CHAPTER - IV

SOURCES OF DATA AND MEASUREMENT OF VARIABLES

The equations, developed for the proposed model to estimate the parameters of the various relations such as acreage response relation, production relation, demand relation and relations for price mechanism and price variations for each of the six major oilseeds crops, grown in India, have been described in the Chapter III. The success of the model is, however, constrained by availability of data which most suited to variables conceptually specified in the model. The subject of this chapter relates to the statistical data used in the estimation of various (above mentioned) relations of oil and oilseeds economy of India. Besides the sources of data, some preliminary calculations to derive measurement of relevant variables are also described.

The important variables used in this study are acreages, productions, and yields of six major oilseeds crops and their major competing crops, farm harvest prices, wholesale and retail oil prices, rainfall during sowing and growing seasons, technological variables like fertilizer consumption and percentage of irrigation, per capita incomes, estimates of population, exports and imports of
oils and actions against illegal traders/oil millers.

All the variables used in the study relate to national level of aggregation.

1. Acreage \(Y_{1t}\), Production \(Y_{2t}\) and Yield \(X_{2,t-1}\)

Estimation of the acreage sown (in hectares) and yield per hectare (in kgs) for each of the six major oilseeds and their major substitute crops are required for the estimation of acreage response relation. Reliable time series data for the period 1950-51 to 1978-79 on the State and National level of aggregations are available from the following publications of Government of India, Directorate of Economics and Statistics, Ministry of Food and Agriculture:

i) Estimates of Area and Production of Principal Crops in India, Vol. II

ii) Bulletin on Commercial Crops Statistics (Various issues)

iii) Indian Agricultural Statistics Vols. I & II

iv) Agricultural Situation in India (monthly) (various issues)

On the basis of preliminary analysis of state level data, regional preferences etc., the crops that are considered as major competing crops for each of the six
major oilseeds are presented in Table - 4.1

\[
\text{TABLE - 4.1}
\]

Major Oilseeds and their Competing Crops Grown in India

<table>
<thead>
<tr>
<th>Oilseed</th>
<th>Competing Crops</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groundnut</td>
<td>Jowar, Bajra, Maize, Ragi and Cotton</td>
</tr>
<tr>
<td>Rape/Mustard</td>
<td>Jowar, Gram, Wheat and Barley</td>
</tr>
<tr>
<td>Sesamum</td>
<td>Jowar, Maize, Bajra, Gram and Cotton</td>
</tr>
<tr>
<td>Castorseed</td>
<td>Jowar, Bajra and Maize</td>
</tr>
<tr>
<td>Cotton (Seed)</td>
<td>Jowar, Wheat, Sesamum and Groundnut</td>
</tr>
</tbody>
</table>

2. Relative Lagged Farm Harvest Prices \( (X_{1,t-1}) \):

Farm harvest prices are received by farmers during post-harvest period of the concerned crop. The post-harvest period includes six to eight weeks after the normal harvesting period. Since most of the farmers sell their cash crops soon after the harvest, the farm harvest prices are considered as more suitable to represent the true prices received by the farmers. Z.Y. Jasadanwala\(^1\) and S.L. Bapna\(^2\) have arrived at this very conclusion.

For the purpose of estimating acreage response relation, these prices are considered for the present study. The

1. Jasadanwala Z.Y. Marketing Efficiency in Indian Agriculture, Bombay, Allied Publishers, 1966,
state level farm harvest prices of each of the six oilseeds crops and of their major competing crops were taken from various issues of the following publications of Government of India, Directorate of Economics and Statistics, Ministry of Food and Agriculture.

(i) Farm Harvest Prices of Principal Crops in India (Periodicals)

(ii) Agricultural Prices in India

(iii) Agricultural Situation in India (various Issues)

Then, the relative farm harvest prices for each of the six oilseeds were computed by dividing individual oilseed's farm harvest prices by the farm harvest price index of competing crops. In the case of groundnut, this is described as follows:

First, all India weighted average farm harvest prices of groundnut were obtained by using the production figures of the major producing states as weights. The major groundnut producing states are (i) Andhra Pradesh (ii) Tamil Nadu (iii) Gujarat (iv) Karnataka (v) Maharashtra (vi) Madhya Pradesh and (vii) Uttar Pradesh. These states together produce more than 90 per cent of the total production.
Similarly, all India weighted average farm harvest prices of major competing crops were obtained by using production figures of the major producing states as weights. Then, weighted average farm harvest price index for the competing crops (price index of competing crops) were obtained by taking acreages under each of these (competing) crops as weights. For all these crops, the prices are expressed in rupees per quintal.

Then, the relative farm harvest price for groundnut were obtained by deflating the farm harvest price of groundnut by the price index of competing crops. Thus

\[
\text{Relative Lagged Farm Harvest Price of groundnut} (X_{1,t-1}) = \frac{\text{Farm harvest price of groundnut}}{\text{Price index of competing crops}}. 
\]

Then, the index of these relative prices were worked out by taking 1970-71 as the base year i.e. 
\[1970-71 = 100.\]

Similar calculations have been carried out to get relative farm harvest price indices for Rape/ Mustard, Sesamum, Linseed, Castor and Cotton, considering the major producing states (see Table 4.2) of each of the oilseeds.
Oilseeds are mostly rainfed crops in India. Past experience shows that fluctuations in area and production are broadly similar to the pattern of fluctuations in rainfall, particularly during sowing and growing seasons. An analysis of the impact of rainfall distribution pattern during sowing and growing stages of the crop is crucial. Instead of considering the annual rainfall, an attempt has been made to isolate that component of the annual rainfall which is relevant or effective for acreage allocation and production of oilseed under question. For acreage allocation, rainfall during sowing period is considered and for estimating production relation rainfall during growing season is considered as relevant and effective.

The actual monthly rainfall statistics were collected from the reports of the Indian Meteorological Department, Poona, as published in various issues of Agricultural Situation in India, Bulletins on Commercial Crops Statistics published by the Government of India, Directorate of Economics and Statistics. These rainfall figures are expressed in millimetres.

The rainfall indices for these two periods were obtained as weighted average rainfall of major producing states for each of the respective periods of six oilseeds. The weighted average rainfall figures during sowing season were computed by taking the average of state's actual rainfall with acreage under each of the oilseeds crops in each of the major producing states as weights. Similar analysis has been carried out to work out the weighted average rainfall figures for the national level during growing season for each of the six oilseeds using production figures as weights. The sowing season months, growing season months, the weights used and major producing states of each of the six oilseeds are presented in the Table 4.2.

4. Areas under Irrigation ($X_{4t}, X_{9t}$):

Irregular monsoon and lack of assured water supply are two main factors responsible for wide fluctuations in agricultural production.\(^4\) The extension of irrigation facilities plays a vital role in enhancing the agricultural production and cropping intensity.\(^5\) The area under


<table>
<thead>
<tr>
<th>S No.</th>
<th>Oil Seed</th>
<th>Sowing Season</th>
<th>Growing Season</th>
<th>Major Producing States</th>
<th>Weights used in calculating average rainfall during sowing season growing season</th>
<th>Acreage under Production of</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Groundnut</td>
<td>June, July</td>
<td>July, August, September</td>
<td>Gujarat, Tamil Nadu, Andhra Pradesh, Karnataka, Madhya Pradesh, and Uttar Pradesh</td>
<td></td>
<td>Acreage under groundnut Production of groundnut</td>
</tr>
<tr>
<td>2.</td>
<td>Rape/Mustard</td>
<td>September, October, November, December</td>
<td></td>
<td>Uttar Pradesh, Rajasthan, Madhya Pradesh, Punjab, Assam, Bihar</td>
<td></td>
<td>Acreage under rape/mustard Production of rape/mustard</td>
</tr>
<tr>
<td>3.</td>
<td>Sesamum</td>
<td>June, July, September</td>
<td></td>
<td>Uttar Pradesh, Madhya Pradesh, Gujarat, Madhya Pradesh, Andhra Pradesh, Tamil Nadu, Karnataka, Rajasthan</td>
<td></td>
<td>Acreage under Sesamum Production of Sesamum</td>
</tr>
<tr>
<td>4.</td>
<td>Linseed</td>
<td>October, November, December, January</td>
<td></td>
<td>Bihar, Uttar Pradesh, Rajasthan, Madhya Pradesh, Maharashtra, Andhra Pradesh, Karnataka</td>
<td></td>
<td>Acreage under Linseed Production of Linseed</td>
</tr>
<tr>
<td>5.</td>
<td>Castorseed</td>
<td>July, August, November, September, December</td>
<td></td>
<td>Bihar, Madhya Pradesh, Gujarat, Andhra Pradesh, Karnataka, Tamil Nadu</td>
<td></td>
<td>Acreage under Castorseed Production of Castorseed</td>
</tr>
<tr>
<td>6.</td>
<td>Cotton</td>
<td>July, August, September, December</td>
<td></td>
<td>Gujarat, Madhya Pradesh, Andhra Pradesh, Tamil Nadu, Karnataka, Punjab, Rajasthan</td>
<td></td>
<td>Acreage under Cotton Production of Cotton</td>
</tr>
</tbody>
</table>

Source: Based on various issues of Bulletin on Commercial Crops, Directorate of Economics & Statistics, Government of India.
irrigation has an important bearing on acreage allocation and production of oilseed crops. For acreage response relation, the irrigation variable is measured by the percentage of area under irrigation at the national level. This will help us to know to what extent a given increase in the national level of irrigation goes in favour of a particular oilseed crop under question. The percentage of area under irrigation by all crops is taken to be the ratio of gross irrigated area to gross sown area i.e.

\[
\text{Percentage of Irrigation in the year } t \left( X_{4t} \right) = \frac{\text{Gross Irrigated Area}}{\text{Gross Sown Area}}.
\]

In the case of production relation, the irrigation variable used is the percentage of concerned oilseed area under irrigation to the total area under that crop. This helps us to know the effect of irrigated area on production. This variable is defined as

\[
\text{Percentage of Irrigated area to the total cropped Area of concerned oilseed in the year } 't' \left( X_{9t} \right) = \frac{\text{Irrigated Area of concerned oilseed}}{\text{Total Area under concerned oilseed}}.
\]

The data on irrigation were collected by referring to various issues of Bulletin on Commercial Crops Statistics, Agricultural Situation in India, Estimates of Area, Production of Principal Crops-published by

5. Price Risk \( (X_{5,t-1}) \) and Yield Risk \( (X_{6,t-1}) \):

In acreage response relation a crude representation of farmer's behaviour regarding risk aversion factors is introduced. Behrman for the first time, has introduced these variables in the form of standard deviations of price and yield in his modified Nerlovian dynamic supply response model. The three yearly standard deviations for farm harvest price of the concerned oilseed, relative to the three yearly standard deviations for farm harvest price index of competing crops and standard deviations for yields measured over three past years, are included as proxies for the variability measures of the subjective probability distributions for prices and yields respectively. Since the farm prices of concerned oilseeds and price indices of competing crops for each of the six oilseeds were already calculated, the three yearly moving standard deviations were computed without much difficulty. Similarly, three yearly moving standard deviations for the yield were worked out.

6. Fertilizer Consumption \( (X_{3t}) \):

The chemical fertilizer is considered to be one of the important determinants of crop yield.

The actual consumption of N.P.K. has been considered to measure the impact of chemical fertilizer on production of oilseeds. Data on fertilizer consumption has been taken from the Fertilizer Association of India, New Delhi.

7. Domestic supply of oil \( (Y_{3t}) \):

Domestic supply of oil under question is taken to be a constant proportion of seeds/kernels available for crushing after adjusting that part of production which is used for the purposes of direct consumption and exports. In the case of groundnuts, the production figures are adjusted as follows to get the estimated indigenous production of oil. The groundnuts in shell are required to convert into kernels. According to official estimate, the standard conversion rate of shells into kernels is 70 per cent. The seeds/kernels are then adjusted for seeds purpose, direct consumption and export purposes to get the kernels available for crushing. The figures for seeds

purposes, direct consumption were taken from various issues of "Oilseeds in India", "Bulletin on Commercial Crops Statistics" published by Government of India which give the utilization of oilseeds for such purposes. The standard rates (in percentages) of utilization of oilseeds for various purposes are presented in the following Table - 4.3

**TABLE - 4.3**

<table>
<thead>
<tr>
<th>Oilseeds</th>
<th>Seeds</th>
<th>Purpose Direct consumption</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groundnut</td>
<td>12.00</td>
<td>6.50</td>
<td>18.50</td>
</tr>
<tr>
<td>Rape / Mustard</td>
<td>1.50</td>
<td>6.60</td>
<td>8.10</td>
</tr>
<tr>
<td>Sesamum</td>
<td>2.30</td>
<td>20.00</td>
<td>22.30</td>
</tr>
<tr>
<td>Linseed</td>
<td>5.00</td>
<td>6.30</td>
<td>11.30</td>
</tr>
<tr>
<td>Castorseed</td>
<td>6.00</td>
<td>-</td>
<td>6.00</td>
</tr>
</tbody>
</table>


Applying the average oil recovery rates to the estimated seeds/kernel available for crushing, we get the estimated domestic supply of oil. The oil recovery rates for various oilseeds are assumed to be constant throughout the period. These rates are presented in the following Table 4.4.
**TABLE - 4.4**

Proportion of Oil and Oilcake for Selected Oilseeds

<table>
<thead>
<tr>
<th>Oilseed</th>
<th>Proportion of oil $(\times 1)$</th>
<th>Proportion of cake</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groundnut</td>
<td>44</td>
<td>56</td>
</tr>
<tr>
<td>Rape/Mustard</td>
<td>33</td>
<td>67</td>
</tr>
<tr>
<td>Sesamum</td>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>Linseed</td>
<td>33</td>
<td>67</td>
</tr>
<tr>
<td>Castorseed</td>
<td>37</td>
<td>63</td>
</tr>
</tbody>
</table>


These rates are based on the rates reported in various issues of Bulletin on Commercial Crops Statistics published by Government of India. Data on imports of palm/soybean oils $(X_{13t})$ and also data on imports and exports of seeds/kernels and oils were taken from the various issues of Monthly Statistics of the Foreign Trade of India (D.G.C.I & S), Ministry of Commerce and Industry, Calcutta.

8. Per Capita Annual Domestic Consumption of Oil $(Y_{4t})$:

In the absence of data on consumption of different oils, the estimates of apparent consumption were derived as residual after adjusting the domestic production of oil to imports and exports. Estimates of per capita


domestic apparent consumption of oil under question for all purposes (domestic and industrial purposes) in the year 't' was worked out on the basis of gross availability of oil (under question) in that year. Thus:

\[ \text{Gross availability} = \text{Domestic Production} + \text{Imports} - \text{Exports} \]

The gross availability of oil under question is expressed on per capita basis in terms of kgs, dividing the gross availability of oil by mid year population estimates, except castor oil. The consumption of castor oil is expressed in absolute quantity in terms of '000' tonnes per year. Statistics on stocks of oils and oilseeds are not maintained and even if they are available they are very negligible in quantity. Thus the apparent consumption of oil under question in the year 't' is equivalent to the gross availability of that oil in that year. The variation in the time period for which the data are available also poses a problem. For example, the data on production relate to agriculture years ending June while imports and exports figures are for calendar or financial years. Suitable adjustments were, however, made for these differences on accounting period while estimating apparent consumption.

9. Wholesale \((Y_{st})\), Retail \((Y_{rt})\) Prices of Oils and Farm Harvest Price \((Y_{ft})\) of Oilseeds;

The data on wholesale and retail oil prices
published by the Ministry of Food and Agriculture, Government of India, are based on weekly price series collected from different market centres in the country. The required data on prices were collected from the following publications:

(i) Bulletin of Agricultural Prices (Various issues)
(ii) Agricultural Prices in India ( " " )
(iii) Agricultural Situation in India ( " " )

In the absence of continuous series of data on wholesale and retail oil prices for various market centres, it is decided to take the prices prevailing at important market centres. In the case of groundnut oil, we have considered the prices prevailing at two most important market centres namely Bombay and Madras where required data are available for the whole period continuously. The Bombay market is the most important and effective market for the groundnut oil and oilseeds. It exerts great influence over many oils and oilseeds markets of North, West and Central parts of the country. Similarly, Madras market also is equally effective and exerts sufficient influence over many oils and oilseeds markets of Southern part of the country. So all India average wholesale and retail oil price indices for groundnut oil were based on the prices prevailing at Bombay and Madras market centres.
In the case of rape/mustard oil, all India average wholesale and retail oil price indices were worked out on the basis of prices prevailing at important market centres like Kanpur and Calcutta. For sesame, these price indices were worked out on the basis of prices prevailing at Bombay and Madras Centres. For linseed, the prices prevailing at Kanpur and Calcutta were considered to get all India average wholesale and retail oil price indices. In the case of castor oil, these price indices were based on the prices prevailing at Hyderabad, Bombay and Kanpur. In the case of cottonseed, the analysis is restricted to acreage response and production behaviour relations only for the simple reason that cottonseed oil has yet to establish its credibility for direct consumption by masses of people (due to odour and tastes). The estimation of demand and price mechanism relations are not attempted for this promising oilseed. Therefore, the problems of collecting prices of this oilseed did not arise. All these prices refer to calendar year prices. These price series were deflated by the wholesale price index of all commodities based to 1970-71 = 100 to get the real prices. Then the price indices of these real prices were worked out taking 1970-71 = 100 as the base i.e. 1970-71 = 100. The wholesale price index of "all commodities" (Calendar year) is taken from the Monthly Bulletin on Wholesale Prices in
The most appropriate prices that should be used for the purpose of estimating consumption price relationship seem to be the retail oil prices. However, the data on retail oil prices are not available for the entire period i.e. for the period 1951-52 to 1978-79. The retail prices of oil are available only from 1963 onwards. This necessitated the use of wholesale oil price index in the consumption relation. The weighted farm harvest prices of concerned oilseed were deflated by the wholesale price index of all commodities based to 1970-71 = 100 to get the real farm harvest price index.

10. Per Capita Income ($X_{12t}$):

The estimates of per capita national income at 1970-71 prices were used in the analysis of demand and price mechanism relations. These estimates were taken from the reports of the Economic Survey 1980-81 as estimated by Expert Committee set up by Planning Commission, Government of India.


Estimates of population figures refer to mid year estimates. These population estimates from 1971 onwards refer to the latest projections made by the Expert Committee set up by the Planning Commission, Government of India. Upto 1970, these estimates of population refer to the estimates made by the Office of the Registrar General of India.

12. Traders/Oil millers Involvement in Illegal Activities, ($X_{14t}$):

The Forward Market Commission takes regularly the actions against illegal traders and oilmillers whenever traders/oil millers involve in illegal activities like hoarding, daba trading etc. Such actions are reported regularly in the Forward Market Bulletins. As a proxy to represent the traders/oil millers' behaviour, this dummy variable has been introduced in the price behavioural relation. Such reported actions were taken from various issues of Forward Market Bulletin from 1956 onwards. This dummy variable takes the value 'one' if there were large number of traders/oil millers involved in illegal activities in a given year 't' and takes value 'zero' otherwise.