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# Wheat Economy of India: Development, Nature and Trade Prospects [1]

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## Abstract

Wheat production in India has increased by over ten times in the past five decades and India has become the second largest wheat producer in the world. Today wheat plays an increasingly important role in the management of India's food economy. However, studies that research the wheat economy of the country as a whole remain scarce. This present study examines the characteristics and developments of India's evolving wheat economy.

It seeks to answer questions such as, what is the nature of India's wheat economy? Will the production be able to keep pace with consumption growth? What are the prospects for international trade? Our analyses show that India's wheat production increase is driven principally by yield growth, and to some extent by shift in production from other crops to wheat and an increase in cropping intensity. Among the major factors that affect yield, fertiliser use appears to have less effect in recent years while expansion in irrigated and high yielding variety (HYV) area seem to play a more important role in raising yield. However, with irrigation and HYV having already reached 85-90 per cent area coverage for wheat, future growth in wheat production will be constrained.

On the other hand, the demand for wheat is likely to grow fairly rapidly. Depending on the population and income growth, poverty alleviation and the rate of urbanisation, a demand-supply gap may open at a rate of about 1 to 2 per cent per year which is equivalent to 0.7 to 1.4 million tonnes of wheat, growing larger over the years. Promoting rapid economic development and income growth in India which embraces the poor, and particularly the rural poor, may lead to considerable growth in demand for wheat and thus an expansion in trade opportunities.

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## 1. Introduction

India produces about 70 million tonnes of wheat per year or about 12 per cent of world production. It is now the second largest producer of wheat in the world. Being the second largest in population, it is also the second largest in wheat consumption after China, with a huge and growing wheat demand.

There have been several studies of wheat in India focusing on specific regions or states, such as Sidhu and Byerlee (1991, 1992), Sims (1988) and Gandhi (1997), and overall studies on foodgrains as a whole in India, such as Sarma and Gandhi (1990) and Bhalla, Hazell and Kerr (1999). However, there do not appear to be any overall studies of the wheat economy of the country as a whole. Thus, there is a need to examine the development and characteristics of the evolving wheat economy of India.

What is the nature of the wheat economy of India? How has wheat production grown in India? Will it be able to keep pace with consumption growth? How do wheat markets function? What are the prospects and the market environment for international trade? This paper seeks to explore and examine these issues.

## 2. Foodgrain Production in India: The Place of Wheat

Foodgrain production occupies the most dominant position in India's agriculture, covering over 65 per cent of the gross cropped area. Since the beginning of the green revolution in the mid 1960s, the country has shown quite impressive growth in foodgrain production (Sarma and Gandhi 1990). Chronic food deficits and a hovering Malthusian crisis were overcome and had given way to self-sufficiency and occasional marginal surpluses by the 1980s and 1990s. However, with the population growing at nearly 2 per cent per year (nearly 18 to 20 million people being added every year) and the income growth rates accelerating, the demand for food is continuing to grow rapidly.

In the 1950s, the decade after independence, there was scope for increasing production of foodgrains through expansion of the cultivated area, but this had been exhausted by the end of the 1960s. Table 1 shows that there has been almost no expansion in the foodgrain area from 1970/71 onwards and, on the contrary, a slight tendency to decline as land is diverted to non-foodgrain crops. Despite this, foodgrain production doubled from 51 million tonnes in 1950/51 to 108 million tonnes by 1970/71 and doubled once again to 203 million tonnes by 1998/99. This has been achieved almost entirely through yield growth: yields have tripled from 522 kg/ha in 1950/51 to 1620 kg/ha in 1998/99.

Table 1 Foodgrain Production in India

| Year | Area (m ha) | Production (m t) | Yield (kg/ha) |
|---|---|---|---|
| 1950/51 | 97.3 | 50.8 | 522 |
| 1960/61 | 115.6 | 82.0 | 710 |
| 1970/71 | 124.3 | 108.4 | 872 |
| 1980/81 | 126.7 | 129.6 | 1023 |
| 1990/91 | 127.8 | 176.4 | 1380 |
| 1997/98 | 123.9 | 192.3 | 1552 |
| 1998/99 | 125.4 | 203.0 | 1620 |
| 1999/00 | 123.3 | 199.1 | 1614 |

Sources: Directorate of Economics and Statistics (a); Ministry of Finance.

The yield growth has been achieved principally through the green revolution technology package of high yielding varieties, fertilisers and irrigation. Figure 1 shows that the growth has been punctuated by periodic declines as the production is dependent to a substantial extent on a fluctuating rainfall. Besides, there have been major challenges in overcoming numerous constraints to achieving technological change over millions of small farms spread across the country.

Figure 2 indicates that, even though about 65 per cent of the gross cropped area in the country is devoted to foodgrains, the percentage varies substantially across the regions of the country, ranging from 76 per cent in the northern region to 51 per cent in the south. This variation is related to the nature of resource endowment, agroecology, market development and crop diversification.

**Figure 1: India's Foodgrain Production, 1950/51-1998/99**

**Figure 2: Per cent Area under Foodgrains**

**Figure 3: Grain Production: Distribution of Crops**

**Figure 4: Foodgrain Production across Regions**

Figure 3 shows that rice has the largest share in foodgrain production, accounting for 42 per cent, followed by wheat at 35 per cent. Coarse cereals and pulses hold much smaller shares of 16 per cent and 7 per cent, respectively. Figure 4 shows that the shares vary substantially across regions. In the north, wheat dominates and the region produces 47 million tonnes of wheat. Wheat is almost non-existent in the south, very limited in the east, and the only other significant region is the west, which produces 18 million tonnes. Rice, on the other hand, is found in every region but is greatest in the eastern region with a production of 29 million tonnes, followed by the south at 24 million tonnes, and the north at 23 million tonnes. Coarse cereals and pulses have the highest production in the western region.

Table 2 and Figure 5 show that wheat has made an enormous contribution to the growth in foodgrain production in India. Whereas rice production has doubled between 1950/51 and 1970/71 and doubled again from 1970/71 to 1999/2000, wheat production has increased four times from a little over 6 million tonnes to 24 million tonnes between 1950/51 and 1970/71, and has increased nearly three times again to 69 million tonnes by 1999/2000. Whereas wheat production was below that of rice, coarse cereals and pulses in 1950/51, it was far larger than coarse cereals and pulses by 1999/2000 and is approaching rice production. On the other hand, coarse cereal and pulse production stagnated between 1970/71 and 1999/2000.

**Table 2 Growth and Composition of Foodgrain Production in India (mt)**

| Years | Rice | Wheat | Coarse Cereals | Pulses | Foodgrains Total |
|---|---|---|---|---|---|
| 1950/51 | 20.6 | 6.5 | 15.4 | 8.4 | 50.8 |
| 1970/71 | 42.2 | 23.8 | 30.4 | 11.8 | 108.4 |
| 1980/81 | 53.6 | 36.8 | 29.0 | 10.6 | 129.6 |
| 1990/91 | 74.3 | 55.1 | 32.7 | 14.3 | 176.4 |
| 1997/98 | 82.5 | 66.3 | 30.4 | 13.0 | 192.3 |
| 1998/99 | 86.0 | 70.3 | 31.5 | 14.8 | 203.0 |
| 1999/00 | 87.5 | 68.7 | 29.2 | 13.5 | 199.1 |

Sources: Directorate of Economics and Statistics (a); Ministry of Finance.

**Figure 5: Production of Different Foodgrains**

Figure 6 clearly demonstrates that in the last decade, between 1989/90 and 1998/99, wheat production has grown at a much faster pace. During this period, wheat production has grown at about 3.6 per cent per annum, whereas rice has grown at only about 1.6 per cent. Coarse cereals have declined and pulses have grown only at 1.2 per cent. These growth rates highlight the increasing importance of wheat in the foodgrain economy of India.

**Figure 6: Foodgrain Production Growth Rates: 1989-90 to 1998-99**

## 3. Wheat: Production and Growth Profile

Table 3 shows that the production of wheat has increased over tenfold from less than 7 million tonnes to 69 million tonnes between 1950/51 and 1999/2000. This growth has come both from the expansion of area as well as increase in yield. The area has expanded about 3 times from 9.8 million hectares to 27.4 million hectares, and the growth is continuing, though at a slower pace, into the 1990s. Since wheat and rice are grown in separate seasons, they do not compete for area. It can be shown that the increase in area has come from a shift away from coarse cereals and pulses, and from an increase in cropping intensity through multiple cropping.

**Table 3 Wheat Production in India**

| Year | Area (m ha) | Production (m t) | Yield (kg/ha) |
|---|---|---|---|
| 1950/51 | 9.8 | 6.5 | 663 |
| 1960/61 | 12.9 | 11.0 | 851 |

| | | | |
|---|---|---|---|
| 1970/71 | 18.2 | 23.8 | 1307 |
| 1980/81 | 22.3 | 36.3 | 1603 |
| 1990/91 | 24.2 | 55.1 | 2281 |
| 1997/98 | 26.7 | 66.3 | 2485 |
| 1998/99 | 27.4 | 70.8 | 2583 |
| 1999/00 | | 68.7 | |
| **Annual Growth Rates** | | | |
| 1950-1998 | 2.15 | 5.33 | 3.17 |
| 1966-1998 | 1.65 | 4.67 | 3.03 |
| 1980-1998 | 0.89 | 3.50 | 2.61 |
| 1990-1998 | 1.69 | 3.24 | 1.56 |

Sources: Directorate of Economics and Statistics (a); Ministry of Finance.

Major wheat growing states in India are Uttar Pradesh, Punjab, Haryana, Rajasthan and Madhya Pradesh. Wheat is also grown in Gujarat and Bihar. It may be noted that the major wheat growing areas are all in the north, and therefore, unlike rice, wheat has a relatively narrow geographic land base of production. Wheat is a temperate crop requiring low temperatures, and most of the country is tropical. Even within many of these states the wheat areas are limited and overall only about 18 per cent of the net cropped area is planted to wheat.

Figure 7 gives the shares of the different states in the national production. It shows that Uttar Pradesh (U.P.) contributes the largest share with 36 per cent of production, followed by Punjab with 19 per cent and Haryana with 11 per cent. These three northern states together contribute two-thirds of the production of wheat. These are followed by Madhya Pradesh (M.P.) 11 per cent, Rajasthan 10 per cent, Bihar 6 per cent and Gujarat 3 per cent. All the rest contribute only 4 per cent.

**Figure 7: Distribution of Wheat Production across States**

Wheat yields increased fourfold from 663 kg/ha to 2583 kg/ha between 1950/51 and 1998/99. Whilst there was some growth in yield between 1950/51 and 1960/61, the growth was substantial after that. Figure 8 indicates that there was a significant acceleration in production growth after 1966/67 with the advent of the green revolution. The growth can be largely attributed to the introduction of the new dwarf high yielding variety germplasm from CIMMYT, Mexico, as well as the use of the associated complementary modern inputs, particularly fertilisers and irrigation. The national research system also played a major role in adapting this technology to suit the local conditions and market preference in India. The 1990/91-1998/99 period shows an annual growth rate of 3.24 per cent, but both the yield and the production growth rates appear to show some deceleration in recent years. This could be indicative of constraints to yield growth.

**Figure 8: India's Wheat Production**

Wheat yields vary substantially across the states as shown by Figure 9. Punjab and Haryana show the highest yields of 3853 and 3660 kg/ha, respectively. This is followed, after a significant gap, by Rajasthan, U.P. and Gujarat with 2500, 2498 and 2373 kg/ha, respectively – which are close to the national average of 2583 kg/ha. Bihar and M.P. follow with much lower yields of 1999 and 1625 kg/ha, respectively. These yields can be compared with 2907 kg/ha in USA, 1907 kg/ha in Australia, 1029 kg/ha in Russia, 3667 kg/ha in China and 7603 kg/ha in France (FAO 1998).

What has made the yield growth possible in India? Numerous studies such as Mellor (1988) and Sarma and Gandhi (1990) have indicated that modern technology and inputs have played the major role for foodgrains as a whole. Table 4 shows the trends in the major inputs and resources used in wheat production. Fertilisers, high yielding varieties (HYV) and irrigation all show substantial increase. Estimated fertiliser use on wheat has increased from less than 2 kg/ha to 137 kg/ha between 1950/51 and 1998/99. HYVs were non-existent in 1950/51 and 1960/61 but now cover 88 per cent of the area. Irrigation has risen from 34 per cent to 89 per cent. Thus, clearly, substantial technological change has taken place in wheat production.

**Figure 9: Wheat Yields across States**

**Table 4 Trends in Major Resources and Inputs Used in Wheat Production**

| Years | Area (m ha) | Fertilisers* (kg/ha) | Percent Area under HYV | Percent Area Irrigated | Rainfall Index (Normal=100) |
|---|---|---|---|---|---|
| 1950/51 | 9.8 | 1.8 | 0.0 | 34.0 | 104 |
| 1960/61 | 12.9 | 5.7 | 0.0 | 32.7 | 99 |
| 1970/71 | 18.2 | 31.2 | 35.5 | 54.3 | 113 |
| 1980/81 | 22.3 | 63.7 | 72.3 | 76.5 | 104 |
| 1990/91 | 24.2 | 118.3 | 86.8 | 81.1 | 119 |
| 1997/98 | 26.7 | 127.4 | 86.2 | 87.4 | 102 |
| 1998/99 | 27.4 | 137.4 | 87.6 | 89.3 | 106 |

* Fertiliser use on wheat is estimated by the authors based on fertiliser use and crop statistics.

Sources: Directorate of Economics and Statistics (a); Fertiliser Association of India.

## 4. Analysis of Production Behaviour

This section seeks to examine the relationship between major factors, particularly inputs, in determining wheat production in India, at the aggregate level. It is common practice in the analysis of grain production to separate area and yield effects and to focus on the yield function. In the case of India, the area available for production has reached limits. It is yield growth that is mainly driving production growth and this will continue in the future (see Sarma and Gandhi 1990).

Houck and Gallagher (1976) estimated a yield function for corn in the U.S. using a yield function with relative fertiliser price, an index of moisture conditions, land acreage, dummies for acreage restrictions and a time-trend (for technology) as the explanatory variable (1950-early 1970s). Guise (1969) used a Cobb-Douglas wheat yield function for New Zealand (1917-67) with variables reflecting such factors as soil type, virus incidence, HYV proportion, relative fertiliser price, acreage, livestock, a time-trend, temperatures and rainfall as explanatory variables. Hamblin and Kyneuer (1993) related Australian wheat yields to rainfall, water availability in the root zone, water use efficiency, per cent under semi-dwarf varieties, growing areas, a time-trend (for which a degree four polynomial was used), soil organic matter and nitrogen. Byerlee and Traxler (1995) related experimental wheat yields to the release of varieties related or unrelated to CIMMYT germplasm for different regions of the world. Sarma and Gandhi (1990) estimated yield functions for foodgrains in India with fertilisers, high yielding varieties, irrigation and rainfall as explanatory variables using linear, Cobb-Douglas and transcendental functional forms.

Based on the above literature, and knowledge of the Indian setting, fertiliser use, high yielding varieties, irrigation and rainfall are selected to be the major determinants of wheat yield to test for in a production function framework. Data on some of the other variables emerging from the literature reviewed above are very difficult to get and some of them are not particularly relevant for the present wheat agriculture in India. Many alternative functional forms are possible. The Cobb-Douglas functional form is selected as the function to use because of its reasonable theoretical assumptions (see Fuss, McFadden, and Mundlak 1978, Lau 1986), good record, simplicity of form and the limited degrees of freedom available.

The yield function is specified as below:

YIELD = a ´ FERT $^{b1}$ ´ HYV $^{b2}$ ´ IRRG $^{b3}$ ´ RAIN $^{b4}$

This is linearised by taking logs.

LOG (YIELD) = a + $b_1$ ´ LOG (FERT) + $b_2$ ´ LOG (HYV) + $b_3$ ´ LOG (IRRG) + $b_4$ ´ LOG (RAIN)

Where:

YIELD = Wheat yield in kilograms per hectare

FERT = Fertiliser use on wheat (estimated) in nutrients, kg/hectare

HYV = Percentage of wheat gross cropped area under high yielding varieties

IRRG = Percentage of wheat gross cropped area which is irrigated

RAIN = Index of rainfall based on rain received during the main monsoon season of June to September (usually 85 per cent of the rainfall).

a, $b_1$, $b_2$, $b_3$, $b_4$ are parameters to be estimated.

Production function estimation is frequently affected by multicollinearity. This depends principally on the correlation between explanatory variables. To assess this problem, correlations were calculated, and the correlation matrix of the explanatory variables is given in Table 5. The matrix shows that the correlations are very high. The correlation between fertiliser and irrigation is 0.9607 and this may be because the rise in irrigation and fertiliser use often goes together. Similarly the correlation between fertiliser and HYV is also high at 0.8499 since fertiliser use may increase substantially with HYV use. Correlation between irrigation and HYV is at 0.9327 since irrigation helps HYV adoption. From these results it appears that the regression estimation is likely to be influenced by multicollinearity and the regression procedure may find it difficult to separate the effects of these three inputs on yields. Therefore, their coefficient magnitudes could be unstable and may reflect the effects of each other. It may also be noted that rain does not have a high correlation with any of these inputs, perhaps because of the high degree of irrigation in wheat.

**Table 5 Correlation between Explanatory Variables (1966/67 – 1998/99)**

| | **FERT** | **HYV** | **IRRG** | **RAIN** |
|---|---|---|---|---|
| FERT | 1.0000 | | | |
| HYV | 0.8499 | 1.0000 | | |
| IRRG | 0.9607 | 0.9327 | 1.0000 | |
| RAIN | 0.1748 | 0.1595 | 0.1450 | 1.000 |

Since the Durbin-Watson statistics indicated a high degree of auto-correlation, the production functions were estimated by the GLS regression procedure with the Cochrane-Orcutt procedure for correction of auto-correlation. The main time period used was 1966/67 to 1998/99 which was the entire period since the new green revolution technology arrived. Two sub-periods 1980/81 to 1998/99, and 1990/91 to 1998/99 were also experimented with to examine the more recent environments. The earlier period of 1950/51 to 1965/66 was not used since it represented a markedly different technology and institutional environment, not considered relevant or useful for analysing the present and future scenario.

The regression estimates are given in Table 6. The R-square estimates indicate a good fit of the function. Even though multicollinearity between fertiliser, HYV and irrigation is affecting the results, all of these variables show positive coefficients and each emerges as an important determinant in at least one of the equations. For the 1966/67-1998/99 period fertiliser emerges with a large and highly significant coefficient. This indicates that over the longer period, fertiliser use has played a major role in determining wheat production. HYV is also significant in this period, indicating its important role. However, irrigation does not emerge as a significant determinant of yield in this equation.

For the more recent 1980/81-1998/99 period, fertiliser becomes non-significant but both HYV and irrigation emerge to be significant. The coefficients of both these variables come out to be much larger, indicating a strong role in determining wheat yields. In the very recent 1990/91-1998/99 period both HYV and irrigation emerge as very significant. This indicates that in more recent years irrigation or water seems to have emerged as a major determinant in wheat production growth. This would be a significant concern for future growth: as indicated earlier, 89 per cent of wheat area is already irrigated and therefore there is less scope for growth in it. The other key determinant, HYV, will be another major constraint as HYV is already 88 per cent in coverage. In the case of fertilisers, even though there is scope for expansion (rate stands at 137 kg/ha) the productivity is not very high. Better soil fertility management may help to improve this. A somewhat comforting finding from the estimates is that the relationship between wheat production and rainfall is not significant. This indicates that the wheat yield is not affected very much by the vagaries of rain, which hence would provide stability to foodgrain production in India.

**Table 6 Results of GLS Regression Analysis with Correction for Auto-correlation:**
**Cobb-Douglas Production Function**

| Period | Estimated Coefficients of the Logs of Each Variable |
|---|---|

| | FERT | HYV | IRRG | RAIN | $R^2$ | DW | N |
|---|---|---|---|---|---|---|---|
| 1966/67-1998/99 | 0.3801 | 0.0598 | 0.2295 | 0.1011 | 0.97 | 2.13 | 33 |
| | (3.934) | (1.715) | (0.957) | (1.401) | | | |
| | *** | * | | | | | |
| 1980/81-1998/99 | 0.1705 | 0.8864 | 0.7233 | 0.0749 | 0.94 | 2.00 | 19 |
| | (1.464) | (3.166) | (2.557) | (0.806) | | | |
| | | *** | ** | | | | |
| 1990/91-1998/99 | 0.1893 | 1.0099 | 1.1184 | 0.1065 | 0.88 | 2.77 | 9 |
| | (1.156) | (2.817) | (3.156) | (0.839) | | | |
| | | ** | ** | | | | |

Note: t-statistics are in parenthesis under the coefficients; significance: *** at 0.99, ** at 0.95, * at 0.90.

## 5. Markets and Prices

As a result of the foodgrain crisis in the 1960s, the Government of India developed an elaborate institutional system for the support, control and stabilisation of foodgrain prices in order to make available basic minimum supplies at reasonable prices to the people. The system includes the Commission on Agricultural Costs and Prices (CACP), the Food Corporation of India (FCI), and State Civil Supplies Corporations. Some of the features and indicators related to this system are given in Table 7 for wheat.

**Table 7 Government Minimum Support/Procurement Prices, Issues Prices, Procurement, Offtake and Stocks for Wheat**

| Year | MSP/Pro-curement Price (Rs/ Quintal) | Issue Price PDS (Rs/ Quintal) | Production (million tons) | Procure-ment (million tons) | Offtake from Central Pool (million tons) | Stocks (million tons) 1st April | Stocks (million tons) 1st July |
|---|---|---|---|---|---|---|---|
| 1990 | 215 | 234 | 49.9 | 11.1 | | | |
| 1995 | 360 | 402 | 65.8 | 12.3 | 12.8 | 8.72 | 19.22 |
| 1996 | 380 | 402 | 62.1 | 8.2 | 13.3 | 7.76 | 14.13 |
| 1997 | 475 | 250/450* | 69.4 | 9.3 | 7.8 | 3.24 | 11.42 |
| 1998 | 510 | 250/650* | 66.3 | 12.7 | | 5.08 | 16.70 |
| 1999 | 550 | 250/682* | 70.8 | 14.1 | | | |

*BPL/APL: For Below Poverty Line/Above Poverty Line.

Sources: Directorate of Economics and Statistics (b); Commission for Agricultural Costs and Prices.

Minimum support prices (MSP) or procurement prices are announced by the government every year at the beginning of every wheat season. These prices are based largely on the cost of cultivation, which is systematically studied based on farm-level information every year by the CACP, as well as on market information. Table 7 shows that the MSP has risen considerably over the decade of the 1990s, one of the major jumps coming after the economic reforms in the early 1990s. The issue prices or the price at which the grain is released to the government Public Distribution System (PDS) is fixed and revised only from time to time. The distribution is mainly by state governments through thousands of fair price shops spread throughout the country in the urban and rural areas. There is an element of subsidy in this but the government has been trying to target and reduce this in recent years.

The total procurement of wheat ranges from 8 to 14 million tonnes, accounting for about 11 to 20 per cent of the total production. Thus, the government system handles only a small proportion of the total wheat production and the large proportion is handled by private merchants. Yet the support price operation and the PDS play a significant role in maintaining reasonable and stable foodgrain prices in the country for both the producers and consumers. However, substantial stocks are sometimes accumulated in the process and, as shown in Table 7, these could rise to almost 20 million tonnes after the harvest and market arrivals, but decline over the rest of the year.

Table 8 gives a state-wide profile (major states) of the procurement and distribution (Targeted PDS) of wheat for 1997/98. It shows that there is a substantial spatial gap between locations of supply and demand. The bulk of the procurement comes only from a few states, particularly Punjab and Haryana. Punjab contributes as much as 64 per cent of the procurement of wheat, and Haryana 25 per cent. Uttar Pradesh, which has 36 per cent of the production, contributes only 7 per cent of the procurement, due to its substantial local demand.

**Table 8 Procurement and Offtake of Wheat in 1997/98 by State (000 tonnes)**

| | Procurement | Offtake under TPDS |
|---|---|---|
| Andhra Pradesh | - | 106 |
| Assam | - | 143 |
| Bihar | - | 485 |
| Delhi | 1 | 459 |
| Gujarat | - | 433 |
| Haryana | 2290 | 77 |
| Himachal Pradesh | - | 99 |
| Jammu Kashmir | - | 128 |
| Karmataka | 0 | 214 |
| Kerala | - | 328 |
| Madhya Pradesh | 107 | 247 |
| Maharashtha | - | 914 |
| Orissa | - | 127 |
| Punjab | 5961 | 7 |
| Rajasthan | 320 | 307 |

| | | |
|---|---|---|
| Tamil Nadu | - | 123 |
| Uttar Pradesh | 617 | 753 |
| All India | 9298 | 5993 |

Sources: Commission for Agricultural Costs and Prices.

The offtake under TPDS is spread across a large number of states. Some of the states that are on high demand for wheat are Maharashtra, Uttar Pradesh, Bihar, Delhi, Gujarat, Kerala and Rajasthan. The presence and effectiveness of the government procurement and distribution systems play an important role in providing a reasonably stable market for farmers, especially where there are significant surpluses, and a stable supply at reasonable prices to consumers spread over a huge area.

Table 9 presents the price trends in wheat over the last decade. The all-India wholesale price index for wheat indicates that the wheat prices have been rising over the 1990s, and a comparison with the all commodities price index shows that, by and large, wheat prices have kept pace with the general price rise in the economy. There was a gap in 1990/91 which was corrected over the next few years with the economic reforms that followed, and periodically gaps have emerged but have been corrected over time.

Table 9 Wheat Prices

| | Wholesale Price Index: All Commodi-ties (1981/82=100) | Wholesale Price Index: Wheat (1981/82=100) | Delhi Average Wholesale Price (Rs/ Quintal) | Minimum Support Price (MSP) | | US No.2 Hard Winter (US$/t) | US No.2 Soft Winter (US$/t) | Argen-tina Trigo Pan (US$/t) | Ex-change Rate Rs Per US$ |
|---|---|---|---|---|---|---|---|---|---|
| | | | | (Rs/ Quin.) | (US$/t) | | | | |
| 1990/91 | 182.7 | 172.1 | 284 | 215 | 120 | 118 | 112 | 85 | 17.94 |
| 1991/92 | 207.8 | 203.7 | 349 | 225 | 92 | 150 | 147 | 114 | 24.47 |
| 1992/93 | 228.7 | 227.0 | 365 | 275 | 90 | 143 | 142 | 124 | 30.65 |
| 1993/94 | 247.8 | 253.4 | 385 | 330 | 105 | 143 | 132 | 120 | 31.37 |
| 1994/95 | 274.7 | 272.7 | 414 | 350 | 111 | 157 | 145 | 136 | 31.40 |
| 1995/96 | 295.8 | 271.4 | 432 | 360 | 108 | 216 | 198 | 218 | 33.45 |
| 1996/97 | 314.6 | 330.3 | 588 | 380 | 107 | 181 | 158 | 157 | 35.50 |
| 1997/98 | 329.8 | 333.3 | 554 | 475 | 128 | 144 | 131 | 139 | 37.17 |
| 1998/99 | 352.6 | 337.6 | 543 | 510 | 121 | | | | 42.07 |

Sources: Directorate of Economics & Statistics (a); Ministry of Finance; Commission for Agricultural Costs and Prices; Fertiliser Association of India.

The actual wholesale prices in the sample market of Delhi also reflect the price rise. It can be seen from Table 9 that the market prices have throughout been well above the MSP, which indicates that the MSP mechanism and systems are, by and large, working reasonably well. The international prices of wheat show differences across qualities, but appear to show a rising trend over most of the 1990s. Ignoring the price blip of 1995/96, the U.S. no. 2 hard winter wheat prices have risen from US$118 per tonne in 1990/91 to US$181 per tonne in 1996/97. Converting the MSP into US$ per tonne, the MSP was generally below the international prices.

## 6. Trade, Cost of Production and Competitiveness

India was a significant importer of wheat prior to the 1990s. During the 1990s India has become a marginal importer and even an exporter on occasions. However, since India has a large demand, these marginal quantities can often be significant for the world market. Wheat trade has been under government control in the past, and the import and export quantities reflect government decisions over each year as well as across the years in managing the supply, demand, stocks and the food prices in the country. There has been a tendency to use trade more frequently in the 1990s than in the earlier decades.

Table 10 shows imports and exports in the 1990s. The import quantities varied from nil to 1.36 million tonnes between 1990/91 and 1997/98 while the export quantities varied from almost nil to 1.84 million tonnes. Some of the exports went to neighbouring countries such as Bangladesh and Nepal with which India has a transport advantage, and this often depends on the agricultural situation in those countries.

**Table 10 India's Trade in Wheat (000 tonnes)**

| Year | Imports | Exports |
|---|---|---|
| 1990/91 | 64 | 140 |
| 1991/92 | - | 660 |
| 1992/93 | 1364 | 38 |
| 1993/94 | 242 | 4 |
| 1994/95 | 1 | 92 |
| 1995/96 | 9 | 1092 |
| 1996/97 | 616 | 1848 |
| 1997/98 | 1345 | 2 |

Sources: Directorate of Economics and Statistics (b); Commission for Agricultural Costs and Prices.

Table 11 provides a break-up of wheat imports by type. It shows that in the 1990s imports of Durum wheat, seed and flour have been nil or very limited. The main type of wheat imported is the regular grain wheat.

**Table 11 Wheat Import by Type (000 tonnes)**

| | Durum | Seed | Others | Flour | Total |
|---|---|---|---|---|---|
| 1990/91 | - | - | 62.6 | 1.01 | 63.61 |
| 1991/92 | - | - | - | - | - |
| 1992/93 | 21 | - | 1342.7 | - | 1363.70 |
| 1993/94 | 11.8 | - | 229.9 | - | 241.70 |
| 1994/95 | - | - | 0.5 | 0.03 | 0.57 |
| 1995/96 | - | - | 8.2 | 0.45 | 8.69 |

| | | | | | |
|---|---|---|---|---|---|
| 1996/97 | - | - | 612.7 | 3.33 | 616.01 |
| 1997/98 | - | - | 1344.6 | - | 1344.55 |

Sources: Directorate of Economics and Statistics (b); Commission for Agricultural Costs and Prices

India signed the GATT/WTO agreement in 1994. The WTO Agreement on Agriculture (AOA) requires the conversion of all non-tariff barriers (NTBs) into tariffs (i.e., tariffication). India also agreed to make adjustments in tariff rates for 3373 commodity groups or sub-groups (Gulati, Mehta and Narayanan 1999). These commodities account for around 65 per cent of India's tariff lines. In agricultural lines, India committed to tariffication of 673 lines or sub-groups.

A number of steps have already been taken during the 1990s to liberalise the import regime. With the export-import policy for the year 1999-2000, only 2114 tariff lines (about 20 per cent out of 10261 tariff lines) are now subject to any type of NTBs. Of the lines under NTBs, only 606 (29 per cent) are of agriculture (Gulati, Mehta and Narayanan 1999). India has unilaterally gone ahead to reduce tariff barriers much below the bound rates of duty under the AOA. The most bulky agricultural commodities like rice and milk (skimmed milk powder) have already been committed at zero import duty. For wheat the bound rate of duty is 100 per cent, but roller flour mills are allowed to import at zero import duty. Similarly, for pulses the bound rate is 100 per cent, but they are being imported under OGL at zero import duty. Edible oils, most of which are bound at 300 per cent import duty, are open for imports at 15 per cent duty. It appears that by 2001 most of the quantitative restrictions will be done away with (Gandhi 1999). Table 12 provides a picture of some of the tariff rates.

**Table 12 Tariff Rates on Selected Agricultural Commodities**

| Description | Export Policy | Import Policy | Bound Tariff | Applied Tariff 1997-98 | Applied Tariff 1998-99 | Applied Tariff 1999-2000 |
|---|---|---|---|---|---|---|
| Durum wheat | Free | Restricted | 100% | 0% | 0% | 0% |
| Other | | | 0% | 0% | 0% | 0% |
| Barley | | | 100% | 0% | 0% | 0% |
| Oats | | | 100% | 0% | 0% | 0% |
| Rice in the husk (paddy or rough) | | | 0% | 0% | 0% | 0% |
| Husked (brown) rice | | Canalised | 0% | 0% | 0% | 0% |
| Semi-milled or wholly-milled | | | 0% | 0% | 0% | 0% |
| Broken rice | | Canalised | 0% | 0% | 0% | 0% |
| Grain sorghum | | | 0% | 0% | 0% | 0% |
| Millet | | | 0% | 0% | 0% | 0% |
| Groundnut oilseeds in shell | | | 100% | 40% | 40% | 40% |

Source: Government of India.

The cultivation cost of wheat in India is continuously evaluated through the Cost of Cultivation Surveys of the Government. The summary results for wheat from 1990/91 to 1995/96 are given in Table 13. The table shows that the cost of production of wheat varies considerably across states and ranges from an average of Rs.292 per quintal to Rs.377 per quintal (1995/96). Haryana shows the lowest cost in all the years followed by Punjab and Uttar Pradesh. Madhya Pradesh has the highest cost of production. The differences are due to agroecology as well as crop management.

How competitive is India in the production of wheat? The real picture is not easy to get because of various interventions and distortions.

The results of a study (Naik 1999) are presented in Table 14, in which Domestic Resource Cost (DRC) analysis is used to evaluate the international competitiveness of wheat production in India. A coefficient less than one indicates that the production is internationally competitive. The results show that wheat production in the major wheat producing states in the country is internationally competitive (U.P. was not included in this study). This includes the states of Punjab, Haryana and Rajasthan which are competitive in all the years. Madhya Pradesh and Gujarat are not competitive in some of the years. The competitiveness has eroded somewhat between 1995/96 and 1998/99 mainly due to changes in the international price but Punjab, Haryana and Rajasthan remain competitive. Thus, by and large, wheat production in India is internationally competitive.

**Table 13 Cost of Production of Wheat in India in Major Producing States (Rs/Quintal)**

| States | 1990/91 | 1991/92 | 1992/93 | 1993/94 | 1994/95 | 1995/96 |
|---|---|---|---|---|---|---|
| Haryana | 155.4 | 168.4 | 217.5 | 246.7 | 263.3 | 292.3 |
| Madhya Pradesh | 256.9 | 317.2 | 343.7 | - | 348.2 | 377.0 |
| Punjab | 190.8 | 210.4 | 250.7 | 268.3 | 306.6 | 342.8 |
| Uttar Pradesh | 220.2 | - | - | - | - | 328.0 |

Note: C2 Cost

Source: Directorate of Economics and Statistics (a and c).

**Table 14 Competitiveness of Indian Wheat Production: Estimated Domestic Resource Cost Coefficients for Wheat**

| State | 1995/96 | 1996/97 | 1997/98 | 1998/99 |
|---|---|---|---|---|
| Haryana | | 0.5295 | 0.6333 | 0.7609 |
| Gujarat | 0.6828 | | 0.8410 | 1.0178 |
| Madhya Pradesh | | 0.8884 | 1.0682 | 1.2921 |
| Punjab | | 0.5127 | 0.6090 | 0.7362 |
| Rajasthan | 0.5052 | | 0.6872 | 0.8405 |

Source: Naik (1999).

## 7. Demand and Consumption

The consumption of wheat and many other items in India is surveyed periodically by the National Sample Survey Organisation (NSS). The latest NSS data are available from the survey in the year 1993/94. Table 15 provides the data of cereal consumption for the rural areas against the total consumer expenditure by population deciles. Figure 10 plots the consumption of rice, wheat and coarse cereals against the total consumer expenditure (frequently used as a proxy for income).

**Table 15 Per Capita Total Consumer Expenditure and Cereal Consumption Per Month in Rural Areas, NSS 1993/94**

| Decile | Population Shares Upper Limit | Total Expenditure (Rs/month) | Rice Consump-tion (kg/month) | Wheat Consump-tion (kg/month) | Coarse Cereal Consumption (kg/month) | Total Cereal Consumption (kg/month) |
|---|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | 10 | 116.2 | 4.89 | 3.06 | 2.58 | 10.53 |
| 2 | 20 | 155.1 | 6.38 | 3.52 | 2.12 | 12.02 |
| 3 | 30 | 177.8 | 7.03 | 3.55 | 2.11 | 12.69 |
| 4 | 40 | 202.1 | 7.50 | 3.72 | 1.98 | 13.20 |
| 5 | 50 | 224.8 | 7.43 | 4.07 | 1.86 | 13.36 |
| 6 | 60 | 250.7 | 7.55 | 4.30 | 1.93 | 13.78 |
| 7 | 70 | 283.7 | 7.67 | 4.56 | 1.87 | 14.10 |
| 8 | 80 | 325.3 | 7.60 | 5.00 | 1.83 | 14.43 |
| 9 | 90 | 396.8 | 7.01 | 5.76 | 1.84 | 14.61 |
| 10 | 100 | 681.6 | 7.22 | 6.44 | 1.60 | 15.26 |

Source: Joshi (1998).

**Figure 10: Per Capita Consumption of Cereals and Income Levels; Rural Population**

Both Table 15 and Figure 10 show that the consumption of wheat and rice rises with income whereas the consumption of coarse cereals falls. The consumption of rice rises to a certain level and then tapers off. The consumption of wheat starts at a lower level but continues to increase as income rises – this indicates a more buoyant demand for wheat with income growth. Thus, the three different cereal types show quite different consumption behaviour in relation to income, and wheat shows a sustained rise with income increase.

Table 16 compares the average consumption of cereals in rural and urban areas based on NSS 1993/94 data. The table shows that the average total cereal consumption in urban areas is lower than in the rural areas. Whereas the coarse cereal consumption declines sharply from 1.98 to 0.63 kg/month, the rice consumption also declines considerably from 7.02 to 5.28 kg/month. However, the wheat consumption increases from 4.40 to 4.72 kg/month. This indicates that urbanisation leads to a lower total cereal consumption but higher wheat consumption.

Table 16 Cereal Consumption in the Rural and Urban Areas (kg Per Month)

| | Rice | Wheat | Coarse Cereals | Total Cereals |
|---|---|---|---|---|
| Rural | 7.02 | 4.40 | 1.98 | 13.40 |
| Urban | 5.28 | 4.72 | 0.63 | 10.63 |

Source: Joshi (1998).

Figure 11 gives the profile of wheat consumption in both rural and urban areas over the total expenditure (income) levels. The figure shows that in rural areas the wheat consumption rises significantly with income levels. Thus, income increase in rural areas will lead to a larger increase in wheat consumption. In urban areas, too, the rise is present but not as much. However, as indicated earlier, the average consumption of wheat is somewhat higher in urban than in rural areas.

**Figure 11: Per Capita Wheat Consumption across Income Levels**

What is the magnitude of the income elasticity of demand? To obtain the income elasticities of demand, Engel curves of the following form were estimated:

LOG(CONSUM) = a + b ´ LOG(INCOME) + e

Where:

CONSUM = wheat consumption in kg/month

INCOME = total consumer expenditure in Rs/month

a, b = parameters to be estimated.

b = income elasticity of demand

e = error term

The equation was estimated by regression analysis using the 1993/94 NSS consumption survey data. The results, given in Table 17, show that both equations have a reasonably good fit. The income elasticity of demand works out to be much higher at 0.4561 for the rural areas as compared to that for urban areas which is 0.1540. Both are statistically significant.

**Table 17 Regression Estimates of Engel Curve for Wheat**

| Equation | LOG(INCOME) Coefficient = Elasticity | t-statistic | Significance | $R^2$ | F |
|---|---|---|---|---|---|
| Rural | 0.4561 | 16.208 | *** | 0.97 | 262 |
| Urban | 0.1540 | 6.303 | *** | 0.83 | 40 |

The elasticities indicate that wheat consumption would rise significantly with income growth. Figure 11 given earlier also shows that the demand growth would be sharper if income of the lower deciles of the population (i.e. the poor) were to rise significantly. Thus, poverty alleviation, particularly in the rural areas, would have a large positive effect on wheat demand.

The Government of India estimates a statistic called the “per capita availability of foodgrains (rice and wheat)”. It is actually a food accounting estimate of the human consumption of foodgrains based on the disappearance concept. It is calculated beginning with production, and accounting for estimates of seed and feed use, wastage, imports, exports, and increase/decrease in the public foodgrain stocks. The remainder is estimated as “disappearance” for human consumption. Private and consumer stocks are not taken into account and thus it may be subject to error.

Figure 12, based on the above estimates of the per capita availability of rice and wheat, clearly indicates that both rice and wheat consumption have increased but the wheat consumption has risen considerably more. Wheat consumption was 28.6 kg/year per capita in 1960 and from this it has increased to 48.4 kg/year in 1990 and about 65 kg/year in the late 1990s. Between 1990 and 1997, whereas the rice consumption has only grown at 0.36 per cent per year, wheat consumption has grown 10 times faster at 3.4 per cent per year. This again tends to suggest that there is a more buoyant demand for wheat.

**Figure 12: Capita Availability of Wheat and Rice**

## 8. Concluding Remarks and Future Scenario

India has become the second largest producer of wheat in the world, though it is only seventh largest in land area. Wheat production has increased from about 6 million tonnes in the early 1950s to 70 million tonnes in the late 1990s. The increase is driven principally by yield growth but also by a shift in production from other crops to wheat and an increase in cropping intensity. The steady increase in the procurement price for wheat may also explain part of this growth. The area base is narrower compared to rice, and two-thirds of the wheat is produced in the northern states of U.P., Punjab and Haryana. Production growth driven by yields is determined largely by use of fertilisers, high yielding varieties and irrigation. Our findings indicate that in recent years the use of fertiliser appears to have less effect, and the expansion of irrigated and HYV area seems to play a more important role in production growth. But with these inputs having already reached 85-90 per cent area coverage, future growth in production is likely to be more difficult. Wheat production in India is, however, internationally competitive and markets are stable and well developed.

The analysis in this paper indicates that the wheat demand may grow fairly rapidly with population and income growth, and faster than for other cereals. The production is, however, facing limits and barriers and will be hard pressed in meeting the demand. Analysis indicates that, depending on the rate and nature of economic growth and given the population growth rate and the income elasticity of demand, about 4 or more per cent annual rate of growth in the demand for wheat is likely in the near future. Wheat production may be expected to grow at about 2 to 3 per cent per year considering the various constraints unless new breakthroughs occur. Thus, ignoring fluctuations, a demand-supply gap may open at a rate of about 1 to 2 per cent per year which is equivalent to 0.7 to 1.4 million tonnes of wheat, growing larger over the years.

Recent IFPRI projections (Bhalla, Hazell and Kerr 1999) also suggest that, depending on the outcomes of economic development, significant gaps are likely to emerge between cereal demand and supply in India. However, the final outcome will depend substantially on the rate and nature of the economic development. A faster economic development will lead to a deficit, whereas a slower one may lead to a surplus. The findings from our study confirm that promoting rapid economic development and income growth which embraces the poor, and particularly the rural poor, may lead to considerable growth in demand for wheat and an expansion in trade opportunities.

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## Footnotes

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