THE NATIONAL COUNCIL OF APPLIED ECONOMIC RESEARCH, *Long Term Projections of Demand for and Supply of Selected Agricultural Commodities 1960/61 to 1975/76*, New Delhi, 1962, xvii+262 pp.

The publication under review is a study made by the National Council of Applied Economic Research (NCAER) of India during the two-and-a-half years from 1959 to the middle of 1961. The main purpose of the study was a long-term forecast of the demand and supply of the four commodity groups, —foodgrains (cereals and pulses), oilseeds, raw cotton, and tobacco—the cultivation of which accounts for about nine-tenths of the arable land in India. One of the excellent features of this book is that minute and careful explanation is given of the present-day economic conditions in this country and the theoretical methods applied in their analysis in order to forecast the demand and supply of these important agricultural commodities. Another feature is an appendix consisting of detailed and useful tables which were used in the study. Because of these two features the work stands as one of the best studies dealing with an econometric analysis, positive as well as theoretical, of the agriculture in the underdeveloped countries in Asia.

I will introduce the contents of this book below and make some comments on them.

1. Forecast of Demand

The demand projection which the NCAER has made for the important agricultural commodities of India is based on the conventional method of estimating national imcome levels, population, and the income-elasticity of demand.[1] The estimates of the national income levels were derived from the figures expected in the Five-Year Plans, and the future population was estimated by the NCAER itself.

The NCAER tried to learn the income-elasticity of demand through both time-series and cross-section analyses. In the time-series analysis, the apparent consumption was first calculated for each agricultural commodity group by deducting from its total consumption that part which is directed to purposes other than human food. Next the following regression analysis was made.

(1) $x_1=a_1+b_1x_2+c_1x_3$, and

(2) $\log x_1=a_2\log x_2+c_2\log x_3$,

where x_1 is the per capita apparent consumption, x_2 is the per capita disposable

1 The NCAER used the following equation in its forecast of demand: $D_t=D_0\left(1+\frac{Y_t-Y_0}{Y_0}\right)^{\eta}$. D_t and D_0 are the per capita demand in quantity in the t'th year and the base year, Y_t and Y_0 are the per capita income in these years, and η is the income-elasticity of demand. The aggregate domestic consumption is D multiplied by the population. On the other hand, the Institute of Asian Economic Affairs have used the equation: $D_t=D_0(1+\eta\cdot g)^n\cdot p$. D is the aggregate consumption, g is the rate of the increase of income, p is the rate of the growth of population, and n is the number of the years which have passed from the base year. However, there is no substantial difference between these two equations.

income, and x_8 is the relative wholesale price for each commodity group.

In the cross-section analysis, the NCAER used the data collected by the National Sample Survey (NSS) on consumers' expenditures. They estimated the expenditure-elasticity of the demand for foodgrains by $y=a+b\log x$, and the elasticities of the demand for the other commodity groups by $\log y=a+b\log x$. Then they converted these expenditure-elasticities into the relevant income-elasticities.

However, seasonal variation is very wide in the NSS data. Also, the category of foodgrains (cereals and pulses) is not divided into smaller categories (except for NSS No. 13, 1959, April-September), so that no figures are available for those sub-categories. Therefore, in 1960, the NCAER divided India into three districts: the rice-eating district, the wheat-eating district, and the district where the staple food consists of both rice and wheat. It carried on a survey of the household economy of 600 urban families and 1,200 rural families sampled from each of these districts. Then they estimated the income-elasticity of demand from the correlationship between income and consumption by household by commodity group. The NSS, a world-famous serial survey of the household economy, has been much improved by this NCAER survey.

From a static analysis of only one year, however, it is impossible to know what the trend over time is. Thus, the elasticities of demand finally selected by the NCAER are those which appear in Table, the last line on the right-hand side, in the calculation of which they have also taken into account the elasticities estimated from the NSS data for 1951 to 1955. It is apparent from this table that there is a substantial difference between the NCAER and the NSS data, and between the cross-section and time-series observations, and that to select reliable elasticities requires a considerable amount of arbitrary judgement.

In case in which the basic coefficient for the forecast of demand, in other words, income elasticity of a given commodity, is derived from this sort of insufficient statistical data, it may be effective to make international comparisons between countries in which the supply and demand structure and consumption patterns of the commodity are alike. Among the underdeveloped countries of Asia, data on the household economy are available for Burma, Ceylon, China (Taiwan), India, the Philippines, and Thailand. But these data are not for the same year, because the surveys were carried out in different years.

There is another way of estimating income-elasticity. First, Asian countries are divided into the three groups of food-exporting countries, food-importing countries, and self-sufficient countries. If we adjust the income-elasticities estimated from the data available, taking into consideration the per capita income level, the substitution between rice and wheat, and other factors, we have the left side of the Table. The results may be open to some discussion. Nevertheless, there is no doubt that the income-elasticities of the demand for most foodstuffs are relatively high in India as in the other countries which suffer from a food shortage.

In these countries, however, there are few basic data from which to

estimate the income-elasticities of the demand for minor cereals. As a matter of fact, the only ways to estimate these elasticities are often either by deducting major cereals (rice and wheat) from all cereals or by making estimates from per capita actual consumption trends. Therefore, the estimates by the

INCOME-ELASTICITIES OF THE DEMAND FOR FOODSTUFFS IN ASIAN COUNTRIES

I. Studies by the Institute of Asian Economic Affairs*)

	Commodities				
	Rice	Wheat	All Cereals	Pulses	Potatoes
Exporting Countries[1)]					
Burma	0.1	0.5	0.2	0.25	0.1
Cambodia	0.1	0.5	0.2	0.25	0.1
Thailand	0.1	0.5	0.2	0.25	0.1
South Viet-Nam	0.1	0.5	0.2	0.25	0.1
Importing Countries[2)]					
Ceylon	0.5	0.5	0.4	0.25	0.1
India	0.5	1.2	0.5	0.3	0.2
Indonesia	0.5	1.5	0.5	0.3	0.2
Pakistan	0.5	1.2	0.5	0.3	0.2
Self-Sufficient Countries[3)]					
China (Taiwan)	0.3	1.2	0.2	0.3	0.1
Korea, Republic of	0.3	1.2	0.2	0.3	0.1
Philippines	0.3	0.5	0.2	0.3	0.1
Other Countries					
North Borneo	—	—	—		
Hong Kong	0.3	0.5	0.3	0.3	0.1
Laos	0.3	—	0.2	0.25	0.1
Malaysia	0.3	0.5	0.3	0.3	0.1

II. Studies by the NCAER**)

	Rice	Wheat	Minor Cereals	Pulses
Time-Series Analysis (quantity)	0.16	1.25		
	0.46			
NCAER Data (quantity)	0.24	0.75	−0.39	0.63
	(0.13)	(0.18)	(−0.86)	(−0.12)
NCAER Data (amount)	0.39		−0.29	0.61
	(0.18)		(−0.59)	(0.25)
NSS Data (amount)	0.55		−0.83	0.62
	(0.12)		(−1.32)	(0.45)
The Figures which the NCAER have used in Estimation	0.50		−0.30	0.65
	(0.15)		(−0.60)	(0.35)

Notes: *) The figures are quantity-elasticities.
1) Countries with surpluses.
2) Countries suffering shortage.
3) Countries which are expected to suffer shortage in the future.
**) The figures in the parentheses are for cities and the others for villages of India.

NCAER on the income-elasticity of minor cereals are very valuable figures. Their studies deserve a high valuation also because they have made separate estimates for urban and rural districts. Although in India, which is suffering from food shortage, minor cereals—the staple food in rural districts—account for 30% to 40% of the total food consumption, they are likely to be gradually replaced by higher classes of cereals and farmers are expected to consume more and more of their own products as their incomes increase.

2. Projection of Production

The NCAER obtained the production of an agricultural commodity for one year in the future by multiplying the estimated yield per acre by the estimated acreage which will be planted with that crop. This is the traditional method of estimation, but is worth noting that in analysing these two factors they have used as much as possible the production-function analysis, together with the convenient method of estimating from past trends.

When data on the effects of agricultural investment are scarce, as is the case with most of the developing countries in Asia, it may be permissible to extrapolate the past trend up to the projected year, by using the least squares method, and fitting a type of function on it, which is selected out from the shape of the trend-line. This process may be satisfactorily applied in a projection for the coming five or ten years during which no great structural change is likely to occur in agriculture. But its application cannot be justified when such a change is expected. In such a case a forecast must be done with the help of an analysis of the effects of agricultural investment on the economic structure. Therefore, the efforts expended by the NCAER in undertaking an analysis of the effects of agricultural investment within the limits of the available data must be noted.

(1) In estimating the total dimensions of the gross area to be sown in the future, the NCAER took into account the increase in the double-cropped area which was created by an improvement in irrigation facilities as well as an increase in cultivated land due to reclamation of waste land and reculitivation of fallow land. The ratio of the area of double-cropping to the total area to be cultivated in the future has been estimated from the linear function which expresses the past trend. It has been found from this that during the twenty years from 1956 to 1975 the area of cultivated land is expected to increase by 5% and the area of double-cropping by 167%, thus increasing the total area of cultivated land by 30%. This implies first that new cultivation of waste land is becoming more and more difficult in India, and secondly, that the expansion of double-cropping is imperative in order to feed the population which will increase at an annual rate of 2.5%.

In many cases, waste land and fallow land which is newly cultivated is not very fertile, so minor cereals and pulses are usually grown in these fields. It is important to note that growing pulses after or before the harvest of rice or wheat is encouraged, and that there is a close relationship, that of a linear function, between an increase in the double-cropped area and an

increase in pulse fields. Thus it has been possible for the NCAER to estimate from the parameters derived from this relationship the ratio of the area of the pulse fields to the total double-cropped area. According to the estimates, the total area of the pulses in 1975 is expected to be more than twice as much as that in 1955. This increase in the area given to pulses is the minimum needed to meet the increase in the demand for them which is generally expected to be about twenty million tons in 1970 and twenty-five million tons in 1975,[1] for an increase in the supply of pulses, which are mostly harvested in the district where it does not rain much, depends more on the increase in the cultivated area than on the increase in the yield per acre.

The total increase in the cultivated area estimated in the way mentioned above has been apportioned to each group of commodities according to the following formula: $A_{it}=\frac{A_t\sqrt{m_i\times g_{it}}}{\sum_{i=1}^{n}\sqrt{m_i\times g_{it}}}$ where A_{it} is the increase in the area cultivated for the growth of i crop in the t'th year over the base year, A_t is the increase in the total dimensions of the area cultivated, m_i is the yield per acre of i crop, and g_{it} is $\frac{D_{it}-P_{i0}}{P_{i0}}$, D_{it} meaning the quantity demanded for the commodity in the t'th year and P_{i0} its supply in the base year.

This method of estimation raises some questions, however, for the NCAER assumes that the area cultivated for a crop will increase in accordance with the condition of demand for and supply of the crop.

It seems better, at least methodologically, to estimate separately fields cultivated for the growth of each crop than to estimate the total area cultivated and apportion it to each crop. For farmers usually decide what to grow before they cultivate the land, and do not cultivate until they have decided what to grow. It is more policy than projection to expect that what is scarce will be grown more. Actually farmers will grow what they think will sell more either domestically or abroad.

(2) Next we shall consider the increase in yield due to an improvement in irrigation facilities.

1 Estimates of the Demand for Pulses in India

(Unit: millions of tons)

Studied by	1970	1975	Sources
Planning Commission, Government of India	19.4	24.0	*Notes on Perspective of Development India: 1960/61 to 1975/76*, Apr., 1964.
Indian Institute of Agricultural Research Statistics	23.7	26.7	*Agricultural Projections in India, Ministry of Food and Agriculture*, Sept., 1963.
The NCAER	19.9	24.6	*Long Term Projections of Demand for and Supply of Selected Agricultural Commodities 1960/61 to 1975/76*, Apr., 1962.
The Institute of Asian Economic Affairs	19.6	23.9	*Ajiya no Keizai Seichō to Ikinai Kyōryoku*, July, 1965.

It is the generally accepted notion that a stable supply of water or irrigation and drainage is more important than fertilizing for agriculture in underdeveloped countries. In India, too, adequate irrigation is one of the fundamental conditions for the spreading of double-cropped areas and creating an increase in productivity.

In apportioning irrigated fields to each group of crops, the NCAER assumed from the past trend that the ratio of the large and medium scales of irrigation facilities to the small scale of facilities will be seven to three. Also taken into consideration are the time-lag from the irrigation-investment until it takes effect, and the extent to which those facilities are utilized by farmers. Thus the apportionment of the irrigated fields (A_{it}) is shown by the formula: $A_{it}=\frac{I}{C_{it}}\cdot I_t\left\{\frac{(D_{it}-P_{i0})\times C_{it}}{\Delta Y_i}\right\}\Big/\sum_{i=1}^{n}\left\{\frac{(D_{it}-P_{i0})\times C_{it}}{\Delta Y_i}\right\}$ in which it is the total amount of investment in irrigation facilities in the t'th year, D_{it} is the demand for i crop in the t'th year, P_{i0} is the output of i crop in the t'th year, C_{it} is the cost of irrigation per acre for i crop in the t'th year, and ΔY_t is the increase in output due to the improvement of irrigation facilities.

(3) The NCAER also estimated the quantity of fertilizer which will be applied to each group of crops. The first procedure in the estimation was deducting from the output of fertilizer planned in the Five-Year Plans that part which will be given to such important crops as sugar-cane and jute which were not studied by the NCAER. The remaining part was apportioned to each group of crops. The basis of apportionment was the optimum quantity of fertilizer to be given to each crop per acre, which was taken from the data collected by the agricultural experimental farms. It has been assumed that fertilizer will be applied solely to the irrigated area. The formula of apportionment is $Q_{it}=Q_t\times\frac{A_{it}K_i}{\sum_{i=1}^{n}A_{it}K_i}$. In this formula Q_{it} is the quantity of fertilizer given to i crop in the t'th year, Q_t is the total quantity of fertilizer given, A_{it} is the area irrigated for growing i crop in the t'th year, and K_i is the optimum quantity of fertilizer to be given to i crop.

This formula gives us the apportionment of fertilizer proportional to the quantity needed for each crop. This can be interpreted either to be a policy or projection. But if it is intended to show a policy objective, it is imperfect because more fertilizer may be given to the crops for which the supply is too scarce or to crops for which it is particularly effective. On the other hand, if it is intended to be a pure projection, the NCAER might have also taken into account the actual quantity of fertilizer that was given to each crop in the past and the tendency for increase in the fertilizer applied. For example, whether Q_{it} is the function of Q_t or of some other factor might have been studied. Another shortcoming is that the estimation of fertilizer to be produced depends on the ambitious production programme of the Five-Year Plans.

(4) Improvement of seeds is as important as irrigation and application of fertilizer. According to the expectations of the Five-Year Plans, the NCAER

assumes that by 1965 improved seeds will be sown in all fields.

(5) Such factors as the effect of the agricultural reorganization policies including the rural development programmes, land reform, and agricultural education—factors which are difficult to value quantitatively—have also been considered to try to improve the figures tentatively estimated by the processes mentioned above.

Taking into consideration all the factors mentioned in paragraphs (2) to (5), the yield per acre in the t'th year is shown as $Y_t=Y_0(1+F_t+M_t+S_t)$, where Y_0 is the yield per acre in the base year, F_t is the response coefficient of the chemical fertilizer in the t'th year M_t is the response coefficient of the manure in the t'th year, and S_t is the response coefficient of the improved seeds in the t'th year. These response coefficients signify the degree of the effects on the yield per acre of the optimum level of the input of fertilizer (F), manure (M), or improved seeds (S).

But the following points must be kept in mind about this formula. First, it applies only in case no F, M, or S have been used to produce Y_0. Second, the notion of an optimum level of input is too simplified, so that the above formula cannot be used to consider the effects if the input of F, M, or S is below this optimum level.

Third, these three kinds of response coefficients are computed separately from one another, and the inputs of F, M, and S are considered to have separate effects on Y_t. In other words, the combined and multiplied effects of these three kinds of input are neglected. For example, the effect of the input of F on Y_t is considered to be the same when F is used alone and when both F and M are used at the same time. Though NCAER states on page 161 that it considered this point "broadly," a more detailed explanation is keenly desired.

The procedures of a projection by the NCAER seem to have been as follows. First, all cultivated land is divided into the irrigated area and unirrigated area, and the average yield per acre in the base year is calculated for every crop in both these areas. Next, the increases in the area where fertilizer is applied and of those where improved seeds are used are estimated. Thus the increase in the yield per acre is estimated simply from these two kinds of data. This method of estimation, however, is too rough. Considering that the estimates are for India as a whole, they may be all right as an approximation. But theoretically, at least, the method leaves much to be desired.

At any rate, the NCAER in this way estimates that the yield per acre of rice and wheat will be almost doubled during the fifteen years from 1960 to 1975.

3. Analysis of Demand and Supply

The forecast of the demand for agricultural commodities by the NCAER depends on the estimation of the rate of growth of the per capita income, the income-elasticity of demand, and the rate of population growth. It has considered both high and low estimates of these rates and of elasticity. In

its forecast of production, it also used somewhat optimistic figures which depend on the objectives of the Five-Year Plans, and somewhat pessimistic figures were estimated by making allowance for possible unfavourable circumstances.

According to the final forecast which has been adjusted by these figures (and which the NCAER regards as reasonable), after 1965 the yield per acre, which has been low until that time, will begin to increase rapidly, and in 1965 India will be able to supply almost all the food necessary to feed her population. What she will have to import will be limited to those crops which she needs to keep in stock. She will have surpluses of three million tons in 1970 and six million tons in 1975, and the per capita foodgrains per day will increase from the 16 ounces of 1960 to 18 ounces in 1975. The surpluses will consist mainly of rice and wheat. On the other hand, the surpluses of minor cereals will gradually decrease and their demand and supply will continue to be balanced. The demand and supply of pulses will also be balanced. The supply of oilseeds, which is about the same as the demand, will begin to be abundant. The yield of tobacco will increase so rapidly that a considerable portion of it will be exported after meeting the domestic demand. As for cotton products, both the supply and the demand will increase greatly and they will approximately become balanced at a high level.

Self-sufficiency in food is one of the most important factors in the economic development of India. The estimates mentioned above are interesting since they show when India will attain such self-sufficiency, but at the same time they are refutable at several points.

Estimation of the demand and supply of agricultural commodities in the developing countries, including Asia, has been tried by such organizations as FAO, ECAFE, and the Institute of Asian Economic Affairs.[1] The Studies of the Institute of Asian Economic Affairs, which give detailed estimates by commodity for each country, estimate that the shortage of food in India will continue to become even greater until 1975. R. P. Sinha of India criticizes the NCAER as having too optimistic estimates of the future population, the total acreage of the irrigated area, and the area of double-cropping farms. He predicts that the food shortage in India in 1975 will be between four to five million tons and nine to ten million tons.[2]

The estimate of the NCAER that India will attain agricultural self-

1 i) FAO, *Agricultural Commodities Projections for 1970,* May, 1962. ii) ECAFE, *Long-Term Projections of Supply and Demand for Agricultural Food Products in the Developing ECAFE Region up to 1980,* Preliminary Draft, 1964. iii) Research Department for Economic Growth, the Institute of Asian Economic Affairs, *Ajiya Keizai no Chōki-tenbō* (Long-Term Economic Projections for the Developing Asian Countries), 1964, Chap. 3; ditto, *Ajiya no Keizai Seichō to Ikinai Kyōryoku* (Economic Growth and Regional Co-operation in Asia), Preliminary Draft, 1965.

2 R. P. Sinha, "The Prospects of Agricultural Self-Sufficiency in India," *Journal of Agricultural Economics,* Dec., 1964; R. G. Agarwal and R. P. Sinha, "Food in India: Long-Term Prespective," *The Economic Weekly,* Vol. XVI, No. 38 (Sept., 1964).

sufficiency around in 1965 originates from the policy objectives in the Third Five-Year Plan. But these objectives themselves were reduced by 10% in 1963 because of the unlikeliness of their attainment due to unfavourable weather and insufficient agricultural investment. Interestingly enough, these new objectives fall exactly on the trend line of the agricultural demand and supply actually experienced during the 1950's.

To conclude, the estimates of the NCAER are very optimistic, because they have depended too heavily on the ambitious objectives of the Five-Year Plans. However, even if their estimates are imperfect, we may still admit that the theoretical and technical methods used in their estimation are excellent enough to make up for this imperfection.

4. Further Comments—Trade Projection

The NCAER has not estimated the quantities of foreign trade directly, but assumes that the difference between the domestic production and demand will be exportable surpluses (or import requirements). This is the same method that FAO and ECAFE have adopted. However, the excess of the domestic supply over the demand in one country is not necessarily exported since international trade is greatly influenced by the balance-of-payments positions and protection policies of the importing countries. The reverse applies to the imports of that country. In estimating the international trade of agricultural commodities, therefore, it is not correct to assume simply that the excess of the demand over the supply will be imported or that the excess of the supply over the demand will be exported. If India is to export some commodities, the demand for them in other countries must also be studied. If she is to import, the conditions of the supply side must be analysed. It is necessary to build a model in which all these conditions can be determined simultaneously.[1] For this purpose, time-series observations of a matrix of the international trade for each commodity are required.[2]

When we try to analyse the economic development of a single country as well when we study a regional development from the point of view of international economic co-operation, we must not fail to consider the conditions of the demand and supply of other countries or regions. This is especially true when we study the economy of a country like India whose demand for and supply of certain commodities occupies not a small portion of international demand and supply. (*Takahiko Haseyama*)

1 Institute of Asian Economic Affairs, *Ajiya no Keizai Seichō to*..., Chap. 3, estimates by this method the demand for imports of primary products for each country.

2 The international conditions of the demand and supply of rice have been studied in Chap. 4 of *Ajia no Keizai Seichō to*..., by time-series observations for five years on a matrix of the international trade of this commodity.