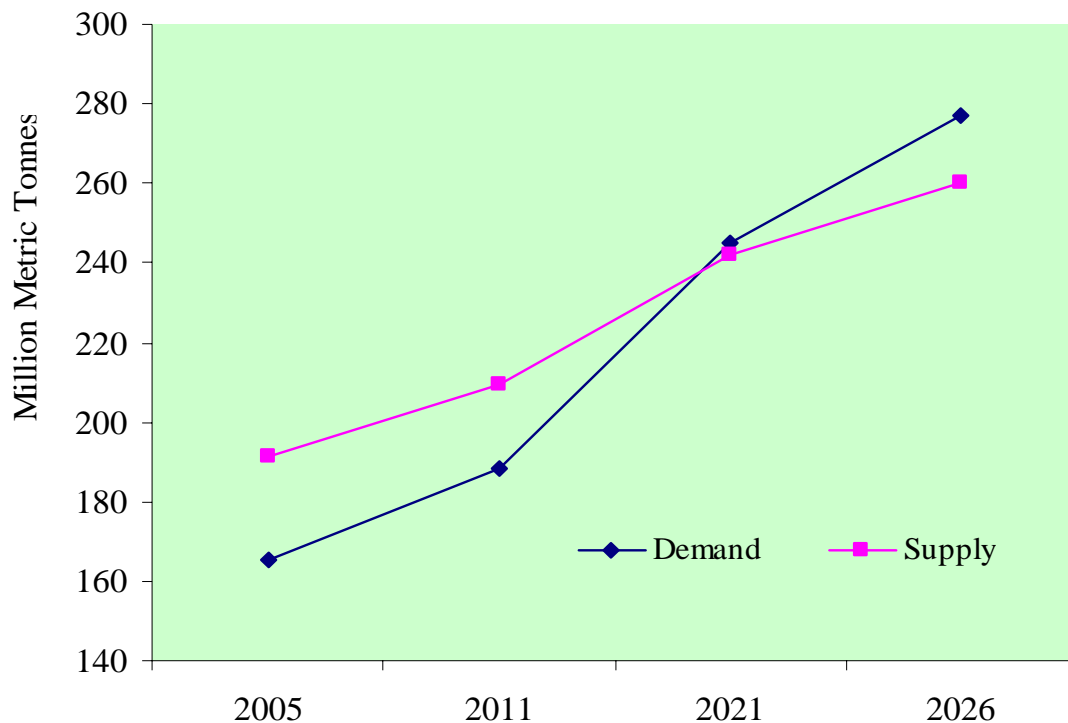
(Unit: million metric tones)

Food Items	Gap (Supply-Demand)		
	2011	2021	2026
Rice	1.26	8.98	9.13
Wheat	21.21	27.33	32.04
Total Cereals	21.19	-2.94	-16.97
Pulses	-8.05	-24.92	-39.31
Edible oil	-6.66	-17.68	-26.99
Sugar	-4.31	-39.67	-74.13

Note: 10.2% is conversion factor of sugarcane to sugar and 33.9% is the average conversion factor of edible oilseed to edible oil. Demand scenario of GDP growth at 9% is considered here.

A negative gap indicates that the demand of the commodity is more than its supply and this implies a deficit of the commodity in future (Table 9). *The gap between supply and demand is narrowing down over the years for all the food items.* The supply-demand gap for total cereals is expected to be 21.19 mt in 2011 whereas it is projected at -16.96 mt in 2026. This is also illustrated in figure 3.

Figure 3: Future Supply and Demand Balance for Total Cereals in India



If we look at the medium-term prospect then in 2011 by the end of the Eleventh Plan, the situation for pulses, edible oil and sugar is alarming. Even at base year domestic edible oil production is less than the demand for edible oil. *In view of increasing demand in future there is need to raise level of production of oilseeds through cost reducing technological change, while research and development efforts need emphasis* (Chand, Jha and Mittal, 2004). In value addition term, the efficiency of the processing sector also needs to be targeted through policy reforms. *The gap in supply and demand for pulses, edible oil and sugar is expected to be negative in future. This implies that in the years to come, the country will have to rely on imports of these food items to meet the*

domestic requirement. Thus, we need to have necessary policy initiatives to increase the supply in future.

Rate of the growth of projected demand for the selected food items is much more than projected supply growths for these. Table 10 shows that *in future, for cereals the demand grows at a much higher rate than the domestic supply.* This difference in growth rates is much higher for pulses, edible oil and sugar.

Table 10: Per cent annual growth rate of projected supply and demand.

Food Items	Demand	Supply
Rice	1.55	1.01
Wheat	1.42	1.34
Total Cereals	3.17	1.45
Pulses	6.51	0.91
Edible oil	5.95	2.13
Sugar	8.22	0.41

Note: Growth rates are between base year and 2026.

Demand scenario of GDP growth at 9% is considered here.

Table 11: Average yield and yield potential at TE 2003-04

(Unit: tonnes per hectare)

Food Items	Yield (India)	Potential Yield (Highest in World)
Rice	3.03	9.71 (Egypt)
Wheat	2.69	8.89 (Namibia)
Total Cereals	2.39	10.41 (Ireland)
Pulses	0.60	5.14 (Barbados)
Edible Oilseed	0.25	4.29 (Peru)
Sugarcane	60.70	122.70 (Malaysia)

Source: Computed from FAO Statistics. <http://faostat.fao.org/>

Countries in parenthesis are the ones which have the highest yield for the specified food item.

To meet the domestic food requirements, the country either needs to increase agricultural production or depend on imports. *Since agricultural growth is limited, imports can help improve the country's supply situation for a short term. But for the long term, the country will need to focus on productivity enhancement, through public investment in irrigation, research and efficient use of water, plant nutrition and other inputs* (Kumar 1998, Fan et al 1999, Evenson et al 1999, Singh 2001). These policies will induce efficiency and can help in maintaining balance between domestic production and demand.

Table 11 shows that there exists a huge gap between the average yield achieved in India at TE 2003-04 and the yield that have been achieved by other countries. This can be an indicator of the yield potential that is achievable through technological enhancement. If we strive to achieve these potential yield levels, then the increasing demand requirements of the country can be met in future.

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Appendix

Appendix 1: Population projections used in projecting demand

Year	Population Projection (Million)	Average annual rate of growth (per cent)
2001	1027.02	-
2011	1178.90	1.39
2021	1345.63	1.33
2026	1414.00	0.99

Source: 2026 Projections by Dyson and Hanchante, 2000.

Other year's population figures are from Registrar General, GOI.

Appendix 2: Expenditure elasticity used in projecting demand.

Food Items	Expenditure Elasticity
Rice	0.010
Wheat	-0.070
Total Cereals	0.165
Pulses	0.590
Edible Oil	0.548
Sugar	0.818

Source: Mittal, Surabhi (2006).

Appendix 3: Base year assumptions in projecting supply

Food Items	Base Year 2003-04		Annual Rate of growth (per cent) (1993-2003)	
	Area (million hectare)	Yield (tones/ hectare)	Area	Yield
Rice	42.50	2.08	-0.05	1.01
Wheat	26.58	2.71	0.54	1.34
Total Cereals	99.88	1.87	-0.22	1.45
Pulses	23.44	0.64	0.48	0.91
Oilseeds	23.70	1.07	0.68	2.13
Sugarcane	4.02	58.99	2.67	0.41*

Source: Agricultural Statistics at a Glance, 2005, Directorate of Economics and Statistics, GoI.

* Growth rates are for 1993-2000.

Appendix 4: Projections of yield used in projecting supply

Food Items	Projected Yield (tones/ hectare)		
	2011	2021	2026
Rice	2.25	2.49	2.62
Wheat	3.02	3.45	3.68
Total Cereals	2.10	2.42	2.61
Pulses	0.68	0.75	0.78
Oilseeds	1.26	1.56	1.73
Sugarcane	50.14	40.93	36.98

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