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# The Role of Policy and Industry Structure in India's Oilseed Markets

**Suresh Persaud and Maurice R. Landes**

## Abstract

High tariff and nontariff protection of the Indian oilseed sector imposes costs on consumers, supports an inefficient processing industry, and has led to negligible gains in oilseed output. Model-based simulations indicate that higher levels of protection would increase the burden on consumers, but do little to meet key policy goals of supporting producers and reducing import dependence. A shift to direct support of oilseed producer prices would increase output, but may be complex to implement and subject to WTO discipline. Liberalization of oilseed imports, by permitting large gains in processing efficiency, could generate a stream of benefits that would allow producers, consumers, and processors to be better off, and also improve the trade balance.

**Keywords:** India, oilseeds, soybeans, vegetable oil, meal, processing industry, industry structure, policy, trade liberalization.

## Acknowledgments

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# Contents

# Summary

Oilseeds and oilseed products emerged during the 1990s as one of the fastest-growing components of global and U.S. agricultural trade, with developing countries accounting for most of the growth in both supply and demand. India is the world's second most populous country, the third largest economy in Asia, and one of the world's fastest growing developing economies. India is also a major producer and consumer of oilseeds and their products, emerging in the late 1990s as one of the world's largest importers of vegetable oils. Higher incomes, low productivity in domestic oilseed production, and more liberal policies for edible oil imports are all expanding trade.

## What Is the Issue?

Stronger income growth in India is likely to be sustained, leading to continued strong demand for oils and oil meals, as well as other foods. Without significant improvement in yields, India is likely to have a growing deficit in vegetable oils to be met by imports of either oils or oilseeds for processing. And, without improved oilseed productivity, particularly for soybeans, rapid growth in meal demand is likely to continue to reduce India's oil meal surplus, eventually creating a deficit in feed protein.

Current policies, which aim to support oilseed producers by imposing high tariffs on oil and prohibitive restrictions on oilseed imports, have not led to significant gains in oilseed area or yields. In addition to imposing substantial costs on all consumers of oil, oil and oilseed import barriers have propped up a processing sector that is technically inefficient and heavily underutilized. As a result, policy change is likely to determine the future growth and composition of India's oilseed and product trade. This report reviews recent developments in India's oilseed sector and, with a model-based evaluation of alternate scenarios, assesses the implications of current and potential policies for oilseed producers, processors, Indian consumers, and international trade.

## What Did the Project Find?

India's current policy of high tariffs on oilseeds and oil affords little benefit to oilseed producers, while supporting processors and imposing high costs on consumers. Direct support of domestic oilseed prices would help growers more, and at lower cost to consumers, but could be costly and difficult to implement so as to ensure processor incentives.

Liberalization of tariff and nontariff barriers to oilseed imports, with high oil tariffs continuing, would lead to large-scale imports of oilseeds, primarily soybeans, as imports of the raw material substitute for imports of the processed commodity. Improved access to oilseeds would allow processors in India to boost capacity utilization, resulting in lower processing costs, and increased net revenues and employment. The windfall gains in processing efficiency and processor returns could be reallocated to producers and consumers through adjustments in oilseed and oil tariffs, with the potential

for growers, consumers, and processors to all be better off than under existing policies.

The ongoing process of consolidation of ownership in India's oilseed processing sector is likely to generate benefits for Indian producers and consumers, as larger, consolidated processors compete more effectively for scarce raw materials and pass on economies associated with increased scale, process integration, and capacity utilization. In this context, liberalization of oilseed imports that boosts raw material supplies may allow smaller-scale processors to remain competitive.

The United States is a minor player in India's edible oil market because Latin American soybean oil and Asian palm oil are less costly than U.S. soybean oil. However, the United States is a competitive supplier of soybeans, and U.S. producers stand to gain if India follows some other developing countries—most notably China—by reducing barriers to oilseed imports. Although U.S. soybeans and products would still face considerable competition from Latin American suppliers, trade liberalization that results in India's substituting imports of soybeans for imports of oil is likely to improve U.S. trade prospects.

## How Was the Project Conducted?

The ERS India Oilseed Sector Model illustrates the impacts of alternative oilseed policies on India's supply, demand, and trade of oilseeds and their products, including implications for producers, consumers, and processors. The model incorporates supply, demand, and trade relationships for each of India's major oilseeds (soybean, peanut, rapeseed, and sunflower) and their products, as well as demand relationships for palm oil. The model first generates a 10-year projection (2001-11), or reference scenario, for India's oilseed sector. The reference scenario is based on existing policies and assumed changes in key exogenous variables, including income growth, exchange rates, and world prices. Policy scenarios analyzed are (1) increased oil tariffs, (2) increased oilseed price supports, (3) oilseed import liberalization, (4) increased ownership consolidation in the oilseed processing industry, and (5) composite scenarios involving changes in both oilseed and oil tariffs. Data were collected from secondary sources and through ERS interviews with oilseed traders, processors, and industry representatives in India. Support for this study was provided by the ERS-India Emerging Markets Project.

# The Role of Policy and Industry Structure in India's Oilseed Markets


## Suresh Persaud and Maurice R. Landes


## Introduction

Oilseeds and oilseed products emerged during the 1990s as one of the fastest growing components of global and U.S. agricultural trade, with developing countries accounting for most of the growth in both supply and demand. Many developing countries—including the rapidly expanding economies of China and India—have become the principal source of growth in demand for feed proteins and edible oils. And following a period of rapid production growth, soybean products from Latin America and palm oil from Southeast Asia now meet most of the growth in oilseed product demand.

U.S. exports of oilseeds and oilseed products—mostly soybeans and products—now account for declining shares of global trade in these products. This stems largely from the comparative advantage of Latin American soybean and Southeast Asian palm oil producers (Schnepf et al., 2001). Policies that affect production, trade, and processing in importing and exporting countries have also affected trade growth and the mix of raw materials and processed products that is traded. For example, government land, credit, and export tax policies support the expansion of production and processing infrastructure for soybeans in Latin America and palm oil in Southeast Asia. In China, rising incomes and trade policy reforms have fueled rapid growth in demand for vegetable oil and feed protein, as well as its shift from an importer of oilseed products to an importer of raw materials.

India is the world's second most populous country, the third largest economy in Asia, and one of the world's fastest growing developing economies since 1990. India is also a major producer and consumer of oilseeds and their products, emerging in the late 1990s as one of the world's largest importers of vegetable oils. Higher incomes, low productivity in domestic oilseed production, and more liberal policies for edible oil imports have driven expanding trade. Despite more open oil import policies, extensive policy intervention continues to affect oilseed production, trade, and processing in India, and policy change is likely to play a major role in the future growth and composition of India's oilseed and product trade.

# India's Oilseed Sector

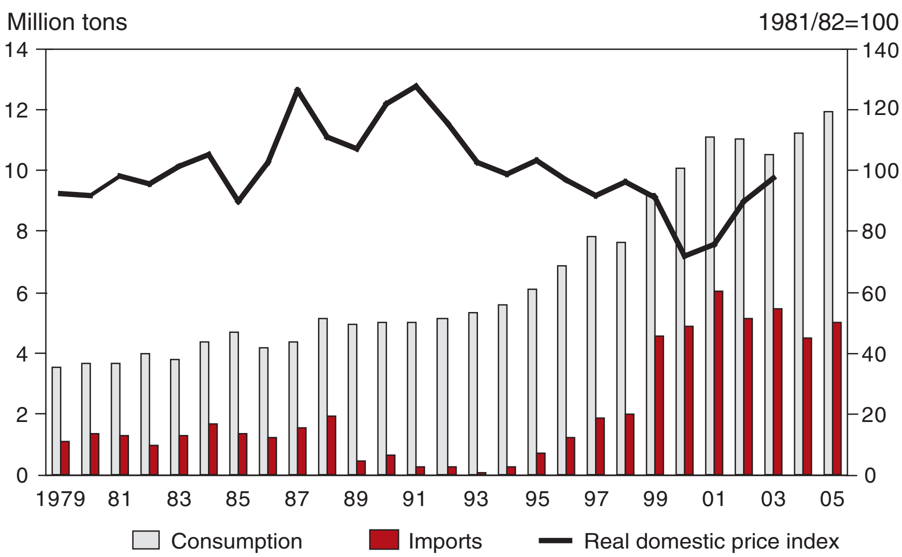
India, the world's seventh largest producer of oil crops (2001-03 average), is a major producer of soybeans, rapeseed, peanuts, cottonseed, and sunflowerseed and their derived products. India is traditionally an importer of vegetable oils and an exporter of protein meals, but a negligible trader in oilseeds. Oil imports have been on the rise as a result of strengthening consumer demand and import liberalization measures implemented in 1994. During 2001-03, India was the second largest edible oil importer in the world, behind the European Union (EU-25) and ahead of China. India is also the world's fifth largest exporter of oil meals, although exports of soybean and other meals have slowed due to rapid growth in domestic feed demand. And, despite substantial excess capacity in the domestic oilseed processing industry, imports of oilseeds remain restricted by tariff and non-tariff policies (Dohlman et al., 2003).

## Oilseed Product Demand

India has been among the fastest growing developing economies since the late 1980s, with real growth in gross domestic product (GDP) averaging more than 6 percent annually. Rising incomes and steady growth in urbanization are stimulating demand for a more diverse array of foods, including fruit, vegetables, edible oils, milk, eggs, and poultry meat. Demand for these products is now outpacing demand for traditional food staples.

India's improved growth has been accompanied by a dramatic improvement in its balance of payments—once a chronic source of weakness. Although a large current account deficit persists, increased export competitiveness associated with more liberal trade and domestic policies has improved India's capacity to import and to borrow foreign capital. The improved payments position provides more flexibility for additional import liberalization.

Figure 1
**Edible oil consumption, imports, and prices, India**



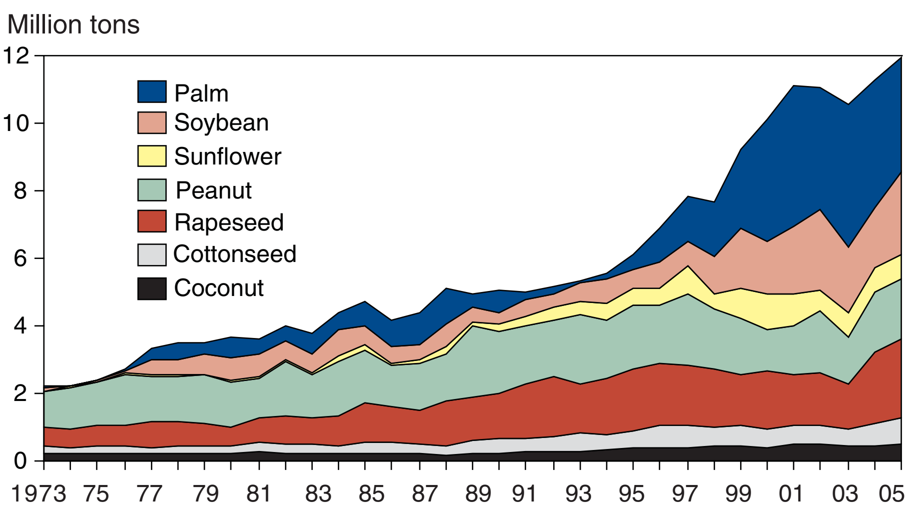

Source: USDA Production, Supply, and Distribution database; Economic Survey, Government of India.

**Oil demand**. Indian edible oil consumption is now growing at more than 6 percent annually, but per capita consumption (9.6 kg) remains below the world average of 11.1 kg. Most oil is used in food preparation, mostly in the home, but also in food shops, restaurants and, to a lesser extent, food processing firms. Driving consumption growth has been rising incomes and a more open trade regime, which has led to increased edible oil supplies and lower domestic prices (fig. 1). In 1994, India shifted from a restrictive state trading regime for oil to unrestricted imports (subject to tariffs) by private traders. Although tariffs remain high, imported oils—mostly palm and soybean oils—have accounted for most of the growth in consumption. Together, these nontraditional imported oils now account for about half of the oil consumed in India, replacing the higher priced, domestically produced oils such as peanut and rapeseed oil.

Indian consumers spend a large share of their income on food—about 55 percent compared with just 10 percent in the United States (USDA, 2005a)—and are generally highly responsive to prices. Middle- and lower income consumers, in particular, substitute items in and out of the diet based on relative prices. Despite high tariffs, prices for edible oils—led by imported palm and soybean oils—have tended to decline compared with other foods since the early 1990s, stimulating increased per capita oil consumption (fig. 2).

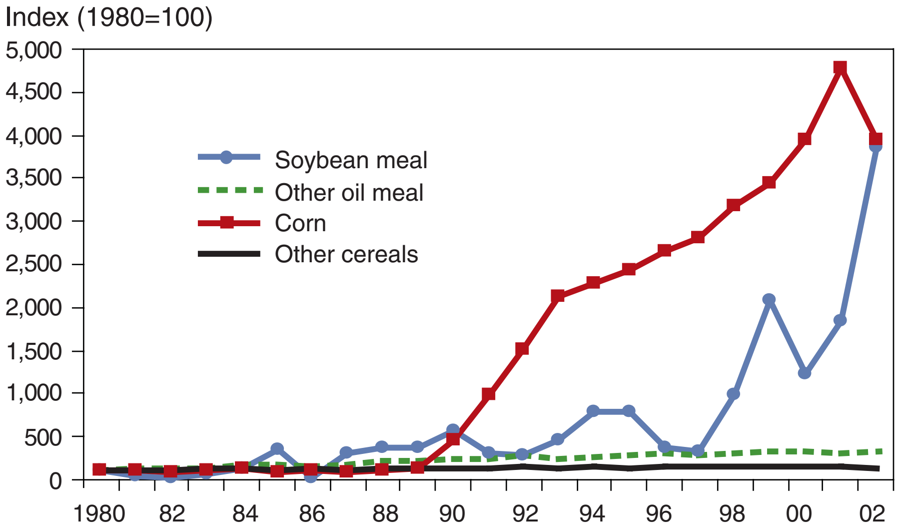
**Meal demand.** Faster income growth is also strengthening demand for animal products and the derived demand for coarse grain and oil meal for feeding. India has a large animal product sector, and both supply and demand have responded to stronger income growth. Since the early 1990s, the dairy, poultry, egg, and aquaculture sectors have registered strong expansion. The dairy sector—now the world's second largest after the EU-25—is expanding at 4 percent annually, eggs at nearly 5 percent, poultry meat at 12.5 percent, and freshwater fish production at 6.1 percent.

Figure 2
**Oil consumption in India by major type**




Source: USDA Production, Supply, and Distribution database.

Figure 3
**Growth in Indian feed demand**




Source: FAOSTAT, May 2005.

The surge in animal product production has been accompanied by accelerated growth in feed use (fig. 3). The poultry and egg sectors—which rely heavily on rations of corn and soybean meal—have been the main drivers of commercial feed demand. During 1990-2001, feed demand for corn and soybean meal grew at annual rates of 21 percent and 17 percent.

The consumer-driven emergence of India's animal products sector, and accompanying growth in demand for commercial feeds, is significant for the future development of India's oilseed and products industry. Historically, returns to oilseed processors and producers have been undermined by weak domestic demand for oilseed meals for feed purposes. Since meals account for the largest physical fraction of most oilseeds, poor market returns from meal have tended to reduce the profitability of processing and returns to growers. Meal exports have buoyed demand and prices for soybeans and soybean meal, but most other meals face weak domestic and export demand and are of poor quality, with significant shares traditionally disposed of as fertilizer.[1] The expanding domestic feed market may reduce India's exportable surpluses of meal, but also strengthen the returns to domestic oilseed production and processing and improve the quality of the meal produced.

## Oilseed and Product Trade

The role of trade in India's oilseed economy is determined primarily by trade policy (see box). India's recent large imports of edible oil have been the result of reduced border protection beginning in 1994. Oilseed imports, though no longer restricted by quantitative measures, are prevented by prohibitive tariffs and sanitary regulations. Exports of oil meals have been aided both by traditionally weak domestic feed demand and by the implicit support that the protected oil market affords to domestic oilseed processors.

**Edible oil trade policy**. From the 1970s until 1994, most edible oil imports were conducted by the Government's State Trading Corporation, with annual import quantities determined by an interministerial committee based on

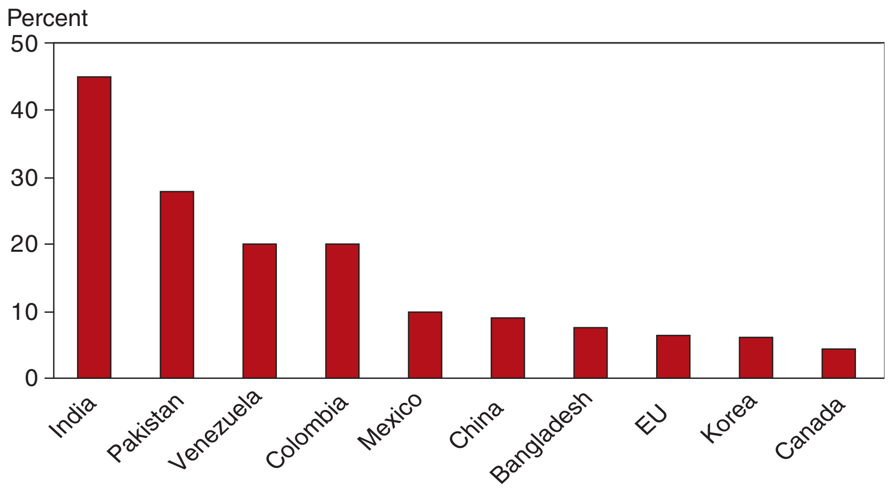
[1] Indian rapeseed varieties are high in glucosinolates (a growth inhibitor in livestock) and indigestible fiber, and low in metabolizable energy and key amino acids. They also contain erucic acid, which causes liver necrosis and thyroid enlargement. Indian peanut meal is low in quality due to aflatoxin, which results from poor postharvest handling.

## India's Oilseed and Product Tariffs

India's applied tariffs for soybeans and products—as well as other oilseeds and products—are high by global standards. For soybeans, for example, India's seed, meal, and oil tariffs are all sharply higher than for any of the world's major producing and consuming countries. The principal reason for India's high tariffs is to protect the welfare of oilseed producers, most of whom are small-scale, limited resource farmers operating under conditions of erratic rainfall.

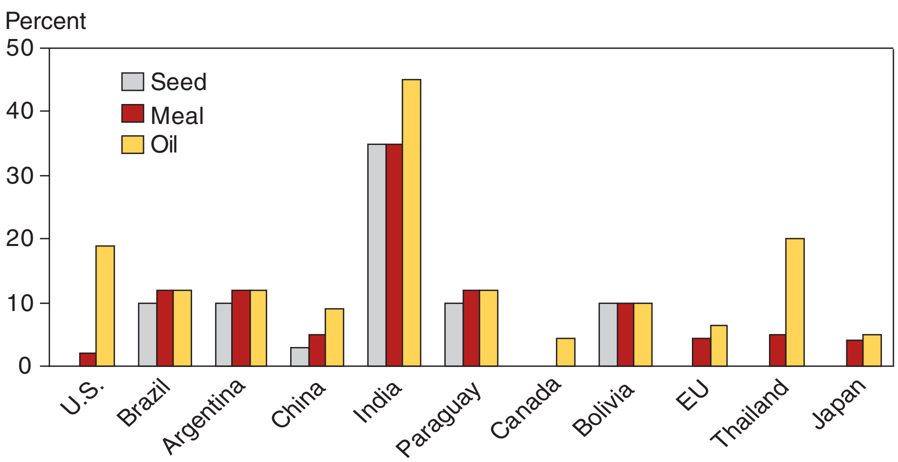
Although India's soybean and product tariffs are higher than for other major countries, it is common for soybean producing countries, including the United States, to provide tariff protection for their soybean and product sectors. For nearly all major producers, the common pattern of protection is to place higher tariffs on products than on raw materials, thus supporting higher margins for processors than without protection. As a result, tariff policies play a role not only in where soybeans are produced, but also where they are processed.

**Applied soybean oil tariffs for major importers**




Source: Agricultural Market Access Database (AMAD).

**Applied soybean and product tariffs for major producers and consumers (ranked by 2002-04 average production)**




Source: Agricultural Market Access Database (AMAD).

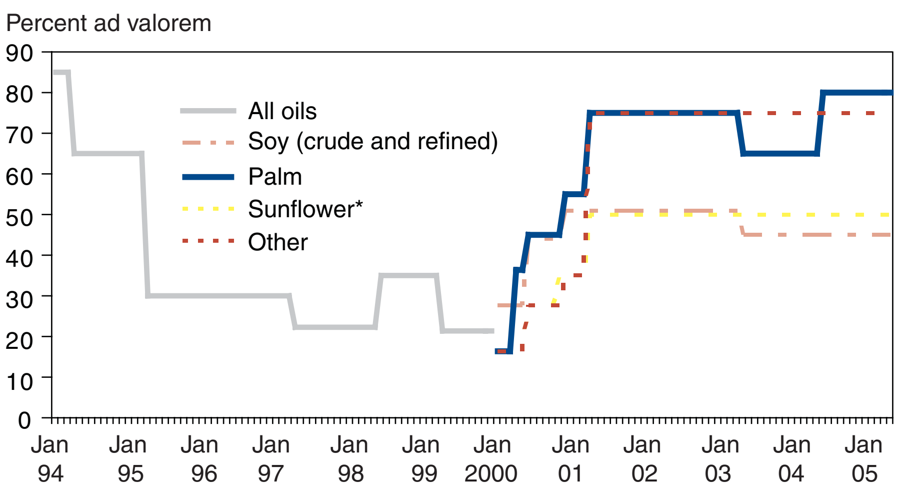
Table 1
**Bound and applied tariffs in India's oilseed sector**

| Commodity | Bound rate | Applied rate[1] |
|---|---|---|
| | *Percent, ad valorem* | |
| Oilseeds | 30 | 30 |
| Oils | | |
| Crude | | |
| Soybean | 45 | 45 |
| Palm oil | 300 | 80 |
| Peanut | 300 | 75 |
| Sunflower[2] | 300 | 50/75 |
| Rapeseed | 75 | 75 |
| Refined | | |
| Soybean | 45 | 45 |
| Palm oil | 300 | 90 |
| Peanut | 300 | 85 |
| Sunflower | 300 | 85 |
| Rapeseed[3] | 75 | 45/85 |
| Oilmeals | 100 | 30 |

[1] Applied sales as of March 2006.
[2] Applied rate of 50 percent within 150,000-ton quota; 85 percent above quota.
[3] Applied rate of 45 percent within 150,000-ton quota; 75 percent above quota.
Source: Ministry of Commerce and Industry, Government of India; USDA/Foreign Agricultural Service attache reports.

domestic supply, demand, and balance-of-payment conditions. Imports were particularly restricted during 1989-94, a period corresponding with the Technology Mission on Oilseeds, a government initiative to boost self-sufficiency in edible oils. Since 1994, when India began conforming to WTO rules and replacing quantitative trade restrictions with tariffs, oil imports have been placed under Open General License (OGL), allowing unlimited imports by private traders subject to applied tariffs (table 1).

Figure 4
**Applied crude vegetable oil tariffs in India**




*Tariffs for imports within tariff-rate quota.
Source: Ministry of Commerce and Industry, Government of India;
USDA/Foreign Agricultural Service attache reports.

Since the introduction of a tariff-based import regime in 1994, applied tariffs have evolved from initially high rates (65-85 percent) during 1994-1995 to lower (20-30 percent) tariffs during 1996-2000. They escalated again during 2001-04 (fig. 4). High WTO bound rates of 300 percent for most oils have afforded India the flexibility to adjust tariffs upward. The major exceptions are crude and refined soybean oils, which are bound at 45 percent. Crude sunflowerseed oil (50 percent) and refined rapeseed oil (45 percent) also have relatively low bound tariffs within 150,000-ton tariff-rate quotas, but only small amounts of these higher priced oils are imported.

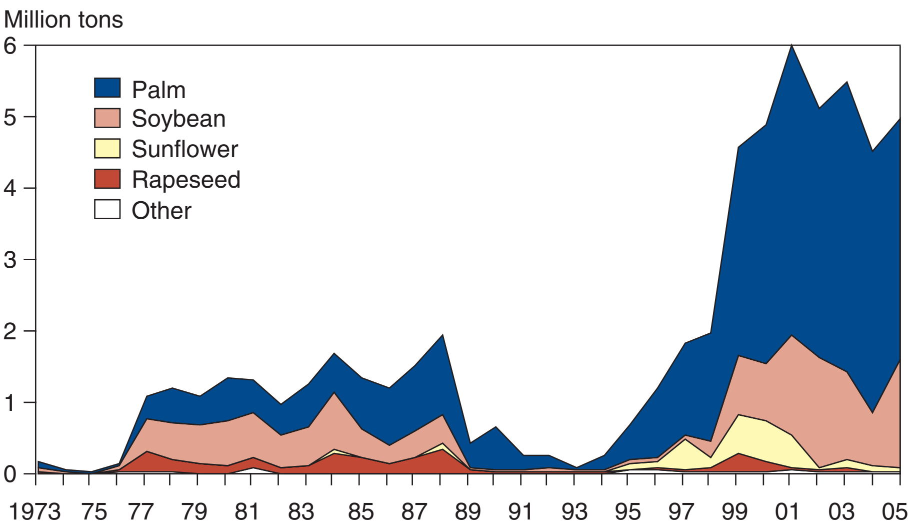
The comparatively low 45-percent bound tariff on soybean oil has tended to limit the scope for upward adjustment of applied tariffs on other oils. This has been controversial among Indian policymakers who would like to increase protection for domestic oil and oilseed producers. Large differentials between soybean and palm oil tariffs, such as the current 35 percentage points, create a market advantage for soybean oil that forces palm oil suppliers to cut prices. The scope for reducing oil imports by raising palm oil tariffs has been limited because palm oil exporters reduce prices to remain competitive with soybean oil, and because importers substitute soybean oil for palm oil.

In addition to adjusting tariffs, the Government influences the cost of imported oils through a system of "tariff rate values," or administered import prices used to calculate the tariff revenue due to the Government for each ton of imported oil. These were introduced in 2000 to prevent under-invoicing of prices by importers. The tariff values are adjusted periodically based on world prices. On occasion, however, tariff-rate values for soybean oil have been above actual market prices, resulting in an effective tariff above the 45-percent bound rate (Dohlman et al., 2003).

**Edible oil trade.** India's oil imports expanded rapidly following the removal of quantitative restrictions in 1994, rising from an average of about 200,000 tons annually in the early 1990s to 5 million tons, or about 44 per-

Figure 5

**Edible oil imports by type, India**




Source: USDA, Production, Supply, and Distribution database.

cent of domestic consumption, during 2003-05. Import growth was most rapid during 1996-2000, when tariffs were relatively low, and was slowed by higher tariffs during 2001-05 (fig. 5).

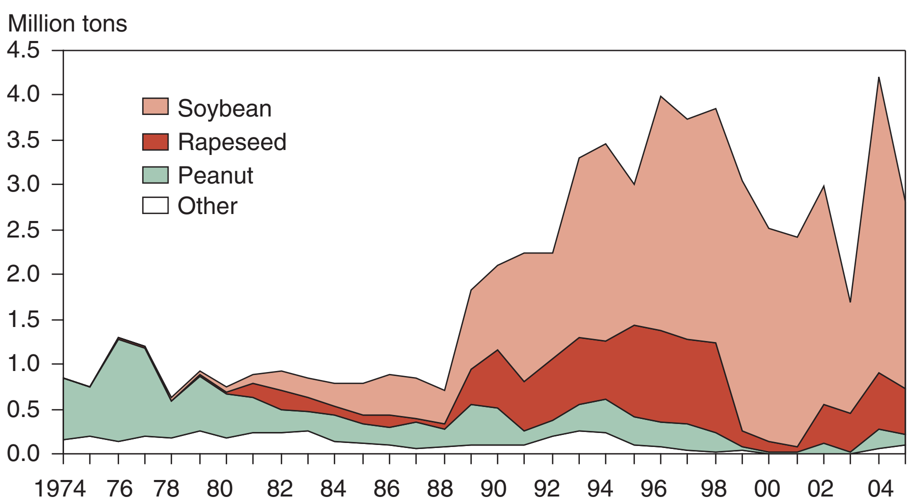
Mindful of the price sensitivity of Indian consumers, India's oil importers have been highly price sensitive in determining the composition of oils imported. Palm oil, generally the lowest priced oil, has dominated Indian imports since the mid-1990s, accounting for about 75 percent of oil imports during 2003-05. Soybean oil, generally the second cheapest oil in the market, accounted for about 23 percent of imports during 2003-05. Higher priced oils—including sunflower oil and oils traditional to the Indian diet, such as peanut and rapeseed oil—were imported in only small amounts.

Price is also a key determinant of the origin of oils purchased by Indian importers. The U.S. share of the Indian soybean oil market declined sharply when U.S. exports shifted from concessional shipments to commercial sales after the mid-1990s. The Indian soybean oil market is dominated by Argentina and Brazil, who offer consistently lower prices than U.S. suppliers (Dohlman et al., 2003; Schnepf et al., 2001).

**Meal trade.** India is the fifth largest exporter of both soybean meal and total oil meals, although its exports trail those of the major global suppliers—Argentina, Brazil, and the United States—by a wide margin. Indian soybean meal is more competitive in world markets in terms of both quality and price than other domestically produced meals (fig. 6). Because soybeans (and sunflowerseed) have been cultivated in India only since the 1970s, they are processed in relatively modern, small- and medium-scale solvent extraction facilities. Indian soybean meal is competitive in small, regional markets that favor India's bagged, as opposed to bulk, product.

The once strong growth in India's exports of soybean meal has slowed due to expanding domestic feed use and slower growth in soybean production. Rapid growth in demand from domestic poultry meat and egg producers has

Figure 6
**Oilmeal exports by major type, India**




Source: USDA, Production, Supply, and Distribution database.

increased domestic soybean meal prices relative to world prices, reducing their competitiveness in world markets and their appeal to exporters.

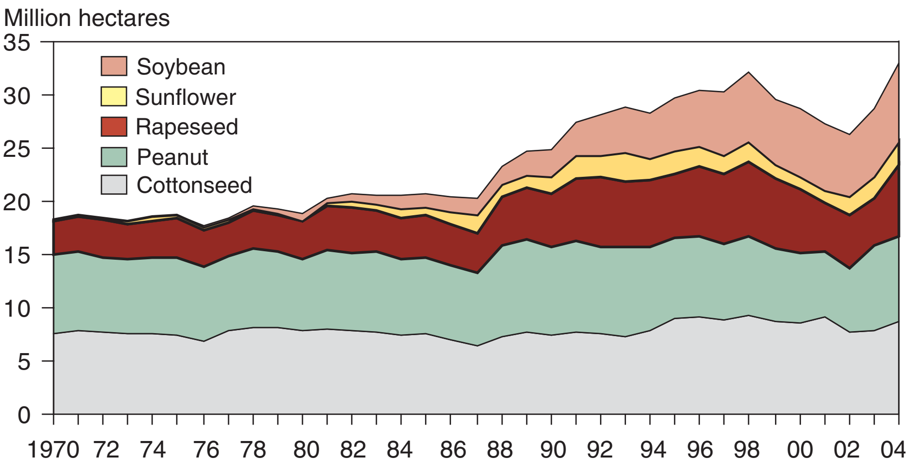
**Oilseed trade.** India is not a significant trader in oilseeds for processing. Oilseed imports are restricted by both a 30-percent tariff and by nontariff barriers. Imports of genetically modified oilseeds are not permitted unless approved by the Government's Genetic Engineering Approvals Committee (GEAC). The GEAC currently has no policy that would permit such approvals. In addition, a 2002 Plant Quarantine Order requires that shipments be certified free of certain pests or that seeds be "devitalized." At present, the only permissible means of "devitalization" is to mechanically split the seed, a process that adds considerable cost and, if done at the point of origin, would lead to unacceptable deterioration in quality during transit.

## Oilseed Production

India produces a broad range of oilseeds, ranking among the world's largest producers of peanut, rapeseed, soybean, cottonseed, and a number of minor oilseeds. Oilseed yields, however, remain well below world averages, with limited success in sustaining productivity growth. Government policy gives priority to protecting oilseed producers by placing quantitative restrictions or high tariffs on imports of oilseeds and products.

**Trends in oilseed area and yields.** Area planted to oilseeds has generally responded to changes in domestic prices associated with changes in trade policy, and in price policy for competing crops. Growth in oilseed area accelerated—and grew faster than the world average—during the 1980s, when stricter controls on imports of oilseeds and products strengthened oilseed prices relative to competing crops (table 2, fig. 7). However, during 1990-2002—a period that includes the liberalization of oil imports—domestic prices of oilseeds and oils declined relative to other crops and oilseed area growth slowed significantly. Higher Government minimum support prices (MSPs) for wheat and rice, important competing crops for oilseeds in some regions, also slowed the growth in oilseed area during the late 1990s.

Figure 7
**Harvested area of major oilseeds in India**




Source: FAOSTAT, May 2005.

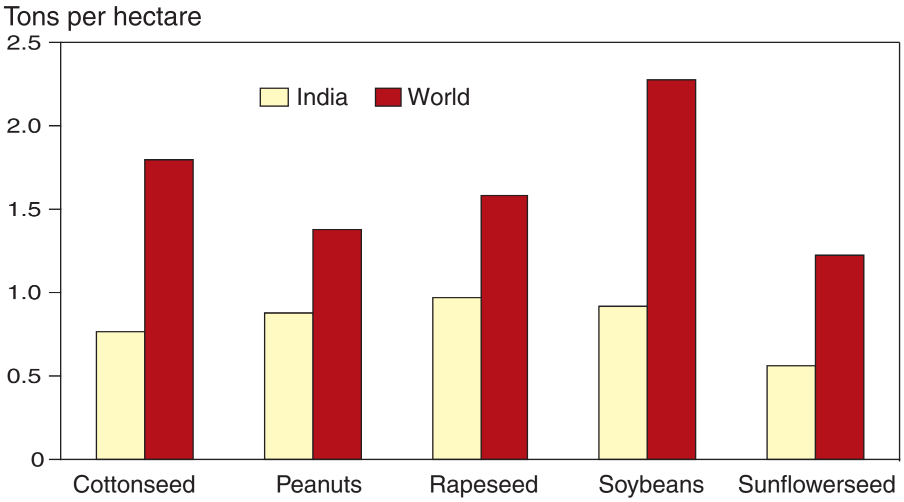
Table 2
**Growth rates of oilseed area, yield, and production, India and world average**

| Oilseed | Area 1970-80 | Area 1980-90 | Area 1990-02 | Yield 1970-80 | Yield 1980-90 | Yield 1990-02 | Production 1970-80 | Production 1980-90 | Production 1990-02 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | *Percent change* | | | | | |
| India | | | | | | | | | |
| Cottonseed | 0.4 | -0.5 | 0.5 | 1.6 | 3.4 | 0.8 | 1.9 | 2.9 | 1.3 |
| Peanuts | -0.3 | 1.8 | -1.2 | 0.6 | 0.5 | -0.1 | 0.3 | 2.4 | -1.1 |
| Rapeseed | 1.7 | 3.4 | 0.3 | -0.4 | 5.8 | 0.7 | 1.4 | 9.4 | 1.1 |
| Soybeans | 32.3 | 17.6 | 7.2 | 4.5 | 2.5 | 0.5 | 38.3 | 20.4 | 7.8 |
| Sunflowerseed | 7.1 | 26.7 | 1.1 | -1.7 | -0.1 | 0.3 | 5.4 | 26.5 | 1.4 |
| Five oilseeds | 0.7 | 2.8 | 1.0 | 0.6 | 2.5 | 0.5 | 1.3 | 5.3 | 1.6 |
| World | | | | | | | | | |
| Cottonseed | 0.0 | -0.3 | -0.2 | 1.9 | 2.8 | 0.7 | 1.9 | 2.5 | 0.5 |
| Peanuts | -0.4 | 0.8 | 1.7 | 0.8 | 1.6 | 1.3 | 0.4 | 2.4 | 3.1 |
| Rapeseed | 3.7 | 4.6 | 2.1 | 1.8 | 3.5 | 1.2 | 5.4 | 8.3 | 3.3 |
| Soybeans | 5.6 | 1.2 | 3.1 | 1.4 | 0.9 | 1.5 | 7.0 | 2.1 | 4.7 |
| Sunflowerseed | 3.7 | 2.9 | 2.1 | 0.0 | 1.5 | -0.8 | 3.7 | 4.5 | 1.2 |
| Five oilseeds | 2.5 | 1.3 | 2.0 | 1.8 | 1.6 | 1.2 | 4.3 | 3.0 | 3.2 |

Source: Computed from FAOSTAT data.

India's average yields for major oilseeds are 40-60 percent below world averages and, with the exception of the 1980s, have been growing at a substantially lower rate (fig. 8). Most oilseeds are grown by small-scale, limited-resource farmers in areas that are dependent on erratic monsoon rainfall, with only about 24 percent of oilseed area irrigated. Faced with considerable weather-related risk, oilseed producers invest little in improved seeds, fertilizer, and pesticides. Oilseed farmers also face considerable price risk because the minimum support prices set for oilseeds are typically either too low to influence market prices or are not adequately defended by Government purchases. Government initiatives to extend credit and technology to oilseed producers, including the 1988-94 Technology Mission on Oilseeds, have had very fleeting impact.

Figure 8
**Oilseed yields, Indian and world average, 2002-04**




Source: FAOSTAT, May 2005.

Soybeans and rapeseed are the two oilseeds that may have the most potential for improvements in area, yield, and production. Soybean area continues to expand outside the traditional area of Madhya Pradesh into the neighboring areas of Rajasthan and Maharashtra, where it competes for land with other dryland crops, including sorghum, millet, and pulses. Returns to soybean cultivation are helped by strong demand for soybean meal and by excess capacity in solvent extraction, which creates some competition for supplies of raw material.

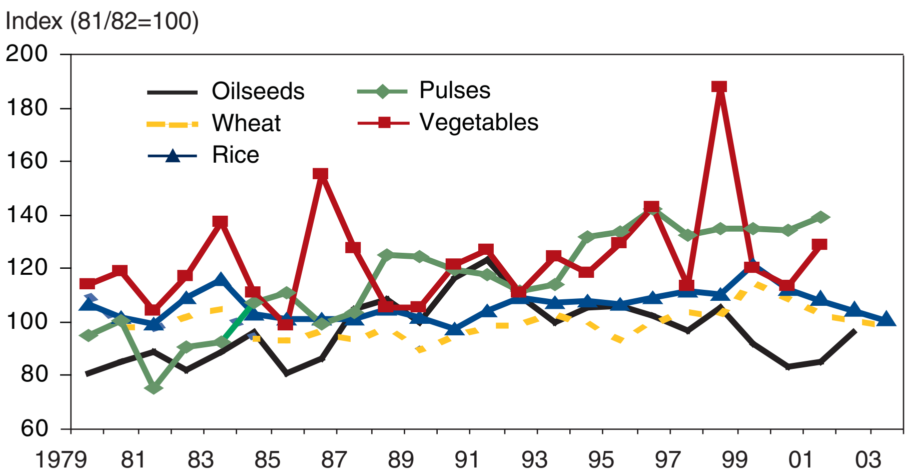
Rapeseed, grown in the winter often in competition with wheat, is the most heavily irrigated of all the oilseeds, with about 63 percent of area irrigated. Rapeseed area and yield increased during the 1980s and early 1990s when high prices boosted plantings on irrigated land. Rapeseed production was slowed by large hikes in wheat MSPs during the late 1990s, but higher oil tariffs and lower relative wheat prices could now stimulate another expansion of output.

**Producer price policy**. The MSP system has had little impact on oilseed prices, which are formed primarily by trade policy and domestic and world market prices for oilseeds and products. With India's large-scale imports, domestic prices for edible oils are linked closely to tariff-adjusted world prices, although domestic supplies affect prices during the harvest period. Similarly, domestic prices of traded oil meals are linked to world prices and domestic seasonal factors, although some meals are often priced below world levels. With oilseed imports restricted by tariff and nontariff barriers, domestic oilseed prices are shaped largely by the prices of their derivative products, their respective oil and meal extraction rates, and processing costs.

Historical trends in prices for oilseeds reflect the impact of trade policy (fig. 9). Oilseed prices tended to rise relative to other crops through the early 1990s when vegetable oil imports were restricted, then decline following the liberalization of oil imports. Oilseed prices have turned up in the early 2000s, reflecting oil tariff hikes during 2000-2002 and, possibly, the impact of higher oilseed MSPs.

Figure 9

**Trends in real wholesale prices for selected crops, India**




Source: Government of India, Ministry of Finance.

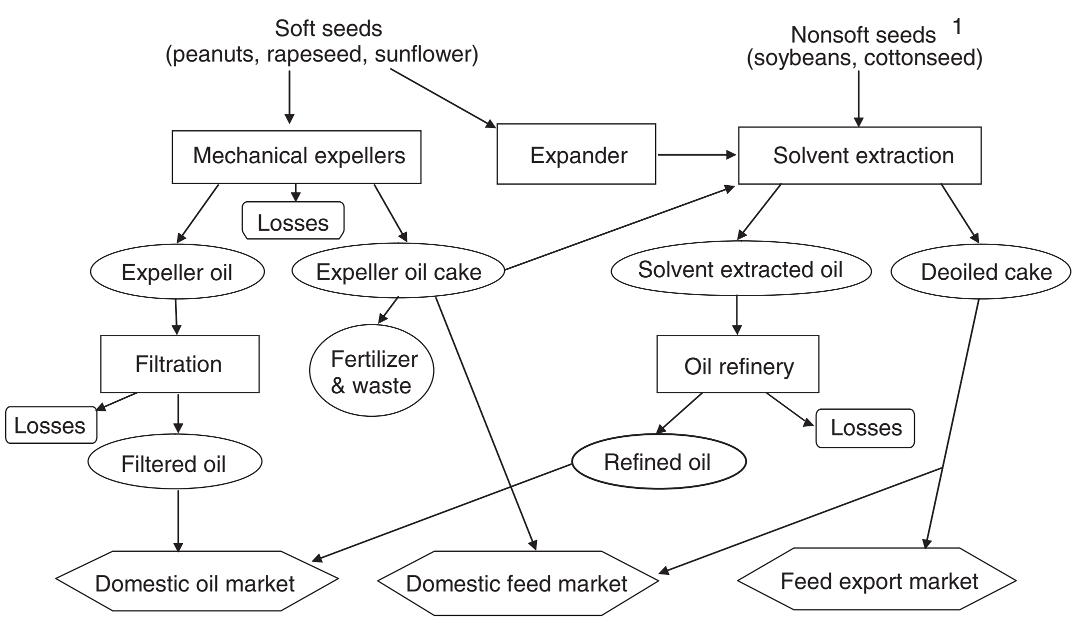
Although oil and oilseed tariffs emerged as primary policy instruments during the 1990s, it is unclear how effectively-and how efficiently-higher tariffs can achieve the avowed policy objectives of supporting small oilseed producers and reducing dependency on oil imports. Because oil accounts for the smallest physical fraction of the oilseed—ranging from 18 percent for soybeans to 40 percent for sunflower—the impact of oil tariffs on the oilseed price is also proportionally small. Benefits to producers are further reduced if processors and traders fail to transmit the full impact of the oil tariff into the oilseed price. Another constraint is that high oil tariffs place most of the proportionally large cost burden of supporting oilseed producers on India's mostly low-income consumers.

## Oilseed Processing

The Indian oilseed processing sector is characterized by a large number of relatively small-scale, low-technology plants and substantial excess capacity. The structure of the industry has been heavily influenced by Government policies that have: regulated plant scale, capital intensity, and oilseed/product marketing; provided incentives for building new capacity; and prevented imports of oilseeds for processing. Also shaping the industry has been a domestic demand preference for crude traditional oils, weak effective demand for quality feed protein, and diverse and erratic supplies of domestic oilseeds for processing.

**Processing sector structure, capacity, and costs**. The Indian oilseed processing industry includes three major processing technologies: (1) traditional mechanical crushing, or expelling, used for oilseeds with relatively high oil content; (2) solvent extraction for processing oilseeds and expeller cake

Figure 10
**India's oilseed processing sector**




[1] Solvent extraction is used for raw materials, such as soybeans,cottonseed, and expeller oilcake with less than 20 percent oil content.

Table 3
**India: Structure of the oilseed processing sector**

| Process | Units | Capacity[1] Total | Average | Use rate |
|---|---|---|---|---|
| | *Number* | *Million tons* | *Tons/day* | *Percent* |
| Mechanical crushing: | | | | |
| "Ghanis" | 130,000 | 2.0 | 0.05 | 10 |
| Expellers | 20,000 | 40.5 | 7 | 30-40 |
| Solvent extraction[2] | 766 | 36.0 | 157 | 30-40 |
| Vanaspati | 241 | 4.8 | 66 | 35 |
| Oil refining | 800 | 4.7 | 20 | 35 |

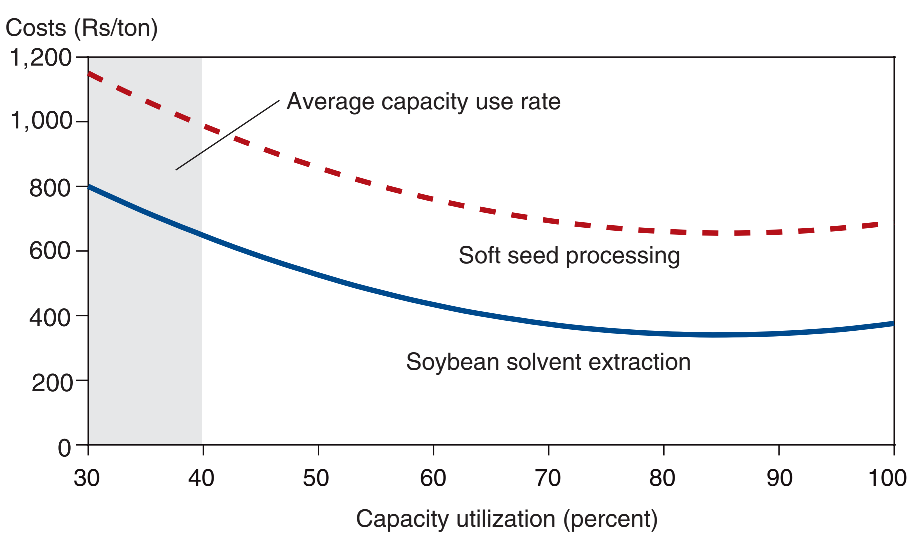
[1] Capacity and use based on raw material; 300 days/year, 24 hours/day basis.
[2] Includes expander units.
Source: Solvent Extractors' Association of India.

3). The traditional mechanical crushing industry has two segments: the very small-scale "ghanis" and the small-scale expellers. The processing industry also includes an oil refining sector, which primarily refines domestic solvent-extracted oils and imported crude and solvent-extracted oils, and a "vanaspati" (hydrogenated oil) sector that refines and hydrogenates domestic and imported oils.

Each segment of India's oilseed processing industry has small capacities and low technical efficiency compared with other major processing countries. On average, India's solvent extraction plants are about one-sixth the size of those in the United States and the EU and use significantly more power, steam, and hexane solvent per unit of oilseeds processed. Even India's largest integrated expeller-solvent extraction plants are small and high-cost by international standards.

Indian processing units also have more excess capacity than units in other major processing countries. On average, Indian expeller and solvent extraction plants operate only around the domestic raw material harvest, or at

Figure 11
**Average cost curves for oilseed processing in India**




Source: ERS estimates.

tion plants operate only around the domestic raw material harvest, or at about 30-40 percent of capacity. This contrasts with capacity utilization rates of 92-96 percent for U.S. plants (Reca, 2003). Low rates of capacity use compound relatively poor technical efficiency and further increase the average and marginal costs of processing raw materials, because fixed costs must be recouped over fewer units of output (fig. 11).

Additional inefficiency arises because some processes are not well integrated. While it is common to see an oil refinery and/or vanaspati unit combined with a solvent extraction plant, expeller units are often not integrated with solvent extraction units. As a result, oil and meal production is lost because significant amounts of expeller cake are not solvent-extracted. In addition, the costs of solvent-extracting the expeller cake rise, and processing delays reduce the quality of the oil and de-oiled cake.

India's oilseed processors are able to operate profitably despite their high costs largely because of the high border protection afforded to vegetable oils. In addition, because the price of oilseeds is determined by the cost of processing—together with the market value of the derived oil and meal—high processing costs dampen oilseed prices, partially offsetting benefits to producers from India's tariffs on oilseeds and oils.

In the short run—with existing processing capacity and low capacity use—India's processors operate their plants at a level where average costs are high. They can reduce unit processing costs by increasing capacity use. In the long run, costs can drop further if larger, more technically efficient plants are built and can operate at high levels of capacity use. Lower processing costs would create a stream of benefits to processors that could be shared with producers (in the form of higher oilseed prices) and consumers (in the form of lower oil prices).

**Processing sector policies.** The fragmentation, low technical efficiency, and excess capacity of India's oilseed processing industry are largely the result of government regulatory and trade policies:

- *Plant scale restrictions*. Under the Small Scale Industry (SSI) reservation policy, expelling of peanut, rapeseed, sesame, and safflower oils is restricted to units with investment of Rs 0.5-7.5 million ($10,000-$170,000), effectively restricting capacities to units small by international standards. In addition, firms that manufacture oilseed crushing equipment are subject to the same scale limits, restricting use of more modern technology. These restrictions do not apply to the processing of soybeans or sunflowerseed, or to the manufacture of solvent extraction equipment, so these commodities are processed in relatively large units.

- *Movement and storage restrictions*. The central and state Governments have the authority, through the Essential Commodities Act (ECA) and an array of control orders, to regulate and restrict movement and storage of farm commodities, including oilseeds and products. These regulations are now seldom enforced, but remain a source of risk that reduces incentives to invest in larger or vertically integrated units.

- *Selective credit controls*. Oilseed processors face restrictions on the availability and cost of credit from commercial banks for storage of oilseeds and oils. The regulations raise the cost of credit and further limit the size and capacity use of processing firms.

- *Restrictions on oilseed imports*. Tariff and nontariff barriers to oilseed imports limit average capacity use in the processing industry to what can be achieved from low and variable domestic production. This raises average processing costs.

- *Taxes and tax incentives*. Oilseeds and products are subject to taxes at the point of sale and—if transported across state borders—to turnover, entry, and central sales taxes. These taxes raise the cost of operating larger enterprises that assemble raw materials or transport products across state borders. Central, state, and local governments also provide tax exemptions and other tax incentives to promote construction of new processing plants, particularly in backward areas. This contributes to excess processing capacity and to the location of plants where they are not economically viable or sustainable (World Bank, 1997).

- *Futures trading restrictions*. From the 1960s until very recently, futures trading in nearly all oilseeds and products was illegal and oilseed processors were unable to legally use futures contracts to manage price risk. The recent legalization of futures trading may eventually provide an effective risk management tool but, at present, traded volumes remain small.

**Industry consolidation.** The last several years have witnessed a trend toward consolidation of ownership of oilseed processing units by larger domestic and multinational companies. The trend appears to be driven partly by short-term factors, particularly financial distress in the industry following several poor harvests. But these larger players are also responding to the potential for cutting costs and increasing profitability, as well as the appeal of participating in a large and expanding market.

Key to larger players' efficiency advantage is the cost of investment and operating capital. Multinational and large domestic firms typically have access to capital near the London Inter-Bank Offer Rate (LIBOR), which has averaged between 1 and 4 percent over the last 3 years. In contrast, domestic firms must borrow commercially at rates ranging from 14-16 percent for smaller firms to 8-10 percent for larger ones. As a result, the consolidating companies will be better able to acquire and store raw material and boost capacity use rates. Consolidating firms are also likely to achieve cost savings by establishing backward (to primary markets or farmers) and forward (to wholesaling and retailing) links. They may also have the advantage of investing in larger, more efficient solvent extraction plants.

Consolidating firms face risks from enforcement of movement or storage restrictions under the ECA, as well as higher costs from taxes on interstate movements. So far, these factors have not been significant deterrents to consolidation. It is not yet clear how significant the consolidation trend will become, but it could lead to closure of some surplus capacity as smaller firms with high operating costs and low capacity use find it difficult to compete.

# Implications of Policy and Structural Change

Future trends in India's production, consumption, and trade in oilseeds and oilseed products are likely to be shaped by changes in domestic and border policies. Current policies appear not to be achieving stated policy goals of benefiting small farmers and reducing import dependence. They are, however, imposing large costs on consumers and creating an inefficient processing sector. Eventually, pressures to improve the performance of the sector, combined with rising demand for animal products and feed protein, are likely to lead to policy reform in the oilseed sector.

Potential changes in domestic and border policies would have differing effects on India's supply, demand, and trade of major oilseeds and products. To help assess how Indian policymakers might view the alternative policy options, we use an economic model of India's oilseed sector that incorporates supply, demand, trade, and processing behavior for major Indian oilseeds and products (see appendix 1 for details). We first generate a 10-year projection, or reference scenario, for India's oilseeds sector beginning in 2001 and ending in 2011. The reference scenario is based on existing policies and assumed changes in key exogenous variables, including income growth, exchange rates, and world prices. Alternative scenarios are then evaluated relative to the reference scenario.

We examine five alternative scenarios:

• Changes in oil tariffs.

• Changes in oilseed price supports.

• Oilseed import liberalization.

• Consolidation in oilseed processing.

• Two composite scenarios, favoring producers and consumers alternately.

## Reference Scenario

The reference scenario provides projections for India's oilseeds sector through 2011 based on data available and policies in place as of June 2005. Assumptions for all other variables exogenous to the model (table 4) are consistent with the most recent USDA baseline projections (USDA, 2005c).[2]

In the reference scenario, supply, demand, and price variables track actual historical developments through 2004, and are determined by model assumptions and results for 2005 through 2011. Real world prices of oilseeds and meals rise during 2001-04, decline during 2005-06, and remain roughly constant thereafter (fig. 12). World oil prices follow a slightly different path, peaking in 2003 and declining during 2004-06 before leveling off. Domestic prices of oils and meals follow world prices, adjusted for tariffs and estimated transport and marketing costs. Although Indian oilseeds are not traded, domestic oilseed prices track world prices because they are determined primarily by the prices of their derived products—oil and

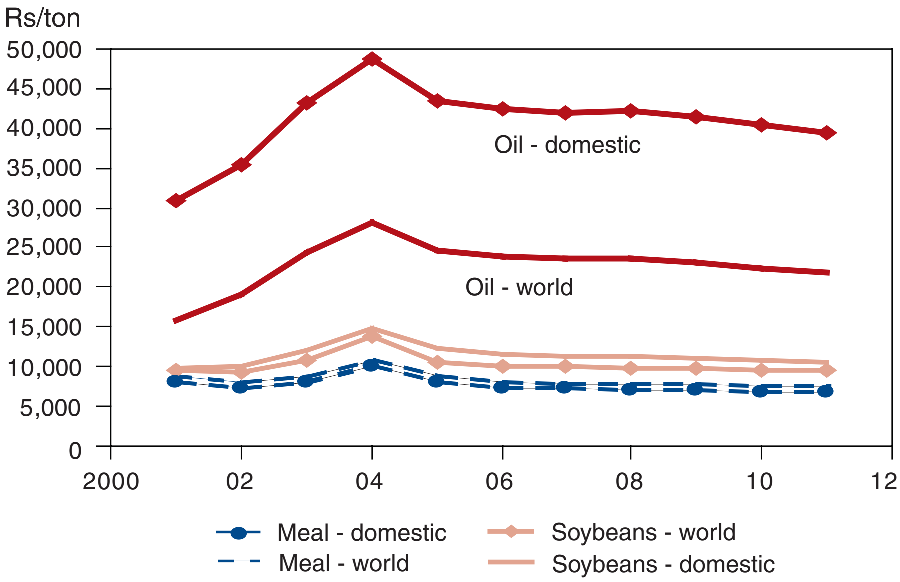
[2] Although reference scenario assumptions are consistent with current USDA baseline projections, the reference scenario projections differ in some respects from the USDA baseline because of the availability of more recent data and differences in model base periods, specifications, and elasticities.

Table 4
**Summary of reference scenario assumptions**

| Variable | 1991-2001 | Assumption 2001-05 | 2005-11 |
|---|---|---|---|
| | *Annual percent change* | | |
| Income/capita, real | 4.0 | 5.8 | 4.6 |
| Exchange rate, real[1] | 2.5 | 0.4 | 1.5 |
| Yield trends:[2] | | | |
| Soybeans | 0.5 | 1.2 | 1.2 |
| Peanuts | -1.3 | 1.0 | 1.0 |
| Rapeseed | -0.5 | 1.0 | 1.0 |
| Sunflower | 0.6 | 1.5 | 1.5 |
| World prices, real: | | | |
| Soybeans | -3.7 | 14.5 | -8.0 |
| Soybean meal | -3.1 | -2.3 | 0.1 |
| Soybean oil | -3.8 | 7.0 | -3.4 |
| Tariffs: | | | |
| Oilseeds | NA | 30 | 30 |
| Oil meals | NA | 30 | 30 |
| Oils, crude: | | | |
| Soybean | NA | 45 | 45 |
| Palm | NA | 80 | 80 |
| Rapeseed | NA | 75 | 75 |
| Sunflower | NA | 50 | 50 |

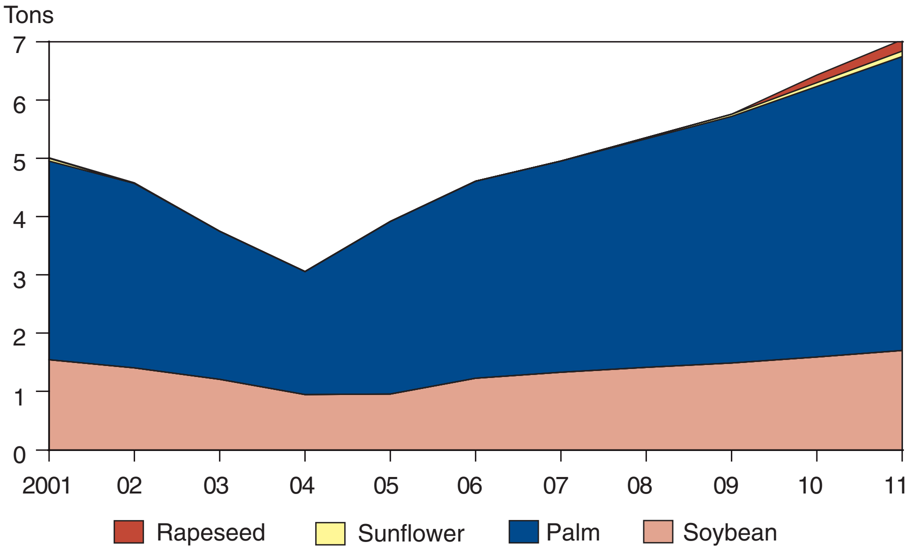
NA = Not available.
[1] Positive numbers indicate real depreciation against the U.S. dollar.
[2] Assumptions are for technical yield trends. Model yields also respond to oilseed prices.

Figure 12
**Reference scenario price trends for soybeans and products, India**




Source: ERS, India oilseed sector model.

Figure 13
**Reference scenario trends in vegetable oil imports, India**




Source: ERS, India oilseed sector model.

meal—which are traded. The exception is the peanut market. Since Indian peanuts and peanut oil are usually not traded in significant volumes, their prices are determined by domestic supply and demand conditions rather than world prices.

Supply and demand projections in the reference scenario broadly reflect underlying price movements (table 5). Higher world prices, coupled with higher Indian oil tariffs, boost domestic oilseed prices and output during 2001-05, before leveling off during 2006-11. Consistent with the recent pattern, soybean and rapeseed continue to show the strongest production growth, while peanuts grow the slowest.

Both imports and consumption of total oils initially decline in the reference scenario, reflecting the drought-induced decline in domestic supplies in 2002/03, as well as higher world prices and oil tariffs (fig. 13). Oil consumption and imports resume growth after 2003, the result of steady growth in domestic supplies, lower world and domestic prices, and the assumption of constant oil tariffs. As has been the case since the early 1990s, palm and soybean oils account for most of the projected growth in oil imports and consumption. Rapeseed and sunflower oil consumption also exhibit stronger growth, reflecting gains in domestic supplies and—given projected world prices—rising imports. Peanut oil, which again is not imported based on projected world prices, continues to show the highest domestic price and slowest consumption growth of the major oils.

In the reference scenario, demand for oil meal continues to be led by growth in soybean meal for feed, which expands about 8 percent annually, consistent with recent trends. Other meals grow more slowly, reflecting the weaker preference for these meals by the poultry and egg industries. Growth in soybean meal demand continues to outstrip production, leading to a steady decline in exports of soybean meal and total meal.

Table 5
**Summary of reference scenario results**

| Variable | 1990-92 average | 2001 base | 2011 | Growth rates 1991-01 | Growth rates 2001-11 |
|---|---|---|---|---|---|
| | *----------------Million tons--------------------* | | | *---------Percent---------* | |
| **Oilseeds**: | | | | | |
| Area (Mil. ha) | 19.7 | 21.9 | 24.6 | 1.0 | 1.2 |
| Soybean | 3.1 | 6.0 | 6.5 | 6.7 | 0.8 |
| Yield (Kgs/ha.) | 0.86 | 0.9 | 1.0 | 0.2 | 1.4 |
| Soybean | 0.88 | 0.9 | 1.1 | 0.2 | 2.3 |
| Production | 17.0 | 19.0 | 24.4 | 1.1 | 2.6 |
| Soybean | 2.7 | 5.4 | 7.4 | 7.0 | 3.2 |
| Crush | 14.6 | 15.7 | 20.3 | 0.7 | 2.6 |
| Soybean | 2.5 | 4.6 | 6.2 | 6.5 | 3.0 |
| Imports | 0 | 0.0 | 0.0 | -- | -- |
| Soybean | 0 | 0.0 | 0.0 | -- | -- |
| Domestic price (Rs/ton) | NA | 12,239 | 15,569 | NA | 2.4 |
| Soybean | NA | 9,545 | 10,266 | NA | 0.7 |
| **Oils**: | | | | | |
| Production | 4.2 | 4.8 | 6.2 | 1.4 | 2.6 |
| Soybean | 0.4 | 0.9 | 1.1 | 6.8 | 3.0 |
| Consumption | 4.4 | 9.8 | 13.3 | 8.3 | 3.0 |
| Soybean | 0.5 | 2.4 | 2.9 | 17.6 | 1.7 |
| Imports | .20 | 5.0 | 7.0 | 38.3 | 3.5 |
| Soybean | 0.0 | 1.5 | 1.7 | 43.3 | 1.0 |
| Domestic price (Rs/ton) | NA | 32,453 | 41,671 | NA | 2.5 |
| Soybean | NA | 30,818 | 39,450 | NA | 2.5 |
| **Meals:** | | | | | |
| Production | 8.3 | 8.9 | 11.6 | 0.7 | 2.7 |
| Soybean | 2.0 | 3.7 | 5.0 | 6.5 | 3.0 |
| Consumption | 5.7 | 6.0 | 8.6 | 0.5 | 3.6 |
| Soybean | 0.4 | 1.3 | 2.8 | 11.0 | 8.3 |
| Exports | 2.6 | 2.9 | 3.0 | 1.1 | 0.3 |
| Soybean | 1.5 | 2.4 | 2.2 | 4.8 | -1.1 |
| Domestic price (Rs/ton) | NA | 7,136 | 5,997 | NA | -1.7 |
| Soybean | NA | 8,118 | 6,856 | NA | -1.7 |
| **Processing:** | | | | | |
| Capacity (Mil. tons) | NA | 52.3 | 52.3 | NA | 0.0 |
| Capacity use (percent) | NA | 30.0 | 39.1 | NA | 2.7 |
| Soybean | NA | 30.0 | 40.3 | NA | 3.0 |
| Avg. cost (Rs/ton) | NA | 1,017 | 887 | NA | -1.4 |
| Soybean | NA | 800 | 665 | NA | -1.8 |
| Quasi-profit (Rs/ton) | NA | 1,466 | 1,571 | NA | 7.2 |
| Soybean | NA | 1,457 | 1,457 | NA | 0.0 |
| Quasi-profit (Rs mil.) | NA | 22,994 | 31,840 | NA | 3.3 |
| Soybean | NA | 6,744 | 9,067 | NA | 3.0 |
| Net imports (Rs bil.) | NA | -53.6 | -119.1 | NA | 8.3 |

NA = Not available.
-- = Cannot be calculated.
Source: ERS-India oilseed sector model.

The reference scenario assumes that processing capacity remains fixed at current levels, and that real prices for processing inputs, other than raw material, remain constant.[3] With these assumptions, rising oilseed production leads to modest gains in capacity use in the processing industry, but rates remain low and unit processing costs high by world standards. Increased capacity use generates modest declines in unit processing costs, but processor "quasi-profits"[4] per unit of production remain constant in real terms because the benefits of cost reductions are passed on to oilseed producers in the form of higher oilseed prices.[5] Domestic oilseed producer prices, which are linked to changes in world oil and meal prices, tariffs, and processing costs, are thus able to grow somewhat faster than world prices. Although processors do not realize higher quasi-profits per unit, they benefit from higher total profits because of increased volumes processed and marketed. Total processor profits expand more than 3 percent annually.

## Impacts of Changes in Oil Tariffs

To evaluate the impacts of oil tariffs, we analyze the impacts of increasing them by 10 percentage points. Because India's current soybean oil tariff (45 percent) and in-quota tariffs on crude sunflower oil (50 percent) and refined rapeseed oil (45 percent) are already set at their bound maximums, actual increases in these tariffs would be violations of WTO disciplines. Increases in these tariffs are analyzed only to demonstrate the impacts relative to other policies. Actual hikes in these bound rates would entail negotiated compensation to trading partners involving costs not accounted for in this analysis. All other assumptions remain as they are in the reference scenario.[6]

The increase of 10 percentage points in oil tariffs leads to smaller percentage increases in average domestic wholesale prices of oil (4.5 percent) and farm prices of oilseeds (2.9 percent) (table 6). World and domestic meal prices are unchanged. Oilseed production and crush increase, but the gains are small—averaging about 2.0 percent—relative to the increase in oil tariffs. Higher prices reduce oil consumption. Oil imports fall due to larger domestic supplies and reduced consumption, while larger supplies allow meal exports to rise. Impacts for peanuts are small compared with other oilseeds because of weak price response among peanut producers, and because prices for peanut oil are linked to domestic supply and demand rather than world prices. Even with the benefit of lower unit processing costs (resulting from higher capacity use) passed on to oilseed producers, the quasi-profits of oilseed processors increase relative to the reference scenario, mostly because larger quantities are processed and marketed.

The impacts of a 10-percent decrease in oil tariffs would be symmetrical with the tariff increase scenario (see appendix 4 for complete results). With lower oil tariffs, lower domestic oil and oilseed prices would result in much smaller percentage declines in oilseed production and crush, and in lower meal exports. Processor quasi-profits would shrink due to higher unit costs associated with lower capacity use, as well as smaller quantities processed and marketed, but would remain substantially positive. Consumers, by contrast, would receive significant benefits as the average domestic price of oil would fall 4.5 percent, consumption would rise 2.5 percent, and imports would rise 6.7 percent over the reference scenario.

[3] Recent data suggest that solvent extraction capacity may be declining, in part because recent poor harvests led to closure of some units. Constant crush capacity is assumed in the reference scenario, with the effects of reduced processing capacity analyzed in the consolidation scenario.

[4] Quasi-profits, as used here, account for the major costs and revenues associated with processing, including the cost of raw materials, labor, interest, power, steam, and hexane, and revenues from sale of oil and meal. Excluded items include such costs as bags and brokerage for de-oiled cake, local and central taxes, and revenues from the sale of processing wastes such as sunflowerseed hulls and peanut pods.

[5] The extent to which changes in crush costs are transmitted to producer prices of oilseeds and consumer prices of products is determined in the model by (1) the price responsiveness of oilseed supply (own- and cross-price elasticities) and (2) the oilseed trade regime in the scenario being analyzed. When oilseeds cannot be imported, the impact of gains in processing efficiency tends to be bid into the price of oilseeds, which are in relatively fixed (inelastic) supply. When oilseeds can be imported, domestic oilseed prices are determined primarily by world market prices, and domestic crush costs have little bearing on domestic prices.

[6] World reference prices for oilseeds and products are maintained at reference scenario levels (consistent with 2005 USDA baseline projections) in all scenarios analyzed. Although India is a large trader in global oil and meal markets, the changes in trade in the scenarios analyzed are small compared with the volume of global trade and unlikely to have significant long-term impacts on world prices. The oilseed import liberalization scenario alters the composition of India's oilseed and

Table 6

**Scenario results: 10-percentage-point increase in oil tariffs**

| Variable | 2011 result | Scenario/reference |
|---|---|---|
| | *Million tons* | *Percent change* |
| **Oilseeds**: | | |
| Production | 24.9 | 2.0 |
| Soybean | 7.6 | 2.8 |
| Crush | 20.7 | 2.2 |
| Soybean | 6.4 | 3.0 |
| Imports | 0.0 | [1] |
| Soybean | 0.0 | [1] |
| Domestic price (Rs/ton) | 16,022 | 2.9 |
| Soybean | 10,682 | 4.1 |
| **Oils**: | | |
| Production | 6.4 | 2.2 |
| Soybean | 1.2 | 3.0 |
| Consumption | 12.9 | -2.5 |
| Soybean | 2.8 | -2.1 |
| Imports | 6.6 | -6.7 |
| Soybean | 1.6 | -5.6 |
| Domestic price (Rs/ton) | 43,556 | 4.5 |
| Soybean | 41,626 | 5.5 |
| **Meals**: | | |
| Production | 11.9 | 2.6 |
| Soybean | 5.1 | 3.0 |
| Consumption | 8.6 | 0.0 |
| Soybean | 2.8 | 0.0 |
| Exports | 3.3 | 10.2 |
| Soybean | 2.3 | 6.7 |
| Domestic price (Rs/ton) | 5,993 | -0.1 |
| Soybean | 6,856 | 0.0 |
| **Processing**: | | |
| Capacity (Mil. tons) | 52.3 | 0.0 |
| Capacity use (%) | 40.0 | 2.4 |
| Soybean | 41.5 | 3.0 |
| Avg. cost (Rs/ton) | 874 | -1.5 |
| Soybean | 651 | -2.1 |
| Quasi-profit (Rs/ton) | 1,584 | 0.8 |
| Soybean | 1,457 | 0.0 |
| Quasi-profit (Rs mil.) | 32,820 | 3.1 |
| Soybean | 9,337 | 3.0 |
| Net imports (Rs bil.) | 107.0 | -10.2 |

[1] Imports are zero in the reference scenario.
Source: ERS-India oilseed sector model.

The analysis of tariff impacts highlights several important issues. First, as expected, the impacts on oilseed producers and processors are opposite the impacts on consumers. The size of the producer and consumer impacts are determined by several factors:

- Oil accounts for a small physical fraction of the oilseed, so changes in oil prices tend to yield proportionally small changes in oilseed prices.

- Based on the elasticities of oilseed supply and oil demand used in the model, consumers are more responsive to changes in oil prices than are farmers to changes in oilseed prices.
- Changes in processing costs associated with different levels of capacity use can affect oilseed prices and oilseed production.

Second, oilseed processors are clear gainers from higher oil tariffs but, even with lower tariffs, would continue to earn significant unit profits. With higher oil tariffs, processors gain from higher returns to oil, as well as increased quantities processed when domestic raw material supplies respond to higher oil prices.

Third, higher oil tariffs tend to reduce foreign exchange costs (the cost of oil imports less earnings from meal exports), while lower oil tariffs would tend to raise foreign exchange costs. However, the net foreign exchange impacts of the scenarios analyzed are small in the context of India's overall balance of payments.

## Impacts of Oilseed Price Supports

A major justification for maintaining high oil tariffs is to provide support to oilseed producers. However, oil tariffs may be a relatively inefficient means of supporting farmers. Another approach would be to make the existing system of minimum support prices (MSPs) more effective in supporting oilseed prices. This would provide direct support to oilseed producers and help diversify production away from food grains and toward crops in short supply (such as oilseeds), another stated policy goal.

The scope for using the MSP program to provide direct support to oilseed producers may, however, be restricted by multilateral commitments and budgetary costs. Oilseed MSPs set above import parity (the international reference price for the commodity plus transport and handling costs) would constitute "domestic support" under current World Trade Organization rules. To the extent that support exceeded WTO permitted levels, an oilseed MSP program could be subject to WTO discipline. Such a program would also imply some government budgetary costs for procurement, handling, and storage of oilseeds purchased to defend the MSP. These costs must be weighed against any estimated benefits of such a policy.

Two scenarios analyze the potential impacts of supporting oilseed prices with the MSP program. Both scenarios raise producer prices for each oilseed by an amount equal to the impact of a 10-percent increase in oil tariffs. This permits comparison of the impacts of providing the same amount of producer support via the MSP (directly) versus the oil tariff (indirectly). The difference between the two MSP scenarios is in the mechanism for supporting higher oilseed prices. In the first scenario, the Government pays the difference between the market price and the MSP, while processors continue to operate based on market prices of raw materials and products. In the second scenario, processors pay for the program by paying the MSP for oilseeds and absorbing the costs by reducing their margins.

These two mechanisms essentially bracket the available options for operating an oilseed MSP. When the Government pays the full cost of supporting oilseed prices above market prices, processor returns are not directly affected. Government costs would include the difference between the MSP and the market price for all of the oilseeds procured in price support operations, as well as any storage and handling costs. Storage periods and costs may be small for oilseeds because of excess demand in the form of idle processing capacity. At the other extreme, when processors are required to pay the new MSP for raw materials, government costs are limited to handling and (likely short-term) storage for oilseeds procured in price support operations. But, with this option, processors will likely cease operations if the oilseed MSP becomes too high relative to market prices of oil and meal and processing margins become negative. Intermediate scenarios would involve some sharing of program costs, with the Government selling procured oilseeds to processors at a price between the market price and the MSP.

With a government-financed MSP, oilseed producer prices rise an average of 2.9 percent (table 7). Prices for traded oils and meals—which remain linked to world prices—are mostly unchanged from the reference scenario. In contrast to the higher oil tariff scenario—which afforded little benefit to peanut producers—peanut prices and production rise, leading to lower prices for peanut oil and higher consumption. Overall, gains in oilseed production and crush, as well as oil and meal production, average about 2 percent, the same as when oil tariffs were increased 10 percent. However, with oil prices mostly unchanged, oil consumption is also unchanged and oil imports fall. Meal exports rise due to higher production and unchanged consumption.

Although the benefits of lower unit processing costs accrue to producers, the quasi-profits of oilseed processors rise because of increased capacity use and sales. Budgetary costs associated with the government-financed MSP are difficult to estimate. Assuming that just 220,000-290,000 tons of oilseeds would have to be removed from the market for an average of 3 months to support a 2.9-percent average price increase, the cost would be about Rs123-164 million ($2.7-$3.6 million).[7] These costs are balanced by producer and processor gains from higher prices and output.

When processors pay the new higher MSP, impacts on production, consumption, and trade are identical to the "government pays" scenario. But processor quasi-profits, while remaining positive, fall about 30 percent compared with the reference scenario. Average returns to processors of peanuts turned negative for some years, meaning that at least some processors would cease operations rather than incur losses.

The MSP scenarios indicate that, by supporting oilseed prices directly rather than indirectly through the oil tariff, producer support is achieved with less adverse impact on oil consumers and with a net savings of foreign exchange. The MSP approach, unlike oil tariffs, also supports peanut producers. But such a policy would entail costs to the Government and/or processors, and may also be subject to WTO disciplines regarding domestic support. A "processor pays" approach is likely to reduce government costs, but may result in private financial losses and supply disruptions. Intermediate solutions that share costs between the government and processors may mitigate private losses, but would add regulatory complexity and, possibly, create processor dependence on government outlays.

[7] The calculation assumes an average oilseed price elasticity of demand in the range of -0.30 to -0.40, implying that 0.87-1.16 percent of total supplies (220,000-290,000 tons) would have to be removed from the market to raise the average reference scenario price by 2.9 percent (Rs456/ton), yielding a cost of Rs99.0-132 million. Adding handling and administrative costs of Rs100/ton and storage costs, computed assuming 10-percent interest for an average storage period of 3 months, results in a budgetary cost estimate of Rs123-164 million ($2.7-3.6 million).

Table 7

**Scenario results: Raising oilseed minimum support prices (MSPs)**

| Variable | 2011 result | | Scenario/reference | |
|---|---|---|---|---|
| | Government pays | Processor pays | Government pays | Processor pays |
| | *--------Million tons-------* | | *-----Percent change-----* | |
| **Oilseeds:** | | | | |
| Production | 24.9 | 24.9 | 2.0 | 2.1 |
| Soybean | 7.6 | 7.6 | 2.9 | 2.9 |
| Crush | 20.7 | 20.7 | 2.3 | 2.3 |
| Soybean | 6.4 | 6.4 | 3.1 | 3.1 |
| Imports | 0.0 | 0.0 | [1] | [1] |
| Soybean | 0.0 | 0.0 | [1] | [1]1 |
| Domestic price (Rs/ton) | 16,025 | 16,024 | 2.9 | 2.9 |
| Soybean | 10,697 | 10,697 | 4.2 | 4.2 |
| **Oils:** | | | | |
| Production | 6.4 | 6.4 | 2.3 | 2.3 |
| Soybean | 1.2 | 1.2 | 3.1 | 3.1 |
| Consumption | 13.3 | 13.3 | 0.0 | 0.0 |
| Soybean | 2.9 | 2.9 | 0.0 | 0.0 |
| Imports | 6.9 | 6.9 | -2.0 | -2.0 |
| Soybean | 1.7 | 1.7 | -2.1 | -2.1 |
| Domestic price (Rs/ton) | 41,663 | 41,663 | 0.0 | 0.0 |
| Soybean | 39,450 | 39,450 | 0.0 | 0.0 |
| **Meals:** | | | | |
| Production | 11.9 | 11.9 | 2.7 | 2.7 |
| Soybean | 5.1 | 5.1 | 3.1 | 3.1 |
| Consumption | 8.6 | 8.6 | 0.0 | 0.0 |
| Soybean | 2.8 | 2.8 | 0.0 | 0.0 |
| Exports | 3.3 | 3.3 | 10.4 | 10.5 |
| Soybean | 2.4 | 2.3 | 7.0 | 7.0 |
| Domestic price (Rs/ton) | 5,993 | 5,993 | -0.1 | -0.1 |
| Soybean | 6,856 | 6,856 | 0.0 | 0.0 |
| Processing: | | | | |
| Capacity (Mil. tons) | 52.3 | 52.3 | 0.0 | 0.0 |
| Capacity use (percent) | 40.0 | 40.0 | 2.4 | 2.4 |
| Soybean | 41.6 | 41.6 | 3.1 | 3.1 |
| Avg. cost (Rs/ton) | 873 | 873 | -1.5 | -1.5 |
| Soybean | 650 | 650 | -2.2 | -2.2 |
| Quasi-profit (Rs/ton) | 1,584 | 1,076 | 0.8 | -31.5 |
| Soybean | 1,457 | 1,040 | 0.0 | -28.6 |
| Quasi-profit (Rs mil.) | 32,831 | 22,310 | 3.1 | -29.9 |
| Soybean | 9,347 | 6,673 | 3.1 | -26.4 |
| Net imports (Rs bil.) | 113.7 | 113.7 | -4.5 | -4.6’ |

[1] Imports are zero in the reference scenario.

Source: ERS-India oilseed sector model.

Table 8
**Domestic and import parity prices for major oilseeds, India**

| Oilseed | Unit | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|
| **Soybeans:** | | | | | |
| World price | $/ton | 208 | 200 | 203 | 240 |
| Freight/ins. | $/ton | 30 | 25 | 36 | 61 |
| Border price | $/ton | 238 | 225 | 239 | 301 |
| Border price | Rs/ton | 10,738 | 10,605 | 11,336 | 14,016 |
| Domestic trans. | Rs/ton | 783 | 800 | 821 | 849 |
| Import parity price | Rs/ton | 11,521 | 11,405 | 12,157 | 14,866 |
| Domestic price[1] | Rs/ton | 9,497 | 10,318 | 12,268 | 14,040 |
| **Rapeseed:** | | | | | |
| World price | $/ton | 190 | 202 | 220 | 284 |
| Freight/ins. | $/ton | 30 | 25 | 36 | 61 |
| Border price | $/ton | 220 | 227 | 256 | 345 |
| Border price | Rs/ton | 9,926 | 10,683 | 12,142 | 16,064 |
| Domestic trans. | Rs/ton | 783 | 800 | 821 | 849 |
| Import parity price | Rs/ton | 10,709 | 11,483 | 12,963 | 16,913 |
| Domestic price[2] | Rs/ton | 12,134 | 13,046 | 15,265 | 18,121 |
| **Sunflower:** | | | | | |
| World price | $/ton | 214 | 219 | 287 | 289 |
| Freight/ins. | $/ton | 30 | 25 | 36 | 61 |
| Border price | $/ton | 244 | 244 | 323 | 350 |
| Border price | Rs/ton | 11,008 | 11,483 | 15,320 | 16,297 |
| Domestic trans. | Rs/ton | 783 | 800 | 821 | 849 |
| Import parity price | Rs/ton | 11,791 | 12,283 | 16,141 | 17,146 |
| Domestic price[3] | Rs/ton | 10,225 | 12,622 | 14,508 | 15,573 |

[1] Soybean: Indore; Source: Solvent Extractors' Association of India.
[2] Rapeseed: Jaipur; Source: Solvent Extractors' Association of India.
[3] Sunflowerseed: Average of Khamgaon (Maharashtra), Jalna (Maharashtra), and Gulbargo (Karnataka); Source Government of India, Ministry of Agricuture.

## Impacts of Oilseed Import Liberalization

Liberalization of oilseed imports, which are now effectively prohibited by tariff and sanitary/phytosanitary (SPS) restrictions, is an additional policy option open to the Indian Government. The oilseed tariffs are intended to protect oilseed producers but, in fact, domestic oilseed prices are determined more by the economics of processing, including oil and meal prices, oil and meal extraction rates, and unit processing costs. Generally, domestic oilseed prices are not afforded protection equivalent to the 30-percent import tariff. Domestic oilseed prices—except in the case of rapeseed—are typically below import parity prices (world reference prices adjusted for transport and handling costs to the farm gate), and well below import parity prices plus the tariff (table 8).

The oilseed import liberalization scenario assumes reduced oilseed tariffs and the removal of—or zero-cost solutions to—existing SPS barriers.[8] All other assumptions on exogenous variables, including oil tariffs and the fixed availability of processing capacity, remain the same as in the reference scenario. To implement this scenario, three important changes are introduced into the analytical framework:

[8] Assessing the feasibility of removing existing SPS barriers to oilseed imports is beyond the scope of this study. For this analysis, it is assumed that the barriers can be reduced or complied with without creating unacceptable pest or disease risks, or unacceptable costs to oilseed processors.

• The scenario is conducted in a way that prevents oilseed imports from leading to losses for oilseed producers. Producer prices are not allowed to fall below reference scenario prices. This is a realistic approach because of the priority that policymakers place on producer welfare. When necessary, producer prices are maintained at the reference scenario level by allowing non-zero tariffs sufficient to maintain reference scenario producer prices. Based on market price conditions during the period analyzed, non-zero tariffs are required for rapeseed only.

• With import liberalization, domestic oilseed prices become linked directly to world oilseed prices rather than domestic oil and meal prices. The only remaining protection of domestic oilseeds and products arises from oil tariffs, plus the "natural" protection afforded by international and domestic transport and handling costs. A key implication of oilseed import liberalization is that India's high oil tariffs would have little or no impact on the oilseed prices received by Indian producers or paid by processors. Processors would, however, continue to benefit from high domestic oil prices and crush margins resulting from oil tariffs. Oilseed producers may also receive less price benefit than they would in a protected market, as increased use of processing capacity reduces processing costs. Any portion of this benefit that would raise oilseed producer prices above import parity would be retained by processors, unless redirected by other policies.

• With no prohibitive restrictions on imports of raw material, processors would likely behave as profit maximizers, importing and processing raw material until marginal revenue equals marginal cost. Additional cost factors include the costs of transporting imported oilseeds to processing plants and, as long as India has a meal surplus, transporting surplus meal back to ports for export.

This scenario includes assumptions on transportation and handling costs for imported oilseeds and exported meal. These costs vary by unit according to distance from ports, access to rail transport, the quality of roads, and other factors. Some processing units may be too remote and inaccessible for imports to be feasible. Based on available information on transport and handling costs and the location of processing capacity, it is assumed that about 76 percent of India's processing capacity could process imported oilseeds, with an average transport and handling cost of Rs800 ($17.78) per ton.[9]

With liberalization of oilseed imports, producer prices rise an average of 1.6 percent (table 9). Soybean and sunflowerseed prices rise 7.5 percent and 6.4 percent because import parity prices are above initial domestic prices. Despite the higher price of imported raw materials, lower average processing costs and increased volumes make soybean and sunflowerseed imports profitable for processors. However, a 34-percent tariff is needed to maintain rapeseed prices at reference scenario levels, and peanuts continue to be untraded with no change in price relative to the reference scenario.[10] Domestic prices of oils and meals remain linked to world prices and are unchanged from the reference scenario.

Soybean and sunflowerseed production increase 4.1 percent and 1.3 percent, while oilseed crush and production of meal and oil rise sharply due to imports of about 8.7 million tons of oilseeds. Soybeans (8.0 million tons in

[9] Oilseed transport and handling costs are accounted for in a way that avoids the detail of plant- or region-specific transport and handling cost data. It is assumed that all processing capacity within about 800 km of major ports could process imported oilseeds. This is reasonable because soybean processors in Madhya Pradesh-roughly 800 km from major ports-now pay the transport costs and earn profits from meal exports. Based on state data, about 76 percent of existing processing capacity meets this criterion (Solvent Extractors' Association of India, 2003). Processors farther from the port are assumed to rely on domestically produced oilseeds. The average costs of transporting oilseeds and meals from and to ports are based on data provided by processors in Madhya Pradesh (Rs850/ton by road, Rs750/ton by rail, Rs800/ton average). Oilseed imports might, in the short run, bid up the transport costs. But since many plants are located closer to ports than 800 km and large-scale imports could lead to investment in more efficient transport, current costs may also overestimate longrun costs.

[10] The 34-percent average tariff needed to maintain rapeseed producer prices is above the current 30-percent tariff, implying that the current tariff would not prevent rapeseed imports in the absence of nontariff barriers.

Table 9

**Scenario results: Liberalizing oilseed imports[1]**

| Variable | 2011 | Scenario/reference |
|---|---|---|
| | *Million tons* | *Percent change* |
| **Oilseeds**: | | |
| Production | 24.8 | 1.4 |
| Soybean | 7.7 | 4.1 |
| Crush | 29.3 | 44.5 |
| Soybean | 14.5 | 133.1 |
| Imports | 8.7 | [2] |
| Soybean | 8.0 | [2] |
| Domestic price (Rs/ton) | 15,816 | 1.6 |
| Soybean | 11,039 | 7.5 |
| **Oils**: | | |
| Production | 8.1 | 29.2 |
| Soybean | 2.7 | 133.1 |
| Consumption | 13.3 | 0.0 |
| Soybean | 2.9 | 0.0 |
| Imports | 5.2 | -25.9 |
| Soybean | 0.2 | -89.7 |
| Domestic price (Rs/ton) | 41,673 | 0.0 |
| Soybean | 39,450 | 0.0 |
| **Meals**: | | |
| Production | 18.6 | 60.6 |
| Soybean | 11.6 | 133.1 |
| Consumption | 8.6 | 0.0 |
| Soybean | 2.8 | 0.0 |
| Exports | 10.0 | 237.5 |
| Soybean | 8.8 | 301.4 |
| Domestic price (Rs/ton) | 6,273 | 4.6 |
| Soybean | 6,856 | 0.0 |
| **Processing**: | | |
| Capacity (Mil. tons) | 52.3 | 0.0 |
| Capacity use (percent) | 67.6 | 72.9 |
| Soybean | 94.0 | 133.1 |
| Avg. cost (Rs/ton) | 637 | -28.2 |
| Soybean | 367 | -44.9 |
| Quasi-profit (Rs/ton) | 1,320 | -16.0 |
| Soybean | 982 | -32.6 |
| Quasi-profit (Rs mil.) | 38,679 | 21.5 |
| Soybean | 14,250 | 57.2 |
| Net imports (Rs bil.) | 118.2 | -1.0 |

[1] The removal of SPS barriers on all oilseeds with zero tariffs on soybeans, rapeseed, sunflowerseed, and peanuts. Rapeseed tariff is maintained to prevent a decline in domestic prices.
[2] Imports are zero in the reference scenario.
Source: ERS-India oilseed sector model.

2011) are the major oilseed imported, followed by rapeseed (0.5 million) and sunflowerseed (0.2 million). Domestic oil and meal consumption are mostly unchanged so, with the large gains in oil and meal production, oil imports fall 26 percent and meal exports more than triple relative to the reference scenario. Soybean processors reap windfall gains in quasi-profits, with smaller gains for processors of other oilseeds. Although the cost of soybeans and sunflowerseed rises, processors benefit from high oil tariffs, the retained benefits of lower unit processing costs, and large increases in volumes processed and marketed.

Under oilseed import liberalization, soybeans, rather than sunflowerseed and rapeseed, account for the bulk of imports. This occurs despite the fact that both rapeseed and sunflowerseed contain a larger oil fraction and are currently protected by higher oil tariffs than soybeans. The reason for this outcome is that India imports only small amounts of rapeseed and sunflower oils. With oilseed import liberalization, these oilseeds are imported only until the derived oil output replaces imports of the oils; larger imports of the oilseeds would drive down domestic prices of the oils and reduce processor profits.

The oilseed import liberalization scenario demonstrates the potential for efficiency gains from using idle processing capacity. Oilseed producers gain on average, consumers are largely unaffected and, with high oil tariffs in place, processors reap large windfall gains. This result may not be optimal for the economy as a whole but, as later scenarios indicate, there is scope to reallocate processor gains so that consumers and/or producers receive more of the benefits.

While gains for processors are large, producer and processor impacts would likely vary by plant and region, and over time. Larger plants with greater scale economies are likely to have an advantage over smaller units. As a result, peanut and rapeseed processors, who are restricted to small-scale units, may receive smaller gains than sunflower and soybean processors. Processors located near ports would have cost advantages over inland units for imports of raw material and exports of meal. While the scenario assumes that processing capacity remains fixed at the 2001 level, larger and more technically efficient units may eventually be built near ports and have a competitive advantage over most existing units. In this event, the least competitive existing units would likely close, and the remaining inland units would tend to process domestic raw materials, selling both oil and meal in the domestic market.

## Impacts of Consolidation in Oilseed Processing

The recent trend in oilseed processing toward consolidation of ownership by larger domestic and multinational firms, though not driven by policy change, is a potentially significant development. With the formation of larger consolidated firms, smaller, less efficient firms are likely to be pressured to exit the industry. As firms exit, average capacity use will rise and average costs of processing will fall. While there would be local employment losses associated with firm exits, benefits would accrue to producers and consumers due to lower average processing costs. Economywide employment effects may be minimal if the overall volume processed by the industry does not change.

Some of the impacts of industry consolidation are analyzed with a scenario that reduces processing capacity at a constant rate during the projection period. By 2011, capacity is reduced to the point where overall capacity use reaches about 94 percent, roughly the rate maintained in other major oilseed

Table 10
**Scenario results: Consolidation of oilseed processing**[1]

| Variable | 2011 | Scenario/reference |
|---|---|---|
| | *Million tons* | *Percent change* |
| **Oilseeds:** | | |
| Production | 24.7 | 1.1 |
| Soybean | 7.5 | 1.9 |
| Crush | 20.5 | 1.2 |
| Soybean | 6.3 | 2.0 |
| Imports | 0.0 | [2] |
| Soybean | 0.0 | [2] |
| Domestic price (Rs/ton) | 15,860 | 1.9 |
| Soybean | 10,564 | 2.9 |
| **Oils:** | | |
| Production | 6.3 | 1.1 |
| Soybean | 1.2 | 2.0 |
| Consumption | 13.3 | 0.0 |
| Soybean | 2.9 | 0.0 |
| Imports | 7.0 | -0.9 |
| Soybean | 1.7 | -1.4 |
| Domestic price (Rs/ton) | 41,647 | -0.1 |
| Soybean | 39,450 | 0.0 |
| **Meals:** | | |
| Production | 11.8 | 1.4 |
| Soybean | 5.1 | 2.0 |
| Consumption | 8.6 | 0.0 |
| Soybean | 2.8 | 0.0 |
| Exports | 3.1 | 5.7 |
| Soybean | 2.3 | 4.5 |
| Domestic price (Rs/ton) | 5,999 | 0.0 |
| Soybean | 6,856 | 0.0 |
| **Processing:** | | |
| Capacity (Mil. tons) | 21.8 | -58.2 |
| Capacity use (percent) | 93.9 | 140.3 |
| Soybean | 94.0 | 133.1 |
| Avg. cost (Rs/ton) | 549 | -38.1 |
| Soybean | 367 | -44.9 |
| Quasi-profit (Rs/ton) | 1,573 | 0.2 |
| Soybean | 1,457 | 0.0 |
| Quasi-profit (Rs mil.) | 32,281 | 1.4 |
| Soybean | 9,248 | 2.0 |
| Net imports (Rs bil.) | 116.5 | -2.3 |

[1] Linear reduction of processing capacity so that processing capacity utilization rate is 94 percent by 2011.
[2] Imports are zero in the reference scenario.
Source: ERS-India oilseed sector model.

processing countries such as the United States, Argentina, and Brazil.[11] All other assumptions remain the same as the reference scenario.

With this consolidation scenario, oilseed producer prices rise modestly when—as in the reference, tariff change, and MSP scenarios—the benefits of higher capacity use and lower processing costs are passed to producers, but domestic oil and meal prices are unchanged (table 10). Increased oilseed production and crush raise oil and meal output, but oil and meal consumption are

[11] In oilseed processing, the convention is to measure capacity based on 24-hour days and 300 days of operation, which builds in 65 days of closure for holidays and plant maintenance.

unchanged. As a result, oil imports drop slightly and meal exports rise. Processor quasi-profits rise as the gains associated with increased volumes more than offset the modest increase in raw material prices.

Under this scenario, even with plants moving out of production, both the processing industry and oilseed producers benefit. Although there would be local employment losses associated with plant closures—and smaller, more labor-intensive firms may exit first—the increase in volume processed makes the change in total employment uncertain.

The recent consolidation trend, because of excess capacity and limited raw material supplies, threatens the least efficient oilseed processors under existing domestic and trade policies. Increased Government support, perhaps through higher oil tariffs, may continue to protect less efficient processors, but would result in additional costs to consumers and, in the case of soybean oil, require renegotiation of the WTO bound tariff. Liberalizing oilseed imports would, however, provide an opportunity for more processors to stay in business if they are sufficiently competitive with other firms.

## Composite Scenarios: Distributing Benefits to Producers and Consumers

The analysis so far has shown that each of the policy options available to the Government—adjusting oil tariffs, providing price supports to oilseed producers, and liberalizing oilseed imports—has differing implications for producers, consumers, processors, government outlays and, in some cases, WTO disciplines. The results for individual policy changes suggest that some composite scenarios—scenarios that combine changes in multiple policies—may meet the goals of supporting oilseed producers and processors at a smaller cost to consumers.

Two such scenarios involve tapping the large potential for efficiency gains in processing associated with liberalizing oilseed imports, but then reallocating the gains to producers or consumers. The first scenario includes the same liberalization of oilseed imports analyzed previously (see table 9), but investigates whether it is possible to transfer the gains in processor quasi-profits to consumers by reducing oil tariffs. The second scenario also includes oilseed import liberalization, but investigates whether it is possible to transfer gains in processor quasi-profits to oilseed producers using oilseed tariffs.

**Oilseed imports with benefits shifted to consumers.** In this scenario, the bulk of any gains in processor quasi-profits (between the reference scenario and the oilseed import liberalization scenario) are shifted to consumers by reducing oil tariffs. This type of transfer appears possible for the soybean sector and, to a lesser extent, for rapeseed, but not for the sunflower or peanut sectors (table 11). The overall decline in domestic oil prices is relatively small—about 1 percent—as the significant consumer gains are confined to soybean oil.

In this scenario, impacts on producers are the same as in the oilseed import liberalization scenario; soybean and sunflower prices and production rise, while peanut and rapeseed production and prices are almost unchanged.

Table 11
**Scenario results: Composite scenarios**

| Variable | 2011 result: Consumers | 2011 result: Producers | Scenario/reference: Consumers | Scenario/reference: Producers |
|---|---|---|---|---|
| | Oilseed import liberalization with benefits to: | | | |
| | --------*Million tons*--------- | | ------*Percent change*------ | |
| **Oilseeds:** | | | | |
| Production | 24.8 | 25.0 | 1.4 | 2.5 |
| Soybean | 7.7 | 7.9 | 4.1 | 7.2 |
| Crush | 29.3 | 29.3 | 44.6 | 44.5 |
| Soybean | 14.5 | 14.5 | 133.1 | 133.1 |
| Imports | 8.7 | 8.5 | [1] | [1] |
| Soybean | 8.0 | 7.8 | [1] | [1] |
| Dom. price (Rs/ton) | 15,845 | 15,945 | 1.8 | 2.4 |
| Soybean | 11,039 | 11,388 | 7.5 | 10.9 |
| **Oils:** | | | | |
| Production | 8.1 | 8.1 | 29.3 | 29.2 |
| Soybean | 2.7 | 2.7 | 133.1 | 133.1 |
| Consumption | 13.3 | 13.3 | 0.4 | 0.0 |
| Soybean | 2.9 | 2.9 | 2.1 | 0.0 |
| Imports | 5.3 | 5.2 | -25.1 | -25.9 |
| Soybean | 0.2 | 0.2 | -86.2 | -89.7 |
| Dom. price (Rs/ton) | 41,228 | 41,674 | -1.1 | 0.0 |
| Soybean | 37,709 | 39,450 | -4.4 | 0.0 |
| **Meals:** | | | | |
| Production | 18.6 | 18.6 | 60.7 | 60.6 |
| Soybean | 11.6 | 11.6 | 133.1 | 133.1 |
| Consumption | 8.6 | 8.6 | 0.0 | 0.0 |
| Soybean | 2.8 | 2.8 | 0.0 | 0.0 |
| Exports | 10.0 | 10.0 | 237.7 | 237.5 |
| Soybean | 8.8 | 8.8 | 301.4 | 301.4 |
| Dom. price (Rs/ton) | 6,273 | 6,273 | 4.6 | 4.6 |
| Soybean | 6,856 | 6,856 | 0.0 | 0.0 |
| **Processing:** | | | | |
| Capacity (Mil. tons) | 52.3 | 52.3 | 0.0 | 0.0 |
| Capacity use (percent) | 67.6 | 67.6 | 72.9 | 72.9 |
| Soybean | 94.0 | 94.0 | 133.1 | 133.1 |
| Avg. cost (Rs/ton) | 637 | 637 | -28.2 | -28.2 |
| Soybean | 367 | 367 | -44.9 | -44.9 |
| Quasi-profit (Rs/ton) | 1,111 | 1,099 | -29.3 | -30.0 |
| Soybean | 661 | 633 | -54.6 | -56.6 |
| Quasi-profit (Rs mil.) | 32,564 | 32,197 | 2.3 | 1.1 |
| Soybean | 9,586 | 9,182 | 5.7 | 1.3 |
| Net imports (Rs bil.) | 119.4 | 115.5 | 0.2 | -3.1 |

[1] Imports are zero in the reference scenario.
Source: ERS-India oilseed sector model.

Consumer prices fall for soybean and rapeseed oils, and consumption rises, as processor gains from oilseed imports are transferred to consumers by reducing oil tariffs. Tariffs on soybean oil are reduced from 45 percent to 37 percent, and for rapeseed oil from 75 percent to 74 percent, leading to declines in consumer prices for soybean and rapeseed oils of about 4 percent and 1 percent, respectively. (The relatively small tariff reduction for rapeseed oil is linked to the relatively small impacts on rapeseed imports and processing costs in the oilseed import liberalization scenario.) Soybean oil tariffs and prices fall the most because soybean processors benefit the most from oilseed import liberalization, thus generating more efficiency gains to transfer to consumers.

It was not possible to lower the sunflower oil tariff because any downward adjustment would reduce processor quasi-profits below the reference scenario. However, sunflower processors, on average, appear to earn significantly higher unit surpluses than other processors, both in the base period and the reference scenario. As a result, there may be more scope for transferring sunflower processor quasi-profits to oil consumers than accounted for in this analysis. Transferring benefits to peanut oil consumers by this approach is not possible because these products continue to be untraded under oilseed import liberalization.

**Oilseed imports with benefits shifted to farmers.** In this scenario, the bulk of any gains in processor quasi-profits are shifted to producers by upward adjustments to oilseed tariffs. This policy approach is feasible for all oilseeds except peanuts.

With processor quasi-profits transferred to producers, oilseed producer prices and oilseed production rise relative to both the reference scenario and the oilseed import liberalization scenario (table 11). Oilseed producer prices rise an average of 2.4 percent. The largest price and output gains are for soybeans, again because soybean processors experience the largest efficiency gains from liberalization of oilseed imports. The soybean tariff rises from zero to 4 percent and the rapeseed tariff rises from 34 percent to 37 percent. Producer prices rise 10.9 percent for soybeans and 1.5 percent for rapeseed.

Sunflowerseed prices, while higher than in the reference scenario, are consistent with the oilseed import liberalization scenario because higher farm prices would reduce processor quasi-profits below the reference scenario. However, the high level of quasi-profits (per unit) apparently earned from sunflowerseed processing may suggest more scope to transfer gains to producers than shown in this analysis. Since peanuts used for processing are not traded, there is no scope to raise producer prices by this mechanism.

Impacts on oil consumers are unchanged from the reference scenario and the oilseed import liberalization scenario. Oilseed processor quasi-profits match those of the reference scenario. Oil and meal trade implications remain the same as under the oilseed import liberalization scenario, but increased oilseed production leads to smaller oilseed imports.

This analysis demonstrates how oilseed import liberalization—with oilseed tariffs set in a way that enables higher processing efficiency while protecting producers—could benefit most oilseed producers with no loss to consumers or processors. In the longer term, if processors respond to oilseed import liberalization by building larger, more efficient plants, even larger efficiency gains may be shared among producers, consumers, and processors than estimated in this analysis. These larger efficiency gains could be channeled to consumers (through reductions in oil tariffs) or to producers (through WTO-legal adjustments in oilseed tariffs) without making other players worse off.

# Conclusions

Stronger income growth in India is likely to be sustained, leading to continued strong demand for oils and oil meals, as well as other foods. Without significant improvement in yields, India is likely to have a growing deficit in vegetable oils to be met by imports of either oils or oilseeds for processing. And, without improved oilseed productivity, particularly for soybeans, rapid growth in meal demand is likely to continue to reduce India's oil meal surplus, eventually creating a deficit in feed protein.

Current policies, which aim to support oilseed producers by imposing high tariffs on oil and prohibitive restrictions on oilseed imports, have not led to significant gains in oilseed area or yields. In addition to imposing substantial costs on all consumers of oil, oil and oilseed import barriers have propped up a processing sector that is technically inefficient and heavily underutilized. The analysis also suggests that future trade or domestic policy changes aimed at improving the performance of the sector could have trade implications of potential significance for world and U.S. trade.

Our analysis indicates that further hikes in oil tariffs are likely to generate limited producer gains and add to already high consumer costs, while providing further support to an inefficient processing sector. By contrast, lower oil tariffs provide significant benefits (reduced costs) for consumers, with only minor adverse impacts on processors and producers.

More effective implementation of the minimum support price (MSP) system to boost oilseed prices would provide direct benefits to producers and processors with negligible consumer impacts, and may be consistent with current priorities for diversifying agricultural production. Such a policy would likely entail budgetary costs and be complex to implement in a way that ensures processor incentives, and may also conflict with WTO domestic support disciplines.

Because of India's large surplus of processing capacity, liberalization of oilseed imports with current oil tariffs in place would lead to windfall gains for processors. Most oilseed producers would benefit from somewhat higher prices, although rapeseed producers would require continued tariff protection to avoid losses. Impacts on consumers, who would continue to pay tariff adjusted world prices for oil, would be negligible. Analysis suggests that when processor gains from oilseed import liberalization are reallocated to consumers (through lower oil tariffs) or to producers (through a small oilseed tariff), producers, consumers, and processors may all be better off than under existing policies. This assessment, however, assumes that an acceptable, low-cost solution can be found to nontariff barriers that currently restrict oilseed imports.

The ongoing consolidation of India's oilseed processing capacity by larger domestic and multinational which have relatively low costs of investment and operating capital and may achieve further economies in vertical integration and marketing—threatens the viability of inefficient processors even under existing policies. Over time, larger consolidated units will likely put less efficient smaller units out of business. However, the resulting gains in processing efficiency indicate potential benefits for producers and consumers, and for the processing sector as a whole.

It is unclear which policy approach India will adopt to meet growing demand for oilseeds and products, while addressing policy goals concerning producers, consumers, and processors. Most major producing countries, while affording some tariff protection for producers and/or processors, provide much lower levels of protection than India. This translates into lower oil prices and more efficient processing, as well as higher average oilseed yields, than in India. China is a recent example of a developing country that lowered protection in its oilseed and products sector to serve dynamic growth in edible oil and feed demand (Tuan et al., 2004).

In the Indian case, the analysis suggests that a large surplus of processing capacity creates the potential to liberalize trade in a way that provides benefits to producers, consumers, and processors. In the long run, if domestic processors invest in larger, more efficient plants that vertically integrate more processing and marketing enterprises, the potential gains to be shared by producers and consumers would be even larger than indicated in this study. Access to imported raw materials would help transform oilseed processing from an inefficient and underutilized industry dependent on high oil tariffs to a more efficient and dynamic sector that better serves producers and consumers.

Finally, if India were to allow oilseed imports, the United States, which tends to be more competitive at exporting soybeans than soy oil, may benefit. Although the United States would still face considerable competition from Brazilian soybeans, oilseed trade liberalization would improve the U.S. competitive position as Indian imports of South American soybean oil are replaced by imports of soybeans.

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# Appendix 1—
# India Oilseed Model Characteristics

The ERS India Oilseed Sector Model was developed specifically to analyze the impacts of alternative oilseed sector policies on India's supply, demand, and trade of oilseeds and products, as well as implications for producers, consumers, and processors. The commodity coverage for this report includes soybeans, rapeseed, groundnut, sunflower, and palm oil. The behavioral equations include India's domestic use of the derivative oils and meals, as well as the area and yield of the oilseeds, excluding palm oil.

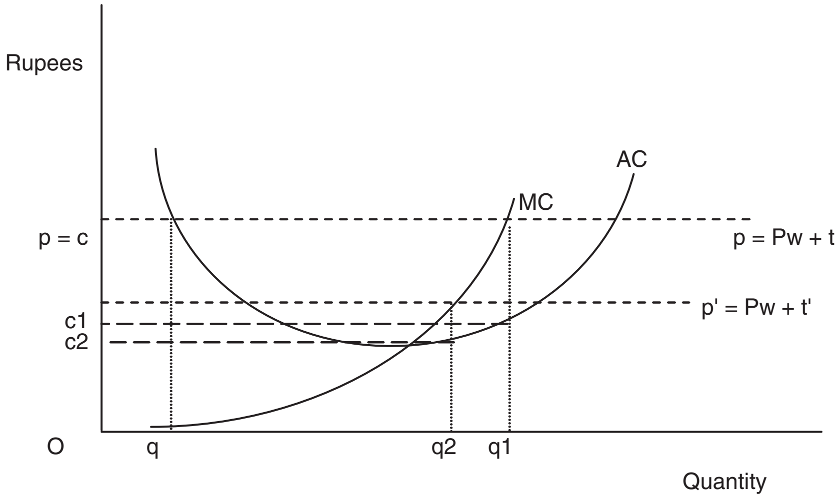
India's demands for the various oils and meals are linear functions of income, own-price, and substitutes. Farm production of the oilseeds is an identity, computed as the product of area and yield. Crop areas are specified as functions of lagged own-price and competing crop prices. For soybeans and rapeseed, 1-year lags of price variables provided the best results, while distributed lag structures worked best for peanuts and sunflowers. Yield is a function of a lagged own-price and a trend variable representing technological improvements. India's palm oil production is negligible, and hence the quantity consumed is made equal to imports. Imports for the other oils and exports of the meals are treated as residuals. Groundnut oil is an exception, in that imports are consistently zero, implying that the domestic price is that which clears India's supply and demand, i.e., an endogenously formed autarchy price. The model incorporates domestic use of oilseeds for seed, feed, and waste as a fixed percentage of domestic production. Food use of oilseeds grows at a trend rate throughout the projection period, apart from sunflower seed where USDA data do not report food consumption.

The analytical framework for this study illustrates possible impacts on farmers, processors, and consumers of permitting imports of the raw material, taking into account that processors currently operate on the high average cost (downward sloping) part of their cost curves due to low capacity utilization. If imports of the raw material are permitted and processors continue to pay the same input prices, processors find it profitable to increase capacity use and move down their cost curves. Thus, processors gain in two key ways: their unit costs fall and their sales volumes increase. Moreover, liberalizing imports of raw materials may be supportive of lower output prices charged to consumers.

**Reference (disequilibrium)**. The impacts of allowing imports of raw material are illustrated in appendix fig. 1.1. The quantity shown on the X-axis is defined as the amount of raw material provided by farmers to produce output purchased by consumers. That is, the output is placed on a farm product equivalent basis. The Y-axis, which is in monetary terms, represents prices and costs. Average processing costs (AC) include labor, electricity, steam, interest, other costs, and most importantly, the price of raw material. In general form, average costs are written as:

AC = AC(Labor, Electricity, Steam, Interest, Other Costs, Oilseed).

Appendix figure 1.1
**Impacts of oilseed imports**




The reference scenario assumes fixed processing capacity, implying that an increase in quantity leads to higher capacity utilization, resulting in an initial decline in unit costs. As quantity continues to expand, unit costs attain a minimum and subsequently begin to rise.

In the disequilibrium case, which serves as the reference scenario, the quantity of the raw material processed is identical to the pre-determined level of domestic farm production, denoted as q in appendix fig. 1.1. The fixed quantity, q, in turn determines the cost of crush, c, on the downward sloping part of the cost curve. The processor would prefer not to operate on the downward sloping part of the cost curve because doing so implies foregone profits. However, over-investment in processing plants and policies preventing raw material imports lead to an artificially depressed rate of capacity use and a relatively high cost, as reflected in the figure. The output price, p, is exogenously determined from a world price (Pw) and a tariff (t), i.e.,

p = Pw + t.

For simplicity, it is assumed that p is identical to the unit cost, c. The cost of producing at q is given by the rectangle with width Oq and length Oc, i.e., (Oq)(Oc). The revenues obtained from producing q are given by the rectangle with width Oq and length Op, i.e., (Oq)(Op). But since p = c, profits, computed as

((Oq)(Op) - (Oq)(Oc), are zero.

Farmers' revenues are computed as the product of the raw material (Oilseed) price and the quantity produced (Oq),

(Oq)(Oilseed).

**Oilseed imports.** In this scenario, nontariff barriers on imports of raw material are removed and tariffs reduced. Nonzero tariffs are used to prevent imports of a raw material from depressing domestic prices below the reference scenario. Since the cost of raw material, as well as all other inputs, does not change, the cost curves do not shift. In other words, the tariff is set to eliminate the price advantage of imported raw materials, thereby controlling for shifts in the cost curves. However, processors operate at a different point (q1), where p intersects marginal cost (MC). That is, processors find it profitable to increase the quantity produced using imported raw materials, where the quantity of imports is given by the difference, q1-q. Consequently, capacity utilization rises and unit costs fall to c1. The total cost of processing q1 is the rectangle (Oq1)(Oc1). If the world price of the output and its tariff remain constant, the output price remains at p, leading to revenues of (Oq1)(Op). Profits, which are now positive, exceed those in the reference (disequilibrium) case, implying that processors benefit:

((Oq1)(Op) - (Oq1)(Oc1) > (Oq)(Op) - (Oq)(Oc).

This result is noteworthy since it is based on an assumed tariff on raw material imports that protects farmer welfare. Farmer revenues, which are the same as in the reference case, are once again computed as the product of the raw material price (Oilseed) and the quantity produced (q),

(Oq)(Oilseed).

Finally, consumers neither gain nor lose because the price of the output has not changed.

The analysis is taken a step further to determine if lower trade barriers on imports of the raw material can be used to compensate processors for reduced duties on imports of the output. The price of the output is reduced to p' from p due to a reduction in the tariff to t' from t. Imports of raw material are curtailed, leading to a decrease in the quantity processed to q2 from q1. With unit costs at c2 and the output price at p', profits are now (Op')(Oq2) - (Oc2)(Oq2), which still exceeds zero, the level of profits in the reference scenario. In other words, processors are still better off even with reduced output tariffs, since the benefits of improved access to raw materials more than offset the impacts of lower output prices. The tariff on raw material imports maintains farm revenues at (Oq)(Oilseed), implying that farmers are indifferent to the policy package. Consumers benefit from the reduction in the output price to p' from p. Thus, reductions in the output tariffs transfer rents from processors to consumers.

Although it is not shown in appendix fig. 1.1, there could also be scope for transferring processor rents to farmers by imposing a higher tariff on oilseeds, such that the import price exceeds the autarchy level. This would have the effect of shifting the cost curves upward due to higher raw material costs. Processors would then have to weigh the benefits of moving down a higher cost curve via oilseed imports, against operating at the autarchy crush level on the original cost curve.

This model illustrates the key role of the shape of the cost curve in determining the optimal quantity of oilseed crush, the likely gains to processors under various oilseed import scenarios, and the scope for transferring rents to consumers and/or farmers. The following sections demonstrate the key role of the cost schedule in the quantitative assessment of oilseed trade liberalization, using soybeans as an example.

**Cost schedule.** Operating costs in India reportedly fall by roughly half to 375 rupees per ton (appendix table 1.1), when moving from 30-percent utilization to full capacity, although, as shown in fig. 11, costs attain a minimum between 85- and 90-percent utilization. The quadratic equation that fits the processing cost data for oilseed i is given by:

$$(1)\ CRcost_i = CR^1_i{*}CapUtil_i{*}{*}2 + CR^2_i{*}CapUtil_i + CR^0_i$$

$$= 0.1176{*}CapUtil_i{*}{*}2 - 21.356{*}CapUtil_i + 1334.9,$$

where $CRcost_i$ is the average variable cost of crush, $CapUtil_i$ is capacity utilization, the operator '*' is for multiplication, and '**2' indicates squared. Total crush costs ($TCRcost_i$) are,

$$(2)\ TCRcost_i = SCrush_i{*}(0.1176{*}(SCrush_i/Cap_i){*}{*}2 - 1.356{*}(SCrush_i/Cap_i) + 1334.9) + FC_i,$$

where $SCrush_i$ is the quantity of soybean crush, $FC_i$ is the fixed cost, and $Cap_i$ is the soybean crush capacity, such that capacity utilization ($CapUtil_i$) is given by $SCrush_i/Cap_i$ in (2).

**Optimal crush quantity**. In the reference scenario, India's trade policies are such that no imports of oilseeds occur. Thus, oilseed crush is simply a residual: the predetermined level of domestic oilseed production less the exogenous quantities of seed, feed, waste, and food uses (see appendix 2, equation A.7, autarchy case). The stock of crush capacity remains constant throughout the projection period, implying that once the quantity of crush is known, capacity utilization can be computed from equation A.6 (appendix 2). We assume that costs of crushing, such as labor, hexane, energy expenses, etc., are constant in real terms, so capacity utilization is the only variable that causes the real cost of crushing to vary throughout the projection period. Given a level of capacity utilization, the model computes the cost of crush. The autarchy wholesale price of oilseeds is formed by subtracting the cost of crushing from a weighted-sum of the oil and meal prices, where the weights are the oil and meal extraction rates (equation (A.19), autarchy case). The farm price of the oilseed is then computed by subtracting a margin from the autarchy wholesale price of the oilseed. The farm price determines the production of oilseeds in the subsequent period.

Appendix table 1.1
**Estimated cost of Indian oilseed processing at 30-percent and 50-percent capacity use**

| | Rapeseed | | Groundnut | | Soybeans | | Sunflower | |
|---|---|---|---|---|---|---|---|---|
| | (30) | (50) | (30) | (50) | (30) | (50) | (30) | (50) |
| | | | | *Rupees* | | | | |
| Power | 325 | 215 | 333 | 275 | 210 | 150 | 210 | 150 |
| Steam | 155 | 65 | 175 | 100 | 150 | 90 | 150 | 90 |
| Hexane | 125 | 70 | 108 | 55 | 134 | 100 | 134 | 100 |
| Labor | 255 | 195 | 210 | 140 | 128 | 100 | 128 | 100 |
| Interest | 156 | 156 | 157 | 157 | 120 | 96 | 120 | 96 |
| Other | 170 | 170 | 130 | 130 | 58 | 25 | 108 | 75 |
| Total | 1,186 | 871 | 1,112 | 857 | 800 | 561 | 850 | 611 |

Note: At full utilization, the costs for rapeseed, groundnut, soybean, and sunflower are Rs680, Rs696, Rs375, and Rs425, respectively. A breakout of individual cost items is not available.
Source: World Bank (1997), ERS estimates.

In the scenarios where oilseed imports are permitted, crush quantities cannot be computed as a residual because optimal oilseed crush may exceed domestic production. The optimizing framework computes the level of oilseed crush to maximize processor surplus, subject to the cost equation and given the output and input prices.

$$(3)\ \underset{SCrush_i}{\text{MAXIMIZE}} \{OEXT_i*OPriceW_i + MEXT_i*MPriceW_i - TCRcost_i - SPriceW_i\},$$

where $OEXT_i$ is the soybean oil extraction rate, $OPriceW_i$ is the domestic price of soy oil, $MEXT_i$ is the soybean meal extraction rate, $MPriceW_i$ is the domestic price of soy meal, and $SPriceW_i$ is the domestic price of the raw material (soybeans). Substituting (2) into (3) for the crush cost yields,

$$(4)\ \underset{SCrush_i}{\text{MAXIMIZE}} [OEXT_i*OPriceW_i + MEXT_i*MPriceW_i - SPriceW_i - \{SCrush_i*(0.1176*(SCrush_i/Cap_i)**2 - 21.356*(SCrush_i/Cap_i) + 1334.9) + FC_i\}].$$

Rather than solving explicitly for the crush demand, the optimization framework iterates to compute the profit maximizing quantity of oilseed crush. A non-deterministic approach is preferable, since the cost curves are nonlinear and it is difficult to obtain closed form solutions. Crush levels that exceed domestic production give rise to oilseed imports. Domestic oil, meal, and oilseed prices, which are influenced by world prices, transport costs, and tariffs (in the case of oils and oilseeds) affect the profit maximizing level of crush. Additionally, the ratio of the tariffs on oils to oilseeds affect the crush and oilseed import decision. All other things equal, an increase in the oil tariff relative to the oilseed tariff favors oilseed imports. Similarly, the ratio of world prices of the outputs (oil and meal) to world oilseed prices, coupled with the ratio of the transport costs of oils to oilseeds, will influence the oilseed import decision. This information is summarized in the crush margins that prevail in the domestic market.

It is important to note that, in the scenarios where oilseed imports are permitted, the wholesale price of oilseeds is *not* simply the lesser of the autarchy and import prices. Oilseed imports may be feasible at import prices that exceed the autarchy prices for two reasons: (1) unit crush costs will fall below the autarchy level because imports allow greater capacity use, (2) total processor profits rise above the autarchy level because oilseed imports allow substantially greater volumes of sales. If oilseed imports are feasible, i.e., profit enhancing even with raw material costs that are somewhat higher, then the domestic wholesale price of oilseeds equals the import price, even if it exceeds the autarchy price due to a tariff wedge and/or transport costs. Clearly, if the import price of oilseeds is too far above the autarchy level, then the benefits of importing oilseeds do not justify the costs and, in this case, the domestic wholesale price is the autarchy price.

# Appendix 2—
# India Oilseed Model: Equations and Variable List

## Oilseed Block

| | | | |
|---|---|---|---|
| (A.1) Oilseed Area | $SArea_i$ | = | $SA^1_i*lag(SArea_i) + SA^2_i*lag(SPriceF_i) + SA^0_i$ |
| (A.2) Oilseed Yield | $SYield_i$ | = | $SY^1_i*lag(SYield_i) + SY^2_i*lag(SPriceF_i) + SY^0_i$ |
| (A.3) Oilseed Production | $SProd_i$ | = | $SArea_i*SYield_i$ |
| (A.4) Non-crush demand | $SNonCrush_i$ | = | $NC_i*SProd_i$ |
| (A.5) Total Crush Cost | $TCRcost_i$ | = | $[CR^1_i*CapUtil_i**2 + CR^2_i*CapUtil_i + CR^0_i]*SCrush_i + FC_i$ |
| (A.6) Capacity utilization | $CapUtil_i$ | = | $SCrush_i/Cap_i$ |
| (A.7) Oilseed crush | $SCrush_i$ | = | { **Autarchy:**<br>$SProd_i - SNonCrush_i$<br><br>**Oilseed Trade:**<br>$\underset{SCrush_i}{MAX} \{OEXT_i*OPriceW_i + MEXT_i*MPriceW_i - TCRcost_i - SPriceW_i\}$ } |
| (A.8) Oilseed imports | $IMS_i$ | = | $SCrush_i + SNonCrush_i - SProd_i$ |

## Oil Block

| | | | |
|---|---|---|---|
| (A.9) Oil Production | $OProd_i$ | = | $OEXT_i*SCrush_i$ |
| (A.10) Oil Demand | $ODemand_i$ | = | $OD^1_i*OPriceW_i + OD^2_i*GDP + OD^3_i*OOPriceW_i + OD^0_i$ |
| (A.11) Oil imports (identity) | $IMOil_i$ | = | $ODemand_i - OProd_i$ |

## Meal Block

| | | | |
|---|---|---|---|
| (A.12) Meal Production | $MProd_i$ | = | $MEXT_i*SCrush_i$ |
| (A.13) Meal Demand | $MDemand_i$ | = | $MD^1_i*MPriceW_i + MD^2_i*GDP + MD^3_i*MMPriceW_i + MD^0_i$ |
| (A.14) Meal exports (identity) | $EXMeal_i$ | = | $MProd_i - MDemand_i$ |

## Oil, Meal, and Seed Price Block

| | | | |
|---|---|---|---|
| (A.15) Wholesale price of oil | $OPriceW_i$ | = | $(1+t_{Oi})*OPriceREF_i + Margin_{Oi}$ |
| (A.16) Oil margin | $Margin_{Oi}$ | = | $OCEAN_{Oi} + Inland_{Oi}$ |
| (A.17) Wholesale price of meal | $MPriceW_i$ | = | $MPriceREF_i - Margin_{Mi}$ |
| (A.18) Farm price of seed | $SPriceF_i$ | = | $SPriceW_i - SHandle_i$ |
| (A.19) Wholesale price of seed | $SPriceW_i$ | = | { **Autarchy**:<br>$OEXT_i*OPriceW_i + MEXT_i*MPriceW_i - TCRcost_i$<br><br>**Oilseed Trade**:<br>$SPriceREF_i*(1 + t_{Si}) + STRAN_i\}$ } |

## Variable List

| | |
|---|---|
| $SArea_i$ | Oilseed area |
| $SYield_i$ | Oilseed yield |
| $SProd_i$ | Oilseed production |
| $SNonCrush_i$ | Non-crush demand |
| $IMS_i$ | Oilseed imports |
| $SCrush_i$ | Oilseed crush |
| $TCRcost_i$ | Total crush cost |
| $CapUtil_i$ | Capacity utilization |
| $Cap_i$ | Oilseed processing capacity |
| $FC_i$ | Fixed cost |
| $OProd_i$ | Oil production |
| $OEXT_i$ | Oil extraction rate |
| $ODemand_i$ | Oil demand |
| $OPriceW_i$ | Wholesale price of oil (own-price) |
| $OOPriceW_i$ | Wholesale prices of competing oils |
| GDP | Gross domestic product per capita |
| $IMOil_i$ | Oil imports |
| $MProd_i$ | Meal production |
| $MEXT_i$ | Meal extraction rate |
| $MDemand_i$ | Meal demand |
| $MPriceW_i$ | Wholesale price of meal |
| $MMPriceW_i$ | Wholesale prices of competing meals and complements |
| $EXMeal_i$ | Meal exports |
| $t_{oi}$ | Oil tariff |
| $t_{si}$ | Oilseed tariff |
| $OPriceREF_i$ | Reference price of oil |
| $Margin_{oi}$ | Wholesale-reference price margin for oil (oil margin) |
| $OCEAN_{oi}$ | Ocean freight & insurance for oil imports |
| $Inland_{oi}$ | Inland transportation and marketing costs for oil |
| $MPriceW_i$ | Wholesale price of meal |
| $MPriceREF_i$ | Reference (border) price of meal |
| $Margin_{mi}$ | Reference-wholesale price margin for meal (meal margin) |
| $SPriceF_i$ | Farm price of oilseed |
| $SPriceW_i$ | Wholesale price of seed |
| $SHandle_i$ | Wholesale-farm price spread for oilseed |
| $SPriceREF_i$ | Reference (border) price of seed |
| $STRAN_i$ | Ocean freight plus inland transportation and handling cost for oilseed |

# Appendix 3—
# India Oilseed Model: Elasticities and Base Data

**Demand and supply elasticities.** Elasticities used in the model are given in appendix tables 3.1, 3.2, and 3.3, and are based on both ERS estimates and the literature. Existing literature does not provide formal estimates of demand elasticities for soybean, sunflower, and palm oils, which are relatively new in the Indian market, and time series price data provide relatively few observations for econometric estimation. Previous studies using household data provide elasticity estimates only for "edible oil" as an aggregate commodity group (Kumar, 1998; Dev et al. 2004). Narappanavar (1989) used time series data to estimate demand elasticities for traditional oils (rapeseed and peanut) and also provides a catalogue of estimates from previous studies. However, these studies are based on older time periods and do not capture substitution relationships between the traditional oils and new oils. The demand elasticities for this study are derived from a synthetic approach that generates a set of elasticities that are both theoretically consistent, and generate projections that roughly in line with recent historical data for 2001-05.

Existing literature does not provide elasticity estimates for India's domestic use of oilseed meals. For meals, initial estimates of domestic use were obtained using Ordinary Least Squares (OLS) and annual time-series data, with Gross Domestic Product (GDP) used as the shift variable and corn prices to represent the energy complement. Meal prices were export unit values, which are closely linked to domestic prices. The single-equation approach is less than ideal, but development of a more complete econometric system was judged too costly. Initial OLS estimates were then calibrated in accordance with the base year data and theoretical conditions.

In the context of poor data for generating reliable econometric estimates of the supply and demand elasticities needed for the analysis, the approach used—starting with available estimates, imposing theoretical consistency, and then calibrating the elasticities to replicate historical data—increases confidence in the model results. In calibrating the model, multiple combinations elasticities were experimented with and generated the same basic analytical outcomes.

**Base-year prices and quantities.** Base year prices and quantities used in the model are given in appendix table 3.4. Due to sharp weather-induced swings in production and market conditions in 2002 and 2003, as well as data limitations, 2001 was used as the base year because it is the most recent normal crop year for which data are available. Policy changes in the alternate scenarios are enacted in 2005 and maintained through the terminal year of the annual simulation (2011).

Model parameters replicate India's domestic prices and quantities in the 2001 base year. India's oil and meal extraction rates and domestic supply and use of oilseeds, meals, and oils are from the USDA PS&D Database. Domestic wholesale prices of the oilseeds and oils are published by the

Government of India, and domestic meal prices are from the Solvent Extractors'Association of India.

Through the projection period, India's real domestic wholesale prices of soybean oil are obtained from the vector of real world prices generated by the USDA Baseline (U.S. Dept. Agr., 2005c), adjusted by the tariff and the same margin that was used to replicate the base period. India's domestic soy meal prices are determined by adjusting the real world prices from the USDA Baseline by the same margin that was computed to replicate the base period. World prices for the oilseeds, the exchange rate for the rupee, and the GDP deflators through 2011 are from USDA baseline projections.

Appendix table 3.1

**Oil demand elasticities for India oilseed model**

| Commodity | Soy oil | Rape oil | Peanut oil | Sun oil | Palm oil | Income |
|---|---|---|---|---|---|---|
| Soy oil | **-0.44** | 0.03 | 0.01 | 0.04 | 0.02 | 0.50 |
| Rape oil | 0.04 | **-0.70** | 0.15 | 0.02 | 0.15 | 0.90 |
| Peanut oil | 0.00 | 0.09 | **-0.80** | 0.02 | 0.02 | 0.90 |
| Sun oil | 0.12 | 0.04 | 0.07 | **-0.30** | 0.01 | 1.00 |
| Palm oil | 0.00 | 0.08 | 0.01 | 0.00 | **-1.05** | 1.20 |

Appendix table 3.2

**Meal demand elasticities for India oilseed model**

| Commodity | Soy meal | Rape meal | Peanut meal | Sun meal | Total protein |
|---|---|---|---|---|---|
| Soy meal | **-1.60** | 0.04 | 0.00 | 0.01 | 1.70 |
| Rape meal | 0.12 | **-0.20** | 0.07 | 0.02 | 0.40 |
| Peanut meal | 0.10 | 0.10 | **-0.25** | 0.02 | 0.35 |
| Sun meal | 0.12 | 0.08 | 0.05 | **-0.30** | 0.43 |

Appendix table 3.3

**Farm supply elasticities for India oilseed model**

| | Soybeans | Rapeseed | Peanut | Sunflower | Tech chg. |
|---|---|---|---|---|---|
| Soybean area | **0.630** | 0 | -0.005 | 0 | -- |
| Yield | 0.003 | -- | -- | -- | 0.020 |
| Rapeseed area | 0 | **0.640** | -0.002 | 0 | -- |
| Yield | -- | 0.003 | -- | -- | 0.013 |
| Peanut area | -0.003 | -0.002 | **0.110** | -0.001 | -- |
| Yield | -- | -- | 0.00001 | -- | 0.004 |
| Sunflowerseed area | -0.001 | -0.0008 | -0.050 | **0.500*** | -- |
| Yield | -- | -- | -- | 0.0004 | 0.022 |

* Longrun elasticity; shortrun is 0.1.

Appendix table 3.4
**Base values for India oilseed model**

| Variable (Definition) | Unit | Soybeans | Rapeseed | Peanut | Sunflower | Palm oil |
|---|---|---|---|---|---|---|
| SArea (Oilseed area) | ha | 6,000,000 | 5,250,000 | 8,200,000 | 2,400,000 | -- |
| SYield (Oilseed yield) | kgs/ha | 0.9 | 0.9 | 0.9 | 0.6 | -- |
| SProd (Oilseed production) | mt | 5,400,000 | 4,500,000 | 7,600,000 | 1,450,000 | -- |
| SCrush (Oilseed crush) | mt | 4,629,000 | 3,985,000 | 5,750,000 | 1,325,000 | -- |
| SNonCrush (Noncrush demand) | mt | 202,000 | 310,000 | 560,622 | 0 | -- |
| IMS (Oilseed imports) | mt | 0 | 0 | 0 | 0 | -- |
| MProd (Meal production) | mt | 3,700,000 | 2,431,150 | 2,243,000 | 530,000 | -- |
| OProd (Oil production) | mt | 855,000 | 1,554,000 | 1,894,000 | 534,000 | -- |
| GDP (Per capita) | rs | 21,649 | 21,649 | 21,649 | 21,649 | 21,649 |
| ODemand (Oil demand) | mt | 2,405,000 | 1,559,000 | 1,894,000 | 584,000 | 3,400,000 |
| IMOil (Oil imports) | mt | 1,550,000 | 5,000 | 0 | 50,000 | 3,400,000 |
| MDemand (Meal demand) | mt | 1,250,000 | 2,121,000 | 2,143,000 | 518,000 | -- |
| EXMeal (Meal exports) | mt | 2,450,000 | 310,150 | 100,000 | 12,000 | -- |
| SPriceW (Wholesale price seed) | rs/mt | 9,924 | 13,139 | 15,668 | 12,622 | -- |
| OPriceW (Wholesale price oil) | rs/mt | 30,818 | 33,078 | 42,908 | 40,250 | 26,160 |
| MPriceW (Wholesale price meal) | rs/mt | 8,118 | 6,097 | 7,119 | 5,117 | -- |
| $t_O$ (Oil tariff) | % | 0.45 | 0.75 | 0.75 | 0.75 | 0.65 |
| OPriceREF (Reference price oil) | rs/mt | 15,809 | 17,515 | 32,222 | 20,131 | 13,481 |
| SPriceF (Farm price oilseed) | rs/mt | 9,545 | 12,760 | 13,844 | 12,243 | -- |
| $t_S$ (Oilseed tariff) | % | 0.30 | 0.30 | 0.30 | 0.30 | -- |
| SPriceREF (Reference price seed) | rs/mt | 9,428 | 9,507 | 29,254 | 10,318 | -- |
| TCRcost (Total crush cost) | rs/mt | 800 | 1,186 | 1,112 | 850 | -- |
| Cap (Crush capacity) | mt | 15,430,000 | 13,283,333 | 19,166,666 | 4,416,667 | -- |
| CapUtil (Capacity utilization) | % | 30 | 30 | 30 | 30 | -- |
| FC (Fixed cost) | rs/mt | 225 | 200 | 200 | 225 | -- |
| OEXT (Oil extraction rate) | % | 18 | 39 | 33 | 40 | -- |
| MEXT (Meal extraction rate) | % | 80 | 61 | 39 | 40 | -- |
| $Margin_O$ (Wholesale-reference price margin for oil) | rs/mt | 7,895 | 2,426 | -- | 3,916 | 5,021 |
| $OCEAN_O$ (Ocean freight & insurance for oil imports) | rs/mt | 1,457 | 1,457 | -- | 1,457 | 1,222 |
| $Inland_O$ (Inland transport & marketing costs for oil) | rs/mt | 6,438 | 969 | -- | 2,459 | 3,799 |
| MPriceREF (Reference (border) price of meal) | rs/mt | 8,844 | 6,612 | 5,450 | 5,549 | -- |
| $Margin_M$ (Reference-wholesale price margin for meal) | rs/mt | 726 | 515 | -1,669 | 432 | -- |
| STRAN (Ocean freight, inland transport & handling cost for seeds) | rs/mt | 1,974 | 1,974 | -- | 1,974 | -- |

-- = Not required.

Appendix table 4.1

**Detailed results for the soybean sector**

| Variable (Unit) | Base year 2001 | Reference scenario 2011 | Change over reference in 2011 (Percent): Change oil tariffs: Increase 10 percent | Decrease 10 percent | Oilseed price support: Processor pays | Government pays | Oilseed import liberalization | Processor consoli-dation | Composite scenario: Consumer benefits | Producer benefits |
|---|---|---|---|---|---|---|---|---|---|---|
| **Soybeans:** | | | | | | | | | | |
| Area (1,000 ha) | 6,000 | 6,529 | 2.7 | -2.7 | 2.8 | 2.8 | 4.1 | 1.8 | 4.1 | 7.1 |
| Yield (Tons/ha) | 0.9 | 1.13 | 0.1 | -0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.1 | 0.2 |
| Production (1,000 tons) | 5,400 | 7,400 | 2.8 | -2.8 | 2.9 | 2.9 | 4.1 | 1.9 | 4.1 | 7.2 |
| Imports (1,000 tons) | 0 | 0 | [1] | [1] | [1] | [1] | [2] | [1] | [2] | [3] |
| Crush (1,000 tons) | 4,629 | 6,223 | 3.0 | -3.0 | 3.1 | 3.1 | 133.1 | 2.0 | 133.1 | 133.1 |
| Farm price (Rs/ton) | 9,545 | 10,266 | 4.1 | -4.1 | 4.2 | 4.2 | 7.5 | 2.9 | 7.5 | 10.9 |
| **Processing sector:** | | | | | | | | | | |
| Utilization (Percent) | 30 | 40 | 3.0 | -3.0 | 3.1 | 3.1 | 133.1 | 133.1 | 133.1 | 133.1 |
| Crush margin (Rs/ton) | 2,257 | 2,122 | -0.7 | 0.7 | -20.3 | -0.7 | -36.4 | -14.1 | -51.6 | -52.9 |
| Processing cost: | | | | | | | | | | |
| Seed cost (Rs/ton) | 9,924 | 10,645 | 3.9 | -3.9 | 4.1 | 0.1 | 7.3 | 2.8 | 7.3 | 10.5 |
| Avg. cost (Rs/ton) | 800 | 665 | -2.1 | 2.2 | -2.2 | -2.2 | -44.9 | -44.9 | -44.9 | -44.9 |
| Unit surplus (Rs/ton) | 1,457 | 1,457 | 0.0 | 0.0 | -28.6 | 0.0 | -32.6 | 0.0 | -54.6 | -56.6 |
| Quasi-profit (Rs mil.) | 6,744 | 9,067 | 3.0 | -3.0 | -26.4 | 3.1 | 57.2 | 2.0 | 5.7 | 1.3 |
| **Soy oil sector:** | | | | | | | | | | |
| Consumption (1,000 tons) | 2,405 | 2,854 | -2.1 | 2.1 | 0.0 | 0.0 | 0.0 | 0.0 | 2.1 | 0.0 |
| Production (1,000 tons) | 855 | 1,149 | 3.0 | -3.0 | 3.1 | 3.1 | 133.1 | 2.0 | 133.1 | 133.1 |
| Imports (1,000 tons) | 1,550 | 1,705 | -5.6 | 5.6 | -2.1 | -2.1 | -89.7 | -1.4 | -86.2 | -89.7 |
| Wholesale price (Rs/ton) | 30,818 | 39,450 | 5.5 | -5.5 | 0.0 | 0.0 | 0.0 | 0.0 | -4.4 | 0.0 |
| **Soy meal sector:** | | | | | | | | | | |
| Consumption (1,000 tons) | 1,250 | 2,778 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Production (1,000 tons) | 3,700 | 4,974 | 3.0 | -3.0 | 3.1 | 3.1 | 133.1 | 2.0 | 133.1 | 133.1 |
| Exports (1,000 tons) | 2,450 | 2,196 | 6.7 | -6.7 | 7.0 | 7.0 | 301.4 | 4.5 | 301.4 | 301.4 |
| Wholesale price (Rs/ton) | 8,118 | 6,856 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

[1] No change from reference scenario.
[2] Imports increase to 8.01 million tons.
[3] Imports increrase to 7.80 million tons.
Source: ERS-India oilseed sector model.

Appendix table 4.2
## Detailed results for the rapeseed sector

| Variable (Unit) | Base year 2001 | Reference scenario 2011 | Change over reference in 2011 (Percent): Change oil tariffs | | Oilseed price support | | Oilseed import liberalization | Processor consoli-dation | Composite scenario | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Increase 10 percent | Decrease 10 percent | Processor pays | Government pays | | | Consumer benefits | Producer benefits |
| **Rapeseed:** | | | | | | | | | | |
| Area (1,000ha) | 5,250 | 5,785 | 3.8 | -3.8 | 3.9 | 3.9 | 0.0 | 1.6 | 0.3 | 0.7 |
| Yield (Tons/ha) | 0.9 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Production (1,000 tons) | 4,500 | 5,812 | 3.9 | -3.8 | 3.9 | 3.9 | 0.0 | 1.6 | 0.3 | 0.7 |
| Imports (1,000 tons) | 0 | 0 | [1] | [1] | [1] | [1] | [2] | [1] | [3] | [4] |
| Crush (1,000 tons) | 3,985 | 5,042 | 4.2 | -4.2 | 4.3 | 4.3 | 10.0 | 1.8 | 10.3 | 10.0 |
| Farm price (Rs/ton) | 12,760 | 16,787 | 5.8 | -5.8 | 5.9 | 5.9 | 0.0 | 2.3 | 0.8 | 1.5 |
| **Processing sector:** | | | | | | | | | | |
| Utilization (Percent) | 30 | 38 | 4.2 | -4.2 | 4.3 | 4.3 | 14.6 | 147.5 | 14.9 | 14.6 |
| Crush margin (Rs/ton) | 3,480 | 3,338 | -0.8 | 0.8 | -29.9 | -0.8 | 0.0 | -11.6 | -7.9 | -7.6 |
| Processing cost: | | | | | | | | | | |
| Seed cost (Rs/ton) | 13,139 | 17,166 | 5.7 | -5.7 | 5.8 | 0.2 | 0.0 | 2.3 | 0.8 | 1.5 |
| Avg. cost (Rs/ton) | 1,186 | 1,044 | -2.5 | 2.6 | -2.5 | -2.6 | -8.2 | -37.0 | -8.4 | -8.2 |
| Unit surplus (Rs/ton) | 2,294 | 2,294 | 0.0 | 0.0 | -42.3 | 0.0 | 3.7 | 0.0 | -7.6 | -7.4 |
| Quasi-profit (Rs mil.) | 9,142 | 11,566 | 4.2 | -4.2 | -39.8 | 4.3 | 14.1 | 1.8 | 1.9 | 1.9 |
| **Rapeseed oil:** | | | | | | | | | | |
| Consumption( 1,000 tons) | 1,559 | 2,162 | -2.6 | 2.7 | 0.0 | 0.0 | 0.0 | -0.1 | 0.3 | 0.0 |
| Production (1,000 tons) | 1,554 | 1,966 | 4.2 | -4.2 | 4.3 | 4.3 | 10.0 | 1.8 | 10.3 | 10.0 |
| Imports (1,000 tons) | 5 | 196 | -71.8 | 71.4 | -43.7 | -43.7 | -100.0 | -18.5 | -100.0 | -100.0 |
| Wholesale price (Rs/ton) | 33,078 | 44,781 | 5.4 | -5.4 | 0.0 | 0.0 | 0.0 | 0.0 | -0.7 | 0.0 |
| **Rapeseed meal:** | | | | | | | | | | |
| Consumption (1,000 tons) | 2,121 | 2,621 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Production (1,000 tons) | 2,431 | 3,076 | 4.2 | -4.2 | 4.3 | 4.3 | 10.0 | 1.8 | 10.3 | 10.0 |
| Exports (1,000 tons) | 310 | 455 | 28.7 | -28.4 | 29.3 | 29.3 | 67.4 | 12.1 | 69.9 | 67.4 |
| Wholesale price (Rs/ton) | 6,097 | 4,985 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

[1] No change from reference scenario.
[2] Imports rise to 0.50 million tons.
[3] Imports rise to 0.51 million tons.
[4] Imports rise to 0.46 million tons.
Source: ERS-India oilseed sector model.

Appendix table 4.3

**Detailed results for the peanut sector**

| Variable (Unit) | Base year 2001 | Reference scenario 2011 | Change over reference in 2011 (Percent) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Change oil tariffs | | Oilseed price support | | Oilseed import liberalization | Processor consoli-dation | Composite scenario | |
| | | | Increase 10 percent | Decrease 10 percent | Processor pays | Government pays | | | Consumer benefits | Producer benefits |
| **Peanuts:** | | | | | | | | | | |
| Area (1,000 ha) | 8,200 | 9,183 | 0.1 | -0.2 | 0.1 | 0.1 | 0.0 | 0.3 | 0.0 | 0.0 |
| Yield (Tons/ha) | 0.9 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Production (1,000 tons) | 7,600 | 8,859 | 0.1 | -0.2 | 0.1 | 0.1 | 0.0 | 0.3 | 0.0 | 0.0 |
| Imports (1,000 tons) | 0 | 0 | [1] | [1] | [1] | [1] | [1] | [1] | [1] | [1] |
| Crush (1,000 tons) | 5,750 | 6,855 | 0.1 | -0.2 | 0.1 | 0.1 | 0.0 | 0.3 | 0.0 | 0.0 |
| Farm price (Rs/ton) | 13,844 | 20,113 | 0.7 | -0.6 | 0.5 | 0.5 | 0.0 | 1.4 | 0.0 | 0.0 |
| **Processing sector:** | | | | | | | | | | |
| Utilization (Percent) | 30 | 36 | 0.1 | -0.2 | 0.1 | 0.1 | 0.0 | 162.8 | 0.0 | 0.0 |
| Crush margin (Rs/ton) | 1,243 | 1,158 | -0.1 | 0.1 | -11.4 | 0.0 | 0.0 | -30.1 | 0.0 | 0.0 |
| Processing cost: | | | | | | | | | | |
| Seed cost (Rs/ton) | 15,668 | 21,937 | 0.6 | -0.6 | 0.5 | -0.1 | 0.0 | 1.3 | 0.0 | 0.0 |
| Avg. cost (Rs/ton) | 1,112 | 1,027 | -0.1 | 0.1 | -0.1 | -0.1 | 0.0 | -33.9 | 0.0 | 0.0 |
| Unit surplus (Rs/ton) | 131 | 131 | 0.0 | 0.0 | -100.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Quasi-profit (Rs mil.) | 753 | 898 | 0.1 | -0.2 | -100.4 | 0.1 | 0.0 | 0.3 | 0.0 | 0.0 |
| **Peanut oil:** | | | | | | | | | | |
| Consumption (1,000 tons) | 1,894 | 2,258 | 0.1 | -0.2 | 0.1 | 0.1 | 0.0 | 0.3 | 0.0 | 0.0 |
| Production (1,000 tons) | 1,894 | 2,258 | 0.1 | -0.2 | 0.1 | 0.1 | 0.0 | 0.3 | 0.0 | 0.0 |
| Imports (1,000 tons) | 0 | 0 | [1] | [1] | [1] | [1] | [1] | [1] | [1] | [1] |
| Wholesale price (Rs/ton) | 42,908 | 62,604 | 0.6 | -0.6 | -0.1 | -0.1 | 0.0 | -0.3 | 0.0 | 0.0 |
| **Peanut meal:** | | | | | | | | | | |
| Consumption (1,000 tons) | 2,143 | 2,554 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Production (1,000 tons) | 2,243 | 2,674 | 0.1 | -0.2 | 0.1 | 0.1 | 0.0 | 0.3 | 0.0 | 0.0 |
| Exports (1,000 tons) | 100 | 120 | 3.2 | -3.7 | 2.5 | 2.5 | -0.5 | 7.3 | -0.9 | -0.8 |
| Wholesale price (Rs/ton) | 7,119 | 6,342 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

[1] No change from reference scenario.

Source: ERS-India oilseed sector model.

Appendix table 4.4
## Detailed results for the sunflower sector

| Variable (Unit) | Base year 2001 | Reference scenario | Change over reference in 2011: Change oil tariffs | | Oilseed price support | | | | Composite scenario | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Increase 10 percent | Decrease 10 percent | Processor pays | Government pays | Oilseed import liberalization | Processor consoli-dation | Consumer benefits | Producer benefits |
| **Sunflower seed:** | | | | | | | | | | |
| Area (1,000ha) | 2,400 | 3,116 | 2.1 | -2.3 | 2.3 | 2.0 | 1.3 | 0.5 | 1.1 | 1.3 |
| Yield (Tons/ha) | 0.6 | 0.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Production (1,000 tons) | 1,450 | 2,352 | 2.1 | -2.3 | 2.3 | 2.0 | 1.3 | 0.5 | 1.1 | 1.3 |
| Imports (1,000 tons) | 0 | 0 | [1] | [1] | [1] | [1] | [2] | [1] | [3] | [1] |
| Crush (1,000 tons) | 1,325 | 2,149 | 2.1 | -2.3 | 2.3 | 2.0 | 11.4 | 0.5 | 10.9 | 11.4 |
| Farm price (Rs/ton) | 12,243 | 12,131 | 7.0 | -7.0 | 7.1 | 7.1 | 6.4 | 2.5 | 6.4 | 6.4 |
| **Processing sector:** | | | | | | | | | | |
| Utilization (Percent) | 30 | 49 | 2.1 | -2.3 | 2.3 | 2.0 | 11.4 | 91.8 | 10.9 | 11.4 |
| Crush margin (Rs/ton) | 5,646 | 5,511 | -0.3 | 0.3 | -15.6 | -0.3 | -14.1 | -5.4 | -14.1 | -14.1 |
| Processing cost: | | | | | | | | | | |
| Seed cost (Rs/ton) | 12,622 | 12,510 | 6.8 | -6.8 | 6.9 | 0.1 | 6.2 | 2.4 | 6.2 | 6.2 |
| Avg. cost (Rs/ton) | 850 | 715 | -2.0 | 2.0 | -2.0 | -2.0 | -41.7 | -41.7 | -41.7 | -41.7 |
| Unit surplus (Rs/ton) | 4,796 | 4,796 | 0.0 | 0.0 | -17.7 | 0.0 | -10.0 | 0.0 | -10.0 | -10.0 |
| Quasi-profit (Rs mil.) | 6,355 | 10,309 | 2.1 | -2.3 | -15.8 | 2.0 | 0.3 | 0.5 | -0.2 | 0.3 |
| **Sunflower oil:** | | | | | | | | | | |
| Consumption (1,000 tons) | 584 | 965 | -0.2 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | -0.4 | 0.0 |
| Production (1,000 tons) | 534 | 866 | 2.1 | -2.3 | 2.3 | 2.0 | 11.4 | 0.5 | 10.9 | 11.4 |
| Imports (1,000 tons) | 50 | 98 | -20.4 | 22.4 | -20.5 | -17.9 | -100.0 | -4.4 | -100.0 | -100.0 |
| Wholesale price (Rs/ton) | 40,250 | 41,166 | 5.0 | -5.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Sunflower meal:** | | | | | | | | | | |
| Consumption (1,000 tons) | 518 | 673 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Production (1,000 tons) | 530 | 860 | 2.1 | -2.3 | 2.3 | 2.0 | 11.4 | 0.5 | 10.9 | 11.4 |
| Exports (1,000 tons) | 12 | 186 | 9.7 | -10.8 | 10.7 | 9.3 | 52.4 | 2.2 | 50.2 | 52.4 |
| Wholesale price (Rs/ton) | 5,117 | 3,575 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

[1] No change from reference scenario.
[2] Imports rise to 0.22 million tons.
[3] Imports rise to 0.21 million tons.
Source: ERS-India oilseed sector model.

Appendix table 4.5

## Detailed results for palm oil

| Variable (Unit) | Base year 2001 | Reference scenario 2011 | Change over reference in 2011 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Change oil tariffs | | Oilseed price support | | Oilseed import liberalization | Processor consoli-dation | Composite scenario | |
| | | | Increase 10 percent | Decrease 10 percent | Processor pays | Government pays | | | Consumer benefits | Producer benefits |
| **Palm oil:** | | | | | | | | | | |
| Consumption (1,000 tons) | 3,400 | 5,036 | -4.2 | 4.2 | 0.0 | 0.0 | 0.0 | 0.0 | -0.1 | 0.0 |
| Production (1,000 tons) | 0 | 0 | [1] | [1] | [1] | [1] | [1] | [1] | [1] | [1] |
| Imports (1,000 tons) | 3,400 | 5,036 | -4.2 | 4.2 | 0.0 | 0.0 | 0.0 | 0.0 | -0.1 | 0.0 |
| Wholesale price (Rs/ton) | 26,160 | 32,307 | 5.3 | -5.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

1 No change from reference scenario.
Source: ERS-India oilseed sector model.

Appendix table 4.6
**Selected aggregate results**

| Variable (Unit) | Base year 2001 | Reference scenario | Change over reference in 2011: Change oil tariffs: Increase 10 percent | Change oil tariffs: Decrease 10 percent | Oilseed price support: Processor pays | Oilseed price support: Government pays | Oilseed import liberalization | Processor consoli-dation | Composite scenario: Consumer benefits | Composite scenario: Producer benefits |
|---|---|---|---|---|---|---|---|---|---|---|
| **Total oilseed:** | | | | | | | | | | |
| Area (1,000ha) | 21,850 | 24,612 | 1.9 | -2.0 | 2.0 | 2.0 | 1.2 | 1.0 | 1.3 | 2.2 |
| Yield (Tons/ha) | 0.87 | 0.99 | 0.1 | -0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.3 |
| Production (1,000 tons) | 18,950 | 24,423 | 2.0 | -2.0 | 2.1 | 2.0 | 1.4 | 1.1 | 1.4 | 2.5 |
| Imports (1,000 tons) | 0 | 0 | [1] | [1] | [1] | [1] | [2] | [1] | [2] | [3] |
| Crush (1,000 tons) | 15,689 | 20,269 | 2.2 | -2.3 | 2.3 | 2.3 | 44.5 | 1.2 | 44.6 | 44.5 |
| Farm price (Rs/ton) | 12,239 | 15,569 | 2.9 | -2.8 | 2.9 | 2.9 | 1.6 | 1.9 | 1.8 | 2.4 |
| Value of farm prod. (Million Rs) | 231,925 | 380,241 | 5.0 | -4.8 | 5.1 | 5.0 | 3.0 | 3.0 | 3.2 | 5.0 |
| **Processing sector:** | | | | | | | | | | |
| Quasi-profit (Million Rs) | .22,994 | 31,840 | 3.1 | -3.1 | -29.9 | 3.1 | 21.5 | 1.4 | 2.3 | 1.1 |
| **Total oil sector:** | | | | | | | | | | |
| Consumption (1,000 tons) | 9,842 | 13,275 | -2.5 | 2.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 | 0.0 |
| Production (1,000 tons) | 4,837 | 6,240 | 2.2 | -2.3 | 2.3 | 2.3 | 29.2 | 1.1 | 29.3 | 29.2 |
| Imports (1,000 tons) | 5,005 | 7,036 | -6.7 | 6.7 | -2.0 | -2.0 | -25.9 | -0.9 | -25.1 | -25.9 |
| Wholesale price (Rs/ton) | 32,453 | 41,671 | 4.5 | -4.5 | 0.0 | 0.0 | 0.0 | -0.1 | -1.1 | 0.0 |
| **Total meal sector:** | | | | | | | | | | |
| Consumption (1,000 tons) | 6,032 | 8,626 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Production (1,000 tons) | 8,904 | 11,584 | 2.6 | -2.6 | 2.7 | 2.7 | 60.6 | 1.4 | 60.7 | 60.6 |
| Exports (1,000 tons) | 2,872 | 2,958 | 10.2 | -10.2 | 10.5 | 10.4 | 237.5 | 5.7 | 237.7 | 237.5 |
| Wholesale price (Rs/ton) | 7,136 | 5,997 | -0.1 | 0.1 | -0.1 | -0.1 | 4.6 | 0.0 | 4.6 | 4.6 |

[1] No change.
[2] Imports rise to 8.7 million tons.
[3] Imports rise to 8.5 million tons.
Source: ERS-India oilseed sector model.