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.

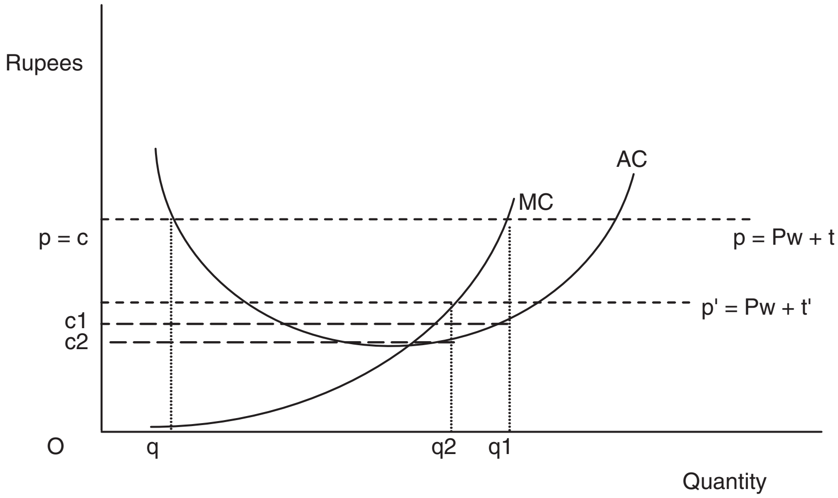
India's demands for the various oils and meals are linear functions of income, own-price, and substitutes. Farm production of the oilseeds is an identity, computed as the product of area and yield. Crop areas are specified as functions of lagged own-price and competing crop prices. For soybeans and rapeseed, 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	$SCrush_i$	=	$\left\{ \begin{array}{l} \textbf{Autarchy:} \\ SProd_i - SNonCrush_i \\ \\ \textbf{Oilseed Trade:} \\ \underset{SCrush_i}{MAX} \left\{ \begin{array}{l} OEXT_i * OPriceW_i + MEXT_i * MPriceW_i \\ - TCRcost_i - SPriceW_i \end{array} \right\} \end{array} \right\}$
(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	$SPriceW_i$	=	$\left\{ \begin{array}{l} \textbf{Autarchy}: \\ OEXT_i * OPriceW_i + MEXT_i * MPriceW_i - \\ TCRcost_i \\ \\ \textbf{Oilseed Trade}: \\ SPriceREF_i * (1 + t_{Si}) + STRAN_i \} \end{array} \right\}$

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				Composite scenario	
			Increase 10 percent	Decrease 10 percent	Processor pays	Government pays	Oilseed import liberalization	Processor consoli-dation	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: 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
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	Decrease 10 percent	Oilseed price support: Processor pays	Government pays	Oilseed import liberalization	Processor consoli- dation	Composite scenario: Consumer benefits	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.