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Food Price Inflation in India: Causes and Cures

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Food Price Inflation in India: Causes and Cures

ABSTRACT

Inflation in general and food price inflation in particular has been a persistent problem in India over the past few years. Price stability is crucial for sustainable growth as persistent inflation implies higher demand relative to supply. Therefore, we analyse here demand and supply of food in India to understand the domestic policies needed to control food inflation.

First, we estimate food demand in India by categories (cereals, vegetables, fruits, dairy products, meats, etc.) using the ARDL co-integration procedure using consumption data from the Food and Agricultural Organization (FAO) for 1967 onwards. We then project food demand in India until 2022 using our estimated relations. Our analysis shows that the structure of demand by food category is in the process of undergoing significant changes with rising income levels, and that the demand for fruits, vegetable, cooking oils, dairy products, and meat will increase by 60–75 per cent over the next 10 years, while demand for cereals will increase only 10 per cent, and that for pulses will decline slightly.

We then consider supply side policies needed to ensure that this rising demand can be met and food inflation controlled. Concerted action will be needed to increase agricultural yields, given that cropped land will be hard to increase. These include improving irrigation facilities, better seeds and other technological measures to improve productivity, improved cold storage and transportation facilities to reduce waste (currently 30 per cent for perishable crops), reallocation of land from cereals and pulses to vegetables and fruits, etc. Thus, if good policies are followed, food inflation can be managed, possibly with limited imports when needed.

Key words*:* Food demand, food suply, food inflation, food security

JEL codes: E_{31} ,O_{13}, Q_{11}, Q_{15}, Q_{18}

1. INTRODUCTION

Food price inflation has become a major problem in India over the past few years. Price stability is crucial for sustainable growth, as persistent inflation implies higher demand relative to supply. Thus, there is an urgent need to understand this problem and to respond with appropriate agricultural policies to keep food prices stable if we are to reduce hunger and poverty in India. One reason for the rising food prices could be increasing demand for food, as income levels increase with rapid economic growth. Another reason could be supply and distribution problems. Another factor could be the increasing diversion of cereals such as corn to production of bio-fuels, especially in USA, that eventually also reflect in other countries through international food markets. However, imports of food, especially cereals, are relatively small in India's case, so food inflation is likely to be driven mainly by domestic factors.

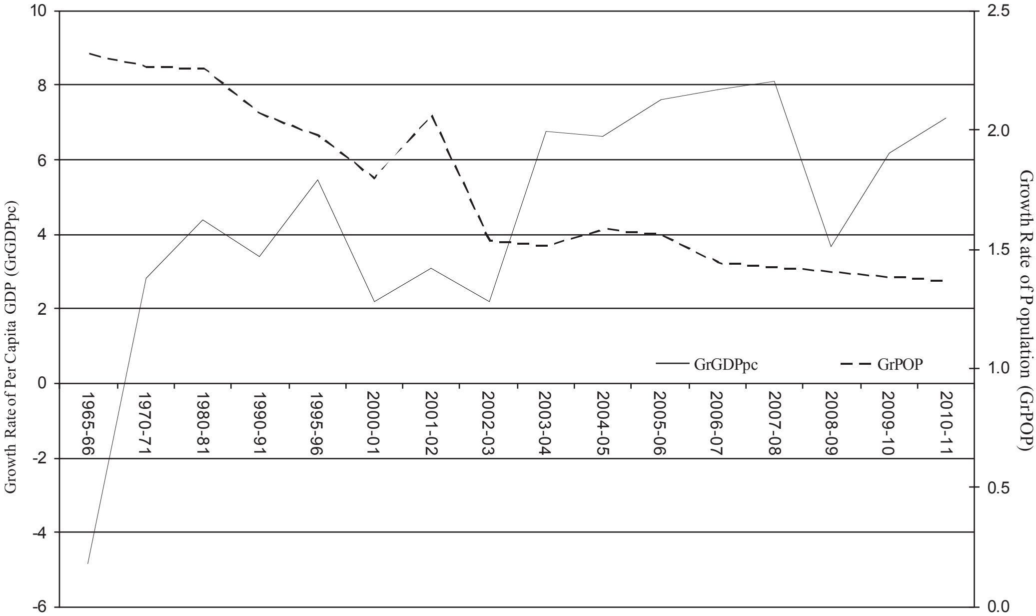
Given this situation, it should be useful to undertake a careful analysis of the demand and supply of food in India. This is what this paper attempts to do. We first estimate the demand for food in India. This is done separately for various food categories such as cereals, pulses, fruits, vegetables, milk and milk products, meat, etc., for more precise and category-wise estimates. We then project the future demand for various food categories for the next 10 years up to 2022. Such projections could be helpful in understanding likely forthcoming food consumption patterns in the country. Finally, we examine whether the available land resources in the country would be sufficient to meet the future food demand by investigating supply factors such as total agricultural land area, yield per hectare, and cultivation of various food categories. From the projected demand and supply considerations, the study also explores whether the projected future demand could be met with suitable re-allocation of agricultural land among various food categories and what other policies could be helpful in meeting the rising future demand. These considerations yield significant insights for formulating appropriate future agriculture sector policies for the country.

The remaining section is organised as follows. Section 2 provides a brief review of food consumption pattern in India and compares it with other emerging and developed countries. Section 3 develops a demand function for various food categories, and discusses the econometric methodology used for its empirical estimation as well as the sources of data used for the purpose. Empirical results of the estimations of demand for different food categories are discussed in Section 4 and projections of future per capita and total countrywide demand are analysed in Section 5. Section 6 examines the land utilisation pattern and agricultural policies needed to ensure that future supplies of various food categories would be adequate to meet future demand as per our projections so that food inflation can be controlled in the future. Section 7 summarises the main conclusions and policy implications of our research.

2. FOOD CONSUMPTION PATTERN IN INDIA

Figure 1 shows that the growth rate of per capita income has increased manifold, from 0.77 per cent in 1971–1980 to 3.45 per cent in 1991–2000, and to 7 per cent in 2010–11. On the other hand, population growth has been declining—to 2.26 per cent in 1980-81, 2.03 per cent in 1990–91, 1.54 per cent by 2001–02, and to 1.37 per cent in 2010–11. The rapid increase in per capita income combined with population growth could lead to a rapid increase in demand for various food categories. In case demand for some categories grows much faster than that for other categories, there could be significant shifts in consumption patterns over time, and agricultural policies will need to be adjusted to ensure adequate supplies of different food categories to meet the evolving demand patterns.

Figure 1: Growth Rate of Per Capita GDP and Population in India



Source: Handbook of Indian Economy (2010–2011), Reserve Bank of India

Table 1 shows data on consumption of different food categories in different countries at fairly different levels of per capita income. This should give an inkling of the likely future changes in consumption patterns in India as income levels increase over time. The table shows that as we move from low to high per capita income countries, the per capita consumption of cereals and pulses tends to fall, while that of vegetables, fruits, milk, meat, and fish increases. Thus, it is likely that a similar pattern would be seen in India in the future. Indeed, this rapidly increasing demand for fruits, vegetables, milk, etc. might have

Table 1: Per Capita Consumption of Various Food Categories for Selected Countries (Kg Per Person Per Year)

Year	GDP per capita (US$)[1]	Cereals	Pulses	Fruits	Vegetables	Starchy roots	Milk & milk products	Sugar	Oil crops	Fish, eggs, & meat
India										
1990-92	320.17	160.60	12.78	28.47	52.20	20.08	52.93	21.17	7.30	9.13
1995-97	388.84	155.86	12.78	34.31	54.39	21.90	58.77	22.63	7.30	9.49
2000-02	467.02	148.56	11.32	35.41	64.24	23.36	61.69	23.36	6.21	10.22
2005-07	637.17	151.11	11.68	42.34	62.42	25.92	67.16	18.62	7.30	10.22
China										
1990-92	429.83	171.92	1.83	18.62	104.03	67.16	6.57	8.03	5.48	47.82
1995-97	716.38	172.65	1.46	35.04	163.16	66.80	8.03	8.40	7.30	76.65
2000-02	1025.22	163.16	1.46	45.99	240.17	78.11	11.32	6.57	7.30	90.52
2005-07	1656.36	154.40	1.10	61.32	276.31	68.26	26.28	7.67	6.57	97.46
Brazil										
1990-92	3328.74	107.31	14.97	98.19	33.58	66.07	94.90	48.55	5.84	64.61
1995-97	3646.45	103.66	16.06	112.79	37.96	59.13	114.61	51.47	8.40	84.32
2000-02	3714.00	103.66	16.43	101.84	40.15	60.23	112.79	39.79	15.33	91.25
2005-07	4117.19	115.34	16.06	105.85	45.26	64.24	123.01	41.98	18.25	91.98
United Kingdom										
1990-92	19858.41	93.805	4.745	76.29	89.06	104.03	227.03	40.88	3.65	101.84
1995-97	22108.09	97.09	5.475	79.94	81.03	111.69	229.59	39.06	4.02	102.57
2000-02	25585.32	109.14	5.84	91.62	90.89	124.10	227.76	40.15	3.65	108.77
2005-07	28345.63	112.78	2.92	131.04	94.17	109.50	243.46	34.68	4.02	115.71
United States of America										
1990-92	28183.32	109.86	3.65	110.60	114.25	59.13	257.33	63.88	5.11	149.29
1995-97	30903.44	117.16	4.015	113.52	121.91	63.15	253.31	67.53	4.75	151.11
2000-02	35196.22	112.78	4.015	114.61	124.10	64.24	256.96	68.26	5.48	157.32
2005-07	38248.13	110.23	4.38	109.87	122.64	59.13	252.58	68.62	5.48	162.06

Note: 1. GDPpc–Per capita GDP at constant price (base year 2000) in terms of US$.

Source: FAOSTAT Database, Food and Agricultural Organization of the United Nations.

been responsible for the food inflation in India for the past several years. If this trend continues over the next 10–20 years, and as per capita income levels rise, not only will the demand for food per capita increase, but its composition will also shift from cereals and pulses to other food categories like fruits, vegetables, dairy products, and meat and fish. Therefore, agricultural sector policies will need to ensure adequate supplies of various food categories to meet the likely future demand and compositional changes in demand.

3. DEMAND MODEL, ECONOMETRIC METHODOLOGY AND DATA SOURCES

3.1 Modeling the Demand for Food

In our empirical study, we assume that food as an overall category has hardly any substitutes or complements. Thus, at least as a resonable first approximation, a typical consumer's food demand does not depend on the price of various non-food items; however, it does depend on his total income. Further, given that different food items or categories like cereals, pulses, vegetables, fruits, milk and meat, etc. can be substitutes or complements for each other, their demand could depend on their own price as well as the price of other food categories. Thus, the national demand for each food category is represented as a function of the per capita income of India, prices of its own category, and cross-prices of other food categories. Therefore, the demand function for various food groups can be depicted as follows:

$$Lnq_{it} = k_{i0} + \alpha_i \, LnY_t + \beta_i LnP_{it} + \gamma ij \; Ln \, p_{jt} + \varepsilon it \qquad (1)$$

where
$Ln\ q_{it}$ is the log of per capita food consumption for the commodity i;
LnY is the log of per capita income of the consumer;
LnP_i is the own price of the commodity i;
LnP_j is the log of price of commodity j; and
εi is the error terms and t denotes time period.

In equation (1), the coefficient α_i of log of income per capita (LnY) measures the income elasticity of the food category *i*. Generally, if the income increases, the consumer tends to increase his expenditure on most food categories. The sign and magnitude of the percentage change in demand of food group, i, per 1 per cent change in income is measured by the income elasticity (α_i.). Usually, for most goods, $\alpha_i > 0$ (normal goods) but can be zero (neutral goods) or even negative (for inferior goods, such as staple cereals, that people move away from as they are able to eat more of other goods like dairy, meat , fruits, etc.). The coefficient β_i of log of own-price (LnP_i) of a commodity measures its own-price elasticity. For most goods, an increase in price of the commodity *i* would reduce the quantity demanded so that we expected that $\beta_i < 0$ for most *i*. However, occasionally, demand can increase with increase in price, i.e., $\beta_i > 0$. Such goods are called Giffen goods (usually staple and/or inferior goods, possibly because low-income consumers may be forced to consume even more of such goods when food prices increase and they are unable to afford more expensive items). The coefficient γ_{ij} measures the cross price elasticity of demand for good i with respect to prices of another food category *j*. Two food groups *i* and *j* are substitutes if an increase in the price of category *j* leads to increased consumption of category *i* (i.e., $\gamma_{ij} > 0$) or complements if an increase in the price of category *j* leads to decreased consumption of food category *i* ($\gamma_{ij} < 0$). Using the income and price elasticities, one can project future demand for various food categories for given changes in income per capita and prices, as discussed in Section 5.

3.2 Econometric Methodology

As is the usual procedure with time series data, we first carried out the unit root tests to see the degree of integration of the various variables. Most variables were found to have a unit root at the levels but not in their first difference series, i.e. they were non-stationary and integrated of order 1 (denoted (I(1)). But a few variables did not have any unit roots, i.e. they were stationary or integrated of order zero (denoted (I(0))—see Table A1 in the Appendix. Given this mix of I(1) and I(0) variables and a relatively small sample size consisting of 43 annual observation on most variables, the Auto-Regressive Distributed Lag (ARDL) estimation procedure was used for estimating the long-run demand functions for different food categories.

The ARDL estimation procedure (developed by Pesaron and Shin 2001) is valid for non-stationary variables as well as for a mixture of *I(0)* and *I(1)* variables. The existence of the long run relationship is confirmed with the help of an F-test that tests that the coefficients of all explanatory variables are jointly different from zero. The usual critical values are applicable for the F-test when all variables are *I(0)*. However, different and higher critical values (provided in Pesaron and Shin 1999) are applicable when all or some of the variables are *I(1)*. The augmented ARDL model can be written as follows

$$\alpha(L,p)\, y_t = \mu_0 + \sum_{i=1}^{k} \beta_i(L,q)\, x_{it} + u_t \qquad (2)$$

where μ_0 is a constant; y is the dependent variable; x_{it}, is the vector of explanatory variables and α(L) and β(L) are polynomials of the lag operator L such that : $L^1X_t=X_{t-1}$:

$$\alpha(L,P) = \alpha_0 + \alpha_1 L + \alpha_2 L^2 + \cdots + \alpha_t L^p \text{ and}$$

$$\beta_i(L,q_i) = \beta_{i0} + \beta_{i1} L + \beta_{i2} L^2 + \cdots + \beta_{iq} L^{qi},\ i = 1, 2 \ldots\ldots, k$$

In the long-run equilibrium and $y_t = y_{t-1} = y_{t-2} = \ldots y_0$ and $x_{it} = x_{it-1} = x_{it-2} = \ldots . x_{i0}$.

Using these equilibrium conditions and solving for y, we get the following long run relation:

$$y = a + \sum_{i=1}^{k} b_i x_{it} + \gamma_t \tag{3}$$

Where $a = \dfrac{\mu_0}{\alpha_0 + \alpha_1 + \ldots\alpha_p}$

$$b_i = \frac{\beta_{i0} + \beta_{i1} + \beta_{i2} + \ldots\beta_{iq}}{\alpha_0 + \alpha_1 + \alpha_2 + \ldots\alpha_p}$$

$$\gamma_t = \frac{u_t}{\alpha_0 + \alpha_1 + \alpha_2 + \ldots\alpha_p}$$

The error correction (EC) representation of the ARDL method can be written as follows:

$$\Delta y_t = \Delta\alpha_0 + \sum_{j=1}^{p} \alpha_j \, \Delta y_{t-j} + \sum_{i=1}^{k} \sum_{j=1}^{q} \beta_{ij} \Delta x_{i,t-j} - \gamma \, EC_{t-1} + u_t \tag{4}$$

where $\mathrm{EC_t = y_t} - \hat{a} - \sum_{\mathrm{i=1}}^{\mathrm{k}} \mathrm{\hat{b}_i x_{it}}$

where Δ is the first difference operator; α_j, and β_{ij} are the short-run dynamic coefficients and γ measures the speed of adjustment.

3.3 Data Sources

The present study is based on yearly data for the period 1967 to 2007. The data on availability of food for consumption are collected from the FAOSTAT database of the FAO for food categories such as cereals, pulses, fruits, vegetables, milk, starchy roots, and fish, eggs, and meat (FEM). The data on consumption of edible oil and sugar are collected from Economic Survey, 2008-09 as this data is not available in the FAO data set. Together, these food categories account for almost all the major items in the regular diets of consumers, and hence have been selected for the demand estimation and for projection of future demand in this study. We followed the FAO's concept of human food consumption given in the Food Balance Sheets, which refers to household consumption. As per this concept, human food consumption is defined as food production at home plus imports less export, less feed, seed and waste from farms, households and stocks. Although this is not the most perfect measure of demand for food by categories, it is reasonably close to it. Furthermore, the FAO has provided consistent annual data for these series from 1967 to 2007. There is no other consistent time series data available for undertaking rigorous econometric work. The only other source of such data is the household consumption survey data from the NSSO. Although conceptually closer to consumer demand data, the NSSO data is not collected at regular yearly intervals, and the definitions of items included in each category have not been constant (e.g., precise names and numbers of vegetables and fruits included under these categories keeps changing from survey to survey). This makes it unsuitable for the statistical analysis of long-term demand elasticities etc. that is attempted here.

Although our study estimates the consumer's demand function, we were constrained to use producer prices for the selected food categories from the FAOSTAT database and from the Ministry of Commerce and Industry (MCI), Government of India because reliable consumer price data was not available and because we believe that there must necessarily be a very strong correlation between consumer and producer prices, so that the latter can be used as a reasonable proxy for the former as consumer price data is not available. One problem we faced was that FAOSTAT did not provide producer price on fish, while the producer price on eggs and meat showed inconsistent data over part of the period under consideration. Further, the database provides the producer price of oil crops and raw sugar cane, whereas we needed prices of processed sugar and edible oil consumed. Hence, we have used the wholesale price index (WPI) of fish, eggs and meat (FEM), sugar, and edible oil collected from Ministry of Commerce and Industry, Government of India.[1] Furthermore, the price indices in different base years (1981–82, 1993–94, and 2004–05) have been spliced and converted to the 2004–05 base year throughout. The producer prices of different food items (from FAOSTAT and Government of India) are then converted into real terms by dividing by the WPI deflator (base year 2005). To derive consumer per capita income, we divided GDP at market price by population size. Both sets of data were collected from the Handbook of Indian Economy, Reserve Bank of India.

4. EMPIRICAL RESULTS

The results of long run estimates for demand for various food categories using equation (1) and the ARDL estimation procedure are shown in Table 2 below. The table presents the results of the bounds F-test for checking the existence of co-integration in the model. It also presents the income, price, and cross price elasticities in different columns for the per capita food consumption of major food categories (shown on separate rows in the table). It is clear from Table 2 that the F-test is within the critical value at 1 per cent and 5 per cent respectively, using the higher critical values applicable for I(1) variables, suggesting that all the models are co-integrated, and thus confirming the existence of long-run relation

[1] The wholesale price indices of sugar and edible oil were available for the 1981–2007 period.

between the variables. Several diagnostic tests such as Lagrange Multiplier (LM) test for serial correlation, Ramsey RESET test for functional form, Jarque-Bera normality, and White's hetroskedasticity test were conducted on these estimated relations for each food category reported in Table 2. Most diagnostic tests accepted all the models (Appendix, Table A-2).

Table 2: Long-Run Elasticities for Major Food Groups Estimated Using ARDL

Dependent variables (Q_{dit})	ARDL bounds f-test (F)[2]	Income elasticity (Y_{it})	Own-price elasticity (P_{it})	Cross-price elasticity (P_{jt})		
		α_i	β_i	Other Food items (j)	γ_{ij}	S/C[3]
Cereals	8.69***	-0.05***	-0.23***	-		
Pulses	4.42**	-0.20***	-0.29**	Milk	0.62**	S
Fruits	11.27***	0.59***	-0.56***	-		
Vegetables	4.94**	0.55***	-0.29***	Cereals	-0.32***	C
				Milk	0.45***	S
Starchy roots	5.05***	0.64***	-0.001	Vegetables	-0.32***	C
Milk & milk products	12.8***	0.57***	-1.26***	-		
Edible oils	7.06***	0.68***	-0.48***	-		
Sugar	7.05***	0.26*	-0.27*	-		
Fish, eggs, & meat	7.28***	0.38***	-0.16***	Vegetables	-0.18***	C
				Pulses	0.30***	S

Note:

1. The table shows only long run results of the ARDL, where all the coefficients are statistically significant at 1% (***), 5% (**), and 10% (*) respectively.
2. See Pesaran, Shin and Smith (2001, p.300) for the critical value bounds from Table CI (III).
3. S and C indicate substitute ($\gamma_{ij} > 0$) and complementary ($\gamma_{ij} < 0$) respectively.

The results of Table 2 have some important implications. These can be discussed in terms of the income, price and cross-price elasticities of various food categories, as considered below.

4.1 Income Elasticity

The income elasticity depicts the percentage changes in consumer demand for different food categories for each 1-per-cent increase in income. Most goods have a positive income elasticity of demand and hence they are called 'normal' goods. However, a few goods have negative income elasticity, which means their consumption declines with increasing incomes—for obvious reasons, such goods are referred to as 'inferior' goods. The income elasticity would enable to identify the nature of the food items (viz., normal or inferior goods) and help to project its likely future demand. It is clear from Table 2 that cereals and pulses are inferior goods. For instance, when the per capita income increases by 1 per cent, the demand for cereals would decline by 0.05 per cent and that for pulses by 0.20 per cent. All other food categories are normal. Thus, a 1-per-cent increase in per capita income would increase the per capita consumption of vegetables, fruits, and milk by 0.55 per cent, 0.59 per cent, and 0.57 per cent respectively, and of edible oils, sugar, and FEM by 0.68 per cent, 0.26 per cent, and 0.38 per cent respectively. This suggests that over the next 10–20 years, as income levels increase, per capita demand may decline for cereals and pulses but will likely increase for vegetables, fruits, milk, edible oil, sugar, and FEM.

4.2 Price Elasticity

The own price elasticity of demand for almost all food items is negative and statistically significant, as expected. The own price elasticity of fruits and milk (and milk products) is -0.56 per cent and -1.26 per cent respectively, indicating that both are quite sensitive to price changes. On the other hand, the price elasticity of starchy roots is -0.001, indicating that these food items are insensitive to price changes. The price elasticity of other food items like cereals, pulses, vegetables, edible oil, sugar, and FEM are between -0.16 per cent and -0.48 per cent respectively, which indicates that their demand is moderately sensitive to price changes. The estimate suggests that consumers are only moderately responsive to change in the prices of most food categories. The demand is most responsive to prices in the case of fruits and milk, suggesting that these are perceived as luxury items by most consumers (especially the poor). Thus, the poor may often do without milk (taking tea instead) and fruits, but may increase their consumption once prices of these products decline or their incomes rise.

4.3 Cross-price Elasticity

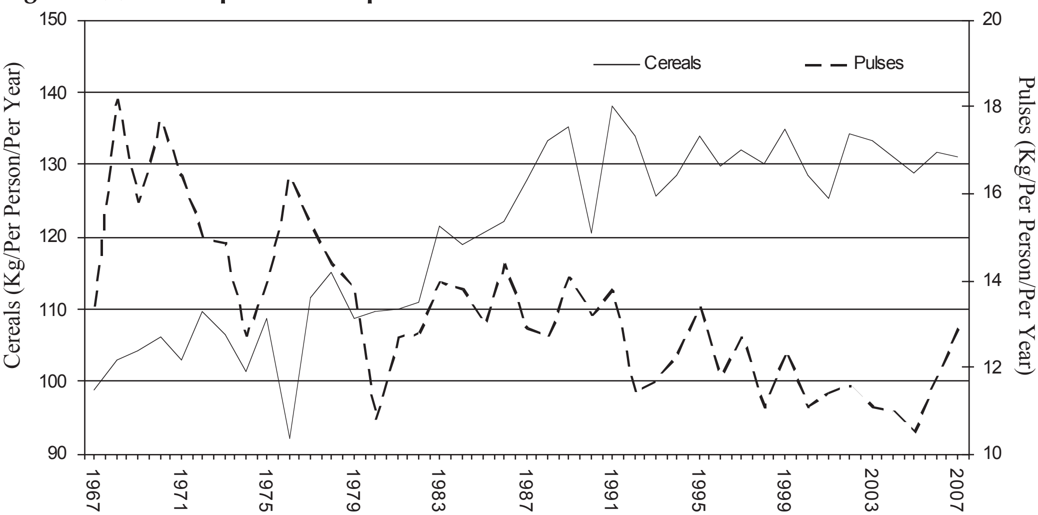
Cross-price elasticity measures the responsiveness of the demand for one food item to a change in the price of another food item. Table 2 reveals that the consumption of fruits, milk, edible oils, and sugar largely depends on consumer income and the own price of these food categories, and there is not much cross-price effect from other food categories.

However, many other food categories do show some cross-price effect with other food categories. Thus, cereals are complementary for vegetables, as a 1-per-cent increase in prices of cereals would lead to decreased consumption of vegetables (by about 0.34 per cent), other things being constant. In Indian cuisine, the consumption of starchy roots, especially potatoes, is very common. Potatoes are curried and eaten with Indian bread and also cooked with other vegetables. Thus, starchy roots and vegetables complement each other. For instance, a 1-per-cent-increase in prices of starchy roots would lead to a 0.32-per-cent decrease in vegetable consumption, other things being constant, as starchy roots are cheap and easily available in India.

Milk and milk products are an important protein supplement for the Indian diet, especially for the large percentage of vegetarians, and a good majority of Indians consume it. The prices of milk products are increasing due to supply constraints. The demand for milk is very sensitive to price changes, and our results (Table 2) suggest that as milk prices increase, the consumer tends to reduce milk consumption and switch to pulses and vegetables. For instance, a 1-per-cent increase in milk price would lead to increase pulses and vegetable consumption by 0. 62 per cent and 0.45 per cent, respectively. Similarly, there are some other cross-price effects as well; for example, pulses are substitutes for FEM with a cross-price elasticity of 0.30, while vegetables were found to be complementary to FEM consumption.

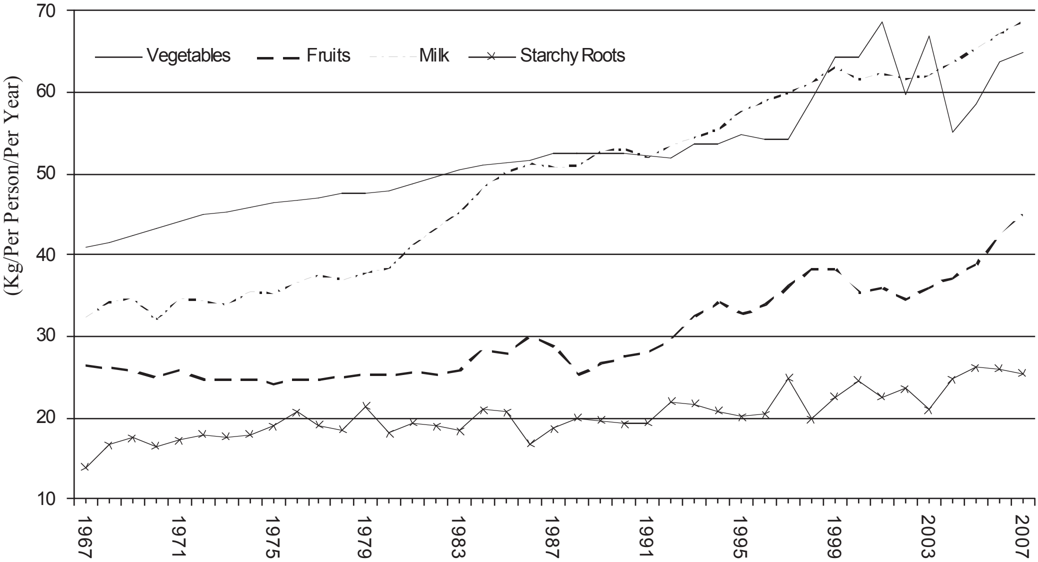
Thus, it is apparent from Table 2 that over time, when real incomes rise rapidly while real prices are reasonably stable, per capita consumption will increase for foods such as vegetables, fruits, milk, starchy roots, and FEM; stagnate for cereals; and decline for pulses. These trends are clear in the past data on per capita consumption of various food categories as well (Figure 2 (a, b, and c)).

Figure 2(a): Per Capita Consumption of Cereals and Pulses in India



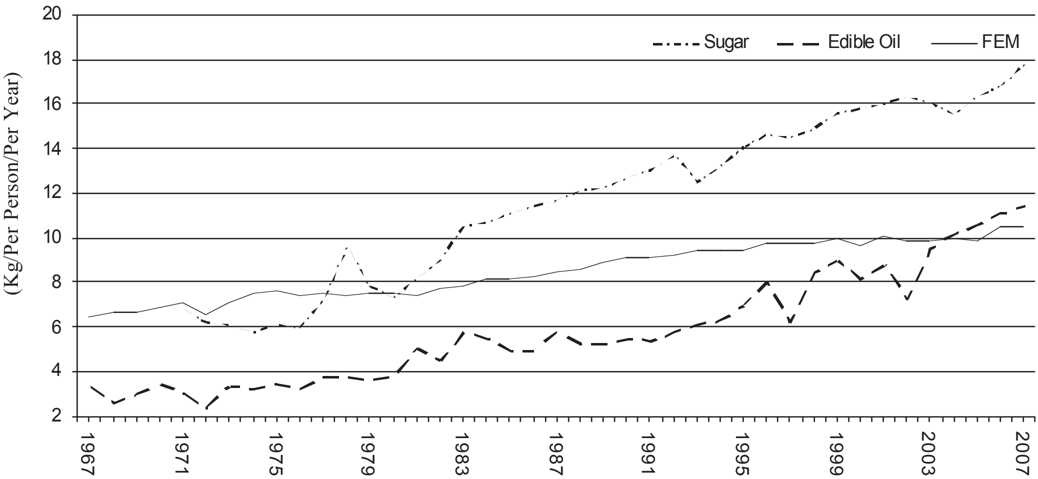
Sources: FAOSTAT Database, FAO of UN

Figure 2(b): Per Capita Consumption of Vegetables, Fruits and Milk in India



Sources: FAOSTAT Database, FAO of UN.

Figure 2(c): Per Capita Consumption of Sugar, Edible Oil and Fem in India



Sources: Economic Survey 2008-09 and FAOSTAT Database.

5. PROJECTIONS OF FUTURE DEMAND FOR FOOD BY CATEGORIES

In this section, we use the demand model estimated above (see equation (1) and Table 2) to project the demand for various food categories for the next 10 years untill 2022, although we report the results mainly for the year 2017 (concluding year of India's 12th Five Year Plan) and the year 2022 (concluding year of India's 13th Five Year Plan).

First, note that the growth of per capita demand of a food category, i, can be obtained using our demand relation (equation (1)):

$$Ln\, q_{it} = k_{i0} + \alpha_i\, LnY_t + \beta_i\, LnP_{it} + \sum_j \gamma_{ij}\, Ln\, p_{jt} + \varepsilon_{it} \qquad (1)$$

Differentiation of the demand equation (1) for food category i with respect to time yields the relation (where a hat (^) on top of a variable denotes its rate of growth):

$$\hat{q}_{it} = \alpha_i \hat{Y}_t + \beta_i \hat{p}_{it} + \sum_j \gamma_{ij} \hat{p}_{jt} \qquad (5)$$

If we assume that price increases in various food categories are roughly the same as the increases in the general price level, then real prices Pi and Pj, of different food categories will be essentially constant over time, so that P_i and P_j are zero and the last two terms on the right hand side of the above equation drop out. Further, the growth rate of per capita income, *Y*, is very well proxied by the growth rate of per capita GDP, g. Thus, for the case when real food prices are constant, equation (5) simplifies to:

$$\hat{q}_i = \alpha_i g \qquad (6)$$

Using this relation, the future growth rate of per capita demand for food category, i, can be calculated from the income elasticity αi of the food category and the expected future growth rate of GDP per capita. These projections can be seen as indicating the likely demand growth rate for various food categories if the real food prices were constant (i.e., food price inflation be same as general inflation). Alternatively, they can also be thought of as the growth rate of the production of various food categories needed to ensure that food price inflation is not higher than general inflation—this is the growth in food production that agricultural sector policy should aim to achieve. If food supplies grow at a slower pace than suggested by equation (6), food inflation will be higher than general inflation while, if they grow at a faster rate, food prices will rise less rapidly than general inflation. Of course, food prices rising slower than general prices for long periods may also be undesirable in a country such as India, which has a large rural population, as it could hurt the farmers and the rural economy. Thus, the estimates given by equation (6) may be the best rates that the government should aim for.

Further, the country's total demand Qi of a food category, i, can also be obtained from equation (1), by noting that

$$Ln\, Q_i = Ln\, q_i\, N = Ln\, q_i + Ln\, N \qquad (7)$$

where qi is the per capita consumption of food category i and N is the population of the country. Therefore, the growth rate of the country's total demand Qi when the population is growing at a constant rate of n is given by (irrespective of whether real prices of food groups are constant or not):

$$\hat{Q}_i = \hat{q}_i + n \tag{8}$$

where a hat (^) on top of a variable denotes its growth rate.

Using equation (6), we can project the likely future growth rate of per capita food consumption for various food categories for several plausible future growth rates of GDP per capita, g (and constant real food prices). This is also the rate agriculture sector policy must aim to achieve to avoid the problem of food inflation exceeding general inflation. The average growth rate GDP for the last 10 years (2001 to 2011) was about 7.6 per cent. While there are some concerns of a slowdown in India, we believe that if good policies are followed, the average GDP growth rate for next 10 years should be in the 6–9 per cent range. Thus, we project here food demand for the GDP growth rates of 6, 7, 8, and 9 per cent and corresponding growth rate of GDP per capita of 4.8, 5.8, 6.8, and 7.8 per cent (assuming population growth rate of approximately 1.2 per cent, as is projected for India for the next 10 years (see National Commission on Population 2006). These rates may seem on the higher side to some, but we believe that food security is so important that it is better to err on the side of caution and plan for a slightly higher growth rate than the other way around.

We have considered the case of real food prices remaining constant, i.e., food prices rising at the same rate as a general price index (such as WPI). While there can be short-run fluctuations from this (which will be extremely difficult to forecast), it seems a reasonable assumption for the long-run forecasting exercise being attempted here. The case of 5.8–6.8 per cent growth in per capita income (which corresponds to real GDP growth of about 7–8 per cent) is perhaps the most likely scenario, and other rates can be seen as defining the likely margin of error in the projections. Then, using equation (8), we can also calculate the growth rate of the country's total demand for each food category (Tables 3 and 4).

Table 3 shows that per capita demand of cereals and pulses (being inferior goods) would slow down in the future with rising incomes. For annual per capita income growth of 4.8–7.8 per cent, the annual growth rates of demand would be in the -0.24 to -0.39 per cent range for cereals and in the -0.96 to -1.56 per cent range for pulses. For instance, if per capita income grows at 6.8 per cent, then the per capita consumption of cereals would decrease slowly from 150.9 kg in 2012 to 148.3 kg in 2017 and 145.8 kg in 2022. Similarly, the per capita consumption of pulses would decrease from 12.3 kg in 2012 to 11.5 kg in 2017 and 10.7 kg in 2022 (Table 4).

Table 3: Projected Growth Rate of Per Capita Food Consumption

Categories	Income elasticity	Growth rate of per capita demand for various food categories for different growth rate of per capita income			
		4.8%	*5.8%*	*6.8%*	*7.8%*
Cereals	-0.05	-0.24	-0.29	-0.34	-0.39
Pulses	-0.20	-0.96	-1.16	-1.36	-1.56
Fruits	0.59	2.83	3.42	4.01	4.60
Vegetables	0.55	2.64	3.19	3.74	4.29
Starchy roots	0.64	3.07	3.71	4.35	4.99
Milk	0.57	2.74	3.31	3.88	4.45
Edible oil	0.68	3.26	3.94	4.62	5.30
Sugar	0.26	1.25	1.51	1.77	2.03
FEM	0.38	1.82	2.20	2.58	2.96

Table 4: Projection of Per Capita Demand for Selected Food Categories (Kg Per Person Per Year)

Items	2012[1]	Per capita food demand projection at different growth rates of per capita GDP							
		For year 2017				For year 2022			
		4.8%	5.8%	6.8%	7.8%	4.8%	5.8%	6.8%	7.8%
Cereals	150.9	149.1	148.7	148.3	147.9	147.3	146.6	145.8	145.1
Pulses	12.3	11.7	11.6	11.5	11.4	11.2	10.9	10.7	10.5
Fruits	51.6	59.4	61.2	63.0	64.9	68.4	72.6	77.0	81.7
Vegetables	73.4	83.7	86.1	88.5	90.9	95.6	100.9	106.7	112.7
Starchy roots	29.4	34.2	35.4	36.5	37.7	39.9	42.5	45.4	48.4
Milk & milk products	78.2	89.6	92.2	94.9	97.6	102.8	108.8	115.2	121.9
Edible oil	13.3	15.6	16.2	16.7	17.3	18.4	19.7	21.1	22.6
Sugar	18.9	20.10	20.4	20.6	20.9	21.4	21.9	22.5	23.1
FEM	11.5	12.5	12.8	13.0	13.3	13.7	14.3	14.8	15.4

Note: 1. Values for 2012 are for March 2012 , i.e. for 2011-12 (similarly for 2017 and 2022) and projected from 2007-08 data using the actual growth rate of per capita income for each intervening year.

However, with rising real income levels, the per capita consumption of almost all other food categories would increase. Again, assuming that the per capita real income will be growing in the 4.8–7.8 per cent range annually, the growth rate of per capita consumption of vegetables will increase by 2.64–4.29 per cent, of starchy roots by 3.07–4.99 per cent, of fruits by 2.83–4.60 per cent, of milk by 2.74–4.45 per cent, and of edible oils by 3.26–5.30 per cent, respectively. Per capita FEM consumption would increase somewhat more gradually, by 1.82 per cent in 2017 and 2.96 per cent in 2022. For instance, if per capita income grows at 6.8 per cent, the per capita demand for consumption of fruits, vegetables, starchy roots, milk and edible oil would grow from 51.6 kg, 73.4 kg, 29.4 kg, 78.2 kg and 13.3 kg in 2012 to 63.0 kg, 88.5 kg, 36.5 kg, 94.9 kg and 16.7 kg in 2017, respectively. Similarly, FEM would increase from 11.5 kg in 2012 to 13 kg for the year 2017 (Table 4).

It is apparent from Tables 3 and 4 that as the per capita income grows in 2017 and 2022, consumption would diversify away from food grains (cereals and pulses) to non-food grains like vegetables, starchy roots, fruits, and milk, and also to animal products like FEM. Consumption of edible oils and sugar would also grow considerably, partly due to rising consumption of packaged food, sweets, junk foods, etc. This reflects changes due to increasing urbanisation, lifestyle changes, and an increasing range of packed food varieties available for consumption in the domestic market which would increase consumption of oils, sugars, fruits (in the form of juices), etc. As we discussed earlier in Table 1, it is the ongoing phenomenon of rising income levels swelling the ranks of the middle classes and increasing demand for almost all categories of food items except cereals and pulses. A comparison of Tables 1 and 4 shows that by 2022, the consumption of cereals, fruits, and vegetables in India will be approaching the current consumption of these categories in developed regions such as in the UK and USA. However, our per capita FEM consumption will remain far below theirs (only about 15 per cent of per capita consumption in developed countries), probably due to the much greater prevalence of vegetarianism in India. Somewhat surprisingly, even by 2022, the consumption of milk and milk products, a rather popular and important part of the Indian diet, will still be only about half the current level of the developed countries.

Table 5 shows the projected growth rate of total food demand for the selected items for GDP growth rates of 6–9 per cent (which corresponds to per capita income growth rates of 4.8–7.8 per cent, assuming an annual population growth rate of 1.2 per cent). The table shows that the growth rate of total demand for cereals is in the 0.81–0.96 per cent range and for pulses in the 0.24 to –0.36 per cent range. On the other hand, the growth rates of demand for fruits, vegetables, starchy roots, and edible oils are in the 3.8–6.5 per cent range. Total demand for milk and milk products would grow at about 3.9–5.6 per cent, while the demand for animal products such as FEM would grow at a slightly lower rate of about 3–4.2 per cent. Demand is projected to grow at 1 per cent per annum for cereals, stagnate for pulses, and grow at 4-6.5 per cent per annum for fruits, vegetables, starchy roots, edible oils, milk and milk products, and FEM.

Table 5: Projected Growth Rate of Total Food Consumption

Categories	Income elasticity	Growth rate of demand for various food categories for growth rate of per capita GDP for 4.8% to 7.8% and population growth rate of 1.2%			
		4.8+1.2=6%	*5.8+1.2=7%*	*6.8+1.2=8%*	*7.8+1.2=9%*
Cereals	-0.05	0.96	0.91	0.86	0.81
Pulses	-0.20	0.24	0.04	-0.16	-0.36
Fruits	0.59	4.03	4.62	5.21	5.80
Vegetables	0.55	3.84	4.39	4.94	5.49
Starchy roots	0.64	4.27	4.91	5.55	6.19
Milk	0.57	3.94	4.51	5.08	5.65
Edible oil	0.68	4.46	5.14	5.82	6.50
Sugar	0.26	2.45	2.71	2.97	3.23
FEM	0.38	3.02	3.40	3.78	4.16

The detailed projection of total food demand for the years 2017 and 2022 are given in Table 6. As mentioned in Table 5, both the demand for cereals and pulses would grow rather slowly. For instance, if per capita income grows at 6.8 per cent per annum and population grows at 1.2 per cent per annum, demand for cereals would increase from 182.6 million tonnes in 2012 to 190.3 million tonnes in 2017 and 197.7 million tonnes in 2022. There would be meagre rise in the demand for pulses, from 14.9 million tonnes in 2012 to 14.7 million tonnes in 2017 and 14.6 million tonnes in 2022.

On the other hand, the demand in the case of fruits, vegetables, starchy roots, milk, and edible oils would increase about 70 per cent by the year 2022 (i.e., from 62.4, 88.8, 35.5, 94.6 and 16.1 million tonnes in 2012 to 104.4, 144.6, 61.5, 156.1 and 28.6 million tonnes respectively in 2022). Similarly, in the case of FEM, the demand would increase by about 45 per cent by 2022 (i.e., from 13.8 million tonnes in 2012 to 20.1 million tonnes on 2022).

The projection of food demand over the next 10 years shows that while the demand for cereals will rise slowly, at under 1 per cent annually, and demand for pulses will stagnate, the demand for vegetables, fruits, milk, edible oils, and animal products will be rising substantially due to changing consumption patterns because of rising income levels and, to some extent, the rising population. The agricultural policy responses needed to meet this expected future demand are considered in the next section.

Table 6: Projections of Demand for Selected Food Categories for 2017 and 2022 (million tonnes)

Items	**2012**[1]	**Demand projection for different GDP growth rates**							
		2017				*2022*			
		6.0%	*7.0%*	*8.0%*	*9.0%*	*6.0%*	*7.0%*	*8.0%*	*9.0%*
Cereals	182.6	191.2	190.7	190.3	189.8	199.6	198.6	197.7	196.7
Pulses	14.9	15.1	14.9	14.7	14.6	15.2	14.8	14.6	14.3
Fruits	62.4	76.2	78.5	80.8	83.2	92.7	98.4	104.4	110.7
Vegetables	88.8	107.5	110.4	113.5	116.7	129.6	136.9	144.6	152.8
Starchy roots	35.5	43.9	45.4	46.8	48.3	54.1	57.7	61.5	65.6
Milk	94.6	115.0	118.3	121.7	125.3	139.3	147.5	156.1	165.3
Edible oil	16.1	20.1	20.8	21.5	22.2	25.0	26.7	28.6	30.6
Sugar	22.8	25.8	26.1	26.5	26.8	29.0	29.7	30.5	31.3
FEM	13.8	16.1	16.4	16.7	17.0	18.6	19.3	20.1	20.8
Percentage increase in total demand from 2011 to 2017 and 2022									
Cereals	-	4.7	4.5	4.21	3.9	9.3	8.8	8.3	7.7
Pulses	-	1.0	0.0	-0.9	-1.9	1.7	-0.3	-2.2	-4.2
Fruits	-	22.1	25.8	29.5	33.4	48.7	57.7	67.3	77.4
Vegetables	-	20.9	24.3	27.8	31.4	45.8	54.1	62.8	72.0
Starchy roots	-	23.6	27.6	31.7	36.0	52.3	62.3	73.0	84.5
Milk	-	21.5	25.1	28.7	32.4	47.2	55.8	65.0	74.7
Edible oil	-	24.8	29.1	33.6	38.2	55.2	66.1	77.8	90.4
Sugar	-	12.8	14.3	15.8	17.3	26.9	30.2	33.6	37.2
FEM	-	16.1	18.3	20.6	22.9	34.4	39.6	45.0	50.6

Note:1. Values for 2012 are for March 2012 , i.e. for 2011-12 (similarly for 2017 and 2022) and projected from 2007-08 data using the actual growth rate of per capita income for each intervening year.

6. ENSURING ADEQUATE SUPPLY OF FOOD FOR THE FUTURE

In this section we consider the land availability and productivity issues facing Indian agriculture and consider the agricultural sector policy initiatives needed in India to ensure sufficient availability of food to meet the increasing demand without undue food price increases.

Table 7: Land Use Classification in India (million hectares)

Year	Total cropped area	Uncultivated land including fallow land	Uncultivated land (%) 2/1	Gross irrigated area	Land irrigated (%) 4/1
	1	2	3	4	5
1960	152.77	60.46	39.57	27.98	18.31
1970	165.79	54.46	32.85	38.20	23.04
1980	172.63	56.87	32.94	49.78	28.83
1990	185.74	53.58	28.85	63.20	34.03
2000	185.34	52.81	28.49	76.19	41.11
2001	188.29	53.41	28.36	78.42	41.65
2002	175.58	61.24	34.88	73.41	41.81
2003	190.08	52.92	27.84	78.15	41.11
2004	191.55	52.30	27.30	81.18	42.38
2005	193.32	51.73	26.76	84.26	43.59
2006	192.49	52.99	27.53	86.77	45.08
2007	195.16	51.96	26.63	87.92	45.05
2008	195.10	51.36	26.33	88.42	45.32
2009(P)	192.20	52.59	27.36		

Note: P - Provisional data.

Source: Ministry of Agriculture, Govt. of India.

Does India have sufficient land to produce enough food to meet the expected increase in food demand? To answer this question, it is useful to consider the current availability of land and its likely future requirement. Table 7 provides data on the total cropped and uncultivated agricultural land in India. The table shows that the total cropped area has grown quite slowly since the late 1960s, i.e., from 152.77 million hectares in 1960 to 192.10 million hectares in 2009. Further, the growth of the total cropped area has been slowing down over the last two decades, increasing from 185.7 million hectares in 1990 to

192.2 million hectares in 2009 or an increase of a mere 6 million hectares in 17 years—an annualised growth rate of only about 0.2 per cent (compared to about 1 per cent over 1960–90). Thus, given the high population density and the high environmental costs of deforestation, etc., which has already gone too far according to many researchers, it seems reasonable to assume that any significant increases in cropped area are unlikely.

Table 7 also shows that the share of gross irrigated area to total cropped area has been rising over the decades, from 18.3 per cent in 1960 to 45.3 per cent in 2008. This is good, since irrigation increases yields, reduces risk of crop failure, and also encourages higher use of fertilisers and high yield variety seeds. Given the growing demand for food in India, especially fruits, vegetables, starchy roots, and edible oils, the government should further facilitate the availability of irrigation facilities for more land as a way to increase agricultural output and reduce vulnerability to the weather and monsoons.

Table 8 presents data on utilisation of cropped land area for various food categories. The table shows that land utilisation has been dominated by the production of cereals and pulses since the 1960s, although the proportion of land going to production of fruits, vegetables, and starchy roots, etc. has been growing steadily. The data shows that the share of total cropped area used for cereal and pulses cultivation has declined from 60.34 per cent and 13.47 per cent in 1971 to 50.05 per cent and 13.40 per cent in 2010. However, in absolute terms, the land used for cultivating cereals and pulses has remained practically constant since 1971—at around 99 million hectares for cereals and about 22 million hectares for pulses—because of increase in the total cropped area. On the other hand, over the same period (1971–2010), the land area used for cultivation of fruits has increased from 1.87 million hectares to 6.41 million hectares, for cultivating vegetables from 3.58 million hectares to 7.25 million hectares, and for cultivating starchy roots from 0.69 million hectares to 1.95 million hectares. This data supports our findings above that the demand for fruits, vegetables, and starchy roots, etc. has been growing relatively rapidly while that for cereals and pulses is largely stagnant.

Table 9 (columns 2 and 3) presents data on growth rates of production and yield of different food categories for the post-reform period (1991–2010), when the growth rate of GDP per capita has been higher, and which may be a better approximation to the future regarding growth rates of income as well as yield increases with the maturing of green revolution techniques over the 1970s and 1980s. The table shows that the annual growth of production and yield of cereals has averaged about 1.37 per cent and 1.46 per cent over the 1991–2010 period, respectively, which is still somewhat greater than the projected growth rate of cereal demand (0.86 per cent), and thus explains a reasonable situation with regard to the availability and prices of cereals in the country.

Table 8: India's Land Utilisation under Different Crops (1961–2010) (million hectares)

Year	Total cropped area	Cereals	Pulses	Fruits	Vegetables	Starchy roots	Sugarcane	Oil crops
1961	156.21	92.24 (59.05)	23.81 (15.24)	1.55 (0.99)	2.78 (1.78)	0.54 (0.34)	2.41 (1.54)	23.67 (15.15)
1971	165.18	99.67 (60.34)	22.26 (13.47)	1.87 (1.13)	3.58 (2.17)	0.69 (0.42)	2.62 (1.58)	25.69 (15.56)
1981	176.75	105.51 (59.69)	22.22 (12.57)	2.27 (1.28)	4.40 (2.49)	0.94 (0.53)	2.67 (1.51)	27.59 (15.61)
1991	182.24	100.24 (55.01)	24.66 (13.53)	2.80 (1.53)	4.86 (2.67)	1.09 (0.60)	3.69 (2.02)	34.84 (19.12)
2001	189.67	100.27 (52.87)	18.62 (9.82)	3.90 (2.06)	6.02 (3.17)	1.33 (0.70)	4.32 (2.28)	33.00 (17.40)
2005	193.32	99.52 (51.48)	22.02 (11.39)	4.82 (2.49)	5.84 (3.02)	1.66 (0.86)	3.66 (1.89)	38.48 (19.90)
2006	192.49	99.24 (51.56)	22.86 (11.88)	5.35 (2.78)	6.33 (3.29)	1.69 (0.88)	4.20 (2.18)	37.96 (19.72)
2007	195.16	100.83 (51.67)	24.84 (12.73)	5.61 (2.87)	6.56 (3.36)	1.87 (0.96)	5.15 (2.64)	39.06 (20.01)
2008	195.10	102.11 (52.34)	22.86 (11.72)	5.89 (3.02)	6.80 (3.49)	1.92 (0.98)	5.06 (2.59)	38.48 (19.72)
2009 (P)	192.20	96.71 (50.32)	20.93 (10.89)	6.18 (3.22)	6.77 (3.52)	1.95 (1.02)	4.42 (2.30)	38.98 (20.28)
2010 (P)	195.31	97.76 (50.05)	26.17 (13.40)	6.41 (3.28)	7.25 (3.71)	1.95 (2.14)	4.17 (2.14)	37.65 (19.28)

Note: P denotes provisional data. The numbers in parentheses show the percentage share of total cropped area devoted to each food category.
Source: Compiled from Ministry of Agriculture and FAO, UN.

A similar situation exists with regard to pulses, whose production and yield has been increasing at about 0.5 per cent per annum, while the demand has been essentially static.

Thus, the sharp increase in recent years in the price of pulses seems to be the result of some short-term problem, such as bad weather in 2009 (which also reduced the land area used for cultivating pulses to a 10-year low of 20 million hectares). On the other hand, the annual growth rate of production of 3.5–5 per cent for fruits, vegetables, starchy roots, milk, edible oils, etc. has generally lagged behind the projected demand growth rate of about 5–6 per cent per annum. This could explain the upward pressure on the prices of these items over the last few years. Thus, urgent policy action is needed to mitigate this shortage and control undue increases in their prices.

Table 9: Additional Annual Land Requirement for Different Food Categories

Food category	Cropped land used (2010)	Growth rate[1] of production	Growth rate[1] of yield	Projected demand growth (%) at 8% GDP growth	Difference of (4) and (3) in %	Additional land needed (million hectares)
	(1)	(2)	(3)	(4)	(5)	(6)
Cereals	97.76	1.37	1.46	0.86	-0.60	-0.59
Pulses	26.17	0.06	0.5	-0.16	-0.66	-0.17
Fruits	6.41	4.45	0.33	5.21	4.88	0.31
Vegetables	7.25	3.55	1.24	4.94	3.70	0.27
Starchy roots	1.95	4.02	1.18	5.55	4.37	0.09
Milk	-	4.24	2.42	5.08	2.66	-
Edible oil	37.65	1.51	1.08	5.82	4.74	1.78
Sugar	4.17	1.14	0.04	2.97	2.93	0.12
FEM	-	3.5		3.78		
Total						1.81

Next, we consider whether India's additional food demand can be met from its existing land resources. Table 9 (columns 3 to 6) provides some simple calculations for likely additional land requirement for meeting food requirement based on the annualised growth rate of yield and projected demand for different food categories. The growth rate is obtained by regressing log of production (or yield) against constant and time trend for the period between 1990 and 2010. Assuming that the growth rates of yields will continue, the table projects that land requirement for cereals and pulses would decline by 0.76 million hectares per annum (because of rising yields and stagnant demand), while land requirement for fruits, vegetables, starchy roots, and sugar will together increase by about 0.79 million hectares per annum to meet the increasing demand. Further, the requirement for edible oils may increase sharply and need an additional 1.78 million hectares. These demands can be partly met by the reallocation of land away from cereals and pulses and towards fruits, vegetables and edible oils, but we will still fall short of about 1.81 million hectares or about 1 per cent of total cultivated land (currently about 195 million hectares). But, unfortunately, there is little scope for significantly increasing the cultivated land area in India, as this would entail high environmental costs such as deforestation, which is already a problem.

Thus, the only way to meet the growing food demand will be to invest in the agricultural sector to increase yields by about an additional 1 percentage point per year above the existing rates. To achieve this, there is an urgent need for additional research in agriculture to find ways to increase land productivity and to deploy more of the fallow and uncultivated land that it constitutes about 27.36 per cent of our total cultivable land (Table 7). Since about 55 per cent of our cultivated land still lacks irrigation facilities (Table 7), an important way to increase land productivity would be to further increase irrigation facilities that increase yield, reduce risk, and encourage greater use of fertilisers and high yielding seeds. Genetically modified crops that lead to a major improvement in output per hectare can be carefully evaluated in a way similar to how new drugs are evaluated and can be considered for human use if found safe.

A major endeavour to create additional irrigation facilities, such as the programme to interlink our major rivers, is needed. It could provide additional irrigation in about 30 million hectares and put agriculture on a sustained growth path (NCAER 2008). The study suggests that this progamme could supplement agriculture growth by 1.65 per cent and overall economic growth by 0.37 per cent. Future growth will therefore have to continuously depend on productivity increases, and this will require the constant spread of irrigation and other yield-enhancing technologies and better management of agricultural resources.

To achieve the needed level of productivity increase, technology alone may not be sufficient, and may need further support in the form of better management. Perhaps, farmers are not growing enough fruits and vegetables due to the additional risk (relative to growing cereals and pulses) because of their perishable nature and the lack of proper cold storage and refrigerated transportation facilities or support prices for them. It would thus be useful to encourage the development of vegetable and fruit growers' cooperatives, somewhat along the lines of dairy cooperatives like Amul. Such cooperatives can facilitate access to cold storage and refrigerated transportation as well as to stable marketing facilities. The government should aid in the development of such cooperatives and in the development of the cold storage and refrigerated transportation facilities for fruit and vegetable growers. It should also encourage the development of food processing industries. These steps could significantly reduce the wastage of perishable crops, which is currently about 30 per cent. Introduction of support prices for fruits and vegetables should also be considered; however, for this to be feasible, the government will need to develop a nationwide marketing agency for fruits and vegetables (somewhat along the lines of 'Safal' in Delhi).

If the above ideas are implemented, the increasing demand for food can be easily handled even without any increase in cropped area, and food price inflation can be avoided.

7. CONCLUSIONS AND POLICY IMPLICATIONS

This study has attempted to understand the reasons for the rapid food price inflation witnessed in India over the past few years and to examine how it can be controlled through appropriate agricultural sector policies.

We began by estimating the demand for food in India. This was done separately for various food categories like, cereals, fruits, vegetables and milk products, fish and meat, etc. Our estimations showed that for every 1-per-cent increase in per capita income, the demand per capita for cereals and pulses is likely to decline by 0.05 per cent and 0.20 per cent, respectively, while the demand for fruits, vegetables, milk, and edible oil is likely to increase by about 0.55–0.65 per cent and that for animal products such as FEM is likely to increase by 0.38 per cent. It appears that rising income levels are increasing the size of the middle and upper income groups, who are reducing their consumption of cereals and pulses somewhat and eating more of vegetables, fruits, dairy products, and meat, etc. Some of the most poor might be able to increase their consumption of cereals etc. with rising incomes, but the first effect seems to be dominating.

From the estimated demand function, we also projected the future demand for various food categories for the next 10 years, especially 2017 and 2022 at different growth of per capita income levels. Our projections show that for annual per capita income growth of 4.8–7.8 per cent, the annual per capita growth rate would decline by about 0.24–0.39 per cent for cereal consumption and by 0.96–1.56 per cent for pulses but increase by about 4–5 per cent for all other food categories, such as fruits, vegetables, starchy roots, milk, and edible oil would and by about 2–3 per cent for fish and meat. Thus, as the per capita income grows, by 2022 food consumption would increasingly diversify towards fruits, vegetables, starchy roots, edible oils, milk and milk products and to animal products such as FEM. Our projections suggest that per capita consumption of cereals, fruits, and vegetables in India will approach that of developed regions such as the UK by 2022. However, our consumption of milk products and meat and fish will still remain significantly below that of developed country levels even by 2022. While this is quite understandable in the case of meat, fish, etc., given that most Indians are vegetarians, it is rather surprising in the case of milk and milk products, given its importance in the Indian diet. Indeed, it suggests the need to further increase production of milk and milk products and to make them cheaper.

When we also take account of the increase in population, along with increases in per capita income, India's total consumption of vegetables, fruits, oils, and dairy products is projected to increase by about 60–75 per cent over the next 10 years while that of meat products will likely increase by about 45 per cent. On the other hand, the total consumption of pulses will remain roughly constant and that of cereals increase by about 7–9 per cent only. These are dramatic changes in demand that deserve the careful attention of policy makers.

Thus, there is an urgent need for agricultural sector policy to focus on increasing food production. The additional demand has to be met through productivity increases as there is little scope for increasing the area under cultivation in India. Given that the production of cereals and pulses use up 60 per cent of our cultivated land, we particularly need to increase their yield per hectare to ensure that their supply does not fall below demand in the process of shifting more land towards producing fruits, vegetables, dairy products, etc. We need to provide irrigation facilities to cover more land (55 per cent of our cultivated land is still un-irrigated). There is also an urgent need for additional research in agriculture to find ways to increase land productivity by an additional 1 per cent above the existing level to keep up with demand increases and to catch up with the much higher productivity levels in China and most other parts of the world.

Further, it is not going to be simply a matter of increasing production along the existing pattern. Given the dramatic shift in demand toward fruits, vegetables, edible oils, dairy and meat products, we will need to focus particularly on increasing production of these, possibly with some reallocation of land currently used for growing cereals and pulses. Further, to help encourage greater production of fruits and vegetables, the government should also try to encourage the development of fruits and vegetable growers' cooperatives, somewhat along the lines of dairy cooperatives like Amul, as the perishable nature of fruits and vegetables and lack of adequate cold storage and transportation facilities is one of the reasons why many farmers do not grow vegetables. Well developed farmers' cooperatives would solve this problem. Another reason why many farmers do not grow fruits and vegetables is the lack of government's support prices (as for cereals and pulses). If feasible, the government should consider creating cold storage and transportation facilities and provide reasonable support prices for fruits and vegetables as well. About 30 per cent of fruits and vegetables grown in India are wasted due to lack of proper processing, storage, and transportation facilities. In fact, only 2–3 per cent of food production is processed in India as against 83 per cent in Malaysia, 72 per cent in Thailand, and 70 per cent in Brazil (Dev and Rao 2004). Thus, the food processing and packaging sectors also need to be strengthened to reduce wastage and increase employment in rural areas.

If the steps suggested above are taken, we can have adequate supplies of all food categories to meet the country's future demand and avoid the problem of food inflation.

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Appendix

Table A-1: Unit Root Tests Using the ADF and PP Tests

Sl. No.	Variables	ADF Test		PP Test	
		Levels	1st Difference	Levels	1st Difference
	Log of food consumption for the selected items				
1.	Cereals	-4.47***	-8.39***	-4.25***	-8.21***
2.	Pulses	-2.36	-6.62***	-2.58	-18.04***
3.	Fruits	0.85	-5.37***	0.76	-5.374***
4.	Vegetables	-1.15	-4.92***	-0.91	-10.45***
5.	Starchy roots	0.05	-5.63***	-2.89*	-29.22***
6.	Milk	-0.54	-6.82***	-0.54	-6.77***
7.	Edible oil	-0.99	-11.18***	-0.36	-15.20***
8.	Sugar	-0.76	-5.89***	-0.49	-8.96***
9.	FEM	-0.73	-8.73***	-0.96	-9.66***
	Log of real income				
10.	LGDPpc	3.53	-5.18***	6.02	-5.30***
	Log of real prices for the selected items				
11.	Cereals	-3.19**	-8.00***	-3.14**	-9.29***
12.	Pulses	-2.36	-6.62***	-2.36	-7.32***
13.	Fruits	-2.63***	-6.52***	-2.66*	-10.09***
14.	Vegetables	1.18	-4.47***	0.936	-6.92***
15.	Starchy roots	-2.77*	-7.75***	-2.86*	-8.06***
16.	Milk	-2.91*	-7.04***	-2.44	-7.94***
17.	Edible oil	-0.82	-7.06***	-1.76	-5.35***
18.	Sugar	-0.83	-5.73***	-1.59	-1.65
19.	FEM	-0.85	-5.03***	-0.85	-4.96***

Note:

1. ***, ** and * indicates 1%, 5% and 10% level of significance respectively.
2. LGDPpc means log of per capita gross domestic product at constant prices;
3. FEM means Fish, Egg and Meat.

Table A-2: Diagnostic Test for Estimations Reported in Table 2

Sl. No.	Dependent variables	$\bar{R}^2$	Serial correlation (LM test)	Ramsey functional form test of estimated equation	Jarque-Bera normality test of the error term	White heteroskedasticity test
1.	Cereals	0.46	0.323	0.881	0.64	0.05
2.	Pulses	0.63	0.79	2.61	0.31	0.03
3.	Fruits	0.97	0.59	2.57	0.67	0.04
4.	Vegetables	0.89	1.00	3.49*	0.21	8.81***
5.	Starchy roots	0.79	0.07	0.14	0.88	1.78
6.	Milk	0.99	0.05	1.31	0.96	3.30*
7.	Edible oil	0.92	0.55	1.54	1.26	1.62
8.	Sugar	0.94	0.01	4.53**	2.63	0.003
9.	FEM	0.97	4.31**	0.01	0.42	3.03

Note: The figures in the tables are Lagrange multiplier statistics for respective test with 1% (***), 5% (**) and 10% (*) respectively.