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Indian Wheat and Rice Sector Policies and the Implications of Reform

Shikha Jha, P.V. Srinivasan, and Maurice Landes

Abstract

During 1998-2002, India experienced record public surpluses of wheat and rice, sharply higher government grain subsidy outlays, and declining per capita consumption of wheat and rice. By 2006, despite continued high subsidies and sluggish domestic consumption, India developed a large wheat deficit because of reduced price incentives, weak yield growth, and rising subsidized consumption. The pronounced market cycles and declining per capita consumption for India's major food staples are creating pressure for Indian policymakers to adjust longstanding policies. While there has been no political consensus on more fundamental reform, recent policy changes have moved toward better targeting of food subsidies to low-income consumers, decentralization of government operations, and slowed growth in producer price subsidies. Decentralization is likely to reduce government costs with little impact on producers, consumers, or trade. Lower price supports would aid consumers at the cost of producers, and sharply lower government costs. Adoption of a U.S.-style deficiency payment program could maintain producer support with less market distortion and lower cost, but would require devising a viable system to make and monitor farmer payments.

Keywords: India, wheat, rice, production, consumption, trade, policy, reform

About the Authors

Shikha Jha is a Country Economist with the Asian Development Bank (ADB), P.V. Srinivasan is a Professor at the Indira Gandhi Institute for Development Research in Mumbai, India, and Maurice Landes is a Senior Economist at the Economic Research Service, USDA. The views expressed in this paper do not necessarily reflect the views or policies of the ADB, its Board of Governors, or the governments they represent. Support for this study—including the analysis of policy options and the analysis of Indian producer support policies—was provided by the ERS–India Emerging Markets Project.

Contents

Summary

Between 1947, when India achieved independence, and 2000, the country's food grain sector turned perennially large deficits into large surpluses of the major Indian food staples, wheat and rice. During the 1960s and 1970s, the turnaround was achieved through rapid gains in yields, combined with policies that balanced producer and consumer interests. In the 1990s, growth in yields and consumption slowed and government policy sought to sustain progress by increasing producer support and improving the targeting of food subsidies to low-income consumers. By 2000, the Government faced an unwanted combination of high domestic prices, declining per capita consumption, record grain surpluses, and soaring budgetary costs. More recently, in 2006, lower prices, weak yield growth, and rising subsidized distribution have led to the reemergence of a substantial wheat deficit.

What Is the Issue?

Weak growth in food grain production and consumption, and pronounced recent market cycles, have created pressure for reform of India's long-standing food grain policies. Because India's food grain economy is one of the world's largest, the path India eventually takes on food grain policy is likely to have important implications for U.S. and global markets for wheat and rice. There has been considerable public debate in India on the need for changes in agricultural and food grain policy, but political consensus on major reform has proved difficult to achieve. This study examines recent developments in India's markets and policies for wheat and rice, and analyzes the impacts of several policy changes already underway or under consideration to rebalance producer and consumer interests and control budgetary costs.

What Did the Study Find?

The Indian Government has taken steps to decentralize public food grain operations in order to reduce budgetary costs and to improve the targeting of India's large food subsidy outlays to low-income consumers. Although there has been no explicit change in price support policy, wheat and rice support prices declined in real terms between 2000 and 2006. This study analyzed potential impacts of three policy reform options that might be pursued over the next several years:

1. Complete decentralization of government wheat and rice procurement and distribution
2. Decentralization plus 10- and 20-percent real reductions in wheat and rice support prices
3. Decentralization plus a shift to use of deficiency payments rather than government purchases to support wheat and rice producers.

Results indicate that decentralizing procurement from the Central to the State Governments (option 1) can substantially reduce government costs with little overall impact on producers, consumers, or trade. Decentralization may also allow more scope for efficient private traders to participate and invest in grain marketing.

Changes in price support policy that reduce minimum support prices for wheat and rice (option 2) would yield larger impacts on domestic supply and demand than decentralization, as well as sharply lower budgetary costs. Production and producer welfare may decline, but these losses are more than offset by gains in consumption and consumer welfare, particularly among lower income consumers. Although trade impacts are minor in the scenario analyzed, lower domestic prices are likely to boost the competitiveness of Indian exports in years of surplus, while the recovery in consumption and lower stocks increase the potential for imports in years of deficit.

Replacing the existing system of supporting producer prices through government purchases with a U.S.-style deficiency payment program (option 3) would sharply reduce the budgetary costs of supporting producers while also reducing market distortion. However, this option would require development of a viable mechanism to make payments to producers and thwart corruption. This option possibly could be based on a recent initiative to create a system of verifiable and negotiable warehouse receipts.

The major options available to the Indian Government to improve performance and reduce distortions in the wheat and rice sectors appear able to deliver significant cost savings and improved overall welfare. In the medium term, these reforms also may boost consumption and lower stocks, with increased likelihood of imports in years of poor harvests, as well as competitive exports in years of surplus. Further analysis is needed to assess the longer term implications of decentralization and changes in producer subsidies in the food grain sector, including the impacts of shifting subsidy outlays to public investments, and of measures to strengthen private investment in food grain markets.

How Was the Study Conducted?

Data and information used to analyze developments in India's wheat and rice sectors were taken from published literature and publicly available Indian data sources. A spatial model of India's wheat and rice sectors was developed to analyze the impacts of alternative policies on India's supply, demand, and trade of wheat and rice, including impacts on producers, consumers, and government costs across the various States of India. Support for this study was provided by the ERS–India Emerging Markets Project.

Introduction

During the 60 years since independence in 1947, progress in India's wheat and rice sectors—which supply the bulk of daily caloric food intake for a population that now exceeds 1 billion people—has made India self-reliant in its major food staples. During the 1960s and 1970s, progress was achieved through the successful adoption of yield-enhancing Green Revolution technology, supported by market interventions that sought to balance producer and consumer interests. In the 1990s, when yield and consumption growth slowed, the policy response was to combine higher producer incentives with efforts to better target consumer subsidies. Since then, the wheat and rice sectors have become more volatile. In 2000, the Government faced a combination of record grain surpluses, high domestic prices, declining per capita consumption, and soaring budgetary costs. And, by 2006, reduced price incentives, weak yield growth, and rising subsidized consumption led to the reemergence of a large wheat deficit. Concerns with the recent trends in production and consumption and sharp market cycles are creating pressure for reform of India's longstanding policy regime in the food grain sector.

Because India's food grain economy is one of the world's largest, the path India eventually takes on food grain policy is likely to have important implications for U.S. and global markets for wheat and rice. Once a major cereal importer, India's cereal imports trended downward between the 1970s and the late 1990s when, aided in some years by export subsidies aimed at reducing surpluses, India became a major exporter of rice and a significant exporter of wheat. Future trends in wheat and rice trade will be determined not only by changes in yield growth and consumer demand, but, perhaps more importantly, by changes made in policies affecting producers and consumers.

This study examines recent trends in India's markets and policies for wheat and rice, and analyzes the impacts of several policy options—decentralizing government procurement and distribution by having State governments directly purchase grain to meet distribution needs, reductions in producer support prices, and a shift to U.S.-style deficiency payments for producer support—to rebalance producer and consumer interests and control budgetary costs. The analysis indicates that the ongoing process of decentralizing procurement from the Central to the State Governments can substantially reduce the government costs with little impact on producers, consumers, or trade. Allowing the minimum support prices for wheat and rice to decline in real terms would have even more significant impacts on costs and provide benefits for consumers, but would reduce stocks and exportable surpluses and increase the potential for future imports. Replacing the existing system that relies on government purchases to maintain cereal support prices with a U.S.-style deficiency payment program would have little impact on supply and demand and provide further significant cuts in budgetary costs, but may face prohibitive implementation problems.

Production and Producer Policy

Growth in India's production of wheat and rice was robust during the 1970s and 1980s, but has slowed significantly since 1990, and particularly during 2000-2005 (table 1). Earlier gains in wheat and rice output were driven by the adoption of high-yielding varieties (HYVs), expansion of irrigated area, increased cropping intensity, and supportive input and output price policies. Although poor weather played a role in the recent slowdown in production, slowed growth also corresponded with a period of rising input subsidies and output price incentives that should have provided an environment for rising area and yields (see box, Producer Support Estimates). There is now growing concern that other nonprice factors, such as the declining scope for further gains from existing HYVs, deteriorating soils and groundwater supplies, and reduced public investment in irrigation, have contributed to poor performance and must be addressed (Chand, 2005; Landes and Gulati, 2004; Government of India, 2002).

India's low average wheat and rice yields compared with other major world producers suggest that there is significant scope to further boost yields and output. Rice yields are among the lowest for major producers and wheat yields remain near the world (and U.S.) average despite the fact that a relatively high share—about 87 percent—of Indian wheat area is irrigated (Government of India, 2003). Although roughly 90 percent of wheat area and 75 percent of rice area is already planted to HYVs, average wheat yields in major States remain about 25 percent lower than levels achieved in experiment stations, while rice yields are about 50 percent lower (Chand, 2005).

There is still significant scope to boost average yields by improving the poor quality of seed used by most farmers, as well as suboptimal farm-level use of fertilizer, plant protection, and water inputs. But, there is also growing evidence that the system of intensive double-cropping of wheat and rice in the Indo-Gangetic Plain region—where most of India's surplus wheat and rice is produced—now faces constraints associated with depletion of soil

Table 1
Annual growth rates of Indian cereal area, yield, and production[1]

Commodity/years	Annual growth rate		
	Area	Yield	Production
		Percent	
Wheat:			
1970-1990	1.7	3.0	4.8
1990-2003	0.6	1.5	2.1
Rice:			
1970-1990	0.6	2.3	2.9
1990-2003	-0.1	0.9	0.8
Wheat and rice:			
1970-1990	1.0	2.6	3.6
1990-2003	0.1	1.2	1.4

[1] Compound annual growth rates between 3-year averages centered on the years indicated.

Source: Computed from USDA Production, Supply, and Distribution Database.

Producer Support Estimates

Producer support estimates (PSEs) for Indian wheat and rice by the International Food Policy Research Institute document the impact of India's price support and input subsidy policies on India's producers (Mullen et al., 2005). The PSEs are composed of market price support and budgetary support. Market price support captures the effect of India's minimum support price (MSP) and trade policies (quantitative restrictions and tariffs) for wheat and rice based on differences between India's farm-gate prices and appropriate international reference prices, taking account of international and domestic marketing costs. Budgetary support accounts for the subsidies for power, fertilizer, and irrigation water, with the total subsidy apportioned to wheat and rice based on shares of farm output.

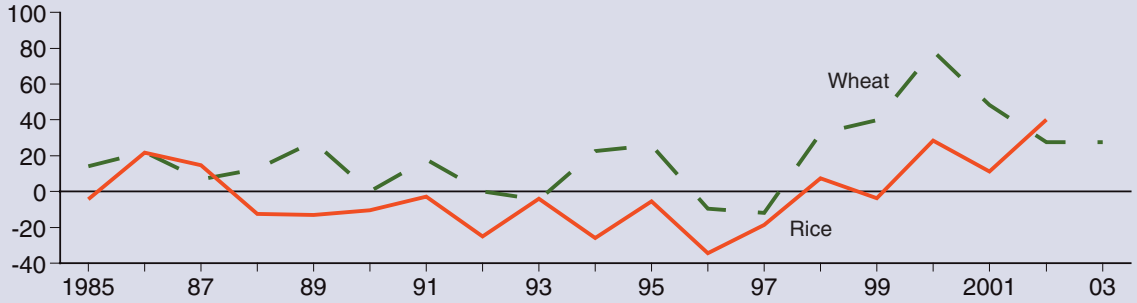
The PSEs exhibit a trend toward increasing support to wheat and rice producers during the 1990s (fig. A). Total support, as a percentage of the value of output, has fluctuated significantly but remained generally positive for wheat and negative for rice until the late 1990s. However, beginning in 1997/98, the percentage PSEs have been positive and trending upward.

The estimates of market price support and budgetary support indicate that rising input subsidies have contributed to higher producer support for wheat and rice since 1990, but the more significant changes in market price support have been due to the rise in domestic producer prices relative to world reference prices (fig. B). Market price support was often negative for wheat and, particularly, rice during the 1980s and early 1990s, meaning that domestic farm prices were often below world prices (adjusted for transport and marketing costs). Beginning in the late 1990s, however, the combination of higher domestic prices and trend- or below-trend world prices, led to increased market price support and total support, particularly for wheat.

Figure A

Percentage producer support estimates for wheat and rice in India[1]

Percent of farm value



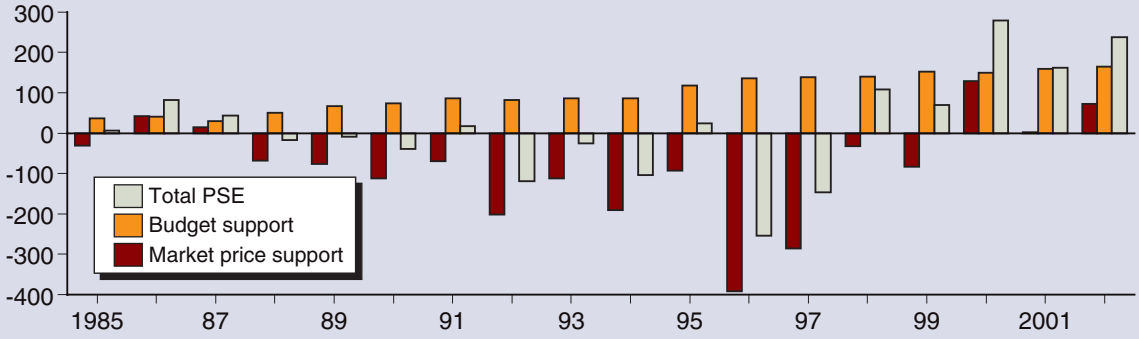
[1]Total producer support estimate as a percentage of output valued at international reference prices.

Source: Mullen et al., 2005.

Figure B

Producer support estimates for rice and wheat in India

Billion 1993/94 rupees



Source: Mullen et al., 2005.

and water resources and pest problems that may continue to slow yield growth and result in shifts to other crops (RWC-CIMMYT, 2003).

Sustaining adequate growth in wheat and rice output to meet domestic demand is likely to be increasingly dependent on public and private investments to strengthen research, education, delivery of quality inputs, and development and use of water resources. But, while private investment in agriculture has increased modestly in recent years, public investment has declined, falling from the equivalent of 10 percent of agricultural output in 1981-83 to just 5 percent in 1998-2000 (Landes and Gulati, 2004).[1] Total public and private investment in agriculture amounted to about 16 percent of agricultural output in 2000-03, below the 29-percent investment/output ratio for the remainder of the Indian economy. Public investment has been weakened, in part, by budgetary pressures stemming from the large increase in expenditures on the "food grain" subsidy (the cost of food grain price support and procurement, storage, and public distribution), and input subsidies on fertilizer, water, and power. Incentives for private investment are reduced by policies that constrain private agricultural markets, regulate movement and storage of essential commodities, and impose relatively high taxes on processed foods (Landes and Gulati, 2004).

[1] Investment includes onfarm investments and off-farm investment in research and farm-related infrastructure, such as rural markets and roads.

Producer Price Policy

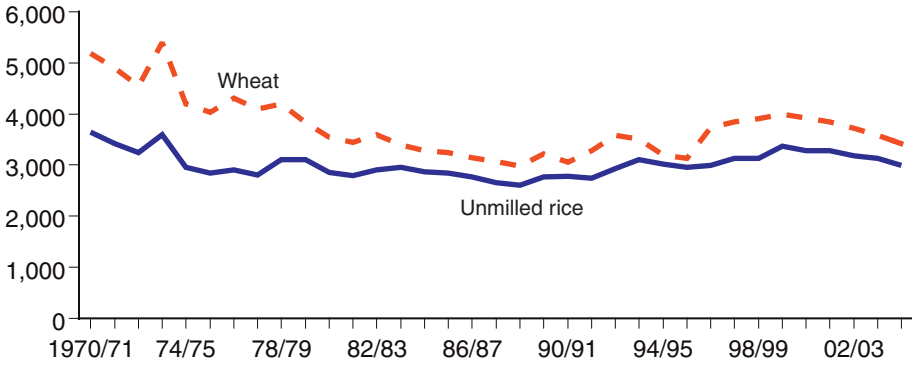
Producer price policy has played an important role in supporting the growth of India's wheat and rice output since the 1970s. Price policy for wheat and rice is implemented through minimum support prices (MSPs) for fair-to-average quality (FAQ) grain that are revised annually and defended by Indian Government purchases in surplus areas during harvest. For wheat, the MSP is paid directly to farmers in the primary markets where they sell their grain. For rice, about half of total procurement is purchased in primary markets in the form of unmilled rice (paddy) at the MSP and about half is purchased as milled rice through a statutory, fixed-price levy imposed on rice millers in some States. Under the levy, millers are obligated to deliver a share of the rice they process to the government at a fixed, below-market price. The levy shares vary from State to State (from a low of 10 percent to a high of 75 percent) and, particularly in States with high levies, the system results in an actual farm price below the rice MSP under most market conditions. Grain procured in price-support operations is stored by the Food Corporation of India (FCI), a parastatal, which either makes the grain available to State governments for subsidized distribution, holds it in storage, or, when conditions permit, allocates surplus grain for export.

During the 1970s and 1980s, wheat and rice MSPs trended downward in real terms. MSP policy still afforded adequate producer incentives because of steady yield gains, and the benefits of rising yields were transferred to cereal consumers in the form of declining real consumer prices, both through government programs and the open market. Beginning in the early 1990s, however, several factors have led to an upward trend in real MSPs for wheat and rice (fig. 1).

Figure 1

Real minimum support prices (MSPs) for wheat and unmilled rice in India

1993/94 rupees per ton



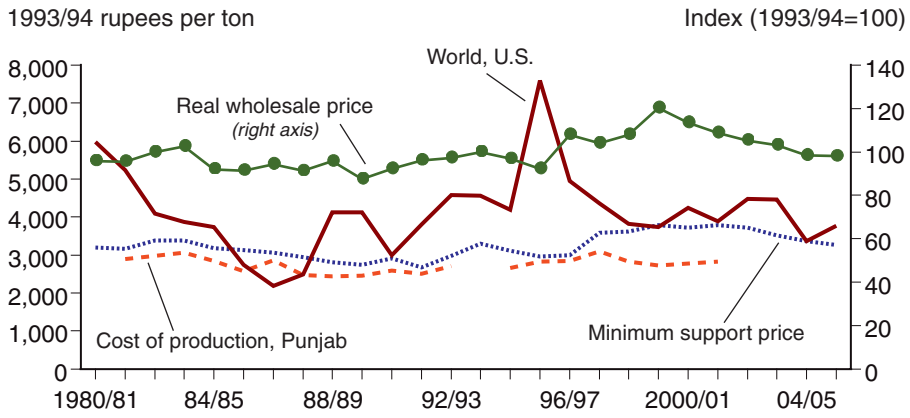
Source: Government of India, Economic Survey; Bansil.

- MSPs are based largely on costs of production—as estimated by India's Commission on Agricultural Costs and Prices (CACP)—using a "full cost" measure that includes the costs of variable inputs, the rental value of land, the imputed value of family labor, and a 10-percent return to management. Devaluation of the rupee in the early 1990s helped push up the costs of traded inputs. In addition, production cost hikes have likely been compounded as MSP benefits are reflected in the costs of land, labor, and management. Basing MSPs on production costs allowed MSPs to become increasingly disconnected from market conditions as India transitioned from deficits to surpluses.
- When India began to eliminate quantitative restrictions on cereal exports in the second half of the 1990s, producers initially benefited from relatively high world prices. When world prices fell back toward trend in the late 1990s, there was pressure to compensate producers for the impact of lower world prices by increasing MSPs more than indicated by the CACP estimates of changes in production costs.
- The political environment for cereals policy changed in the 1990s, when India entered an era of coalition governments and the farm lobby became more influential. During 1995/96-2001/02, just before and during the accumulation of surpluses, the Government set MSPs above the recommendations of the Commission on Agricultural Costs and Prices (based on production costs) in 4 of 7 years for rice and 5 of 7 years for wheat (Parikh et al., 2003).
- The MSP mechanism is one of the few policy levers available to Indian policymakers in the food grain sector and there is a tendency to try to use it to achieve multiple policy goals, including price stabilization and income support.

During the late 1990s, the MSPs set for wheat and rice in India fell out of step with domestic and world market conditions. Breaking the historical pattern, wheat and rice MSPs strengthened relative to both world and domestic prices and moved above domestic market clearing levels (figs. 2, 3). This trend benefited the relatively small share of producers in surplus areas who received the MSPs, but higher market prices had adverse impacts

Figure 2

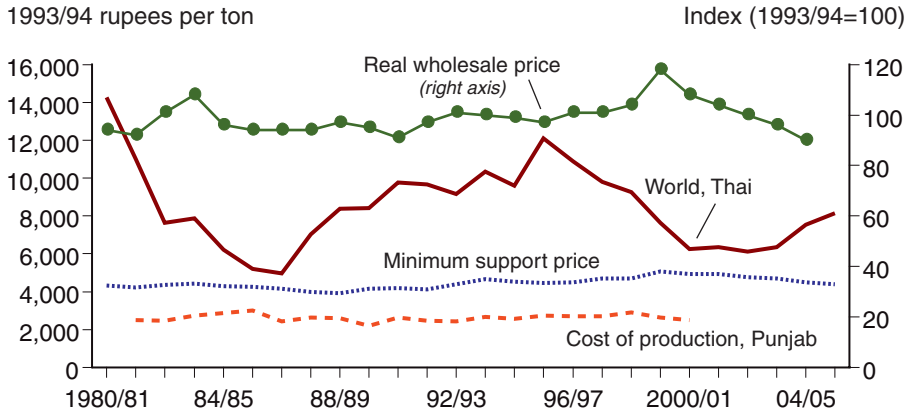
Wheat prices and production costs in India



Sources: Government of India, Ministry of Finance, Economic Survey; Government of India, Ministry of Agriculture, Commission on Agricultural Costs and Prices; ERS data.

Figure 3

Rice prices and production costs in India



Sources: Government of India, Ministry of Finance, Economic Survey; Government of India, Ministry of Agriculture, Commission on Agricultural Costs and Prices; ERS data.

on consumers. By maintaining high prices, the Government became responsible for the storage and transport of most of the marketed surplus of wheat and rice in the country—which some observers termed a "de facto nationalization" of grain trade. Further, because high-quality grain tended to be purchased at above the MSP by private traders, and government agencies were often obliged to buy grain below the FAQ standard, most government-owned grain was of medium or low quality. This resulted in rising budgetary costs for procurement, storage, and storage losses, together with reduced incentives for private investment in grain storage and handling. The policy of maintaining high wheat and rice prices—along with subsidies on water and fertilizer—has also contributed to emergent problems with soil and water-resource depletion associated with the intensive wheat-rice cropping system in northern India.

Since 2001, following the accumulation of large surplus stocks, there have been relatively small nominal annual increases in wheat and rice MSPs. In

real terms, wheat and rice MSPs have declined by 14 percent and 11 percent, although, because of appreciation of the rupee against the dollar, MSPs have continued to rise in dollar terms. MSPs for rice and, particularly, wheat have also tended to decline relative to both MSPs and market prices for competing crops of oilseeds, pulses, and sugarcane. As a consequence, there has been slower growth in wheat and rice output, including both area and yield, slowed growth in government procurement of wheat and rice in price support operations, and real declines in domestic wholesale prices.

Input Policies

The major input policies affecting India's wheat and rice sectors are subsidies on fertilizer, power, and irrigation water, together with public investments in surface, and to a lesser extent, ground water irrigation. Together, the subsidies on fertilizer, power, and water have grown about 6 percent annually in real terms since 1990, reaching nearly 500 billion rupees (Rs) (about $10 billion), equivalent to about 11 percent of total agricultural output, in 2002/03 (fig. 4). The cost of providing free or subsidized (depending on the State) electricity for agriculture accounts for more than two-thirds of total input subsidies, as well as most of the growth since 1990.[2] Irrigation is a key factor in boosting crop yields, but it is widely acknowledged that the subsidies for irrigation have played a role in promoting the inefficient use of water and the overpumping of groundwater.

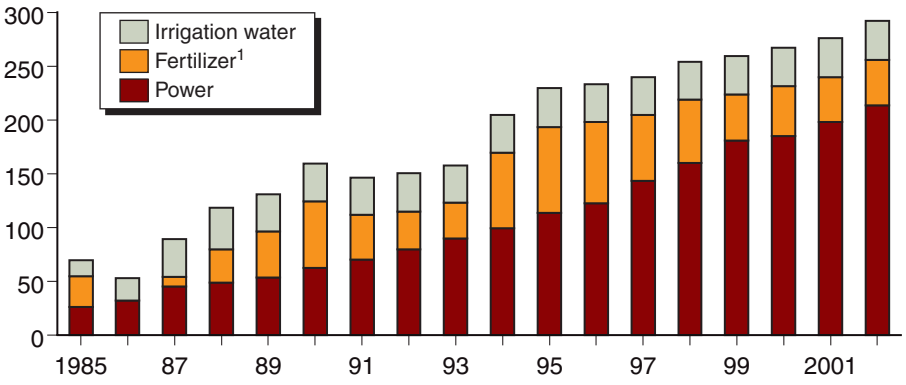
Fertilizer subsidies are provided to farmers in the form of reduced prices for domestic and imported fertilizers, and to the fertilizer industry in the form of preferential prices to offset the losses of higher cost plants. The portion of the fertilizer subsidy going to Indian farmers amounted to about Rs70 billion ($1.4 billion) in 2002/03, and has tended to decline since the mid-1990s. Subsidies on irrigation water were about Rs60 billion ($1.2 billion) in 2002/03 and have also shown little growth.

[2] In Indian agriculture, electricity is used primarily for ground water irrigation sets.

Figure 4

Major input subsidies in India

Billion 1993/94 rupees



[1]Includes only portion of fertilizer subsidy that goes to farmers rather than to fertilizer manufacturers.

Source: Government of India, Ministry of Finance, Economic Survey.

Reform of policies in the power sector is seen as the key to containing subsidy costs and allowing public resources to be shifted toward productive investments in irrigation, research, and market infrastructure. Moreover, the power subsidies tend to mostly benefit larger farmers, who own more pump sets (Gulati and Narayanan, 2003). Decisions on power sector reform lie primarily with State Governments, which complicates reaching an agreement to withdraw or reduce the power subsidies, which are popular among rural voters.

Production credit is also a key input in the rice and wheat sectors. Although there is a large network of commercial, cooperative, and "regional rural" banks extending institutional credit for agriculture, total institutional credit as a share of farm output has not been increasing, indicating that there has been little improvement in credit availability (Government of India, Ministry of Finance, Economic Survey). Available evidence suggests that a large share of farmers, particularly smaller farmers, remain dependent on noninstitutional credit supplied by moneylenders, landlords, and traders at high interest rates relative to institutional credit (Rao and Jeromi, 2006). Institutional credit to agriculture, considered a priority sector, is typically extended at prime commercial lending rates. However, official debt relief, which was on the order of 2 percent of total credit extended in 2005/06, is periodically extended to farmers.

Consumption and Consumer Policy

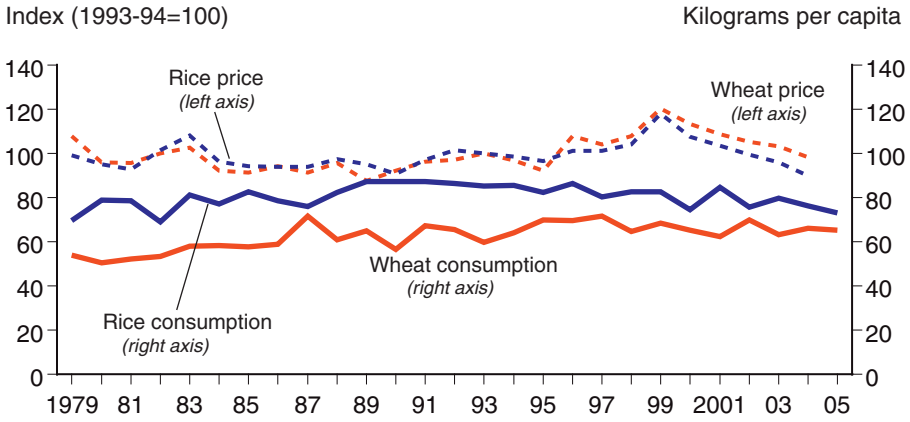
During the 1970s through the early 1990s, per capita consumption of wheat and rice rose, reflecting strong gains in production, income growth, and stable real prices. In the mid-1990s, however, per capita consumption of wheat leveled off and rice began to decline. Slowed growth in consumption occurred despite substantially faster growth in incomes, as the result of changing consumer preferences, changes in government price and distribution policies, and rising open-market cereal prices.

Recent studies of the relationship between income, prices, and consumption of wheat and rice indicate that, at least among some Indian consumers, wheat and rice demand is no longer rising with incomes. Although there is controversy on this issue, analyses based on India's National Sample Survey data (Kumar, 1998; Bhalla et al., 1999) suggest that, while low-income groups still show positive income elasticities of demand for cereals, income responsiveness for the population as a whole is declining and may now be near zero. As in other developing Asian countries, higher incomes and urbanization are diversifying consumer demand away from food staples, and gradually reducing the growth rate of wheat and rice production needed to meet domestic demand. However, wheat and rice remain the dominant source of calories and protein in the diets of most Indian consumers, and together still account for about 22 percent of household expenditure in rural areas and 13 percent in urban areas—more than any other item.

The demand studies have also generally shown that wheat and rice consumption respond to relative prices, with lower income consumers being the most price responsive. From the 1970s through the mid-1990s, the upward trend in per capita wheat and rice consumption corresponded with variable, but roughly constant, real prices (fig. 5). There was stronger evidence of the impact of prices on consumption between the mid-1990s and 2000, when slowed per capita consumption (particularly of rice) corresponded with rising real MSPs and market prices. Since 2000, however, declining market prices have yet to reverse the slowdown in consumption. Although the most recent behavior may suggest that wheat and rice

Figure 5

Wheat and rice consumption and real prices in India



Sources: Government of India, Ministry of Finance, Economic Survey; USDA Production, Supply, and Distribution database.

consumers are becoming less responsive to changes in relative prices, it is likely that the relatively low-income consumers served by India's food-distribution programs remain responsive to changes in relative prices.

Food Distribution Policies

Changes in government food procurement and distribution programs, which accounted for about 20 percent of total wheat and rice consumption during 1995-2005, have been a factor in the slowed growth in wheat and rice consumption since the mid-1990s. In 1997/98, the Indian Government revamped the public distribution system (PDS)—a system for distributing subsidized wheat, rice, and other essential commodities through a nation-wide network of more than 460,000 "fair price shops"—in an effort to reduce costs and improve targeting to low-income consumers. The revamped PDS was renamed the targeted public distribution system (TPDS). The previous practice of offering quotas of wheat and rice to all consumers at one subsidized rate through the PDS was replaced by a system with a separate, highly subsidized rate for consumers certified as below poverty line (BPL) and a higher rate for everyone else (termed above poverty line or APL). Prices for BPL sales of wheat and rice were initially set 33-38 percent below those charged under the PDS (figs. 6,7). The new rates covered only about a third of the total costs incurred by the Food Corporation of India (FCI). Prices for APL sales were set 12-30 percent higher than under the PDS, rates that covered about 60 percent of FCI costs in the case of wheat and 75 percent in the case of rice.

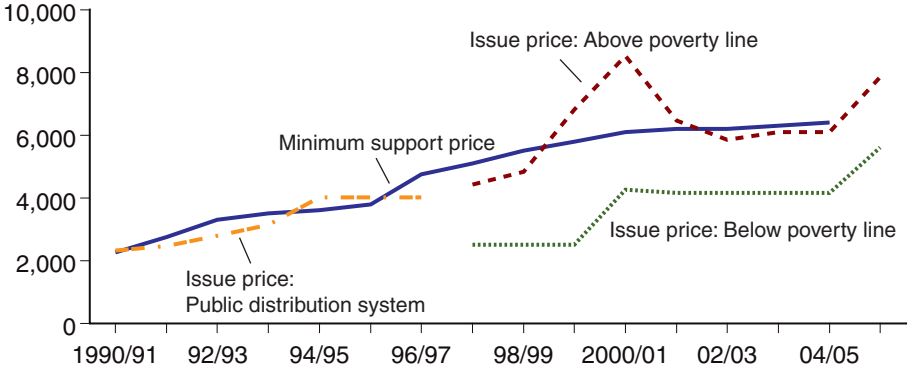
An additional change made with the goal of better reaching low-income consumers was the expansion and introduction of programs to distribute wheat and rice through school lunches, food-for-work programs, employment guarantee schemes, and more highly subsidized sales to the "poorest of the poor."

During the initial years of implementation of the new TPDS and other welfare schemes (1997/98-2000/01), total distribution of wheat and rice declined and remained well below the amounts procured in price-support

Figure 6

Wheat policy prices in India

Rupees per ton

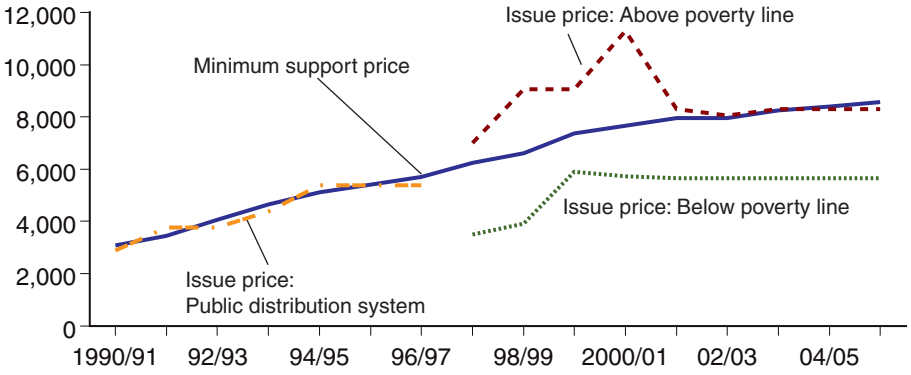


Source: Government of India, Ministry of Finance, Economic Survey.

Figure 7

Rice policy prices in India

Rupees per ton



Source: Government of India, Ministry of Finance, Economic Survey.

operations. Under the TPDS, BPL distribution initially remained low, largely due to administrative difficulties in certifying poor households, and there was very limited distribution through the APL channel because APL prices were typically above market prices. The new welfare programs also began slowly due to implementation delays. The net impact of government operations during this period was to reduce market supplies of wheat and rice available for consumption, with the FCI either adding grain to public stocks or making it available for export.

In recent years, there has been expansion in wheat and rice distribution through the BPL program and various welfare schemes, and reduced APL prices have also boosted sales through that channel. Welfare programs have shown the most growth, rising from about 11 percent of total distribution in 1997/98 to nearly 40 percent in recent years. The TPDS and welfare programs continue to face criticism because of difficulty in accurately identifying and reaching targeted groups and because of problems with "leakages" of subsidized grain into the open market (Government of India, Ministry of Consumer Affairs, Food, and Public Distribution, 2002).

India's government food distribution programs, including both the old PDS and the current TPDS, have been criticized for their limited impact on the poor, and for inefficiency. Although large amounts of grain appear to have been distributed through the PDS and TPDS, poor households still rely primarily on the market for their supplies of wheat and rice. According to the 1999/00 National Sample Survey, only about 10 percent of poor rural households and 14 percent of poor urban households purchased grain from the TPDS (Ramaswami and Murugkar, 2005). A study of TPDS efficiency estimated that it cost Rs3.14 to transfer Rs1.00 of benefit to poor households through the TPDS in the State of Andhra Pradesh and Rs4.00 to transfer the same benefit in the State of Maharashtra. Out of the total expenditure on food subsidies in these States, 26.5 to 31 percent was lost in transfers to nonpoor households; 16 to 26.5 percent was lost because of the abnormally high costs of grain transport, handling, and storage; and 15 to 28 percent was lost because of "leakages" to the open market and other forms of fraud. The share of subsidy expenditure actually reaching poor households

was about 25 percent in Maharashtra and 32 percent in Andhra Pradesh (Ramaswami, 2002).

Because a high proportion of India's food subsidy costs stem from the Government's involvement in owning, transporting, and storing grain, a shift to a program based on food stamps, such as that used in the United States, would have the potential to significantly reduce government costs. With a food stamp program, physical handling and distribution of grain would lie with the private sector, thereby reducing or eliminating a large share of current government costs. The corruption-related "leakages" of grain during government handling and storage could also be avoided. Setting up a U.S.-style food stamp program would involve many of the same problems in identifying and targeting poor households as the TPDS has, but might have advantages in reaching remote areas where TPDS shops are not viable, and in subsidizing foods, particularly coarse grains, that are important for poor households in some areas but are not handled by the TPDS.

A key precondition for implementing a food stamp program in India is development of an administratively workable system of issuing and redeeming coupons that will prevent food stamps and program benefits from being used fraudulently. Another issue is concern about loss of government control of physical grain markets and private traders in the current system. The potential benefits of shifting to a food stamp program are discussed in India's 10th Five Year Plan (Government of India, Planning Commission, 2002). To date, there has been a small State-level food-coupon scheme in Andhra Pradesh, with plans for a food stamp pilot project in Maharashtra that is intended to evaluate the feasibility of implementing the program on a larger scale (Ramaswami, 2002; Ramaswami and Murugkar, 2005).

Trade and Trade Policy

Since 1970, India's trade in cereals has shown a trend from net imports to net exports of both wheat and rice—a trend that reflects shifts in trade policy, as well as longer term changes in supply and demand (fig. 8). Through the 1980s and early 1990s, Indian agriculture had export restrictions and overvalued exchange rates that resulted in net taxation of the farm sector. Exports of agricultural goods, including wheat and rice, were restricted through various regulations to bolster India's domestic food security. For wheat and rice, quantitative controls on imports and exports were administered through the Food Corporation of India (FCI).

In the mid-1990s, trade policies were changed when quantitative restrictions on imports were lifted and replaced by tariffs. The wheat tariff was initially set at zero, but was raised to 50 percent in 1999 to curb imports into southern India at a time when surpluses were growing in the north. The rice tariff has remained at 70 percent, a level that prohibits trade from occurring.[3] Export restrictions on wheat and rice, historically imposed through State trading, quotas, and minimum export prices, have been progressively liberalized.

In 2000, India began to provide budgetary subsidies to support exports of surplus wheat and rice when the combination of declining world prices and higher domestic prices made Indian wheat and rice uncompetitive in world markets. In 2005, the Government halted export subsidies because of tightening domestic supplies and reduced Indian competitiveness in international markets, although private traders remain free to export wheat and rice.

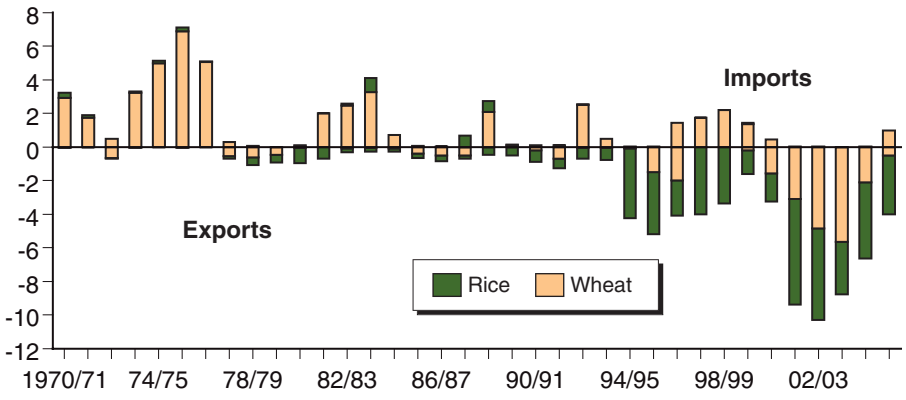
The removal of quantitative restrictions on exports and imports, while having potentially positive impacts on investment and competitiveness in the wheat and rice sectors, has exposed problems with the existing mechanism for minimum support prices (MSPs) and created new challenges for meeting the needs of consumers through the targeted public distribution system (TPDS):

[3] India's World Trade Organization bound tariffs are 100 percent for wheat and 70 percent for milled rice.

Figure 8

Trends in India's wheat and rice trade

Million tons



Source: USDA Production, Supply, and Distribution database.

- The removal of quantitative trade restrictions has exposed the need for an MSP-setting mechanism that keeps support prices better connected to domestic and world prices, rather than production costs. While the MSP based primarily on production costs worked effectively and benefited producers and traders in an environment of relatively high international prices during the mid-1990s, it created problems when world prices fell from their 1995/96 peak. In the late 1990s, MSPs set largely on the basis of production costs and political imperatives to support producers became disconnected from market realities, leading to declining consumption and large grain surpluses and budgetary costs.
- The removal of export restraints has increased demands on domestic distribution programs to stabilize supplies for lower income consumers. An important rationale for earlier restraints on exports was to ensure stable supplies and prices for domestic consumers. Higher domestic prices and declines in per capita rice consumption in the period following the liberalization of wheat and rice trade suggest that at least some consumers have been adversely affected. However, since global rice prices have been declining since the mid-1990s, these impacts were likely at least partially driven by high MSPs and declines in distribution associated with implementation of the TPDS, and not just the removal of export restraints.

Government Food Grain Operations

The most noteworthy recent development in Indian agriculture was the accumulation of large government surpluses of wheat and rice during the late 1990s. For both wheat and rice, the stock accumulation was caused by the combination of rising procurement, as higher MSPs were defended with increased government purchases, and flat or declining subsidized distribution, as the shift from PDS to TPDS led to less distribution from government stocks (table 2). Despite rising exports, including subsidized exports, government stocks rose to record levels during 1996/97-2001/02, far in excess of the levels targeted as necessary for food-security purposes.

Since 2001/02, both wheat and rice stocks have been declining and have generally been more closely aligned with the food-security targets of about 15.8 million tons (4 million tons of wheat and 11.8 million of rice) as of April 1. The decline in stocks has been associated with declining (in the case of wheat) or flat (in the case of rice) procurement because of lower real MSPs and poor weather, together with a recovery and rise in subsidized distribution. By 2002/03, domestic distribution rose to record levels due to large increases in both the TPDS and an array of school lunch, food-for-work, and other welfare programs (fig. 9). In 2005/06 (July/June), the State Trading Corporation (STC) contracted to import about 500,000 tons of wheat for delivery during 2005/06 as buffer stocks fell below target. In response to rising domestic wheat prices, the Government reduced the tariff applicable to wheat imports by private traders from 50 percent to 5.2

Table 2
Government wheat and rice operations in India

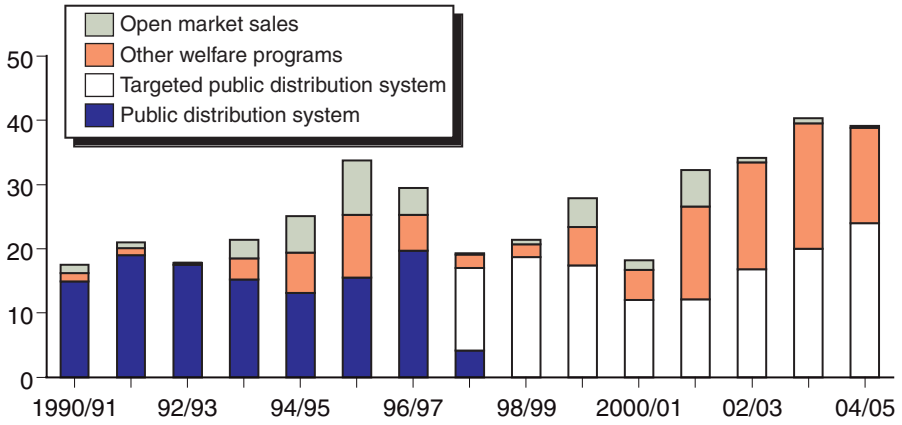
Commodity/years April/Marc)	Procurement	Domestic distribution	Imports	Exports	Ending stocks
			Million tons		
Wheat:					
1995/96	12.33	12.72	0.00	0.10	7.76
1996/97	8.18	12.88	1.35	0.38	3.24
1997/98	9.30	7.76	1.63	0.00	5.08
1998/99	12.65	8.90	2.10	0.00	9.66
1999/00	14.14	10.63	1.27	0.00	13.19
1900/01	16.36	6.32	0.34	1.47	21.50
2001/02	20.63	13.25	0.00	2.74	26.04
2002/03	19.06	15.50	0.00	4.85	20.11
2003/04	15.80	17.59	0.00	5.65	7.15
2004/05	16.79	15.93	0.00	2.12	5.46
Rice:					
1995/96	10.03	12.51	0.00	1.49	13.06
1996/97	12.56	12.39	0.00	0.05	13.17
1997/98	16.23	11.36	0.00	0.00	13.05
1998/99	12.29	11.83	0.00	0.00	12.16
1999/00	17.45	12.71	0.00	0.00	15.72
2000/01	18.93	10.40	0.00	0.02	23.19
2001/02	20.29	13.37	0.00	1.92	24.91
2002/03	19.00	17.92	0.00	6.94	17.20
2003/04	20.78	21.95	0.00	3.09	13.10
2004/05	19.79	22.89	0.00	0.09	13.30

Sources: Ministry of Consumer Affairs, Food, and Public Distribution, GOI; Commission on Agricultural Costs and Prices, Ministry of Agriculture, GOI; USDA PS&D database.

Figure 9

Domestic wheat and rice distribution by program in India (April/March years)

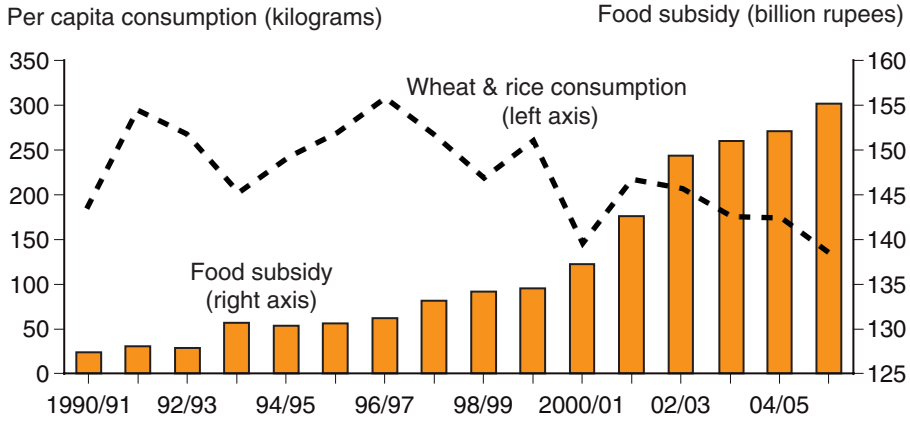
Billion 1993/94 rupees



Sources: Government of India, Ministry of Consumer Affairs, Food, and Public Distribution; Government of India, Ministry of Agriculture, Commission on Agricultural Costs and Prices; USDA, Production, Supply, and Distribution database.

Figure 10

India wheat and rice consumption and food subsidy



Sources: Government of India, Ministry of Consumer Affairs, Food, and Public Distribution; USDA, Production, Supply, and Distribution database.

percent in June 2006 and then to zero in September. An additional 5-6 million tons of imports have been contracted for delivery during 2006/07, including about 1 million tons by private traders.

Government policies since the mid-1990s have led to higher costs for government wheat and rice operations (fig. 10). Initially, rising costs were driven by the need to defend high MSPs resulting in large procurement and storage costs, and the need to dispose of excess stocks through subsidized exports. More recently, although MSPs have declined gradually in real terms and stocks have fallen, costs have remained high because of record levels of distribution through the more highly subsidized BPL channel of the TPDS and various welfare programs. The cost of wheat and rice operations reached about Rs269 billion ($6 billion) in 2004/05.

Wheat and Rice Sector Reform Options

Indian policymakers are considering a range of policy options to strengthen the performance of the wheat and rice sectors and control budgetary costs. The introduction of the targeted public distribution system (TPDS) in the mid-1990s, as well as the recent trend toward smaller increases in minimum support prices (MSPs) for wheat and rice, have been aimed at reducing the government stock surplus, better targeting of food subsidies to the poor, and correcting price distortions. However, subsidy costs remain high and food grain policies are essentially the same as during the Green Revolution period, when more extensive government intervention was justified by concern with large cereal deficits, the need to protect poor consumers, and the need to promote the adoption of new technology by producers.

There is growing recognition that the policy framework that may have served India well in the past must be reformed to be consistent with changing consumer demand and an increasingly market-oriented economy, to more efficiently meet the needs of low-income consumers, and to provide an environment for stronger public and private investment in the farm sector. India's 10th Five Year Plan, the Government's current official planning document, identifies a number of food-policy issues, including MSP reform, decentralization of the PDS, and the introduction of food stamps as policy goals (Government of India, Planning Commission, 2002). Recent studies have also made the case for changes in food grain policy (Government of India, Ministry of Consumer Affairs, Food, and Public Distribution, 2002; Chand, 2003), but it has proven difficult to achieve consensus on reform and it is unclear which reforms will eventually be implemented (table 3).

In this section, we describe and analyze several of the major policy options available to the Indian Government, specifically: (1) the ongoing process of decentralizing government procurement and distribution by making the States responsible for grain purchasing and distribution, (2) the implications of reducing wheat and rice MSPs, and (3) the possible implications of shifting to a U.S.-style producer deficiency-payment program as a means of providing producer support. These policy scenarios are analyzed using a spatial model of India's wheat and rice sectors that accounts for differences in supply, demand, and prices across India's various States, as well as the logistical costs involved in transport, handling, and storage across the States. The analytical framework is described in appendix 1, along with model data and elasticities. More detailed results are reported in Jha and Srinivasan (2006).

Some issues faced by policymakers and noted in studies of India's wheat and rice policy, particularly alternative approaches to assuring domestic price stability and the efficient distribution of food, were not analyzed for this study (table 3). Approaches to price stability were examined in an earlier study using a different analytical framework (Jha and Srinivasan, 1999). The results of that study indicated that buffer stocks are a relatively high-cost option for achieving a given level of price stability compared with international trade, conducted by either the private sector or the Government, under a system of variable levies. Study of the cost and effectiveness of food distribution under the TPDS awaits the availability of household survey data from the 2004/05 round of India's National Sample Survey.

Improving the Efficiency of Government Food Grain Operations

Containing the cost of wheat and rice procurement, distribution, and storage operations by the Food Corporation of India (FCI) has become a key government priority. One option for containing costs is to decentralize responsibility for purchasing the wheat and rice needed for distribution and welfare programs in the various States, instead of having the FCI meet all of these needs with centrally procured grain. Most of the major food-deficit States are located a long distance from the major surplus areas of Punjab, Haryana, and western Uttar Pradesh in northern India, while the major deficit regions are Maharashtra and Gujarat in western India, Bihar, and Orissa in the east, and Kerala in the far south (fig. 11). As a result, movement of grain to deficit States involves high costs of transport, storage, and pilferage and also puts

Table 3
Selected recommendations of recent Indian food grain policy studies

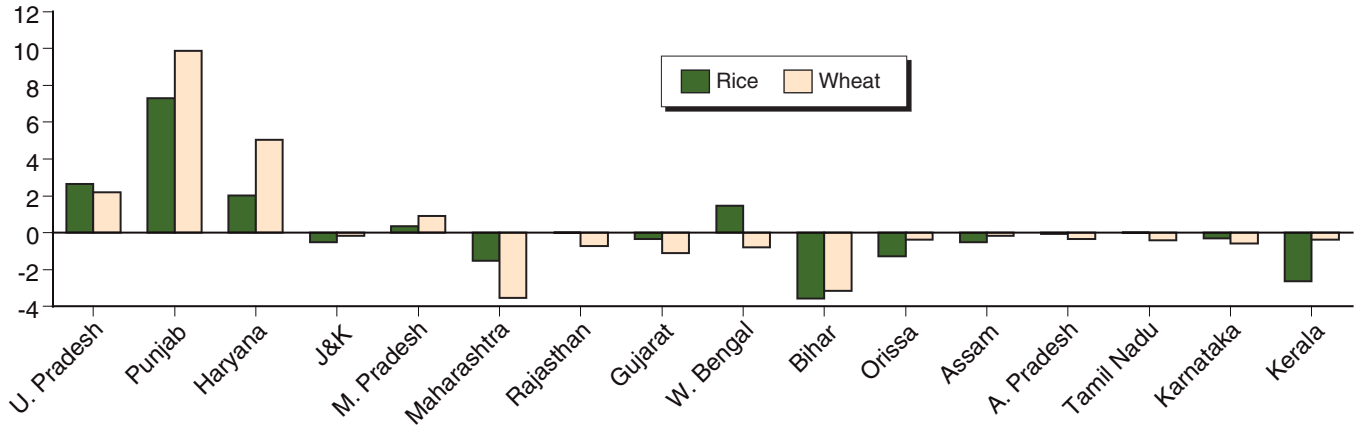
Issues	Report of the High Level Committee on Long-Term Grain Policy[1]	National Center for Agricultural Economics and Policy Research[2]
Minimum support prices (MSPs)	1. MSPs based on costs of production, including cost of family labor, owned capital, and rental value of farm land. 2. Allow open-ended purchase of all grain offered at MSPs.	1. Base MSPs on market clearing prices in normal market conditions. 2. Continue procurement but pursue other options, including deficiency payments to reach all regions.
Procurement	Decentralize to the States with central Government covering costs.	
Price stabilization	Use variable import tariff and export tax policy.	Use buffer stocks.
Public food distribution	1. Discontinue corruption-prone TPDS. Return to universal PDS with single issue price. 2. Provide additional subsidy to poor consumers, administered by States.	
Food Corporation of India	FCI is needed, but reduce scope to improve efficiency.	Limit role of Government to "genuine needs."
Role of private trade	Legal reforms needed to enable increased role for private trade.	Private trade driven away by government procurement and price interventions.
Long term	Exploit production potential in western and eastern India.	Need technical revolution to reduce costs of production.

[1]Government of India, Ministry of Consumer Affairs, Food, and Public Distribution, 2002.
[2]Chand, 2003.

Figure 11

Regional wheat and rice surpluses and deficits in India, 1999/2000

Million tons



Sources: Government of India, Ministry of Consumer Affairs, Food, and Public Distribution, 2002.

enormous pressure on limited rail freight capacity. It is anticipated that decentralized procurement will provide a greater role for State governments and private traders and reduce these logistical costs.

With decentralized procurement, both surplus and deficit States could commercially purchase wheat and rice from local private traders (or, in some cases, government agencies) at market prices, and distribute the grain through the TPDS and welfare programs. Private traders, in this scenario, are able to buy, sell, and transport grain without any regulatory impediment, such as quantitative restrictions or taxes that could restrict interstate movements. State governments would receive a subsidy from the central government to cover the difference between the purchase price plus costs of distribution and the distribution price. The amounts claimed by the States would be controlled by the Indian central government based on cost norms, with incentives for States to be efficient.

With this approach, the FCI would remain responsible for price support operations necessary to ensure the MSP in surplus States, holding only the grain needed to meet buffer stock targets. The existing approach of procuring rice in surplus States using levies calculated to meet distribution needs in deficit areas is inconsistent with decentralized procurement. As a result, complete decentralization will entail elimination of the rice levy. Deficit States will purchase milled rice at market prices to meet distribution needs, while price support operations in surplus areas would be conducted by procurement, then custom milling, of unmilled rice (paddy).

The analysis of the shift to decentralized procurement, including elimination of the rice levy, indicates that decentralization will have negligible impacts on wheat supply, demand, and prices (table 4). Impacts on the rice market would be somewhat larger than for wheat, mostly because of the increase in rice prices stemming from the removal of the rice levy, but are still estimated to be relatively small. Average producer rice prices would rise about 2 percent, and consumer prices about 1 percent. Overall rice consumption rises somewhat, despite higher average consumer prices, because the impact

of higher prices and somewhat lower open-market consumption in deficit States is offset by lower prices and higher consumption in surplus States, together with steady availability of subsidized grain.

The impacts of decentralization on central government operations and costs would be more significant, with about a 29-percent decline in procurement, an end to central grain supply to distribution programs, and somewhat lower government wheat and rice stocks. Government costs would drop more than 20 percent, as the increased costs incurred by States in meeting distribution needs through open-market purchases are offset by lower central procurement and stockholding costs. Given the weak condition of most State government finances, it is likely that the central government would have to compensate the States for any increase in States' costs due to decentralization.

Table 4

Impacts of decentralization of procurement and targeted public distribution system (TPDS)[1]

Variable	Wheat	Rice	Total/ average
		Percent change	
Production	0.0	0.1	0.1
Consumption	0.1	0.4	0.3
Producer price	0.0	1.9	1.1
Consumer price	0.0	0.9	0.5
Procurement	-15.7	-38.1	-28.9
Central TPDS requirement	-100.0	-100.0	-100.0
Stocks	-0.6	-1.6	-1.1
Government costs	-12.3	-26.0	-21.2
Net TPDS costs	19.4	75.7	61.2
Procurement costs	-15.7	-37.4	-29.9
Storage costs	0.0	-1.6	-0.8

[1]Percentage change from before decentralization based on current policy.

Source: Jha and Srinivasan, 2006.

Table 5

Consumption impacts of decentralization of procurement and targeted public distribution system[1]

Population group[2]	Wheat	Rice	Total
		Percent change	
Rural	0.11	0.52	0.33
Poor	0.09	0.50	0.33
Middle	0.12	0.59	0.37
Rich	0.13	0.10	0.11
Urban	0.11	0.33	0.22
Poor	0.10	0.47	0.29
Middle	0.13	0.22	0.18
Rich	0.00	0.41	0.20

[1]Percentage change from before decentralization based on current policy.

[2]Expenditure classes are based on monthly per capita expenditure classifications from the National Sample Survey: poor (rupees 0-340/month), middle (rupees 340-775), and rich (rupees 775+)

Source: Jha and Srinivasan, 2006.

The analysis also estimates the impacts of decentralization at the State level and for rural and urban consumers by income class. Despite some variation by State, the overall impacts of decentralization appear to be positive for rural and urban consumers across income groups (table 5). In India, where policymakers are sensitive to economic policy changes that would particularly affect the cost of basic foods and the welfare of low-income consumers, positive impacts across income groups increase the feasibility and sustainability of a policy change.

The results suggest that the process of decentralization of procurement is likely to have negligible impacts on wheat or rice trade, at least with the existing tariff structure. However, with States responsible for meeting their own distribution needs, deficit States in peninsular India with proximity to ports may be more likely than the FCI currently is to resort to imports—as opposed to domestic purchases from surplus areas of northern India—in the event that tariffs are reduced.

Producer Price Policy Reform

The emergence of large food-grain surpluses during the late 1990s was largely due to the failure of price policy to successfully adapt to a new environment that included changes in consumer demand, slowed growth in food-grain yields, and more open-border policies. In this context, the "cost of production plus" formula for producer support resulted in minimum support prices (MSPs) that were out of line with domestic and world market conditions, declining consumption, and burgeoning food subsidies.

A recent study of the economywide impacts of increasing the wheat and rice MSPs when they are above market-clearing levels highlights the limitations of the producer price policies pursued during the late 1990s (Parikh et al., 2003). The study found that boosting wheat and rice MSPs above market-clearing levels leads not only to lower total consumption, but also to lower agricultural investment that ultimately offsets any short-term price-induced gains in output. With higher MSPs, public investment falls as budget-constrained government expenditure is shifted from investments to current subsidies. And, although higher MSPs may boost private investment in wheat and rice production by some households, overall private investment in agriculture falls because many low-income households—which typically spend a large share of income on food staples—must shift expenditure from investment to consumption. Analysis of distributional impacts found that 80 percent of rural consumers and all urban consumers are ultimately worse off when MSPs are set above market-clearing levels.

Reform of minimum support price policy. Since 2001, although there has been no explicit change in MSP policy, MSPs for wheat and rice have trended downward in real terms and relative to most other crops. Since

Table 6

Impacts of procurement and targeted public distribution system (TPDS) decentralization and reducing wheat and rice minimum support prices (MSPs)[1]

Variable	10-percent MSP reduction			20-percent MSP reduction		
	Wheat	Rice	Total/ average	Wheat	Rice	Total/ average
	Percent change					
Production	-0.8	-0.3	-0.5	-1.5	-0.6	-1.0
Consumption	6.1	9.9	8.2	12.0	16.4	14.4
Producer price	-8.2	-4.7	-6.2	-16.2	-9.3	-12.3
Consumer price	-8.2	-5.7	-6.7	-16.3	-10.2	-12.8
Procurement	-46.5	-74.9	-63.3	-77.0	-100.0	-90.6
Central TPDS requirement	-100.0	-100.0	-100.0	-100.0	-100.0	-100.0
Stocks	-36.9	-60.1	-48.9	-72.9	-100.0	-86.9
Government costs	-46.2	-64.6	-58.2	-76.1	-88.2	-84.0
Net TPDS costs	0.0	54.9	40.6	-19.4	38.8	23.7
Procurement costs	-50.2	-76.6	-67.5	-80.2	-100.0	-93.1
Storage costs	-37.1	-60.0	-49.0	-72.4	-100.0	-86.7

[1]Percentage change from before decentralization and MSP reduction based on current policy.

Source: Jha and Srinivasan, 2006.

2001, in contrast to the late 1990s, wheat and rice MSPs have tended to be set at or very near the cost-based levels recommended by the Commission on Agricultural Costs and Prices, with little or no change imposed by policymakers.

This study examines the impacts of reductions in MSPs using scenarios that assume 10- and 20-percent real declines in both the wheat and rice MSPs, in addition to the TPDS decentralization scenario presented earlier. Although the results show declines in production of wheat and rice, production impacts are small relative to gains in consumption (table 6). The smaller price declines and larger consumption gains in the rice market are largely due to the partially offsetting impact of the removal of the rice levy that is incorporated into the scenario. With lower MSPs, wheat and rice procurement both drop significantly, resulting in similarly large declines in stocks. Government costs drop nearly 60 percent with 10-percent lower MSPs and more than 80 percent with 20-percent lower MSPs, reflecting lower procurement, storage costs, and unit subsidies.

The model results indicate that the distributional impacts of the MSP declines on wheat and rice consumption are positive, with relatively large gains in consumption by poor rural and urban consumers (table 7). In this aggregated partial-equilibrium framework, this result is indicative only of the benefits of lower prices for net buyers of rice and wheat and does not account adequately for the implications of lower prices for producers and net sellers. The general equilibrium analysis by Parikh et al., however, suggests that producers can also gain as reductions in government subsidies and in household food expenditures lead to increased public and private investment and farm productivity.

The trade implications of the scenarios analyzed are negligible given the elevated level of base period stocks. However, the adjustments to supply, demand, and stocks from the price declines analyzed clearly indicate that

Table 7

Consumption impacts of procurement and targeted public distribution system decentralization and reducing wheat and rice minimum support prices (MSPs)[1]

Population group[2]	10-percent MSP reduction			20-percent MSP reduction		
	Wheat	Rice	Total/ average	Wheat	Rice	Total/ average
	Percent change					
Rural	7.5	12.6	10.2	14.7	20.7	17.9
Poor	7.9	15.6	12.5	15.3	25.5	21.4
Middle	7.3	12.0	9.7	14.4	19.7	17.2
Rich	7.7	6.9	7.4	15.5	11.8	13.9
Urban	2.8	6.1	4.5	5.8	10.3	8.1
Poor	5.3	8.3	6.8	10.4	13.9	12.2
Middle	1.2	5.1	3.2	2.6	8.8	5.8
Rich	0.8	1.3	1.0	2.0	2.4	2.2

[1]Percentage change from before decentralization and MSP reduction based on current policy.
[2]Expenditure classes are based on monthly per capita expenditure classifications from the National Sample Survey: poor (rupees 0-340/month), middle (rupees 340-775), and rich (rupees 775+).
Source: Jha and Srinivasan, 2006.

imports become more likely as MSPs decline and reduced procurement lowers stock levels.

Our approach to analyzing the impacts of lower real MSPs does not deal with the issue of how MSPs are set. MSP reductions are unlikely to stem from the cost-based approach currently in use, and would likely require that recent domestic and international market price trends be given a larger weight in setting MSPs.

Because of the limitations of the two-commodity, partial equilibrium model (see appendix 1), the impacts of reduced MSPs described here are most useful for the short and medium run. The model does not account for cross-commodity developments in supply and demand or changes in input markets and technology that may alter the responsiveness of producers and consumers to changing prices in the longer term.

Deficiency payments. A deficiency payment system would allow the Indian Government to maintain a desired level of support for producers with less distortion of market prices and without incurring the costs of procuring, handling, and storing grain. With deficiency payments, farmers would receive a direct government payment covering the difference between the market price at which they sell their grain and the price level supported by the Government—such as the MSP.

We analyze the market and government cost impacts of maintaining the same level of support in the reference scenario (before decentralization or reductions in MSP) by means of farmer deficiency payments instead of by government procurement. Compared with supporting the MSP through procurement, the deficiency payment scheme provides consumers with lower prices because all grain remains in the market rather than moving into government stocks after procurement. The analysis indicates that wheat

prices would fall an average of 26 percent, and rice prices about 10 percent. Although some producers (those previously selling above the MSP) would experience somewhat lower returns despite deficiency payments, losses in producer welfare would be more than offset by large gains in consumer welfare. Government costs are also estimated to fall sharply—about 60 percent below the current system—as the cost of making deficiency payments to farmers is more than offset by the elimination of government procurement and storage costs.

The deficiency payment would, in theory, allow the Government to support producers with lower consumer and budgetary costs and less distortion of domestic markets. However, a major impediment to this approach is devising a mechanism for administering deficiency payments that reaches all producers and is not susceptible to fraud. One possibility would be to build on the relatively recent initiative to create a system of verifiable and negotiable warehouse receipts that is being promoted in some States, in part by India's rapidly expanding futures markets for farm commodities.

Conclusions

The economic environment for India's food grain sector has changed significantly since the Green Revolution of the 1960s and 1970s, but policies have not. Higher incomes are diversifying consumer demand away from staple food grains. More open borders are increasing linkages between domestic and global markets and prices. And, slowed growth wheat and rice productivity is signaling the need to boost lagging investment in new technology and improve the performance of input markets.

Government price support, procurement, and distribution policies have, in recent years, come under increasing criticism because they distort markets and have high budgetary costs. High minimum support prices for wheat and rice resulted in increased production and procurement of these crops, with the income transfers accruing to large farmers in surplus States. Coupled with subsidies on fertilizers, power, and irrigation, wheat and rice price policies have had a detrimental effect on the production of other crops, as well as on soil and water resources in major producing areas. Price and procurement policies have had adverse impacts on consumers—particularly lower income consumers—by raising prices and restricting open market supplies of wheat and rice. And, perhaps more importantly in the long run, Government policy interventions in the market have contributed to weakening investment in agricultural production technology, as well as undermining incentives for private investment to improve the efficiency of input and output markets.

Concern with the recent performance of the wheat and rice sectors has led to increased recognition of the need for reform, and considerable public debate. Although there has been no consensus on major reforms, the Indian Government has taken steps to improve the performance of the distribution system in reaching target groups and increasing the efficiency of public food grain operations through decentralization. In addition, although there has been no explicit change in price support policy, wheat and rice support prices announced since 1999/2000 have been declining in real terms.

Analysis of the potential impacts of decentralization of the procurement and distribution system by making State governments responsible for procurement indicates that the overall impacts on supply, demand, prices, and trade will be small. At the same time, this approach can lead to substantial budgetary savings by reducing procurement and public stockholding to meet public distribution needs, and also allow further scope for efficient private traders to participate in grain marketing.

Changes in India's price support policy that reduce minimum support prices (MSPs) for wheat and rice would have more significant impacts on domestic supply and demand, and on the costs of government food grain operations, than decentralization. This analysis also shows declines in domestic open market prices as a result of a reduction in wheat and rice MSPs. Although production and producer welfare decline, the results show that these losses are offset by larger gains in consumption and consumer welfare, particularly among lower income consumers. Lower procurement costs and stocks also lead to sharp declines in budgetary costs. Although trade impacts are minor in the scenario analyzed, the reduction in domestic market prices associated

with this scenario increases the competitiveness of Indian exports in years of surplus, while the recovery in consumption and lower stocks increase the potential for imports in years of deficit.

Introduction of a deficiency payment program, while presenting administrative problems, would provide a means of maintaining a desired level of support for wheat and rice producers with less market distortion and lower budgetary costs than the current system of physical procurement and distribution. Analysis of this option indicates that it could sharply reduce the budgetary cost of maintaining producer support while also allowing open-market prices to fall and consumption to rise.

The policy options available to the Indian Government to improve performance and reduce distortions in the wheat and rice sectors analyzed here should be able to deliver cost savings and improved overall welfare. At least in the near and medium term, for which the analytical framework used in this study is most suited, they also appear likely to deliver higher levels of consumption, lower stocks, and an increased potential for imports in years of poor harvests, as well as competitive exports in years of surplus. Further analysis is required to assess the longer term impacts on India's markets if reduced public spending on food grain operations is translated into productive public investment, and if improved incentives for private investment enhance the performance of input and output markets.

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Appendix 1—Spatial Model of India's Wheat and Rice Sectors[1]

The wide variation in regional agricultural production and consumption patterns in India suggests that a spatial equilibrium model is an appropriate tool for analyzing the welfare impacts of domestic reforms. A multiregional, partial-equilibrium model of the wheat and rice sectors is used to analyze the impact of selected alternative farm support programs for rice and wheat markets in India. The spatial trade equilibrium model covers 18 major States (regions) that account for 99 percent of total production of these grains. Demand and supply functions for rice and wheat are specified for each State based on elasticity estimates available from the existing literature. These functions are calibrated for the base year 2000-01 using data on all exogenous and endogenous variables. In the model, regional demands and supplies of rice and wheat interact with each other through their substitution possibilities, both in consumption and in production. Equilibrium prices and other variables are obtained as a solution to the commodity balance equations subject to the constraints imposed due to government interventions.[2]

The two-commodity model described and used here has both strengths and weaknesses for this analysis. A key strength is that, by focusing only on the two crops (rice and wheat) that are most important for the policy issues being examined, the model remains relatively small, simple, and easy to interpret and understand. Rice and wheat are India's dominant food commodities in both production and consumption, and they account for nearly all government expenditure on procurement, distribution, and storage. Interactions with other crops are unlikely to have a major impact on model results in the short- or medium term. Focusing on rice and wheat also plays to the strengths of available data and research on supply and demand elasticities, and minimizes reliance on the relatively poor data and larger number of assumptions necessary to expand the model to other commodities.

Model Limitations

While this two-commodity is useful in evaluating short- and medium-term implications of the scenarios analyzed, it has more limited value in understanding the longer term implications of the policy options studied. In the longer term, changes in consumer preferences and the prices of other food and nonfood items can be expected to play a larger role in shaping rice and wheat demand. In addition, longer term supply developments are likely to be shaped more significantly by the prices of competing crops, as well as technical trends and developments in water, fertilizer and other input markets that are not accounted for. For more in depth analysis of longer term implications, a more detailed, multi-commodity framework may be needed.

A further limitation of the model, relevant primarily for the analysis of minimum support price (MSP) reductions, is that it does not account for the impacts on production associated with increased producer price risk. Lower MSPs would expose producers to more price risk that could potentially

[1] Model specification, data, calibration of parameters, and results are reported in more detail in Jha and Srinivasan (2006) at http://www.igidr.ac.in/pub/pdf/PP-052.pdf and Jha and Srinivasan (2004) at http://www.ifpri.org/divs/mtid/dp/mtidp67.htm.

[2] Computation of equilibrium prices is formulated as a mixed complementarity problem (MCP). The market equilibrium that satisfies the commodity balance equations and the set of inequalities depicting government interventions is obtained as a solution to the MCP using PATH solver in generalized algebraic modelling systems (GAMS) software.

affect planting and input use decisions, indicating that the model will tend to underestimate declines in production associated with lower MSPs. However, since the scenarios analyzed only reduce rather than eliminate the MSPs, it is not clear how significant the impacts are on model results.

Demand and Supply Functions

The total population is divided into six income groups—three for rural areas (rural poor, rural middle class, rural rich) and three for urban areas (urban poor, urban middle class, and urban rich)—with demand functions specified for each group. Aggregate demand in each State is obtained as the sum of group demands weighted by the population of each group. Linear demand functions are used to incorporate the effects of own price, cross price and income. For each region i, the open market demand function for each category of consumers is specified as:

$$D_i = \alpha_i + \beta_i\, pr_i + \gamma_i\, qr_i + \lambda i\, y_i \qquad (1)$$

where

pr_i = Own retail price

qri = Retail price of the other crop

y_i = Per capita income

The supply function is also assumed linear. It depends on the weighted average of market and procurement prices received by the farmers.[3]

$$S_i = a_i + b_i\, wap_i + c_i\, qf_i \qquad (2)$$

where

S_i = Production

wap_i = $\{\lambda\, pf_i + (1 - \lambda)\, lvp_i\}$ = weighted average of procurement and market prices

pf_i = Farm harvest price

lvp = Levy price (MSP in case of wheat and levy procurement price in case of rice)

qf_i = Weighted average farm harvest price of substitute crop

Interstate Trade

Aggregate regional imports are defined as the difference between free market demand, i.e., total consumption net of consumption through government distribution programs, and free market supply, i.e., production net of procurement. In addition to transport costs, private traders incur other transaction costs that manifest in the form of policy induced market restrictions, infrastructure bottlenecks, other trade obstacles etc. These transaction costs are modeled as implicit tariffs on interstate trade. In the absence of such transaction costs, spatial arbitrage possibilities are determined by transport costs alone.

[3] Depending on the production patterns in different States, rice and wheat are substitutes in production in only some States. However, from the available literature we could not find significant cross price elasticity estimates and had to drop this variable from the supply equations for all States.

Trade from Region i to Region j is determined by the following complementarity (no spatial arbitrage) condition

$$T_{ij} \geq 0 \perp [p_i + tc_{ij} + tm] \geq p_j \qquad (3b)$$

where

T_{ij} = Trade from Region i to Region j
tc_{ij} = the transportation cost from State i to State j
p_i = wholesale price
tm = traders' margins.

With the above complementarity condition, trade will not take place ($T_{ij} = 0$) so long as the sum of purchase cost in State i, cost of transporting grains to State j, and the traders' margin inflated by the implicit tariff exceeds the returns, the open market price in State j, i.e., $(p_i + tc_{ij} + tm) > p_j$. Trade takes place so long as the reverse inequality holds. Perfectly competitive markets imply that trade from State i to j will continue to grow until all the arbitrage benefits are exhausted and total cost equals the open market price in the destination State. Thus, $T_{ij} > 0$ implies that $(p_i + tc_{ij} + tm) = p_j$. Transport costs are assumed to be exogenous (constant average unit costs).

Foreign Trade

External trade is modeled by treating the rest of the world as another region with which individual States can directly trade by incurring the additional costs of transport from the nearest/ cheapest port. Given that the world rice market is thin, we make the large country assumption. Imports, e.g., would tend to become costlier as the magnitude of imports goes up. Similarly, the price received for exports would decline as quantity traded goes down.

Exports take place so long as the price received remains higher than the cost of purchasing the grains plus transport cost from the State center to the port. Imports take place if it is cheaper to import than to buy in the domestic local market. Exports/imports are therefore obtained from the following complementarity conditions

$$x_{i,ROW} \geq 0 \perp [p_i + tc_{i,ROW} + \text{traders' margins}] \geq p_x \quad (4a)$$
$$m_{i,ROW} \geq 0 \perp [p_m + tc_{i,ROW} + \text{traders' margins}] \geq p_i \quad (4b)$$

where x and m denote exports and imports and p_x and p_m denote their respective prices

p_x = border price – port clearance charges – (ec × x)
D_m = border price + port clearance charges + (ic × m)

where border price is expressed in domestic currency, *ic* is the import coefficient and *ec* the export coefficient. The coefficients *ic* and *ec* are obtained from their respective price elasticities of exports (imports) with respect to exports (imports), evaluated at the base year values.

Price Relationships

Equilibrium prices computed in the model are at the wholesale level. However, consumers face the retail price, which enters in the demand equation:

$$pr_i = p_i * (1 + \text{retail margin})^{4} \quad (5)$$

Farmers receive the farm harvest price pf_i, which enters the supply equation:

$$pf_i = p_i / (1 + \text{wholesale margin} + \text{marketing cost}) \quad (6)$$

The targeted public distribution system (TPDS) sale price in State i for both rice and wheat is expressed as a fixed percentage lower than the market price:

$$TPDSP_i = n_i\, p_i$$

The procurement, or farm, price is assumed to be the same for all States and it is exogenous. For rice it is the fixed levy price whereas for wheat it is a fixed minimum support price (MSP).

Public Intervention

Public distribution: Quantities distributed through the targeted public distribution system (TPDS) are fixed exogenously for each State.

Procurement of grains under the MSP: In all scenarios where MSP policy is implemented by physical procurement of grain, the quantities procured of both rice and wheat is determined endogenously based on the complementarity conditions.

$$proc_{Ri} \geq 0 \quad \perp \quad p_{Ri} \geq MSP_{Ri}$$
$$proc_{Wi} \geq 0 \quad \perp \quad pW_i \geq MSP_{Wi} \quad (7)$$

where $proc_{Ri}$ and $proc_{Wi}$ denote quantities procured of rice and wheat respectively.

The above complementarity conditions imply that quantities procured will be zero when the open market price is higher than the MSP. Moreover, whenever quantity procured is positive, open market price will equal the MSP. The exception is when rice procurement is by levy, in which case rice procurement is taken as an exogenously fixed percentage of production, $proc_{Ri} = \mu_i\, S_{Ri}$ where μ_I is the levy fraction of output in State i.

Market Equilibrium

The market clearing condition equates net availability to demand in each State. Since TPDS quantities are exogenously specified, the condition reduces to equating open market demand with net supply, which caters to the domestic open market demand. The net grain available for consumption within a State through open market purchase is obtained by subtracting from production the outflows from the State, which consist of net regional

[4] Since we do not have data on retail profit margins, we assume them to be the same percentage as the wholesale margin applied on farm harvest prices to derive wholesale prices.

imports, government procurement and net foreign exports. Thus the equilibrium condition for each State i is

$$S_i + (\Sigma_j T_{ij} - \Sigma_j T_{ji}) - proc_i - (E_i - M_i) = D_i \qquad (8)$$

Markets are cleared by the adjustment of price p_i. The level of MSP is such that the quantity procured is more than enough to cover the TPDS requirements. Similarly, the size of the rice levy is such that TPDS needs are met. The difference between the quantity procured and TPDS distribution is taken to be the stocks held by the government.

Welfare Measures

Change in Producer Surplus

$$PS = S_i (wap_1 - wap_0) + ½ (spe) S_i (wap_1 - wap_0)^2 / wap_0$$

where

wap_0 = weighted average of procurement and market prices in the base year scenario,

wap_1 = weighted average of procurement and market prices in the alternative scenarios.

spe = price elasticity of supply.

Change in Consumer Surplus

$$CS = - D_i (pr_1 - pr_0) - ½ (dpe) D_i (pr_1 - pr_0)^2 / pr_0$$

where

pr_0 = own retail base year price,

pr_1 = own retail current year price.

Dp_e = price elasticity of demand.

Gains to Traders

Apart from consumers and producers, other agents in the economy also experience welfare changes. They include traders who earn profit margins by trading within State from farm to wholesale market (*wholesale traders*) and from wholesale to retail market (*retail traders*) and *interstate traders*. The surplus of these traders arises from different sources: (1) if production goes up, more grain is brought from farm gate to wholesale market and hence increases their surplus; (2) if more grain is traded across States, interstate traders gain; and (3) if more grain is consumed, then retailers' surplus goes up. The entire amount of difference between prices at the two points of trade does not constitute the income of traders as they incur some costs to provide services (e.g., finding a buyer and arranging payments, etc). Wholesalers help in the delivery of grain from farm gate to the wholesale markets (within-State transaction) or between wholesale markets in different States.

Using data on profit margins in trading from farm to wholesale market and from wholesale to retail market, we can calculate the gains from trade accruing to traders in each State. The gains from trade are obtained by comparing the surpluses in different scenarios with surpluses in the base scenario.

Wholesale Traders' Surplus (From Farm to Wholesale Markets)

To get this surplus, the margin is multiplied with the wholesale price and local production net of procurement, net exports abroad and net exports to other States. This captures the margins of wholesalers both from inside and outside State i.

$$WTS_i = \text{margin} * p_i * [S_i - proc_i - \{E_i - M_i\} - \{\Sigma_j T_{ij} - \Sigma_j T_{ji}\}]$$

Retail Traders' Surplus (From Wholesale to Retail Markets)

The retail traders' surplus is obtained by applying the margin to the free market demand times the retail price.

$$RTS_i = \text{margin} \times pr_i \times D_i$$

Savings in Government Costs

Total government cost = purchase cost + procurement incidental cost + storage cost + distribution cost

where

Purchase cost = government procurement × MSP in the case of wheat,

Purchase cost = government procurement × levy price in the case of rice,

Procurement incidental cost = government procurement × incidental cost,

Storage cost = (procurement – PDS) × storage cost,

Distribution = TPDS × distribution cost

Sale realization = TPDS × central issue price

Net government cost = total government expenditure – sales realization

Quantity Data

Supply is taken to be production net of seed, feed and wastage. Rice and wheat consumption is obtained from National Sample Survey data for 1999-2000. TPDS quantities are also taken from the same source and are assumed fixed in the model. Procurement is carried out under price-support for wheat and as a levy for rice in the base scenario. The base year data satisfy commodity balances across States by appropriately adjusting for interstate trade (table 1.1).

Total demand is disaggregated into six different income groups (rural poor, rural middle, rural rich, urban poor, urban middle, and urban rich) based on monthly per capita consumption expenditure data for 1999-2000 (Government of India, Ministry of Statistics and Programme Implementation,

National Sample Survey Organization). Data on groupwise per capita expenditure is obtained by extrapolating 1993-94 expenditure data to 2000-01 using the consumer price index (Murty, 2001). Estimates of open market demand for the six groups are computed based on 1999-2000 State-level survey data on monthly per capita consumption expenditures, rice and wheat consumption, and purchases of TPDS rice and wheat in rural and urban areas by expenditure class for individuals and households, together with State population data. The consumption data are summarized in tables 1.2 - 1.4.

Price Data

Consumer demand is modeled in terms of retail price, which is obtained by applying the retail margin to inflate wholesale prices, taken from Chand (2003). The model equilibrium solution is derived in terms of wholesale price but, since levy prices and MSPs are fixed in terms of farm-gate prices, these are inflated using wholesale margins to make them comparable to wholesale level prices. Adjustments are made using data on margins in surplus States where government procurement occurs. Data on MSPs for wheat and MSPs and levy prices for rice are taken from Government of India sources (table 1.5).

Model Elasticities

Model elasticities are based on the results of recent comprehensive studies of supply response and food demand. Own price elasticities of supply are taken from Jha and Srinivasan (1999) and Mythili (2001). The supply elasticities are estimated in terms of net production obtained after adjusting for seed, feed and wastage. For wheat, an average all-India elasticity is used due to nonavailability of State estimates. Cross-price elasticities are not used in the supply equations because available data shows no substitution in production of rice and wheat in major producing States, since these crops are largely grown in different seasons,.

For demand, own-price and income elasticities of demand for rice and wheat by State, rural and urban groups, and income class are based on comprehensive estimation work by Murty (1997) using National Sample Survey data. Cross-price elasticities of demand for rice and wheat are based on estimations by Gulati and Kelly (1999).

For the purpose of the scenarios analyzed in this study, the results are most sensitive to the size of the price elasticities of supply and demand that govern responses to changes in producer and consumer prices across States resulting from decentralization, and over time as MSPs are adjusted. Although alternative studies and methodologies have yielded somewhat different results for price elasticities of rice and wheat supply and demand in India, both supply and demand are consistently found to be inelastic to price and differences between studies are generally small. Because the differences are small, use of alternative available estimates is unlikely to fundamentally change results, although future estimates based on more recent production data and more recent rounds of the National Sample Survey would strengthen confidence in the scenario outcomes.

Appendix table 1.1

Base-year quantities

State	Open Market				Public Distribution			
	Supply		Demand		Procurement		System	
	Rice	Wheat	Rice	Wheat	Rice	Wheat	Rice	Wheat
	Million tons							
Andhra Pradesh	11.45	0.01	8.82	0.30	7.17	0.00	1.40	0.06
Assam	3.89	0.09	3.61	0.24	0.00	0.00	0.17	0.01
Bihar	5.42	4.50	7.71	5.21	0.01	0.00	0.09	0.12
Goa	0.15	0.00	0.10	0.03	0.00	0.00	0.03	0.01
Gujarat	1.01	0.65	1.12	2.41	0.00	0.00	0.14	0.20
Haryana	2.68	9.65	0.26	2.41	1.48	4.50	0.00	0.01
Himachal Pradesh	0.12	0.59	0.22	0.41	0.00	0.00	0.08	0.06
Jammu & Kashmir	0.41	0.15	0.76	0.49	0.00	0.00	0.22	0.06
Karnataka	3.73	0.24	3.09	0.65	0.23	0.00	0.51	0.14
Kerala	0.75	0.00	2.16	0.25	0.00	0.00	1.16	0.14
Madhya Pradesh	0.96	3.89	3.45	4.66	1.03	0.35	0.14	0.10
Maharashtra	1.95	0.98	3.50	4.30	0.04	0.00	0.33	0.44
Orissa	4.61	0.01	5.62	0.34	0.92	0.00	0.48	0.03
Punjab	9.15	15.55	0.23	2.58	6.94	9.42	0.00	0.00
Rajasthan	0.16	5.55	0.20	6.69	0.03	0.54	0.00	0.09
Tamil Nadu	7.22	0.00	5.25	0.30	1.72	0.00	1.70	0.13
Uttar Pradesh	11.54	24.94	7.89	17.25	1.21	1.55	0.16	0.20
West Bengal	12.43	1.06	10.68	1.35	0.00	0.00	0.23	0.14
Total	77.64	67.86	64.66	49.87	20.77	16.36	6.82	1.94

Sources: Chand (2003), www.indiastat.com, Government of India, Ministry of Statistics and Program Implementation, National Sample Survey Organization.

Appendix table 1.2

Percapita consumption expenditure by expenditure class[1]

States	Rural			Urban		
	Poor	Middle	Rich	Poor	Middle	Rich
	Population share					
	Percent					
	22	44	7	8	16	3
	Annual per capita expenditure					
	Rupees					
Andhra Pradesh	2,528	3,732	7,843	4,343	6,339	14,352
Assam	2,827	4,550	8,883	4,361	6,015	13,071
Bihar	2,521	4,058	7,921	4,049	5,846	12,705
Goa	2,754	4,155	7,724	4,206	6,506	13,998
Gujarat	2,917	4,537	8,302	4,715	7,461	16,537
Haryana	3,463	5,385	11,169	3,959	5,702	12,122
Himachal Pradesh	3,078	4,948	10,607	4,135	5,790	13,581
Jammu & Kashmir	3,479	5,593	11,989	4,501	6,268	14,704
Karnataka	2,824	4,261	7,922	4,119	6,746	14,515
Kerala	2,612	4,203	9,278	4,761	7,637	19,059
Madhya Pradesh	2,570	3,906	7,760	4,514	6,956	15,959
Maharashtra	2,911	4,691	9,218	4,007	7,582	17,710
Orissa	2,779	4,103	8,622	4,299	6,703	15,176
Punjab	3,287	5,285	11,329	3,885	6,474	15,187
Rajasthan	3,026	4,697	8,921	4,864	6,829	13,129
Tamil Nadu	2,725	4,385	9,680	5,008	7,745	19,327
Uttar Pradesh	2,647	4,260	8,317	3,994	6,204	13,483
West Bengal	2,455	3,731	7,414	4,753	7,185	16,485

[1]Expenditure classes are based on monthly per capita expenditure classifications from the National Sample Survey: poor (rupees 0-340/month), middle (rupees 340-775), and rich (rupees 775+).

Sources: Author's calculations based on data from Murty (2001); Government of India, Ministry of Statistics and Program Implementation, National Sample Survey Organization; Government of India, Directorate of Census Operations.

Appendix table 1.3

Rice and wheat consumption by expenditure class[1]

Expenditure classes	Rice			Wheat		
	TPDS consumption	Open market demand	Total demand	TPDS consumption	Open market demand	Total demand
	Million tons					
Rural						
Poor	1.27	14.93	16.19	0.32	8.04	8.36
Middle	3.27	30.52	33.78	0.87	23.13	24.01
Rich	0.93	4.33	5.27	0.23	5.14	5.37
All	5.46	49.78	55.24	1.42	36.32	37.74
Urban						
Poor	0.28	6.07	6.35	0.11	5.22	5.33
Middle	0.87	7.57	8.45	0.33	7.03	7.36
Rich	0.2	1.24	1.44	0.08	1.29	1.37
All	1.35	14.88	16.23	0.52	13.54	14.06
Total (rural + urban)						
Poor	1.54	21	22.54	0.43	13.27	13.69
Middle	4.14	38.09	42.23	1.21	30.16	31.37
Rich	1.14	5.57	6.71	0.31	6.43	6.74
All	6.82	64.66	71.47	1.94	49.87	51.8

[1]Expenditure classes are based on monthly per capita expenditure classifications from the National Sample Survey: poor (rupees 0-340/month), middle (rupees 340-775), and rich (rupees 775+).

Sources: Author's calculations based on data from Murty (2001); Government of India, Ministry of Statistics and Program Implementation, National Sample Survey Organization; Government of India, Directorate of Census Operations.

Appendix table 1.4

Rural and urban open market demand by State

States	Rice			Wheat		
	Rural	Urban	Total	Rural	Urban	Total
	Million tons					
Andhra Pradesh	6.61	2.22	8.82	0.14	0.16	0.30
Assam	3.18	0.43	3.61	0.19	0.05	0.24
Bihar	7.02	0.68	7.71	4.58	0.62	5.21
Goa	0.06	0.04	0.10	0.01	0.02	0.03
Gujarat	0.69	0.43	1.12	1.22	1.20	2.41
Haryana	0.18	0.09	0.26	1.81	0.60	2.41
Himachal Pradesh	0.20	0.02	0.22	0.37	0.04	0.41
Jammu & Kashmir	0.60	0.16	0.76	0.40	0.10	0.49
Karnataka	1.86	1.23	3.09	0.33	0.32	0.65
Kerala	1.63	0.53	2.16	0.17	0.08	0.25
Madhya Pradesh	2.80	0.65	3.45	3.24	1.42	4.66
Maharashtra	1.88	1.62	3.50	2.01	2.29	4.30
Orissa	4.86	0.76	5.62	0.21	0.13	0.34
Punjab	0.13	0.10	0.23	1.86	0.72	2.58
Rajasthan	0.12	0.08	0.20	5.03	1.66	6.69
Tamil Nadu	2.81	2.44	5.25	0.08	0.22	0.30
Uttar Pradesh	6.72	1.17	7.89	14.01	3.24	17.25
West Bengal	8.45	2.23	10.68	0.66	0.69	1.35
Total	49.78	14.88	64.66	36.32	13.54	49.87

Sources: Author's calculations based on data from Murty (2001); Government of India, Ministry of Statistics and Program Implementation, National Sample Survey Organization; Government of India, Directorate of Census Operations.

Appendix table 1.5

Base-year prices

State	Retail price		Wholesale price		Rice levy farm gate price
	Rice	Wheat	Rice	Wheat	
	Rupees per 100 kiliograms				
Andhra Pradesh	1,477	1,146	1,291	1,002	900
Assam	1,554	1,216	1,328	1,038	846
Bihar	1,378	1,108	1,247	957	861
Goa	1,465	1,261	1,305	1,016	831
Gujarat	1,418	1,062	1,152	863	827
Haryana	1,218	876	1,028	739	904
Himachal Pradesh	1,310	876	1,105	739	904
Jammu & Kashmir	1,442	1,098	1,216	927	904
Karnataka	1,368	1,058	1,277	988	830
Kerala	1,459	1,138	1,317	1,027	830
Madhya Pradesh	1,261	960	1,158	868	840
Maharashtra	1,372	1,157	1,222	932	831
Orissa	1,292	978	1,192	902	869
Punjab	1,218	876	1,028	739	904
Rajasthan	1,248	840	1,097	1,016	881
Tamil Nadu	1,515	1,114	1,305	752	830
Uttar Pradesh	1,176	852	1,028	988	869
West Bengal	1,100	1,040	1,028	791	827

Sources: Chand (2003); http://www.indiastat.com/; and Government of India, Ministry of Consumer Affairs, Food, and Public Distribution, Bulletin of Food Statistics.

Appendix table 1.6

Price elasticities of demand for rice by expenditure class[1]

States	Own price elasticities of demand						Cross price elasticities (rice/wheat)
	Rural			Urban			
	Poor	Middle	Rich	Poor	Middle	Rich	
Andhra Pradesh	-2.22	-1.77	-1.15	-1.32	-0.87	-0.26	0.045
Assam	-2.25	-1.79	-1.18	-1.35	-0.90	-0.28	0.044
Bihar	-2.25	-1.79	-1.18	-1.35	-0.90	-0.28	0.044
Goa	-2.84	-2.39	-1.77	-1.94	-1.49	-0.87	0.046
Gujarat	-1.07	-0.62	0.00	-0.17	-0.28	0.90	0.046
Haryana	-2.21	-1.75	-1.14	-1.31	-0.86	-0.24	0.045
Himachal Pradesh	-1.92	-1.47	-0.85	-1.02	-0.57	0.05	0.046
Jammu & Kashmir	-1.92	-1.47	-0.85	-1.02	-0.57	0.05	0.046
Karnataka	-2.84	-2.39	-1.77	-1.94	-1.49	-0.87	0.047
Kerala	-2.27	-1.82	-1.20	-1.37	-0.92	-0.30	0.045
Madhya Pradesh	-2.59	-2.14	-1.52	-1.69	-1.24	-0.62	0.047
Maharashtra	-2.29	-1.84	-1.22	-1.39	-0.94	-0.33	0.045
Orissa	-2.22	-1.77	-1.15	-1.32	-0.90	-0.26	0.045
Punjab	-1.92	-1.47	-0.85	-1.02	-0.57	0.05	0.046
Rajasthan	-1.87	-1.42	-0.80	-0.97	-0.52	0.10	0.044
Tamil Nadu	-2.27	-1.82	-1.20	-1.37	-0.92	-0.30	0.047
Uttar Pradesh	-2.25	-1.79	-1.18	-1.35	-0.90	-0.28	0.044
West Bengal	-2.59	-2.14	-1.52	-1.69	-1.24	-0.62	0.045

[1]Expenditure classes are based on monthly per capita expenditure classifications from the National Sample Survey: poor (rupees 0-340/month), middle (rupees 340-775), and rich (rupees 775+).
Sources: Murty, 1997; and Gulati and Kelly, 1999.

Appendix table 1.7

Price elasticities of demand for wheat by expenditure class[1]

States	Own price elasticities of demand						Cross price elasticities (wheat/rice)
	Rural			Urban			
	Poor	Middle	Rich	Poor	Middle	Rich	
Andhra Pradesh	-2.43	-2.15	-1.99	-1.17	-0.88	-0.72	0.101
Assam	-1.06	-0.78	-0.62	-0.20	0.48	0.64	0.100
Bihar	-1.06	-0.78	-0.62	-0.20	0.48	0.64	0.100
Goa	-1.93	-1.65	-1.48	-0.66	-0.38	-0.22	0.102
Gujarat	-2.47	-2.19	-2.03	-1.20	-0.92	-0.76	0.103
Haryana	-1.55	-1.27	-1.11	-0.28	0	0.16	0.101
Himachal Pradesh	-1.70	-1.42	-1.25	-1.02	-0.15	0.01	0.102
Jammu & Kashmir	-1.70	-1.42	-1.25	-1.02	-0.15	0.01	0.102
Karnataka	-1.93	-1.65	-1.48	-1.94	-0.38	-0.22	0.102
Kerala	-2.14	-1.86	-1.70	-1.37	-0.59	-0.43	0.104
Madhya Pradesh	-1.69	-1.41	-1.25	-0.43	-0.14	0.02	0.101
Maharashtra	-2.52	-2.24	-2.08	-1.26	-0.98	-0.82	0.103
Orissa	-2.43	-2.15	-1.70	-1.17	-0.88	-0.72	0.101
Punjab	-1.70	-1.42	-1.25	-0.43	-0.15	0.01	0.102
Rajasthan	-1.27	-0.99	-0.83	-0.01	0.28	0.44	0.100
Tamil Nadu	-2.14	-1.86	-1.70	-0.88	-0.59	-0.43	0.104
Uttar Pradesh	-1.06	-0.78	-0.62	-1.35	0.48	0.64	0.100
West Bengal	-1.69	-1.41	-1.25	-0.43	-0.14	0.02	0.101

[1]Expenditure classes are based on monthly per capita expenditure classifications from the National Sample Survey: poor (rupees 0-340/month), middle (rupees 340-775), and rich (rupees 775+).

Sources: Murty, 1997; and Gulati and Kelly, 1999.

Appendix table 1.8

Income elasticities of demand for rice by expenditure class[1]

State	Rural			Urban		
	Poor	Middle	Rich	Poor	Middle	Rich
Andhra Pradesh	1.34	0.77	0.34	1.23	0.66	0.23
Assam	1.23	0.66	0.23	1.12	0.55	0.12
Bihar	1.23	0.66	0.23	1.12	0.55	0.12
Goa	1.54	0.98	0.55	1.43	0.87	0.44
Gujarat	1.26	0.69	0.26	1.15	0.58	0.15
Haryana	1.35	0.79	0.36	1.24	0.68	0.25
Himachal Pradesh	1.40	0.83	0.40	1.29	0.72	0.29
Jammu & Kashmir	1.40	0.83	0.40	1.29	0.72	0.29
Karnataka	1.54	0.98	0.55	1.43	0.87	0.44
Kerala	1.20	0.64	0.21	1.09	0.53	0.10
Madhya Pradesh	1.05	0.49	0.06	0.94	0.38	-0.05
Maharashtra	1.35	0.79	0.36	1.24	0.68	0.25
Orissa	1.34	0.77	0.34	1.23	0.66	0.23
Punjab	1.40	0.83	0.40	1.29	0.72	0.29
Rajasthan	1.86	1.29	0.86	1.75	1.18	0.75
Tamil Nadu	1.20	0.64	0.21	1.09	0.53	0.10
Uttar Pradesh	1.23	0.66	0.23	1.12	0.55	0.12
West Bengal	1.05	0.49	0.06	0.94	0.38	-0.05

[1]Expenditure classes are based on monthly per capita expenditure classifications from the National Sample Survey: poor (rupees 0-340/month), middle (rupees 340-775), and rich (rupees 775+).

Source: Murty, 1997.

Appendix table 1.9

Income elasticities of demand for wheat by expenditure class[1]

State	Rural			Urban		
	Poor	Middle	Rich	Poor	Middle	Rich
Andhra Pradesh	2.06	1.92	1.53	1.75	1.61	1.21
Assam	0.79	0.65	0.25	0.47	0.33	-0.06
Bihar	0.79	0.65	0.25	0.47	0.33	-0.06
Goa	1.22	1.08	0.68	0.90	0.76	0.36
Gujarat	1.18	1.04	0.65	0.87	0.73	0.33
Haryana	0.79	0.65	0.25	0.47	0.33	-0.07
Himachal Pradesh	0.79	0.65	0.25	0.47	0.34	-0.06
Jammu & Kashmir	0.79	0.65	0.25	0.47	0.34	-0.06
Karnataka	1.22	1.08	0.68	0.90	0.76	0.36
Kerala	1.89	1.75	1.35	1.57	1.43	1.04
Madhya Pradesh	1.24	1.10	0.70	0.92	0.78	0.39
Maharashtra	0.99	0.85	0.45	0.68	0.54	0.14
Orissa	2.06	1.92	1.53	1.75	1.61	1.21
Punjab	0.79	0.65	0.25	0.47	0.34	-0.06
Rajasthan	1.11	0.97	0.57	0.80	0.66	0.26
Tamil Nadu	1.89	1.75	1.35	1.57	1.43	1.04
Uttar Pradesh	0.79	0.65	0.25	0.47	0.33	-0.06
West Bengal	1.24	1.10	0.70	0.92	0.78	0.39

[1]Expenditure classes are based on monthly per capita expenditure classifications from the National Sample Survey: poor (rupees 0-340/month), middle (rupees 340-775), and rich (rupees 775+).

Source: Murty, 1997.

Appendix table 1.10

Supply elasticities for wheat and rice

State	Wheat	Rice
Andhra Pradesh	0.090	0.060
Assam	0.090	0.060
Bihar	0.090	0.115
Goa	0.090	0.090
Gujarat	0.090	0.115
Haryana	0.090	0.060
Himachal Pradesh	0.090	0.090
Jammu & Kashmir	0.090	0.090
Karnataka	0.090	0.115
Kerala	0.090	0.115
Madhya Pradesh	0.090	0.115
Maharashtra	0.090	0.115
Orissa	0.090	0.115
Punjab	0.090	0.060
Rajasthan	0.090	0.115
Tamil Nadu	0.090	0.090
Uttar Pradesh	0.090	0.060
West Bengal	0.090	0.060

Source: Jha and Srinivasan, 1999 and Mythili, 2001

Appendix 2—Statistical Tables

Appendix table 2.1

Indian Government wheat and rice operations, April/March years

Years	Beginning stocks	Procure-ment	Domestic distribution						Imports	Exports	Ending stocks
			Total	TPDS[1]	PDS[2]	Antyo-daya[3]	Other welfare	Open sale			
						Million tons					
Wheat											
90/91	2.70	11.07	8.36	0.00	7.08	0.00	0.04	1.24	0.00	0.02	5.60
91/92	5.60	7.75	9.81	0.00	8.83	0.00	0.06	0.92	0.00	0.07	2.21
92/93	2.21	6.38	7.99	0.00	7.85	0.00	0.11	0.03	2.40	0.00	2.74
93/94	2.74	12.84	9.14	0.00	6.09	0.00	0.18	2.87	0.40	0.00	7.00
94/95	7.00	11.87	10.59	0.00	5.11	0.00	0.29	5.19	0.00	0.00	8.72
95/96	8.72	12.33	12.72	0.00	5.81	0.00	0.47	6.44	0.00	0.10	7.76
96/97	7.76	8.18	12.88	0.00	8.52	0.00	0.69	3.67	1.35	0.38	3.24
97/98	3.24	9.30	7.76	5.42	1.66	0.00	0.65	0.03	1.63	0.00	5.08
98/99	5.08	12.65	8.90	7.95	0.00	0.00	0.42	0.53	2.10	0.00	9.66
99/00	9.66	14.14	10.63	5.76	0.00	0.00	0.47	4.40	1.27	0.00	13.19
00/01	13.19	16.36	6.32	4.05	0.00	0.02	1.15	1.10	0.34	1.47	21.50
01/02	21.50	20.63	13.25	4.90	0.00	0.78	2.38	5.20	0.00	2.74	26.04
02/03	26.04	19.06	15.50	8.14	0.00	1.64	5.33	0.39	0.00	4.85	20.11
03/04	20.11	15.80	17.59	9.03	0.00	1.78	6.38	0.41	0.00	5.65	7.15
04/05	7.15	16.79	15.93	10.76	0.00	2.26	2.67	0.24	0.00	2.12	5.46
Rice											
90/91	6.71	12.67	7.89	0.00	7.87	0.00	0.02	0.00	0.00	0.01	10.21
91/92	10.21	10.44	10.29	0.00	10.17	0.00	0.09	0.02	0.00	0.05	8.86
92/93	8.86	12.72	9.79	0.00	9.69	0.00	0.09	0.01	0.00	0.03	9.93
93/94	9.93	14.19	9.34	0.00	9.10	0.00	0.22	0.02	0.00	0.04	13.55
94/95	13.55	13.44	8.85	0.00	8.01	0.00	0.35	0.49	0.00	0.00	18.08
95/96	18.08	10.03	12.51	0.00	9.75	0.00	0.66	2.10	0.00	1.49	13.06
96/97	13.06	12.56	12.39	0.00	11.14	0.00	0.76	0.49	0.00	0.05	13.17
97/98	13.17	16.23	11.36	7.42	2.48	0.00	1.27	0.19	0.00	0.00	13.05
98/99	13.05	12.29	11.83	10.74	0.00	0.00	0.97	0.12	0.00	0.00	12.16
99/00	12.16	17.45	12.71	11.60	0.00	0.00	0.95	0.15	0.00	0.00	15.72
00/01	15.72	18.93	10.40	7.97	0.00	0.01	2.04	0.39	0.00	0.02	23.19
01/02	23.19	20.29	13.37	7.26	0.00	0.90	4.81	0.40	0.00	1.92	24.91
02/03	24.91	19.00	17.92	8.66	0.00	1.90	6.97	0.39	0.00	6.94	17.20
03/04	17.20	20.78	21.95	11.00	0.00	2.38	8.16	0.41	0.00	3.09	13.10
04/05	13.10	19.79	22.89	13.20	0.00	3.19	6.49	0.01	0.00	0.09	13.30

[1]TPDS = targeted public distribution system.

[2]PDS = public distribution system.

[3]Antyodaya = A targeted program that extends the largest price subsidies to the "poorest of the poor."

Note: Annual procurement, distribution, trade, and stock data do not balance due to reporting errors and storage losses.

Sources: Government of India, Ministry of Consumer Affairs, Food, and Public Distribution; Government of India, Ministry of Agriculture, Commission on Agricultural Costs and Prices; ERS estimates.

Appendix table 2.2

Total supply and use of wheat in India, April/March years

Year	Area	Yield	Production	Beginning stocks	Imports	Exports	Consumption				Ending stocks
							Total	Food	Food capita	Feed	
	1,000ha	*Tons/ha*	*1,000 tons*						*Kilograms*		*1,000 tons*
1970/71	16,626	1.21	20,093	4,000	2,927	13	22,007	21,967	41	40	5,000
1971/72	18,241	1.31	23,832	5,000	1,749	5	23,576	23,526	43	50	7,000
1972/73	19,139	1.38	26,410	7,000	502	667	28,245	28,145	50	100	5,000
1973/74	19,463	1.27	24,735	5,000	3,243	0	30,178	30,078	52	100	2,800
1974/75	18,583	1.17	21,778	2,800	4,970	0	27,048	26,948	46	100	2,500
1975/76	18,010	1.34	24,104	2,500	6,900	0	27,004	26,904	45	100	6,500
1976/77	20,454	1.41	28,846	6,500	5,066	0	28,412	28,312	46	100	12,000
1977/78	20,922	1.39	29,010	12,000	298	536	30,772	30,372	48	400	10,000
1978/79	21,456	1.48	31,749	10,000	50	614	33,685	33,335	52	350	7,500
1979/80	22,641	1.57	35,508	7,500	0	481	36,027	35,627	54	400	6,500
1980/81	22,172	1.44	31,830	6,500	50	55	34,325	34,025	50	300	4,000
1981/82	22,279	1.63	36,313	4,000	2,000	0	36,313	36,013	52	300	6,000
1982/83	22,144	1.69	37,452	6,000	2,486	100	37,838	37,538	53	300	8,000
1983/84	23,567	1.82	42,794	8,000	3,270	35	42,029	41,729	58	300	12,000
1984/85	24,672	1.84	45,476	12,000	700	100	43,076	42,776	58	300	15,000
1985/86	23,564	1.87	44,069	15,000	50	400	43,719	43,319	58	400	15,000
1986/87	22,997	2.05	47,052	15,000	15	500	45,567	45,167	59	400	16,000
1987/88	23,131	1.92	44,323	16,000	10	500	56,492	56,092	72	400	3,341
1988/89	23,063	2.00	46,169	3,341	2,100	20	48,929	48,629	61	300	2,661
1989/90	24,109	2.24	54,110	2,661	100	20	53,201	53,001	65	200	3,650
1990/91	23,502	2.12	49,850	3,650	100	200	47,595	47,395	56	200	5,805
1991/92	24,167	2.28	55,134	5,805	100	680	58,009	57,509	67	500	2,350
1992/93	23,260	2.39	55,690	2,350	2,500	50	57,515	57,215	66	300	2,975
1993/94	24,589	2.33	57,210	2,975	500	28	53,377	53,177	60	200	7,280
1994/95	25,100	2.38	59,840	7,280	30	100	58,330	58,130	64	200	8,720
1995/96	25,600	2.56	65,470	8,720	50	1,500	64,978	64,678	70	300	7,762
1996/97	25,011	2.48	62,097	7,762	1,445	2,000	66,064	65,714	69	350	3,240
1997/98	25,887	2.68	69,350	3,240	1,731	0	69,246	68,896	71	350	5,075
1998/99	26,700	2.49	66,350	5,075	2,203	0	63,707	63,357	64	350	9,921
1999/00	27,400	2.58	70,780	9,921	1,372	200	68,793	68,443	68	350	13,080
2000/01	27,486	2.78	76,369	13,080	441	1,569	66,821	66,321	65	500	21,500
2001/02	25,700	2.71	69,680	21,500	32	3,087	65,125	64,625	62	500	23,000
2002/03	25,900	2.77	71,810	23,000	34	4,850	74,294	73,694	70	600	15,700
2003/04	24,860	2.62	65,100	15,700	8	5,650	68,258	67,658	63	600	6,900
2004/05	26,620	2.71	72,150	6,900	32	2,120	72,838	72,338	66	500	4,100
2005/06	26,500	2.59	68,640	4,100	6,000	801	69,971	69,671	63	300	2,000

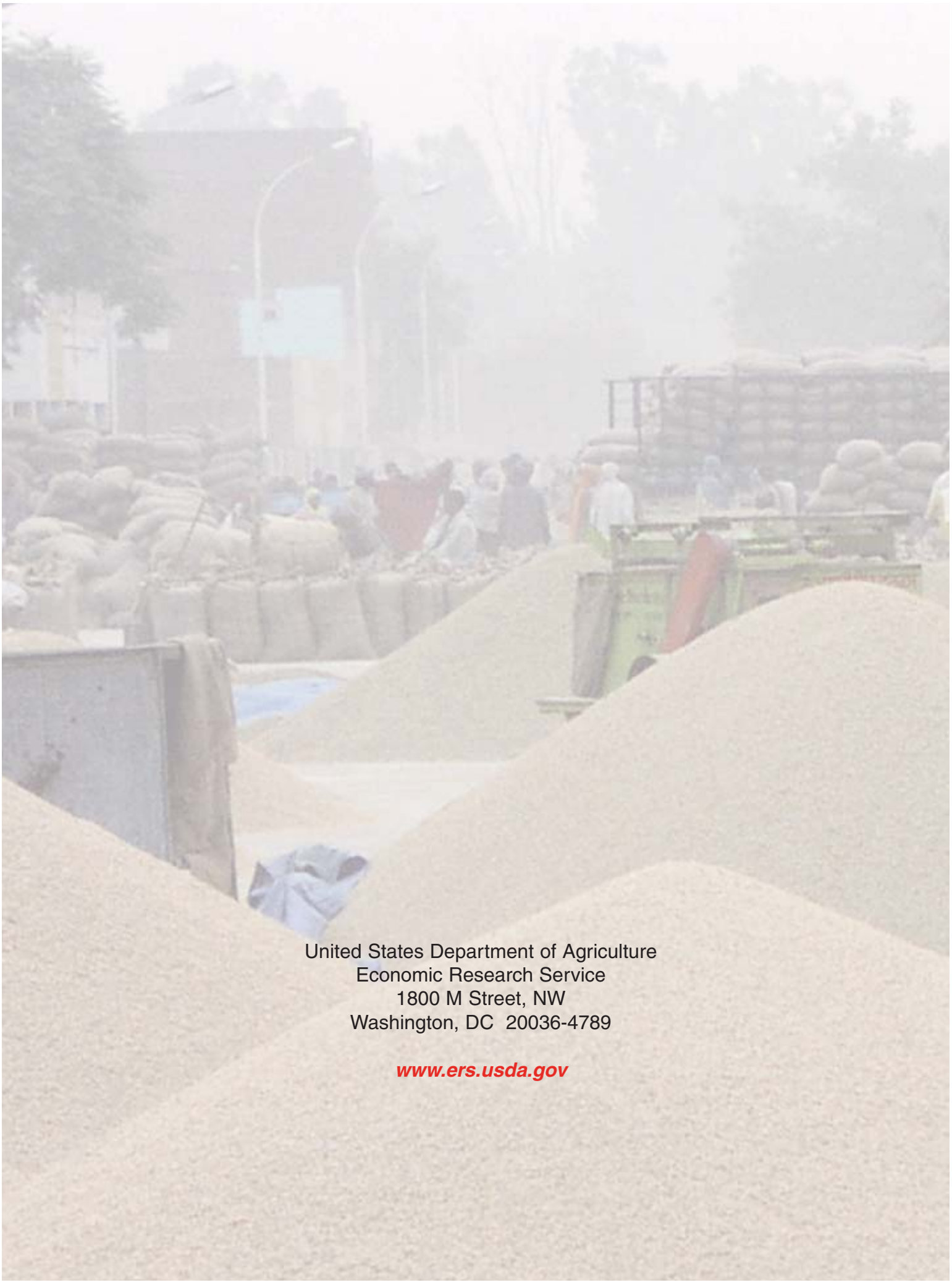
Source: USDA Production, Supply, and Distribution database.

Appendix table 2.3

Total supply and use of rice in India, October/September years

Year	Area	Yield	Production	Beginning stocks	Imports	Exports	Consumption				Ending stocks
							Total	Food	Food capita	Feed	
	1,000ha	*Tons/ha*	*1,000 tons*						*Kilograms*		*1,000 tons*
1970/71	37,592	1.12	42,225	5,000	307	20	41,512	41,512	77	0	6,000
1971/72	37,758	1.14	43,068	6,000	133	10	43,541	43,541	79	0	5,650
1972/73	36,688	1.07	39,245	5,650	0	15	40,780	40,780	72	0	4,100
1973/74	38,286	1.15	44,051	4,100	65	35	43,181	43,181	75	0	5,000
1974/75	37,889	1.04	39,579	5,000	155	18	43,502	43,502	74	0	1,214
1975/76	39,475	1.23	48,740	1,214	230	38	43,646	43,646	72	0	6,500
1976/77	38,511	1.09	41,917	6,500	42	23	43,436	43,436	70	0	5,000
1977/78	40,282	1.31	52,617	5,000	10	143	49,484	49,484	78	0	8,000
1978/79	40,482	1.33	53,773	8,000	10	450	50,333	50,333	78	0	11,000
1979/80	39,414	1.07	42,330	11,000	5	425	45,910	45,910	70	0	7,000
1980/81	40,152	1.34	53,631	7,000	70	900	53,301	53,301	79	0	6,500
1981/82	40,708	1.31	53,248	6,500	10	675	54,083	54,083	79	0	5,000
1982/83	38,262	1.23	47,116	5,000	80	200	48,496	48,496	69	0	3,500
1983/84	41,244	1.46	60,097	3,500	850	220	58,227	58,227	81	0	6,000
1984/85	41,159	1.42	58,337	6,000	10	160	56,687	56,687	77	0	7,500
1985/86	41,137	1.55	63,825	7,500	5	250	62,080	62,080	83	0	9,000
1986/87	40,774	1.48	60,416	9,000	5	350	60,071	60,071	78	0	9,000
1987/88	38,806	1.47	56,862	9,000	650	200	59,312	59,312	76	0	7,000
1988/89	41,736	1.69	70,489	7,000	650	450	65,689	65,689	82	0	12,000
1989/90	42,167	1.74	73,573	12,000	50	500	71,123	71,123	87	0	14,000
1990/91	42,687	1.74	74,291	14,000	0	700	73,091	73,091	87	0	14,500
1991/92	42,650	1.75	74,680	14,500	15	600	74,595	74,595	87	0	14,000
1992/93	41,775	1.74	72,868	14,000	55	650	75,273	75,273	86	0	11,000
1993/94	42,034	1.91	80,300	11,000	0	750	76,050	76,050	85	0	14,500
1994/95	42,500	1.92	81,810	14,500	0	4,150	77,660	77,660	85	0	14,500
1995/96	42,300	1.82	76,980	14,500	0	3,700	76,280	76,280	82	0	11,500
1996/97	43,283	1.89	81,730	11,500	0	2,100	81,630	81,630	86	0	9,500
1997/98	43,420	1.90	82,540	9,500	12	4,000	77,552	77,552	80	0	10,500
1998/99	44,600	1.93	86,080	10,500	4	3,350	81,234	81,234	83	0	12,000
1999/00	45,160	1.99	89,680	12,000	86	1,400	82,650	82,650	83	0	17,716
2000/01	44,361	1.92	84,980	17,716	0	1,685	75,960	75,960	75	0	25,051
2001/02	44,600	2.09	93,340	25,051	0	6,300	87,611	87,611	84	0	24,480
2002/03	40,400	1.78	71,820	24,480	0	5,440	79,860	79,860	76	0	11,000
2003/04	42,400	2.09	88,530	11,000	0	3,100	85,630	85,630	80	0	10,800
2004/05	42,300	2.01	85,130	10,800	0	4,678	83,743	83,743	74	0	8,500
2005/06	43,400	2.11	91,790	8,500	0	3,800	85,220	85,220	77	0	11,270

Source: USDA Production, Supply, and Distribution database.



United States Department of Agriculture
Economic Research Service
1800 M Street, NW
Washington, DC 20036-4789

www.ers.usda.gov