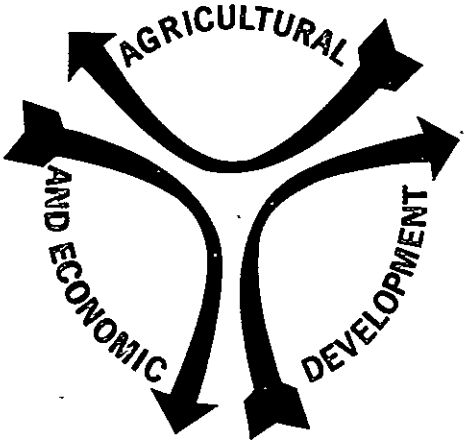
DEMAND AND SUPPLY PROJECTIONS

OF FOOD GRAINS FOR INDIA

1970-71 to 1985-86



CENTER FOR AGRICULTURAL AND ECONOMIC DEVELOPMENT

IOWA STATE UNIVERSITY

AMES IOWA

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DEMAND AND SUPPLY PROJECTIONS OF FOOD GRAINS FOR INDIA 1970-71 to 1985-86

by

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FORWARD

Over the last five years India has experienced sharp fluctuations in foodgrain production. In the mid-1960's food grain output dropped sharply due to drought and perhaps some tendency to postpone appropriate investments in irrigation and other stabilizing techniques of production. As an outgrowth of a serious national problem which required large imports of food, India began new programs and investments in irrigation and other stabilizing techniques of production. These programs have been sufficiently successful to allow considerably reduced food imports in recent years. Hence, discussions have ensued on the potential of balancing food supplies and needs in the near future.

Because of the tremendous importance of an adequate supply of food for India's 500 plus million people, and because India's food situation is of such importance to planning U.S. agricultural production, the Center for Agricultural and Economic Development at Iowa State University requested and supported the National Council of Applied Economic Research in New Delhi (under a grant from the U.S. Agency for International Development), in undertaking a study of projections of food balances through 1985-86.

The present report summarizes results of that study. It includes projections of demand for foodgrains under alternative income elasticities; it projects foodgrain supplies using the most recent data and information on fertilizer, new varieties multiple cropping and other factors determining future production. These projections are compared for four time periods, 1970-71, 1975-76, 1980-81 and 1985-86. We believe these projections can provide considerable information for long range planning of agricultural production in India and provide information to assist interested groups in planning future commercial export levels and government export programs from the United States.

Earl O. Heady
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October 1970
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Introduction

This report projects the demand for and supply of food grains, comprising rice, wheat, other cereals and pulses, for India for 1970-71, 1975-76, 1980-81 and 1985-86. The National Council has completed two earlier studies on this topic - one in 1962[1/] and the other in 1968.[2/] In the first study food grain demand and supply were projected to 1975-76. In the second, these projections were revised in the light of subsequent developments and more recent data, and were extended to cover the period up to 1980-81. The present study is carried further by re-examining the earlier results and by extending the projections to 1985-86.

Demand Projections

Demand projections are generally based on the rate at which per capita real income is likely to grow, the rate at which population is likely to rise, and the estimated coefficients of income elasticity of demand for different commodities. Price elasticity of demand and likely changes in structure of relative prices also affect demand; but the difficulty here is to foresee changes in the structure of relative prices with a sufficient degree of accuracy. It is, therefore, usually assumed that the structure of relative prices will not significantly change over the period of projection. This may not be completely realistic but it appears present economic instruments cannot be improved to help out in this situation, particularly for long term projections.

1/ NCAER: Long-term Projections of Demand for and Supply of Selected Agricultural Commodities, New Delhi, 1962.

2/ NCAER: Projections of Demand for and Supply of Agricultural Commodities, New Delhi (in Press).

Another problem in attempting demand projections is the selection of the base period. It is common knowledge that demand forecasts differ, depending upon the base period selected for projection purposes. The choice of the base year is subjective; there is no objective method for this selection. In this study, after considering some alternatives (whether to use 1964-65 or 1967-68), the average per capita availability of the different commodities for two recent years, 1967-68 and 1968-69, for which data are available, has been accepted as the base.

The quantity of food grains demanded by a household is likely to be influenced by a number of factors besides household income. In the present study, in addition to income, other factors accounted for include items such as the number of consumption units in the household, the employment status of the head of the household (i.e., whether a person is self-employed or is an employee), the level of education of the head of the household, and the level of economic development of the place of the household, etc. Different multiple regression relationships relating the quantity demanded of a commodity (dependent variable) to the factors mentioned above (treated as independent variables), have been fitted (employing the principle of least squares) to cross section budget data. These data are from a probability sample of over 3,000 households collected in the All India Consumer Expenditure Survey conducted by the National Council in 1964-65. The level of education attained by the head of the household has been introduced into the regression equation as a dummy variable. The level of development at the location of the household has

also been included as a dummy variable in some of the regression relationships and as a graded variable in some others.[1/]

The income elasticity of demand and other variables[2/] included in the regression equation have been derived first and are reported in Table 1. Using these, per capita demand for each time period has been estimated employing the following formula:

$$Q_t = Q_o \left(1 + \frac{r_1}{100}\right)^{e_1} \left(1 + \frac{r_2}{100}\right)^{e_2} \left(1 + \frac{r_3}{100}\right)^{e_3}$$

Q_o = Per capita net availability (in quantity) of a given commodity for the base year.

Q_t = Per capita demand (in quantity) of a given commodity for the year 't'.

e_1 = Partial income (value) elasticity of demand of a given commodity.

e_2 = Partial elasticity of demand of a given commodity with respect to the level of education attained.

e_3 = Partial elasticity of demand of a given commodity with respect to the level of development (measured as dummy variable or as a graded variable as the case may be).

r_1 = Percentage increase in per capita income at constant prices over the period 'o' to 't'.

r_2 = Percentage increase in the level of education attained over the period 'o' to 't'.

r_3 = Percentage increase in the level of economic development over the period 'o' to 't'.

1/ There is no difficulty in introducing the number of consumption units in a household into the regression equation since this can be quantified. Employment status of the head of the household has been introduced into the regression equation as a dummy variable.

2/ The elasticity coefficients have been computed at the mean values of the relevant variables.

Table 1. Elasticities of Demand (Partial) of Income, Education and Economic Development

Commodity	Model 1*			Model 2*		
	Elasticity of demand of			Elasticity of demand of		
	Income	'Education'	Economic develop.	Income	'Education'	Economic develop.
Rice	0.28	-	-0.13	0.19	0.03	-0.13
Wheat	0.45	-	0.08	0.25	0.04	0.10
All cereals	0.19	-0.02	-0.09	0.11	-	-0.05
Pulses	0.45	-0.02	-0.07	0.23	0.24	-0.05
Food grains	0.23	-0.02	-0.08	0.13	-	-0.05

* As indicated several linear and non-linear models have been fitted to cross-section data collected from over 3,000 households spread over the entire country to estimate income and other elasticity coefficients. Of these, the one which yielded the highest partial income elasticity has been taken here as model 1; the one which yielded the lowest partial income elasticity has been designated as model 2.

Since the selection of the models was not made on statistical considerations, the standard errors of the estimated parameters in the regression equations have not been shown.

Note: In addition to the above three variables (income, education and economic development), activity status of the head of the household (whether self-employed or employee) and the number of consumption units in a household have also been included into the regression equation as independent variables. It is, however, assumed that there would be no change in the composition of households by activity status of the head of the household and by the number of consumption units in a household. Therefore, the elasticities of demand with respect to these variables are not shown in the Table.

The aggregate demand for a given commodity for any year is then estimated by multiplying per capita demand for that year by the estimated population for that year.

A word may be added about the income and other elasticities of demand used for projections here. As already indicated, different multiple regression equations were studied using different variables to evaluate these elasticities.[1/] For any given commodity, they usually differ depending on the regression relationship employed to derive them. The question then is which among the regression relationships should be used. On this there is no clear scientific procedure. So, regression equations yielding the highest as well as the lowest partial income elasticity have been used in this study. As a result, two estimates of demand for each commodity - one based on the highest income elasticity model (model 1) and the other on the lowest income elasticity model (model 2) - have been worked out. These two estimates provide the range within which the expected demand for the commodity in question is most likely to be.

Assumptions in the projections

The following assumptions have been made concerning the expected changes in the socio-economic structure of the population:

i) The annual compound rate of growth in per capita real income[2/] will be 1.8 per cent up to 1970-71, 2.5 per cent over the period 1970-71 to 1975-76 and 2.6 per cent between 1975-76 and 1985-86.

1/ Reference may be made to the NCAER All India Consumer Expenditure Survey, Vol. II, Pattern of Income and Expenditure, op. cit., Chapter 10, pp. 86-87.

2/ An assessment of the rate of growth in per capita real income in the immediate past has been made in a recent NCAER publication. NCAER: Projections of Demand for and Supply of Selected Agricultural Commodities, op. cit.

ii) On the basis of present indications, it is most unlikely that the rate of growth of population will slow down until after 1980. Therefore the compound rate of population growth is taken to be 2.4 per cent per annum up to 1980-81 and 2 per cent per annum thereafter until 1985-86. This assumption gives the population total for each year, shown in Table 2, these estimates differ from recent projections by the Registrar General.[1/]

iii) The structure of relative prices of the different commodities will remain more or less constant over the period of projection.

iv) The present distribution of population will not undergo significant changes during the period, except on certain explicit grounds taken into account at appropriate places.

v) Relative to the year 1964-65 the level of education in the country goes up 5 per cent by 1970-71, 10 percent by 1975-76, 15 per cent by 1980-81 and 22 per cent by 1985-86.

vi) The proportion of population exposed to developmental activity in the country will be 40 percent by 1970-71, 50 per cent by 1975-76, 60 per cent by 1980-81 and 75 per cent by 1985-86 as against about 34 per cent in 1964-65.

vii) The (partial) elasticities of demand with respect to income and other variables[2/] included in the regression equation are based on 1964-65 data and hence relate to that period; it is supposed that these elasticities will hold through to 1985-86.

1/ Registrar General of India, Ministry of Home Affairs: Report on the Population Projections worked out under the guidance of the Expert Committee set up by the Planning Commission under the Chairmanship of the Registrar General of India, Government of India, New Delhi, 1968. According to the above publication the rate of growth of population is expected to slow down to 2 per cent or even less from 1979 onwards.

2/ Though the number of consumption units and the activity status of the head of the household are introduced as independent variables into the regression equation, it is assumed for this study that the household composition by these variables does not undergo changes over the period of projections.

Table 2. Projected Population Levels for India

Year	Population ('000)
1968-69	524,080 *
1970-71	550,284
1975-76	618,786
1980-81	691,786
1985-86	795,157

* As on 1st July, 1968. The Assumptions made to estimate the total population are:

(1) Between 1968-69 and 1980-81 population grows at 2.4 per cent per annum and

(2) Between 1980-81 and 1985-86 it grows at 2.0 per cent per annum.

Source:

Report of the population projections worked out under the guidance of the Expert Committee set up by the Planning Commission under the Chairmanship of the Registrar General, India, Ministry of Home Affairs, Government of India, New Delhi, 1968.

Demand Estimates

Data relating to aggregate net availability of food grains in India for 1967-69 are shown in Table 3. The per capita net availability of the different commodities in the base period is indicated in Table 4. Using these data and employing the formula already indicated (along with the assumptions), estimates of per capita demand for the different items up to 1985-86 has been worked out (Table 5). Multiplying these by the estimated population for the relevant year, the likely total demand for 1970-71, 1975-76, 1980-81 and 1985-86 has been estimated (Table 6).

Demand is estimated to be 91 million tons in 1970-71, 102 to 103 million tons in 1975-76, 115 to 117 million tons in 1980-81 and 134 to 136 million tons in 1985-86. In other words, relative to the net availability in the base period (86.5 million tons), demand for food grains is likely to increase by about 58 per cent and the demand for cereals by about 50 per cent.

From a level of around 36 million tons in the base period the demand for rice is likely to rise to 54-56 million tons in 1985-86, i.e., by about 50 per cent. On the other hand the demand for wheat is likely to increase by about 79 per cent over the period under study. The demand for minor cereals also goes up but only by 25 per cent.

The average per capita demand for food grains will be rising from about 16.0 ozs. per day per capita in 1970-71 to 16.6 ozs. per day per capita in 1985-86. Since this is also the per capita per day standard suggested by nutritional experts, the per capita demand for

Table 3. Aggregate net availability of food grains in India, 1967-68 and 1968-69

Commodity	1967-68	1968-69	Average for two years 1967-68, 1968-69
			(Million tons)
Rice	34.9	36.7	35.8
Wheat	18.1	19.3	18.7
All cereals	76.6	76.5	76.6
Pulses	10.7	9.1	9.9
Food grains	87.3	85.6	86.5

Source: For 1967-68: Bulletin on Food Statistics, Directorate of Economics and Statistics, Ministry of Food, Agriculture, Community Development and Cooperation, 1969, pp. 216-217.

For 1968-69: The net availability figures are obtained from the Directorate of Economics and Statistics, Ministry of Food and Agriculture, Community Development and Cooperation, New Delhi.

Table 4. Per capita net availability of food grains in India, 1967-68 and 1968-69

Commodity	1967-68	1968-69	Average for two years 1967-68, 1968-69
			(Kgs. per year)
Rice	67.4	69.2	68.3
Wheat	35.0	36.4	35.7
All cereals	148.0	144.2	146.2
Pulses	20.7	17.2	18.9
Food grains	168.6	161.3	165.0

Note: Per Capita net availability is obtained by dividing the aggregate net availability (Table 3) by the average population.

Table 5. Projections of Per capita demand for food grains

Commodity	1970-71		1975-76		1980-81		1985-86	
	High*	Low*	High*	Low*	High*	Low*	High*	Low*
	(In Kgs. per year)							
Rice	68.66	68.36	68.96	68.06	69.81	68.21	70.31	68.02
Wheat	36.48	36.34	39.25	38.29	42.20	40.34	45.53	42.70
All cereals	146.60	146.45	146.95	146.86	148.00	147.55	148.50	148.00
Pulses	19.17	19.04	19.93	19.58	20.83	20.19	21.70	20.88
Food grains	165.80	165.45	167.40	166.25	169.75	167.50	171.55	168.45
Projected per capita per day demand for food grains (in ounces)	16.02	15.99	16.18	16.06	16.40	16.19	16.58	16.28

Note: 1. The projections are based on the assumption that per capita annual income grows at a rate of 1.8 per cent per annum up to 1970-71, 2.5 per cent per annum up to 1975-76 and at 2.6 per cent per annum over the period 1975-76 to 1985-86.

2. The figures of cereals and pulses together do not add up exactly to the food grains figure since they are estimated independently.

High*: Estimates under this column are based on the elasticities worked out on the basis of model 1 (see Table 1) together with the other assumptions in the text.

Low*: Estimates under this column are based on the elasticities worked out on the basis of model 2 (see Table 1) together with the other assumptions in the text.

Table 6. Projections of Total Demand for Food Grains

Commodity	1970-71		1975-76		1980-81		1985-86	
	High*	Low*	High*	Low*	High*	Low*	High*	Low*
	(In million tons)							
Rice	37.78	37.62	42.65	42.09	48.29	47.19	55.90	54.09
Wheat	20.07	20.00	24.27	23.68	29.19	27.91	36.20	33.95
All cereals	80.67	80.59	90.88	80.82	102.38	102.07	118.08	117.68
Pulses	10.55	10.48	12.32	12.11	12.41	13.97	17.25	16.60
Food grains	91.24	91.04	103.52	102.81	117.43	115.87	136.41	133.94

High*: Figures in this column are based on model 1. (See Table 1).

Low*: Figures in this column are based on model 2. (See Table 2).

food grains is unlikely to exceed this limit even for the period beyond 1985-86. The result of any further growth in per capita income and the consequent improvement in the standard of living can therefore be expected to lead to some diversification in food habits and, probably, some decline in the demand for food grains per se. This, at any rate, is what should be expected from the experience of the economically developed countries.

The estimates of demand relate to human consumption alone. To it must be added the requirements for seed, feed and wastage.

Supply Projections

Agricultural production prior to 1969 has followed an erratic trend. After relative stagnation in the first three years of the Third Plan, there was a bumper crop in 1964-65 when the output of almost all crops reached new record levels. The aggregate index of production in 1964-65 was 159.4 (1949-50 = 100), a 12 per cent rise over 1960-61. In the subsequent two years there was a sharp decline in production due to unprecedented drought. In 1965-66, the fall was by 20 per cent and in 1966-67 the overall index was even below the level in 1965-66, despite a marginal recovery in minor food grains and some commercial crops. The next year - 1967-68 - there was a marked spurt and output reached a level of 95.1 million tons. During 1968-69, food grains again registered a slight decline of 1.1 per cent over the previous year on account of adverse weather over parts of the country. Table 7 indicates the rates of growth for 1949-50 to 1968-69.

Over the last two decades, production of food grains increased at

Table 7. All-India Compound Rates of Growth of Agricultural Production, Area under Crops and Agricultural Productivity during 1949-50 to 1968-69.

Sl. No.	Crop	Production	Area	Productivity
		(Per cent per annum)		
1.	Rice	3.02	1.22	1.78
2.	Jowar	2.30	0.86	1.42
3.	Bajra	2.36	1.14	1.21
4.	Maize	3.88	2.79	1.05
5.	Ragi	1.88	0.36	1.51
6.	Wheat	4.20	2.26	1.90
7.	Barley	(-) 0.12	(-) 0.74	0.62
8.	Cereals	3.00	1.17	1.82
9.	Gram	1.77	0.77	0.99
10.	Pulses	1.16	1.26	(-) 0.10
11.	FOOD GRAINS	2.79	1.19	1.65
12.	Groundnuts	3.51	3.45	0.06
13.	Sesamum	(-) 0.34	0.60	(-) 0.93
14.	Rapeseed and mustard	3.34	2.36	0.95
15.	Oilseeds	2.86	2.31	0.53
16.	Cotton	3.93	1.91	1.98
17.	Jute	2.29	2.03	0.27
18.	Fibres	3.49	0.94	1.52
19.	Tea	1.97	0.69	1.27
20.	Coffee	5.96	2.32	3.56
21.	Sugarcane	3.97	2.74	1.20
22.	Tobacco	2.55	1.37	1.87
23.	NON-FOOD GRAINS	3.18	2.19	0.97
24.	ALL-CROPS	2.92	1.37	1.53

Source: Fourth Five Year Plan, 1969-74, Planning Commission, Government of India, page 117.

an average rate of 2.79 per cent per annum, of which 1.19 per cent was due to the increase in area and 1.65 per cent improvement in productivity. Among food grains, there were significant variations in the performance of individual crops. The output of rice, wheat and maize has grown appreciably faster than millet. On the other hand, the output of pulses, of particular importance from the nutritional viewpoint, has increased only about half as fast as that of cereals.

One of the main objectives of the Fourth Plan is to provide the conditions necessary for a sustained increase in food grain production of about 5 per cent per annum over the next decade. According to the long-term perspective given in the Fourth Plan, food grains output is expected to rise from a base period level of 94 million tons in 1968-69 to 167.2 million tons in 1980-81. The Planning Commission, feels that such an increase in the output of food grains is feasible in view of the recent technological developments. It is stated in support that in the recent past, the Intensive Agricultural District and the Intensive Agricultural Area Programmes have demonstrated that the farmer in India responds favorably to a combination of good prices, high-yielding seeds and adequate fertilizers. A major change has thus occurred in the Indian agriculture with the adoption of the new strategy of agricultural development.

The current programme that is being implemented has two important parts for increasing the production of food grains, namely:

(1) Applying a package of practices comprising water management, high-yielding varieties of seeds, pest control and adequate fertilizer applications, along with good cultural practices.

(2) Introduction of short-term varieties of the major cereals which are as good yielders as the long-term varieties, under a suitable package of a major second crop in the irrigated areas of the country where previously only one crop was being grown.

It has been well recognized that there is a close link between programmes for the development of land and water resources on the one hand and the increased use of high-yielding varieties or other improved seeds, fertilizers, pesticides and other elements of modern production technology on the other that would bring about higher yield and cropping intensities.

Fertilizers and Manures

Fertilizers are the key to modern agriculture and as such a crucial role is given for their increased use in the new agricultural programme. The available data on the production, imports and distribution of fertilizers during the years from 1960-61 to 1968-69 are given in Table 8.

The Planning Commission concedes that the upward trend in fertilizers consumption in 1966-67 and 1967-68 has not continued in 1968-69. The main factors inhibiting a further increase in fertilizer use are essentially those on the demand side according to the Planning Commission. The measure contemplated in the Fourth Plan are primarily to stimulate demand. These include improvement and extension of soil-testing facilities, increased use of soil conditioners, intensification of extension and sales promotion, increase in the number of retail points, and increased availability of distribution credit. Measures, such as increasing the supply of production

Table 8. Production, Imports and Distribution of Fertilizers

Year	NITROGEN (N)			PHOSPHATE (P_2O_5)			POTASH (K_2O)	
	Production	Imported	Distribution	Production	Imported	Distribution	Imported	Distribution
				(Tons)				
1960-61	111,987	171,926	211,685	53,722	128	53,134	24,845	29,052
1961-62	154,326	142,920	291,536	65,360	645	63,932	30,381	27,982
1962-63	194,194	227,462	360,033	88,300	7,959	81,385	44,276	36,503
1963-64	219,072	197,691	425,872	107,836	12,267	120,847	64,060	51,860
1964-65	243,230	256,517	492,249	131,021	12,293	148,530	57,176	71,640
1965-66	237,889	376,270	582,588	118,779	21,766	139,075	93,641	89,631
1966-67	308,993	574,628	830,171	145,678	129,158	274,601	143,337	133,666
1967-68	402,648	975,897	1,135,655	207,142	370,776	438,168	276,465	205,750
1968-69	562,981	780,052	1,222,398	213,229	90,828	296,140	165,183	164,077
1969-70*	810,724	670,000	1,243,870	239,970	57,000	314,965	63,000	136,500

* Denotes the estimated figures of consumption or demand for fertilizers

Source: Figures are from the paper of Mr. C. R. Ranganathan, printed in the Fertilizer News, issued by The Fertilizer Association of India, New Delhi-11, July, 1970, page 21.

credit are also expected to make for enhanced fertilizer consumption. It may be added that attention will also be given to certain qualitative aspects relating to the balanced use of fertilizers.

Crop Protection

In the new agricultural programmes crop protection has been given a special significance. According to the Fourth Plan document "this is due to technical and financial reasons. In the case of high-yielding varieties, conditions which are conducive to the growth of the plant population are also favorable for weeds, pests and diseases. Moreover, the high-yielding varieties necessarily entail a high cost of cultivation and hence a cultivator can ill-afford to lose his crop. If full benefit is to be derived from the costly inputs, plant protection measures in various forms such as seed treatment, weed control and pest-sowing prophylactic treatment, must be made an integral part of cultural practices."[1/] Besides seed treatment, weed control and prophylactic spraying, other measures envisaged in the Fourth Plan period relate to rat control and control of epidemics. For all the plant protection programmes taken together, it is contemplated that about 80 million (gross) hectares will be covered by the end of 1973-74. It is difficult to quantify at this stage the requirements of pesticides for Indian agriculture for 1985-86.[2/]

1/ Fourth Five-Year Plan, 1969-74, Planning Commission, Government of India, page 133.

2/ In an interesting exercise, Dr. A. S. Atwal (Dean, College of Agriculture, Punjab Agricultural University, Ludhiana) has estimated that 19.0 thousand tons of pesticides will be needed for the production of food grains in 1985 (see his paper "The requirements and Potentialities of Food Production in India" presented at the National Food Congress held in May, 1970 at New Delhi).

High-Yielding Varieties Programme

As stated earlier the high-yielding varieties programme is of crucial importance for the new agricultural strategy in India. From a base level of 9.2 million hectares in 1968-69, the high-yielding varieties programme is expected to cover 25 million hectares in 1973-74. In the Provisional Indicative World Plan for Agricultural Development prepared by the F.A.O. of the UN, it is indicated that by 1985 the estimated area under high-yielding cereal varieties in India would be 43.3 million hectares. The Fourth Plan observes that for obtaining optimum results from the high-yielding varieties programme, the main thrust of effort will be in the sphere of extension. The new varieties require more refined and precise cultural practices concerning preparation of seed bed and sowing. Perhaps the most significant aspect relates to controlled irrigation so that water is supplied at critical periods of plant growth. Experiments already made show that four irrigations applied at crown-root, flowering, milk and dough stages of development are as efficient in terms of yield as six irrigations applied indiscriminately. This irrigation efficiency so necessary for the success of the high-yielding varieties programme has to be developed as part of the requisite cultural practices. There has to be a change in the practices of the canal irrigation authorities also in order to help water management.

Multiple Cropping

The importance of cropping intensity was often emphasized in the past and a measure of success was achieved in India. By 1964-65, 20.2

million hectares were sown more than once out of 137.9 million hectares of net sown area. However, in the absence of short duration varieties, cropping intenstiy could not be made a focal point of farm growth. During recent years, this barrier is being overcome and techniques of inter-cropping and relay-cropping are being developed. A series of new multiple cropping cycles have been evolved and tested. These are likely to have a significant bearing on future development.

Under the national demonstration programme, several new crop rotations have shown a significant increase in total production per unit of time. In addition to short duration varieties of paddy, maize, jowar, barja and wheat, barley, ragi, oilseeds, potatoes and vegetables have also been brought into crop rotations. If this programme of multiple cropping is implemented it will offer a potential for increase in production comparable to that provided by the high-yielding varieties programme and it will help to increase the income and employment potential of holding of small size.[1/]

Other measures and policies to support the crop production programme envisaged for the seventies are better institutional credit to the farmers, better marketing, storage and warehousing facilities, and an appropriate minimum price policy for food grains and other agricultural commodities.

1/ M. S. Swaminathan, Director, IARI, "Agricultural Research - Progress, Problems and Prospects", a paper presented at the National Food Congress held in New Delhi in May, 1970.

Limitations of Supply Projections

There are broadly two methods for estimating the output (supply) of agricultural commodities. One which is called the positive approach, employs such tools as regression procedures or less sophisticated methods using past growth rates in production. The second, which is the normative approach, is based on what farmers can or should do with regard to the production of specified commodities, and employs budgeting, programming, judgment and related techniques. In the normative approach, the target of production is assumed and the steps leading to it - the actions of the decision makers and the quantities of production of the different commodities - are derived. As Professor Heady has pointed out, both these methods have some limitations as well as advantages.[1/] He adds: "Regression methods based on time series observations cannot predict in the light of new variables and structures previously unencountered but known to exist for the future. They are necessarily tied to the past and are reflections of historic relationships. No satisfactory method is in sight for incorporating major changes in technology, institutions and Government policy into regression approaches. In supply, it is the quantity of the future rather than the record of the past that is important."

No satisfactory econometric methods seem to have been developed and tested as yet specifically for making supply projections. To quote

1/ Earl O. Heady, "Uses and Concepts in Supply Analysis" in Agricultural Supply Projections - Estimating Techniques and Interpretations, edited by Heady and others, Iowa State University Press, 1961, page 17.

Raj Krishna: "There is a crucial reason why the econometric models used hitherto to rationalize the past data cannot be used directly for projection work. If any single-equation model is to be used for predicting the dependent variable, the values of the explanatory variables in future years must be known, assumed or projected. Thus, in order to predict the acreage of a crop from a typical acreage response function, relative price and weather indices must be known. But it is difficult, if not impossible, to predict these for many years. Similarly, if the yield per acre of a crop is to be predicted from a typical yield equation input and weather series and indices of technological change must be available. Now, aggregate input levels can be projected on the basis of firm Government targets, but there may be wide differences from year to year between supplies actually absorbed and applied by peasants. It is extremely difficult to know ex-ante the inputs actually used, but these alone determine realized yields, not targets and total supplies. And it is no less difficult to project the course of technological change in agriculture.[1/]

The limitations of available knowledge of production functions, the problems of forecasting the weather and the problems of prediction of the prices of different agricultural inputs and outputs make it difficult to chart production possibilities over time with any sufficient degree of confidence. In India, such an attempt is further complicated by the fact that technological innovations such as high-yielding variety

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1/ Raj Krishna, "Agricultural Supply Projections" in the Proceedings of the 13th International Conference of Agricultural Economists - Oxford University Press, London, 1969 page 277.

of seeds have been introduced in recent years and hence a simple extrapolation of the past trends may not yield correct projections.

The object of the present analysis is essentially to project the magnitude of supply in 1985-86 as a product of the projected yield rate and the projected area under cultivation of the selected crop or crops as of that year.

This in short means: First, estimate for 1985-86 the possible increase in the crop area by the reclamation of new lands and extension of multiple cropping. Then, estimate the per hectare yield of different crops resulting from the application of known and tested techniques. One should immediately note that the increase in the crop yields over the next two decades cannot be foretold with confidence. Of the numerous factors leading to increase in the per hectare yield, the use of fertilizers and irrigation will be governed largely by each farmers' economic considerations. Undoubtedly, governmental policies will also influence the pattern and level of the use of these inputs. Yields would also be affected by scientific developments such as new varieties, methods of crops protection and improved cultural techniques. None of these is predictable in any exact fashion.[1/]

1/ D. Gale Johnson and Robert L. Gustafson, Grain Yields and American Food Supply, University of Chicago Press, Chicago, 1964.

Supply Estimates

On the basis of the available knowledge of programs for extending the net sown area, it is estimated that this area will increase from 137.39 million hectares in 1964-65 to 138.50 million hectares in 1970-71, 139.00 million hectares in 1975-76 and to 141.00 million hectares by 1980-81.

The Fourth Plan document shows that by 1980-81 the net sown area could be 151 million hectares. Higher as it is than the NCAER estimate, this could be regarded as a target to be achieved; also it implies that a projected increase up to 141.00 million hectares is feasible. The net sown area is projected to be 145 million hectares in 1985-86.

For arriving at the projections of gross area sown under all crops the NCAER has estimated that an area of 25 million hectares is expected to be added by multiple cropping in 1970-71 as compared to 20.19 million hectares added in 1964-65. With the increase in the irrigated area available for cultivation over the projected period and in the light of the measures to be taken by the Government to introduce short duration varieties of crops, it is estimated that in 1975-76 about 33 million hectares could be added by multiple cropping. By 1980-81, the area under multiple crops could go up to 41.9 million hectares. By 1985-86, this area is expected to be at least 45.0 million hectares. Thus, the gross area under cultivation of all crops is projected to increase from 158.11 million hectares in 1964-65 to 163.05 million hectares in 1970-71, 172.0 million hectares in 1975-76, 182.9 million hectares in 1980-81 and to 190.0 million hectares in 1985-86.

On the basis of projected gross area figures, an attempt is made to allocate the gross area sown to different crops for the projected years.[1/] The projected gross area under cultivation of the selected crops for the years 1970-71, 1975-76, 1980-81 and 1985-86 are given in Table 9. The projections of irrigated and unirrigated areas under selected crops are also given in Table 9. It may be noted here that the growth in irrigated areas is a policy-variable which will primarily depend on the rate of exploitation of ground water resources in the future, which again is a function of economic (price) incentives and the availability of electricity, etc.

Next, an attempt is made to project the average yield (output per unit area) of each selected crop for the years up to 1985-86. Yields rates over the projected period are estimated by taking into account the impact of high-yielding varieties of wheat, rice and other cereals and the anticipated increase in the rate of application of fertilizers and other material inputs.[2/] In deriving the present projections, account has been taken of the latest available data on

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1/ The basic method followed in allocating the gross area sown to different selected crops is similar to the one described in Long Term Projections of Demand for and Supply of Selected Agricultural Commodities, op.cit. pp. 158-161.

2/ The technique for projecting the yield rates in irrigated and unirrigated areas separately is similar to the one described in the earlier NCAER study of Long-Term Projections.

Table 9. Projections of Area (Irrigated and Unirrigated) Under Selected Crops

(Million Hectares)

Sl. No.	Crops	Base period: Average for 1967-68 & 1968-69			1970-71			1975-76		
		Total	Irri-gated	Un-irri-gated	Total	Irri-gated	Un-irri-gated	Total	Irri-gated	Un-irri-gated
1.	Rice	36.71	15.25	21.46	37.46	16.50	21.14	39.59	19.57	20.02
2.	Wheat	15.48	5.48	10.00	16.30	6.94	9.36	16.69	8.00	8.69
3.	Major Cereals	52.19	20.73	31.46	53.94	23.44	30.80	56.28	27.57	28.71
4.	Other Cereals	46.78	4.78	42.00	46.67	5.67	41.07	46.65	6.65	40.00
5.	Total Cereals	98.97	25.51	73.46	100.61	29.11	71.50	102.93	34.22	68.71
6.	Total Pulses	21.96	3.25	18.71	24.61	3.61	21.00	26.01	5.28	20.73
7.	Total Food-grains	120.93	28.76	92.17	125.22	32.72	92.50	128.94	39.50	89.44

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Table 9. Projections of Area (Irrigated and Unirrigated) Under Selected Crops --- (Cont.)

(Million Hectares)

Sl. No.	Crops	Base period: Average for 1967-68 & 1968-69			1980-81			1985-86		
		Total	Irri-gated	Un-irri-gated	Total	Irri-gated	Un-irri-gated	Total	Irri-gated	Un-irri-gated
1.	Rice	36.71	15.25	21.46	40.10	20.60	19.50	43.00	24.50	18.50
2.	Wheat	15.48	5.48	10.00	17.62	10.08	7.54	18.50	12.00	6.50
3.	Major Cereals	52.19	20.73	31.46	52.72	30.68	27.04	61.40	36.50	25.00
4.	Other Cereals	46.78	4.78	42.00	48.67	9.05	39.62	48.50	10.00	38.50
5.	Total Cereals	98.97	25.51	73.46	106.39	39.93	66.66	110.00	46.50	63.50
6.	Total Pulses	21.96	3.25	18.71	27.69	7.66	20.03	28.00	8.00	20.00
7.	Total Food-grains	120.93	28.76	92.17	134.08	47.39	86.69	138.00	54.50	83.50

the likely area under high yielding varieties program over the projected period and the technical response coefficients (or the so-called "Yardsticks" of additional production) of different inputs.[1/] The final order of the projected yield rates of the different crops for the years upto 1985-86 are given in Table 10.

A potential exists in the country for obtaining higher yields on irrigated land than the projected average. For evidence, the data given in Table 11 show that under the national demonstration program on cultivators fields, farmers have obtained on an average four to five times more yield per hectare under irrigated conditions and by making use of the new technology. It may be also noted that in our projections, there is a declining importance of unirrigated land in terms of output obtained, relative to the output on irrigated land over time. As Dr. Kanwar has observed, in the traditional dry farming and low rainfall areas the existing land use pattern is more oriented to animal husbandry, though desperate efforts are being made to grow crops such as bajra, jowar, oilseeds, gram, legumes and pulses.[2/] Jodha and Vyas in Rajasthan and Gujarat have observed that in low rainfall areas animal husbandry and sheep raising give more stable and regular income and higher profits than crop farming.[3/]

1/ See for example the booklet entitled "Yardstick of Additional Production of Certain Foodgrains, Commercial and Oilseed Crops", by V.G. Panse, T.P. Abraham and C.R. Leelavati, published by the Institute of Agricultural Research Statistics, New Delhi, 1966, and also the paper entitled "Planning Yardsticks for Fertiliser and Irrigation" by W. David Hopper published in Agricultural Situation in India, 1965, pp. 463-477.

2/ Dr. J.S. Kanwar (ICAR), "Land Resource Use in India to Meet Food Challenge", a paper presented at the National Food Congress in May 1970 at New Delhi.

3/ Jodha N.S. and V.S. Vyas (1969) Condition of Stability and Growth in Arid Agriculture.

Table 10. Projections of Yields of Selected Crops on Irrigated and Unirrigated Area

Sl. No.	Crops	Base period: Average for 1967-68 & 1968-69			1970-71			1975-76		
		Total	Irri-gated	Un-irri-gated	Total	Irri-gated	Un-irri-gated	Total	Irri-gated	Un-irri-gated
		(Kgs./Hectares)								
1.	Rice	1054	1214	940	1116	1367	920	1187	1481	900
2.	Wheat	1136	1965	682	1350	2254	680	1678	2766	675
3.	Major Cereals	1078	1413	858	1187	1629	838	1333	1854	832
4.	Other Cereals	576	990	530	621	1282	530	665	1504	525
5.	Total Cereals	842	1333	670	924	1562	665	1030	1786	653
6.	Total Pulses	512	840	456	488	953	408	538	1074	4020
7.	Total Foodgrains	782	1278	627	839	1494	606	931	1691	595

Note: The projected yields for an irrigated hectare reflect the productivity of the land and whatever water is used plus all the other imports added to an irrigated hectare (including the high yielding varieties of the crop and the amount of fertilizer used).

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Table 10. Projections of Yields of Selected Crops on Irrigated and Unirrigated Area --- (Cont.)

Sl. No.	Crops	Base period: Average for 1967-68 & 1968-69			1980-81			1985-86		
		Total	Irri-gated	Un-irri-gated	Total	Irri-gated	Un-irri-gated	Total	Irri-gated	Un-irri-gated
		(Kgs./Hectares)								
1.	Rise	1054	1214	940	1322	1745	875	1475	1946	850
2.	Wheat	1136	1965	682	1930	2999	500	2216	3159	475
3.	Major Cereals	1078	1413	858	1507	2157	770	1700	2345	753
4.	Other Cereals	576	990	530	719	1613	515	778	1850	500
5.	Total Cereals	842	1333	670	1147	2033	619	1292	2238	600
6.	Total Pulses	512	840	456	650	1309	398	750	1638	395
7.	Total Foodgrains	782	1278	627	1044	1916	566	1182	2150	551

Note: The projected yields for an irrigated hectare reflect the productivity of the land and whatever water is used plus all the other imports added to an irrigated hectare (including the high yielding varieties of the crop and the amount of fertilizer used).

Table 11. Production Potentials Obtained Under National Demonstration Program on Cultivators' Fields

Crop	Average yield obtained under national demonstation				
	1965-66	1966-67	1967-68	1968-69	1969-70
	(Yield in 100 Kgs./hectare)				
Paddy	41.95	47.95	53.54	59.46	55.37
Ratio*	4.7	5.6	4.2	5.6	-
Wheat	39.61	36.82	41.78	40.04	-
Ratio*	4.8	4.2	3.8	3.4	-
Bajra	27.06	30.43	33.35	33.01	34.15
Ratio*	8.5	8.3	8.2	10.4	-
Maize	39.76	43.76	42.36	43.38	39.55
Ratio*	4.0	4.5	3.8	4.5	-
Jowar	31.76	27.15	35.53	46.69	42.26
Ratio*	7.4	5.3	6.5	8.9	-
Paddy	59.40	107.69	110.50	152.89	128.00
Location	W.Bengal	Orissa	J & K	Rajasthan	J & K
Wheat	68.00	84.00	90.60	102.00	-
Location	Delhi	Delhi	Haryana	M.P.	
Bajra	51.75	67.00	60.64	56.25	67.10
Location	Delhi	Haryana	Punjab	Maharashtra	Cujarat
Maize	61.92	74.00	83.50	97.50	74.30
Location	U.P.	U.P.	Mysore	Punjab	M.P.
Jowar	65.61	55.00	85.16	99.44	95.00
Location	A.P.	A.P.	Mysore	Mysore	Mysore

*Ratio between the average yield under National Demonstration and the average yield in the country.

Source: Dr. J.S. Kanwar (ICAR), "Land Resource Use in India to Meet Food Challenge", a paper presented at the National Food Congress in May 1970 at New Delhi.

It seems desirable that in some of these low rainfall areas if emphasis is laid on use of scientific methods for grass and forage production, range land management and animal development projects, it is possible to ensure better land use and more stable income to farmers. The efficiency of cropping can also be increased by developing varieties tailored to rainfall pattern and adopting soil and water conservation measures to improve moistures regime of soils. The new dry farming projects which are being developed, are likely to lead to new land use patterns in these areas.

On the basis of the projected area under cultivation of the selected crops given in Table 9 and the projected yield rates of different crops in Table 10, the projected levels of domestic production of the selected agricultural commodities are worked out and presented in Table 12. Output of all foodgrains in 1985-86 is estimated to be 168.35 million tons. Of this total, 23.70 million tons will be pulses and 144.65 million tons will be cereals. Major cereals (rice and wheat) account for 106.90 million tons.

On the basis of the projections of domestic output of foodgrains for the period up to 1985-86 which are presented in Table 12, the expected supply or net availability for human consumption of foodgrains in the years 1970-71, 1975-76, 1980-81 and 1985-86 are worked out and presented in Table 13. In arriving at the expected supply or net availability for human consumption the requirements for seed, feed and wastage for different foodgrains have been deducted from the projected levels of output. In the absence of firm estimates of such requirements, for different foodgrains, the following assumptions have been

Table 12. Projections of output of Selected Crops on Irrigated and Unirrigated Area

Sl. No.	Crops	Base period: Average for 1967-68 & 1968-69			1970-71			1975-76		
		Total	Irri-gated	Unirri-gated	Total	Irri-gated	Unirri-gated	Total	Irri-gated	Unirri-gated
		(Million Tons)								
1.	Rice	38.69	18.52	20.17	42.00	22.55	19.45	47.00	28.99	18.01
2.	Wheat	17.59	10.77	6.82	22.00	15.64	6.36	28.00	22.13	5.87
3.	Major Cereals	56.28	29.29	26.99	64.00	38.19	25.81	75.00	51.12	23.88
4.	Other Cereals	26.99	4.73	22.26	29.00	7.27	21.73	31.00	10.00	21.00
5.	Total Cereals	83.27	34.02	49.25	93.00	45.46	47.54	106.00	61.12	44.88
6.	Total Pulses	11.26	2.73	8.53	12.00	3.44	8.56	14.00	5.67	8.33
7.	Total Food-grains	94.53	36.75	67.78	105.00	48.90	56.10	120.00	66.79	53.21

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Table 12. Projections of output of Selected Crops on Irrigated and Unirrigated Area --- (Cont.)

Sl. No.		Base period: Average for 1967-68 & 1968-69			1980-81			1985086		
		Total	Irri-gated	Unirri-gated	Total	Irri-gated	Unirri-gated	Total	Irri-gated	Unirri-gated
					(Million Tons)					
1.	Rice	38.69	18.52	20.17	53.00	35.94	17.06	63.41	47.68	15.73
2.	Wheat	17.59	10.77	6.82	34.00	30.23	3.77	41.00	37.91	3.09
3.	Major Cereals	56.28	29.29	26.99	87.00	66.17	20.83	104.41	85.59	18.82
4.	Other Cereals	26.99	4.73	22.26	35.00	14.60	20.40	37.75	18.50	19.25
5.	Total Cereals	83.27	34.02	49.25	122.00	80.77	41.23	142.16	104.09	38.07
6.	Total Pulses	11.26	2.73	8.53	18.00	10.03	7.97	21.00	13.10	7.90
7.	Total Food-grains	94.53	36.75	67.78	140.00	90.80	49.20	163.16	117.19	45.97

Table 13. Expected Supply of Foodgrains for Human Consumption using NCAER Estimates for Seed, Feed and Wastage.

Commodity	1970-71			1975-76		
	Projected output[1/]	Allowance for seed, feed and wastage[2/]	Expected supply for human consumption	Projected output[1/]	Allowance for seed, feed and wastage[2/]	Expected supply for human consumption
	(Million tons)					
Rice	42.00	2.94	39.06	47.00	3.29	43.71
Wheat	22.00	2.33	19.67	28.00	2.97	25.03
Major Cereals	64.00	5.27	58.73	75.00	6.26	68.74
Other Cereals	29.00	6.23	22.77	31.00	6.66	24.34
Total Cereals	93.00	11.50	81.50	106.00	12.92	93.08
Total Pulses	12.00	1.50	10.50	14.00	1.75	12.25
Total Foodgrains	105.00	13.00	92.00	120.00	14.67	105.33

1/ See Table 12.

2/ The requirements for seed, feed and wastage are: Rice 7.00, Wheat 10.60, Other cereals 21.56 and total pulses 12.50.

/2.....

Table 13. Expected Supply of Foodgrains for Human Consumption using NCAER Estimates for Seed, Feed and Wastage --- (Cont.)

Commodity	1980-81			1985-86		
	Projected output1/	Allowance for seed, feed and wastage2/	Expected supply for human consumption	Projected output1/	Allowance for seed, feed and wastage2/	Expected supply for human consumption
	(Million tons)					
Rice	53.00	3.71	49.29	63.41	4.44	58.97
Wheat	34.00	3.60	30.40	41.00	4.35	36.65
Major Cereals	87.00	7.31	79.69	104.41	8.79	95.62
Other Cereals	35.00	7.52	27.48	37.75	8.12	29.63
Total Cereals	122.00	14.83	107.17	142.16	16.91	125.25
Total Pulses	18.00	2.25	15.75	21.00	2.62	18.38
Total Foodgrains	140.00	17.08	122.02	163.16	19.53	143.63

1/ See Table 12

2/ The requirements for seed, feed and wastage are: Rice 7.00, Wheat 10.60, Other cereals 21.56 and total pulses 12.50.

made on subjective judgement. In the case of rice, 7 percent; wheat, 10.6 percent; other cereals, 21.50 percent and for total pulses 12.5 percent of gross production. Conventionally, the Directorate of Economics and Statistics[1/] gives the following allocation for feed, seed and wastages: 12.5 per cent of gross production in respect of cereals and pulses; 7.6 percent for rice; and 12.1 percent for wheat. Thus compared to the conventional proportion of 12½ per cent of gross production in the case of all cereals, the Council has, in the present report, taken a higher proportion of minor cereals for feeds. This is on the assumption that more coarse grains will be required for feeding poultry and livestock than in the past.[2/]

The balances between the projected supply and demand of food grains for different years up to 1985-86 indicating surplus or deficit are presented in Table 14. It is the Council's view that in 1985-86, India is likely to have a net exportable surplus of all foodgrains.

To provide some alternative estimates of food grain production, it may be of interest to mention here that Mr. William Holst (Economic Consultant and Vice-Chairman of the India Committee of Business Council for International Understanding, New York) has projected an output

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1/ Bulletin on Foodgrain Statistics, Directorate of Economics and Statistics, Ministry of Food, Agriculture, Community Development and Cooperation, Government of India, New Delhi, 1969, p. 218.

2/ We have worked out the expected supply or net availability for human consumption and the balances between these and the projected demand for foodgrains using the conventional percentage allowances for seed, feed and other requirements and they are presented in Table 15 and 16 at the end of this report.

Table 14. Projections of Import Demand (-) For or Export Surplus (+) of Foodgrains in India based on a Lower set of allowance for seed, feed and wastage.

Commodity	1970 - 71					1975 - 76				
	Expected supply for human consumption1/	Projected aggregate demand2/		Balance (Supply Demand)		Expected supply for human consumption1/	Projected aggregate demand2/		Balance (Supply Demand)	
		High	Low	High	Low		High	Low	High	Low
	(Million Tons)									
Rice	39.06	37.78	37.62	+1.28	+1.44	43.71	42.65	42.09	+1.06	+1.62
Wheat	19.67	20.07	20.00	-0.40	-0.33	25.03	24.27	23.68	+0.76	+1.35
All cereals	81.50	80.67	80.59	+0.83	0.91	93.08	90.88	90.82	+2.20	+2.26
Pulses	10.50	10.55	10.48	-0.05	+0.02	12.25	12.32	12.11	-0.07	+0.14
Foodgrains	92.00	91.24	91.04	+0.76	+0.96	105.33	103.52	102.81	+1.81	+2.52

1/ See Table 13.

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Table 14. Projections of Import Demand (-) For or Export Surplus (+) of Foodgrains in India based on a Lower set of allowance for seed, feed and wastage --- (Cont.)

Commodity	1980 - 81					1985 - 86				
	Expected supply for human consumption1/	Projected aggregate demand2/		Balance (Supply Demand)		Expected supply for human consumption1/	Projected aggregate demand2/		Balance (Supply Demand)	
		High	Low	High	Low		High	Low	High	Low
	(Million Tons)									
Rice	49.29	48.29	47.19	+1.00	2.10	58.97	55.90	54.09	+3.07	+4.88
Wheat	30.40	29.19	27.91	+1.21	+2.49	36.65	36.20	33.95	+0.45	+2.70
All cereals	107.17	102.38	102.07	+4.79	5.10	125.25	118.08	117.68	+7.17	+7.57
Pulses	15.75	14.41	13.97	+1.34	+1.78	18.38	17.25	16.60	+1.13	+1.78
Foodgrains	122.92	117.43	115.87	+5.49	+7.05	143.63	136.41	133.94	+7.22	+9.69

1/ See Table 13.

2/ See Table 6.

level of 184.4 million tons of foodgrains in India for the year 1985-86.[1/] Similarly, the FAO Indicative World Plan Regional Study for Asia has given the following estimates for India for 1985:

Crops	Production	Requirements	Difference
	(Million tons)		
Rice**	69.07	65.75	- 3.32
Wheat	33.33	30.25	- 3.08
Other cereals	47.62	46.50	- 1.12
Pulses	25.19	25.04	- 0.15
Total foodgrains	175.21	167.54	- 7.67

* Export Availability (-)

** FAO Regional Study gives figures in terms of paddy which have been converted by using milling ratio of 2/3.

Source: J.S. Sarma. Paper presented at the National Food Congress in May 1970, New Delhi.

Compared to the projections of production made for 1985 by the FAO, the projections of output given in Table 12 appear to be realistic and within the realm of realization.

1/ William Holst "Planning for India's Self Sufficiency in Foodgrains" in Agricultural Policy and Food Self-Sufficiency, Edited by S.C. Mathur. Associated Publishing House, New Delhi, 1970, pp. 112-145.

A Review of Projections

The projections of demand and supply presented earlier are based on the best judgement about the key factors that influence the demand for and supply of foodgrains in India. The population of India is likely to reach or exceed 550 million by the end of 1970 and may approach 795 million by 1985. How to feed adequately this growing mass of people will remain one of our chief problems. Even the most brilliant and unhoped for successes in family planning will have little effect on the growth of numbers in the present decade. But, as the National Council's Director General[1/] has observed elsewhere, "the spread of better techniques of production in agriculture holds out the hope that with sustained effort in research, extension, and good management in agriculture it should be possible not only to meet food requirements but to provide a base for all round economic growth. For this, right policies have to be evolved and implemented with steadfastness; equally they have to be modulated in the light of experience and change. In this process it is always necessary to look ahead and envisage the likely effect of policies now being pursued and trends now evident. Long term projections, despite their limitations, have therefore a useful, even indispensable, part to play."

The demand projections made here show a somewhat lower per capita demand in the future than certain other studies. This is explained

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1/ S. Bhoothalingam, "Preface" of Projections of Demand for Supply of Agricultural Commodities, New Delhi, (In Press).

by the fact that in the Council's view the income elasticity of demand for foodgrains is lower than is generally thought. But this has been and will be confirmed by pragmatic experience. As Director Bhoothalingam has suggested, "Higher standards of living will certainly cause increase of demand for food as a whole, for more variety in it, for difference kinds of it and so on, but not necessarily for foodgrains as such for direct consumption. This is in fact the trend in more developed countries. Changes of food habits in this direction may, in time, increase the indirect demand for foodgrains for animal feed and such like. Even for direct consumption, consumer preferences, as among the major foodgrains may undergo change. Thus, with more adequate supplies the tendency to change over from coarse grains to wheat or rice may be strengthened".[1/]

Another important implication of the projections presented in this report is the gradually declining economic importance of cultivation of food crops on unirrigated lands. It is quite possible that even in the foreseeable future the bulk of output comes out of lands which have an assured water supply. In fact, the very techniques of production giving much better yield are usable only on such lands. It is thus equally possible that in time the growing of food crops on unirrigated land, at any rate poor unirrigated land, may become economically not worthwhile. But this is a situation where a host of other problems would arise. And this would call for advance thinking on alternative uses for such lands or alternative occupations for those living on them now.

1/ Op. cit.

Table 15. Expected Supply (for Human Consumption) of Foodgrains in India

Commodity	1970-71			1975-76		
	Projected output1/	Allowance for seed, feed and wastage2/	Expected supply for human consumption	Projected output1/	Allowance for seed, feed and wastage2/	Expected supply for human consumption
	(Million tons)					
Rice	42.00	3.19	38.81	47.00	3.57	43.43
Wheat	22.00	2.66	19.34	28.00	3.39	24.61
Major Cereals	64.00	5.85	58.15	75.00	6.96	68.04
Other Cereals	29.00	3.63	25.37	31.00	3.88	27.12
Total Cereals	93.00	11.63	81.37	106.00	13.25	92.75
Total Pulses	12.00	1.50	10.50	14.00	1.75	12.25
Total Foodgrains	105.00	18.18	91.87	120.00	15.00	105.00

1/ See Table 12.

2/ Expected supply for human consumption is obtained from projected output after deducting the requirements for seed, feed and wastage, percentage of output allocated for seed, feed and wastage are Rice 7.5 Wheat 12.5, other cereals 12.5 and total pulses 12.5, Total cereals 12.5 and total foodgrains 12.5.

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Table 15. Expected Supply (for Human Consumption) of Foodgrains in India --- (Cont.)

Commodity	1980-81			1985-86		
	Projected output1/	Allowance for seed, feed and wastage2/	Expected supply for human consumption	Projected output1/	Allowance for seed, feed and wastage2/	Expected supply for human consumption
	(Million tons)					
Rice	53.00	4.03	48.27	63.41	4.82	58.59
Wheat	34.00	4.11	29.89	41.00	4.96	36.04
Major Cereals	87.00	8.14	78.86	106.41	9.78	96.63
Other Cereals	35.00	4.38	30.62	37.75	4.72	33.03
Total Cereals	122.00	15.25	106.75	142.16	17.77	124.39
Total Pulses	18.00	2.25	15.75	21.00	2.63	18.37
Total Foodgrains	140.00	17.50	122.50	163.16	20.40	142.76

1/ See Table 12.

2/ Expected supply for human consumption is obtained from projected output after deducting the requirements for seed, feed and wastage, percentage of output allocated for seed, feed and wastage are Rice 7.5 Wheat 12.5, other cereals 12.5 and total pulses 12.5, Total cereals 12.5 and total foodgrains 12.5.

Table 16. Projections of Import-Demand (-) For or Export Surplus (+) of Foodgrains in India based on a higher set of allowances for feed, seed and wastage.

Commodity	1970 - 71					1975 - 76				
	Expected supply for human consumption1/	Projected aggregate demand2/		Balance (Supply Demand)		Expected supply for human consumption1/	Projected aggregate demand2/		Balance (Supply Demand)	
		High	Low	High	Low		High	Low	High	Low
	(Million Tons)									
Rice	38.81	37.78	37.62	+1.03	+1.19	43.43	42.65	42.09	+0.78	+1.34
Wheat	19.34	20.07	20.00	-0.73	-0.66	24.61	24.27	23.68	+0.34	+0.93
Total cereals	81.37	80.67	80.59	+0.70	+0.78	92.75	90.88	90.82	+1.87	+1.93
Total pulses	10.50	10.55	10.48	-0.05	-0.02	12.25	12.32	12.11	-0.07	+0.14
Total Foodgrains	91.89	91.24	91.04	+0.63	+0.83	105.00	103.52	102.81	+1.48	+2.19

1/ See Table 13.

2/ See Table 6.

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Table 16. Projections of Import-Demand (-) For or Export Surplus (+) of Foodgrains in India based on a higher set of allowances for feed, seed and wastage --- (Cont.)

Commodity	1980 - 81					1985 - 86				
	Expected supply for human consumption1/	Projected aggregate demand2/		Balance (Supply Demand)		Expected supply for human consumption1/	Projected aggregate demand2/		Balance (Supply Demand)	
		High	Low	High	Low		High	Low	High	Low
	(Million Tons)									
Rice	48.97	48.29	47.19	+0.68	+1.78	58.59	55.90	54.09	+2.69	+4.50
Wheat	29.89	29.19	27.91	+0.70	+1.98	36.04	36.20	33.95	-0.16	+2.09
Total cereals	106.75	102.38	102.07	+4.37	+4.68	124.39	118.08	117.68	+6.31	+6.71
Total pulses	15.75	14.41	13.97	+1.34	+1.78	18.37	17.25	16.60	+1.12	+1.77
Total Food-grains	122.50	117.43	115.87	+5.07	+6.63	142.76	136.41	133.94	+6.35	+8.82

1/ See Table 13.

2/ See Table 6.