AGRICULTURAL PLANNING FOR 700 MILLIONS

A Perspective Study

by

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PREFACE

MY earlier book, *India's Food Resources and Population*, the original version of which was submitted as my doctoral dissertation, discussed the relation of cereals with population over a period of 60 years for 1920-21 to 1980-81. The reception it got at the hands of the press and the public coupled with suggestions from a number of friends for a similar discussion in so far as the agricultural economy of India as a whole is concerned, encouraged me to undertake the present study. When India is committed to a planned development, the importance of a long term view of each sector hardly needs any emphasis. Five Year Plans could then be drawn up with advantage with a view to achieve the desired objectives.

Since the present study essentially constitutes an exercise to assess the future status of Indian agriculture, differences of opinion are bound to arise, particularly when the basic data relating to this segment of the economy, both in terms of quantity and quality, are not free from limitations. The author will, all the same, feel himself amply rewarded if this study results in stimulating further thinking on the subject and also serves as a basis for discussion in so far as the future of Indian agriculture is concerned.

I have greatly profited from the comments of experts whose work and thought have led them to consider, from one perspective or the other, the issues which this book seeks to discuss. I would like to acknowledge the valuable discussions I had with Dr. F. Yates, FRS, Prof. Daniel L. Spencer and Dr. Marion Clawson.

Mr. Mongens Boserup, Mrs. Ester Boserup, Dr. E. M. Ojala, Mr. C. R. Eskildsen, Mr. Horace Davis, Dr. J. S. Patel, Mr. M. S. Sivaraman, Mr. S. C. Chaudhri, Mr. V. M. Jakhade. Mr. V. I. Chacko, Dr. Vidya Sagar and Dr. K. N. Synghal, favoured me with their valuable comments on an earlier draft for the various sections concerning their specialised fields.

My gratitude is also due to my friend Mr. S. P. Malhotra (now with the F. A. O.), who contributed greatly to the preparation of this study and without whose assistance at every stage, my task would have been infinitely more difficult.

For whatever virtues the analysis may contain, I am indebted to all the authorities, although they do not bear any responsibility for the final presentation and the conclusions arrived at. I however accept all responsibility for any shortcomings and deficiencies in the treatment of the subject. This study presents my personal views and not those of the Food and Agriculture Organisation of the United Nations or any of the Government agencies with whom I have been connected from time to time.

New Delhi P. C. BANSIL

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AGRICULTURAL PLANNING FOR 700 MILLIONS

PART ONE

DEMAND PROJECTIONS

1

INTRODUCTION

PLANNING will have no meaning in India if, after a period of thirty to thirty-five years of planned development, the country cannot provide all her citizens with the bare necessities of life and a reasonable living standard. It should also create a self-generating economy—one that has acquired sufficient momentum to move for ward with the internal forces released as a result of its growth.

This study is restricted to agricultural planning only. For this, it is necessary to examine the development of the economy as a whole and find out how far agricultural development of this magnitude would fit into it. It is also necessary to work out broad magnitudes of investment required for this programme not only for the various input factors like fertilisers, pesticides, irrigation, agricultural machinery, etc., but also for the allied processing industries. The reason for not undertaking such studies is that they, in themselves, would constitute independent fields of research which is not within the scope of this book.

With all the limitations which an individual research worker has to face, every possible effort has been made in this book to get into all the possible details in so far as they pertain to agriculture. The guiding principle for fixing the various essentials has been the attainment of the minimum living standards by the target date, which has tentatively been fixed as 1980-85. A balanced nutritive diet and adequate clothing, for example, have been the determining factors in so far as essentials in respect of food and clothing are concerned. These have also been critically examined in the context of likely changes in income and their consequent impact on consumption patterns.

Besides, agriculture has also to supply the needs of rapidly developing industry in the form of various raw materials and to earn sufficient foreign exchange to fill an ever growing gap in the trade balance of the country. Naturally, this aspect has also received due consideration.

The task of planning is a continuous process of matching planned demand by planned supply in physical terms over the whole period of the development programme. This has been dealt with in the two parts of the book. The first part gives targets for major agricultural commodities like the various food items, oil seeds, cotton, jute, tea, coffee and rubber. The second part examines the possibilities of achieving these targets with the available as well as potential resources. In an underdeveloped economy like India, both the present demand and the past trend in production cease to be the guiding motives. This is why the more underdeveloped a country, the longer must be the time horizon for planning and greater the need of thinking in terms of physical resources. This involves a thorough and detailed examination of future population trends, its break-up into rural and urban sectors and the rate of growth of national income. However, it is not possible to go into these details in the present study which is limited in its scope.

The Census Report, 1951, estimated the population of India in 1980-81 at 520 millions. It assumed that the rate of increase during the coming decades will remain more or less equal to that during the previous decade. According to the 1961 census, the population of India is estimated at 438 millions; showing a growth of about 21 per cent during the decade. The rate of population growth during the last years may thus be more than 2 per cent as originally estimated by some experts.[1]

Estimated birth and death rates during 1961 were 41 and 17 per cent respectively, giving a growth rate of about 2·3 per cent. With improvement in the standard of living and other socio-economic factors, militating against rise in birth-rates, it would be rather impossible to say at this stage for how long this high birth-rate

[1] Coale and Hoover, *Population Growth and Economic Development in India*, 1956-86.

will persist; more so when we have before us the example of East European countries which succeeded in bringing down their birth-rates during a comparatively shorter period.[2]

It might be difficult to come to any precise figure with regard to the future population of the country. It is now estimated at about 500 million and the present annual growth rate is placed at 2·38 per cent. With these factors, future population projections assume that the population of India will be of the order of 630 million by 1975. A U.N. study projected this figure for the year 1980 as 686 million[3] and the same is being estimated by the Registrar-General as 690 million. All these assumptions are based on the fact that the country will, perhaps, not be able to achieve much by way of family planning.

The Government has already launched a full scale programme to tackle this problem. In recent years, there have been as many as 0·2 million cases of sterilization each year and since 1956 a total of more than 1·1 million sterilization operations have been performed. India's new plans envisage the development and experimentation with all possible methods of family planning. A real break-through is the discovery of the loop which, unlike the pill and other contraceptives costs little, is easy to insert, reliable, lasting and easily removed. The future population policy of the Government will aim at reducing the growth rate and will have to form an integral part of the long-term plan itself. The distribution of contraceptives has already been made free by the various family planning centres irrespective of the income group to which the person belongs. According to some available estimates, if the efforts to reduce birth rates are fruitful, the best the optimist can hope for is that the present growth rate of 2·38 might be slowed down to between 1·6 to 1·4 per cent in about 10-15 years. It is, however, very difficult to work on a very optimistic assumption.

In the face of these conflicting views and the inadequate data before us, it is rather difficult to come to any realistic assumptions. Instead of fixing a definite target for a fixed year, we have assumed for the purpose of this study that the population of India would be in the minimity of 700 millions somewhere between

[2] R. R. Kuczynski, "The Decrease of Fertility," *Economica*, Vol. 2, No. 9 (May 1935), pp. 128-41.

[3] *The population of Asia and the Far East*, 1950-80 (1959), p. 9.

1980 and 1985. If the population growth can be checked early, the 700 million mark may be reached by about 1985, otherwise a few years earlier.

As regards the rural-urban break-up, it has been assumed that the agricultural population will drop to 55 per cent by 1980-85 as against 70 per cent in 1950-51. The rural population may then be 65 per cent of the total as against 83 per cent in 1950-1951. This would work to an annual shift of roughly 0·5 per cent from the agricultural to the non-agricultural sector which is based on the experience of India during the decade 1941-51 and other countries which moved from an agrarian to industrial economy. Some recent *ad hoc* surveys carried out in India also support this assumption.

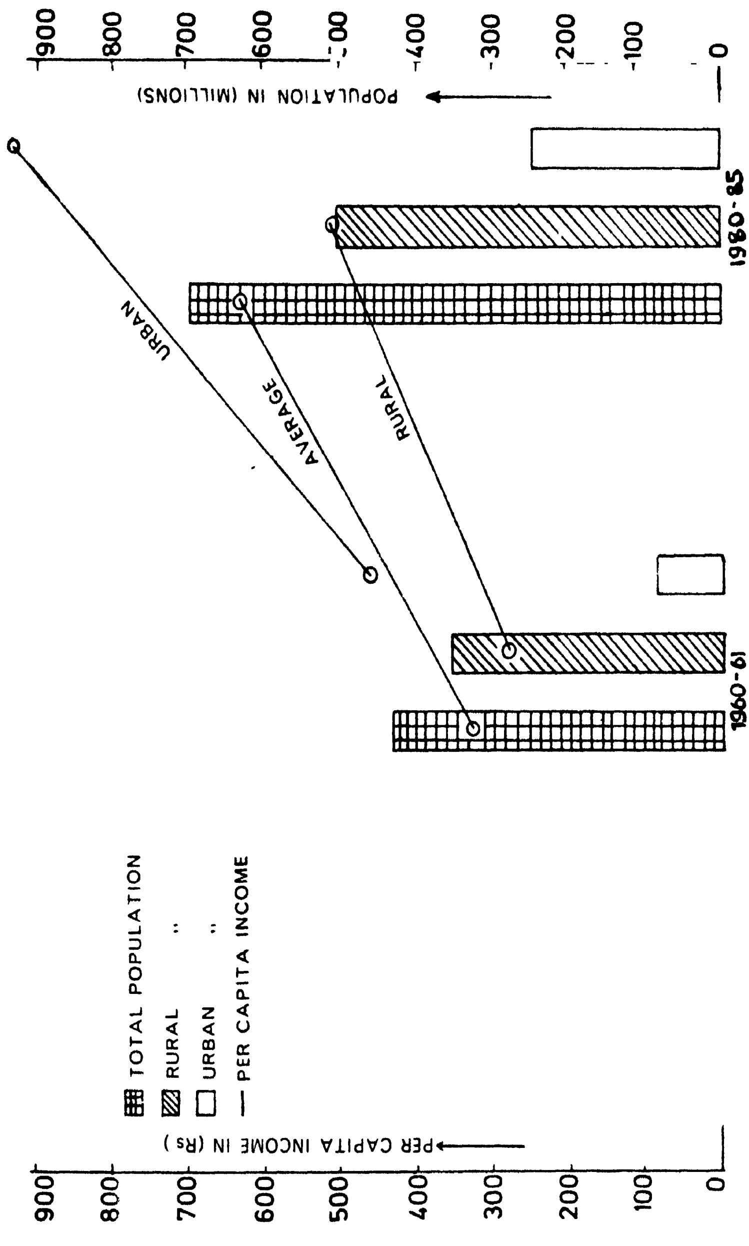
In the field of national income, we may reasonably expect a doubling of the per capita income during the stipulated period over the estimates of Rs. 330 for 1961, of course, at the 1960-61 level. The contribution of agriculture to the total growth of the national income may also be assumed to be double (or slightly higher) of the 1960-61 level. Assumptions regarding population and income details are given in Table 1·1, and Appendix 1 gives the trend in national income over the past few years.

TABLE 1·1

BASIC ASSUMPTIONS REGARDING POPULATION AND NATIONAL INCOME

	Unit	1960-61	1980-85
1	2	3	4
1. *Population*			
Total	millions	438	700
Rural	,,	358	455
Urban	,,	80	245
2. *Per capita income*			
Average	rupees	331	660
Rural	,,	284	512
Urban	,,	467	936

Marshall rightly observed that "every agricultural problem has peculiarities of its own, and some side of it can be mastered by shrewd, experienced, alert and instinctive judgment, better



CHANGES IN RURAL & URBAN POPULATION AND PER CAPITA INCOME (1960-61 TO 1980-85) than by systematic reasoning based on ordered knowledge."[4] An effort has been made to cross-check the targets indicated by past trends in the economy with judgement as to the long-run objectives of socialistic planning this country has in view.

With these few preliminary remarks, it is hoped that this study will be able to provoke thought and interest so that our short-term plans not only take a more concrete shape, but are at the same time directed towards the achievement of long-term goals set before us.

Alfred Marshall, *Industry and Trade*, 1919, p. 199.

2

FOOD FOR MAN

THREE factors which determine man's choice of food are : physical, social and physiological. Physical factors govern the availability of food. For example, there is an understandable tendency to eat foods which are at hand. Geographical considerations and availability of foods during different seasons largely determine different diets consumed by populations in different parts of the world. Social factors which include religion, social customs and educat- onal level, govern the type of food consumed. The physiological factors are heredity, allergy, acceptability and nutritional needs of individuals concerned. They determine one's choice of food.

The purchasing power of the people is another important deciding factor in all such choices. Although people are generally orthodox in their food habits, proper education or a little propaganda may help to change them. But this change cannot be very significant, particularly in low income groups, in whose case real money available determines the composition of the food basket.

Generally speaking, people at large do not take to a particular diet just as a doctor's prescription. Assume that a majority of the people have a rational approach to their everyday problems, i.e., a given income of a family is spent in a manner that the marginal utility of each commodity purchased leads to maximum satisfaction. In the case of such a family, food invariably claims the first priority out of the total expenditure allocated for consumption.

Distribution of the amount set apart for food among its various items will again depend on the comparative utility of each commodity and the price at which it is available.

True, every individual will not behave in a perfect rational manner. Even then, with due consideration to the available disposable income, our future food plans must aim at enabling an average citizen to live well. In order to live well, one must eat well, and by that is meant partaking of judicious and appropriate quantities of various types of food available rather than consuming large quantities of any one article only. The former type of diet is balanced, while the latter is poorly balanced or ill-balanced.

Nutritional Standards

Determination of a balanced diet depends upon a number of factors like body weight, climate, age and nature of work. Experimental data on the subject in India are conspicuously absent. The Nutrition Advisory Committee which laid down certain balances in 1944 and further revised them in 1958 (Table 2·1), based its recommendations on the findings of:

(*a*) the Technical Commission on Nutrition of the League of Nations, Health Organizations,

(*b*) the Food and Nutrition Board of the National Research Council, U.S.A. and

(*c*) various workers in the field of nutrition in India.

Dietary allowances recommended by Nicholas (Column 4, Table 2·1) under tropical conditions would also show that NAC recommendations are on the high side. It has been pointed out by Nicholas that his recommendations contain a fair amount of 'safety margin' to allow for various losses from the human body. They also make allowances for various losses of nutrients due to washing, processing and cooking of food. Since culinary practices differ widely, usually, 10 per cent losses are allowed. Even otherwise while a moderate worker under Indian conditions has been recommended 3000 to 2800 calories, this is the level which has hardly been reached for an average resident of European count-

TABLE 2·1
RECOMMENDED CALORIE ALLOWANCES BY THE NUTRITION ADVISORY COMMITTEE AND NICHOLAS LUSCIOUS

Particulars	*Nutrition Advisory Committee*[a] 1944	1958	*Nicholas Luscious*[b]
1	2	3	4
Man (weighing 55 kg.)			
sedentary	2400	2400	2100
active	3000	2800	2500
very active	3600	3900	3000
Woman (weighing 46 kg.)			
se entary	2100	2000	1750
active	2500	2300	2100
very active	3000	3000	2500
pregnant (latter half)	2100	2300	2500
lactating	2700	2700	2700

[a] By courtesy of Dr. V. N. Patwardhan.

[b] *Tropical Nutrition and Dietetics*, 3rd Edition, London 1951, p. 315.

ries. None of the Asian countries (Appendix 2) have so far reached anywhere near this level.[1]

Finding the recommendations of the Nutrition Advisory Committee of not much help, we have to look to some other material on the subject. Different formulae have been evolved in the West[2] relating to calorific requirements of body, weight, climate, etc.

According to an FAO study,[3] daily requirements of a reference man and woman weighing 65 and 55 kgs. living in a temperate climate at a mean annual temperature of 10°C are 3200 and 2300 calories respectively as shown in Table 2·2.

[1] Long-term plan for Japan aimed at 2200 calories per capita in 1962 against 2143 in 1956. According to an FAO estimate also (quoted in Papers Leading to the Formulation of 2nd Five Year Plan, p. 639) per capita calorific requirements for a country like India are 2250.

[2] For U.K., *Report of the Committee on Nutrition*, British Medical Association, 1950. For Canada, *Bulletin on Nutrition*, No. 2, 1950, Canadian Council on Nutrition. For U.S.A., *Recommended Dietary Allowances*, Revised 1953, A Report of the Food Nutrition Board.

[3] *Calorie Requirements*, FAO, Nutrition Studies, No. 15, 1957.

Again the Report of the Food and Nutrition Board, U.S.A., has drawn out the following simple equations for calculating the number of calories required for men and women with different weights:[4]

Calories for man = $152 \cdot 0\ W^{(0.73)}$

Calories for woman = $123 \cdot 4\ W^{(0.73)}$

'W' in these two equations stands for weight in kilograms. Similar adjustments of calories have been recommended for age, climate and activity.

TABLE 2·2

ENERGY EXPENDITURE OF A REFERENCE MAN AND WOMAN FOR A DAY

	Particulars	*Calories*	
		Man	*Woman*
A	8 hrs working activities	1200	880
B	8 hrs non-occupational activities	1500	1000
	like washing, dressing	180	150
	walking	480	220
	sitting activities	370	420
	active recreation	470	210
C	8 hrs rest in bed at basal metabolic rate	500	420
	Total	3200	2300

Source : *Calorie Requirements*, FAO, p. 56.

An average Indian weighs less than the reference man and lives in the tropical zone. According to the findings of Major D. Macay,[5] average weight of a resident in Bengal is 50·5 kgs. Average weight of a person who is 35 years old and has a height of 5′ 6″ is of the order of 135 lbs., according to Cursetji.[6]

Since the weight of a normal person is not supposed to increase after 25 years, average weight of the reference man under Indian conditions, may be assumed at about 135 lbs. Mean external temperature in India may also be taken as 20–25° as against the reference of 10°C.

[4] *Op. cit.*, p. 4.

[5] *Contour Lectures on Health and Nutrition for India*, p. 169.

[6] *A Pocket Guide to Medical Life Assurance.*

Making allowance for the lesser weight and higher temperature in India, calorific requirements for the reference man and woman may be taken 10 per cent less than provided under European conditions. This would mean a level of 2900 calories for man and 2100 for woman.

Sex ratio[7] in India is about 950. An average person or what we may call a moderate worker under Indian conditions will accordingly have to be provided with about 2500 calories on the basis of this formula.

Basic Metabolism

Calorific requirement for an average person can also be calculated by adding calories for Basic Metabolic Requirements (BMR) to those for different types of work. Investigations carried out in India indicate that BMR for adult males range from 34·3 to 36·7 cals/m²/hr and 30·9 to 35·1 for adult females.[8] This would work out roughly to 1400 calories per man and 1300 per woman. Daily calorific requirements of an average worker would thus be about 2500 as shown in Table 2·3:

TABLE 2·3

DAILY CALORIFIC REQUIREMENTS OF AN AVERAGE MAN

	Consumption per hour (calories)	*No. of hours*	*Total calories*
BMR	—	24	1400
Moderately active work[a]	100-150	6	750
Sedentary work[a]	50	4	200
Leisure[a]	25	6	150
Total	—	—	2500

[a] In addition to BMR which has been provided for all the 24 hours.

Working on the basis of these two approaches, we have to select a diet which provides about 2500 calories for a moderate worker.[9]

[7] Number of women per 1000 men.

[8] V. N. Patwardhan, *Nutrition in India*, p.120. The term cals/m^2/hr stands for calories per sq. metre per hour. Surface area of a man weighing about 50-55 kgs. is estimated at 1·6 sq. metres and that of a woman weighing around 45 kgs. at 1·4 sq. metres.

[9] Sain Dass, *Health*, p. 155 also recommends this number.

Having consulted a number of diet tables given by different authorities, Appendix 3 attempts to draw out some norms for different age groups. An analysis of this diet is given in Appendices 3·1 and 3·2.

The age structure of the population is bound to change in the coming two decades. But in the absence of any reliable data to this effect, we may work on the basis of the 1961 census.

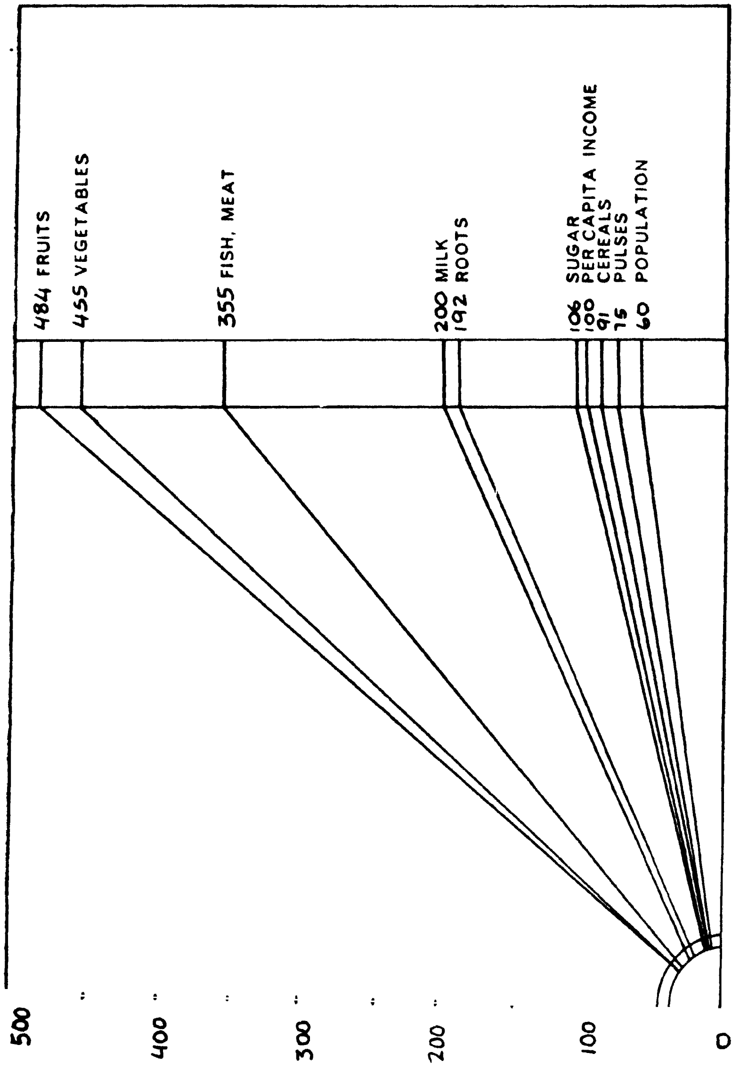
Future Food Targets

Working on the basis of the 1961 population split-up and dietary norms laid down in Appendix 3, per capita requirements of various constituents of food have been shown in column 2 of Table 2·4. This would, however, need some modification in the light of our existing food habits and other obvious factors like the technical possibility of the country to produce the required quantity of animal foods. In the light of the experience of other countries (Appendix 2), we find that the effective demand for sugar, fruits and vegetables which have a very high income elasticity of demand, is likely to be higher. As against this the intake of milk and ghee, etc. will have to be reduced so that our physical targets remain within the feasible limits.

With these considerations, Table 2·4 (col. 3) presents the modified picture. While the total number of calories available remains more or less unchanged, there is a slight reduction in the quantity of proteins and fats. Out of a total of about 72 grams of proteins, some 20 grams are of animal origin, which is in keeping with the current thinking on the subject. Graph below illustrates the changes in the consumption of various food items during the period under study.

The targets arrived at in Table 2·4 represent primarily human requirements. Allowances have been made for seed and wastages in food items etc. other than food grains. Feed, seed and wastage of food grains are at present being calculated at 12½ per cent of the gross availability. But when animal products like milk, meat and eggs have to be increased manifold, cattle will have to be fed properly. This item will then need about 48 million[10] tons of food grains. The total requirements of food grains will accord-

[10] Cf. Chapter 3.



PERCENTAGE INCREASE OF VARIOUS FOOD ITEMS IN 1980-85 OVER 1960-61

TABLE 2·4

TARGETS OF VARIOUS FOOD ITEMS FOR 1980-85

	Per capita per day in Ozs based on Appendix 3	as now recommended	*Total* requirements according to col. 3	*Constituents of column 3* calories (number)	proteins (grams)	fats
1	2	3	4	5	6	7
Cereals	11·9	12·0	84·0	1188	32	5·0
Pulses	3·0	3·0	21·0	297	17	1·1
Roots & tubers	3·0	2·0	17·5[a]	46	1	0·1
Vegetables	5·2	7·0	50·0	70	1·2	0·4
Fruits	1·0	2·0	35·0[b]	20	0·6	0·1
Sugar	1·7	2·5	21·0[c]	275	0·3	0·1
Vegetable oil & ghee	1·0	1·4	10·0	336	—	39·7
Milk	11·5	10·0	72·0	200	11·3	17·0
Fish and meat	1·4	1·4	10·0	45	7·9	2·0
Eggs	0·3	0·3	60·0[d]	15	1·1	1·1
Total	—	—	—	2492	72·4	66·6

[a] Includes industrial uses.

[b] Takes into consideration higher wastage etc.

[c] Includes 18-20 per cent intended for chewing & seed.

[d] Number in billions.

NOTE : Col. 4 is in million tons unless otherwise stated.

ingly be roughly 153 million tons. This much or even little more, for exports as well as additional buffer-stock operations, may not be much of a difficult task for the country to produce[11] when viewed against the 4th plan target of 120 million tons for 1970-71. It is important to note that this target is inter-related with those of others regarding milk, meat, fish, fruit and vegetables etc.

We may also add a word about pulses. Instead of showing any improvement they have indicated a stagnant position during the three Plan periods. Recent research experiments, however, show that more than genetic potentialities, management and a package of improved practices holds the key for higher yields. A 2½ month

[11] New high yielding varieties of rice, wheat and millets, recently introduced are, for example, expected to yield double or treble the existing levels.

crop of Tur and Moong at Hissar and Terai gave a yield of the order of 5000 lbs. per acre under normal conditions when heavy doses of NPK were applied. Realising that India occupies, more or less, a monopolistic position with regard to the production of pulses, this crop which has so far been neglected, will perhaps receive due attention, so that we are able to have a break-through and achieve our targets.

With the failure of the Third Plan in the achievement of its objectives, particularly in respect of agriculture, the nation is already alive to the problems before her. The late Prime Minister —Shri Lal Bahadur Shastri's call of 'Jai Jawan, Jai Kishan' (Victory for the soldier and the farmer) is the one which must stir every citizen. The tasks are challenging, but not insurmountable. Besides food grains, animal husbandry products must also receive proper attention. This becomes all the more important when it is realised that the gestation period for animal husbandry development is fairly long—ten to fifteen years.

The production of milk at the end of the Second Plan is estimated as 18·6 million tons which works out to hardly 4·1 ozs per capita per day. The targets being considered for the years 1970-71 and 1975-76 are 34 and 48 million tons respectively. Slow progress in the past should not stand in our way for higher levels of milk production. The high yielding varieties of seeds, being just introduced, are sure to usher a biological revolution in agriculture. With better irrigation facilities, areas under food grains may be released for dairying in important states like the Punjab and the new scheme of co-ordinated research projects being launched by the ICAR may very well be expected to bring another revolution in livestock development.

A comparison of the projected food targets in this study with those prevailing in a neighbouring country, for example Ceylon, would be of interest. The total availability, of all the food grains—rice, wheat, maize and other grains—as well as pulses is of the order of 1·5 million tons for a population of more than 11 million. Per capita income in Ceylon at present is Rs. 658.[12] With the projected per capita income of about Rs. 660 in India, there is no reason that an average person in India should behave very

[12] Ceylon rupee is 57 per cent higher in value after devaluation, but this does not affect our argument.

much differently from his brother in Ceylon where the food habits are more or less the same. This should be more relevant in so far as food grains and pulses are concerned. Calculating at the existing consumption level in Ceylon, the total requirements of food grains in India for 700 millions would work out to a maximum of 100 million tons against the production target of 132·0 million tons of cereals and of 21·0 million tons of pulses.

It would also be of interest to note that according to the 1962 survey conducted in Ceylon, per capita consumption of rice (total consumption of which is 1·2 million tons in the Island) in the lowest income group Rs. 0-50 was 18·17 measures (36·34 lbs.) as against an average consumption of 18·75 measures (37·50 lbs.) for the country as shown in Table 2·5 below. This would indicate that the consumption pattern in Ceylon has reached more or less a satiation point at the present income levels in so far as cereals are concerned.

TABLE 2·5
ALL ISLAND CONSUMPTION OF RATIONED & UNRATIONED RICE

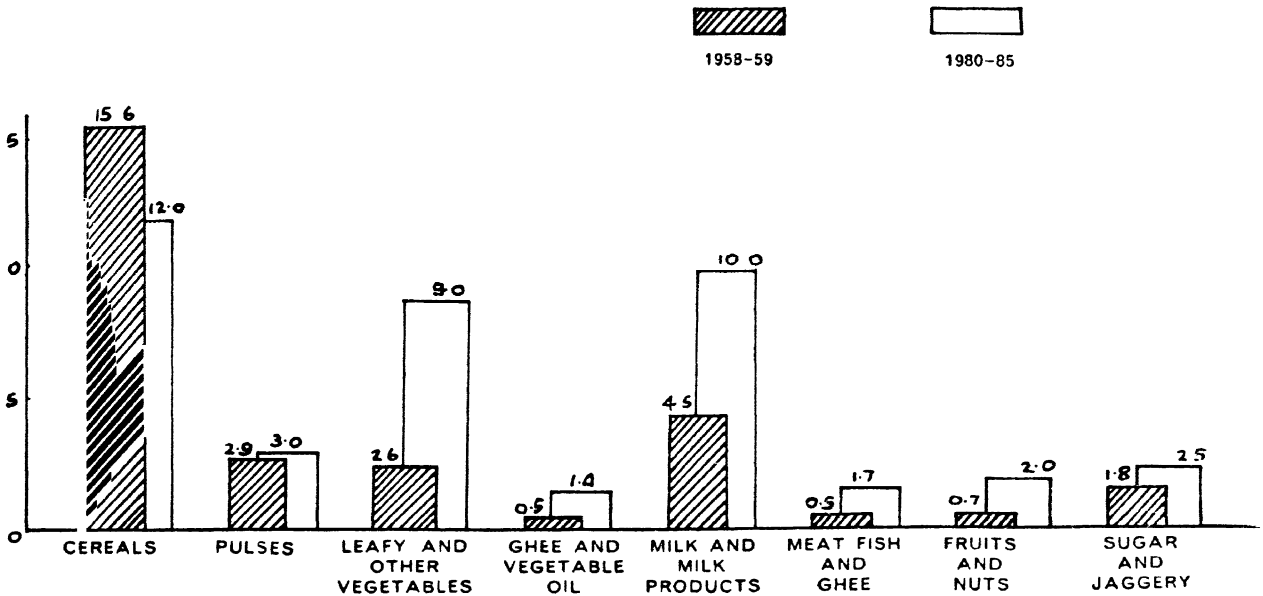
Measures (equal to 2 lbs. each)

Income Group of Spending Unit (Rs. per two months)	*Rationed rice*	*Unrationed rice*	*Total*
0- 50	13·87	4·30	18·17
51- 100	14·30	4·00	18·30
101- 200	14·75	3·90	18·65
201- 400	14·55	4·75	19·30
401- 800	12·86	5·69	18·55
801-1600	11·67	6·35	18·02
1601-2000	11·00	8·00	19·00
2001-3000	11·49	7·44	18·93
Over 3000	7·02	6·17	13·19
	13·84	9·41	18·75

Source : *Survey of Ceylon's Consumer Finances*, 1963, Central Bank of Ceylon, p. 110.

Relation with the Cost of Living

These targets which have been fixed on the basis of nutritive norms, would claim a larger outlay from the family budgets.



PER CAPITA AVAILABILITY OF VARIOUS FOOD ITEMS IN 1958–59 AND 1980–85
(OUNCES PER DAY)

Availability of each of the commodities will have no meaning if the persons who are supposed to consume it are bereft of the required purchasing power.

Many of the food projections being made today are, in fact, primarily based on income elasticity for the different items of food. Underlying object of such studies is to find the level of food consumption in relation to a specific income level. Based as they are on a not very reliable data, the utility of these norms for a long-term study is rather limited.

The well-known Engle's law gives three phases appropriate to different ranges of income as detailed below.[13]

1. Once the starvation level is passed, additional increments of income are associated, for a period at least, with increase of the proportion expended for food. This occurs when the food expense is so low that the population feels underfed and intensely desires more appetizing food.
2. Additional increases in income are associated with an increasing amount spent for food, but at a rate which gives a decreasing proportion of the total income. These relations occur among populations securing food sufficient for existence and comfort.
3. Finally, as income increases further, there is some evidence that the amount spent for food may actually decrease. The upper sedentary and rich classes are in this category.

The main question which needs consideration is the phase in which one would place India at a particular time. It is a matter of common knowledge that in all the well-to-do families, even in a backward economy, the percentage of expenditure on food is less. Not only that, a major portion out of this is spent on protective foods. When such a stage is reached, consumption of food grains, particularly cereals, automatically goes down.

An average family in India consists of 5 members. Annual requirements of the family can thus be calculated from the data presented in Table 2·4. There is, however, some difficulty about the prices of various commodities. They vary not only from one

[13] C. C. Zimmerman, *Consumption and Standard of Living*, pp. 117-18.

TABLE 2·6

EXPENDITURE PATTERN ON FOOD — 1960-61 AND 1960-85

Food stuff	*Price per Kilogram* (*Rs.*)	*Annual Consumption per family of 5 members Kgs.* 1960-61	1980-85	*Expenditure per annum per family of 5 members Rs.** 1960-61	1980-85	*Percentage variation in annual family expenditure in 1980-85 over* 1960-61	*Implied expenditure elasticity*
1	2	3	4	5	6	7	8
Food grains	0·48	848·5	776·1	407·3	372·5	—8·5	—0·09
Roots	0·30	51·7	103·5	15·5	31·1	100·6	1·07
Sugarcane (gur)	0·65	103·5	129·3	67·3	84·0	24·8	0·26
Milk & Milk products	0·60	278·4	517·4	167·0	310·4	85·9	0·91
Meat & Fish	1·50	25·4	72·4	38·1	108·6	185·0	1·97
Fruits	0·89	43·5	103·5	38·7	92·1	138·0	1·47
Vegetables	0·67	104·5	362·2	70·0	242·7	246·7	2·62
Vegetable oils	3·30	23·3	72·4	76·9	238·9	210·7	2·24
Total	—	—	—	880·8	1480·3	68·1	0·72

Increase in the per capita expenditure is taken as 94 per cent, against an increase of 100 per cent in per capita income over 1960-61.

• At 1960-61 prices.

part of the country to another, but also for different varieties of the same commodity.

No precise accuracy can, therefore, be claimed for the correctness or exactness of the prices for each of the commodities studied. What has been done is that all the relevant material on prices has been examined and the rates adopted for this study are those prevalent for some of the common varieties.

Table 2·6 shows the annual expenditure that an average family will have to incur if such a diet is to be purchased by it. Such expenditure will be about Rs. 1500 per annum; 45·5 per cent of the total income of Rs. 3300 per annum.[14] As against this, an average Indian during the base period in the rural areas was spending about 65 per cent and a city dweller 52-60 per cent of the total income on[15] food. On an all-India basis, an average Indian is said to spend nearly 58 per cent of his income on food.[16] Calculating from the data in column 5 (Table 2·6), we come to a figure of 53·3 per cent as the expenditure on food in the base period. The last column of Table 2·6 shows the implied expenditure elasticities for each of the commodities. For a better understanding o

TABLE 2·7

EXPENDITURE ELASTICITIES FOR VARIOUS ITEMS OF FOOD

	Annual expenditure per family (Rs.)		*Percentage changes in 1980-85 over 1960-61*	*Implied expenditure elasticity*
	1960-61	1980-85		
Food grains & roots	422·8	403·6	—4·5	—0·05
Sugarcane (gur)	67·3	84·0	24·8	0·26
Total staple food	490·1	487·6	—0·5	—0·01
Milk & milk products	167·0	310·4	85·9	0·91
Meat & fish	38·1	108·6	185·0	1·97
Fruits & vegetables	108·7	334·8	208·0	2·21
Vegetable oils	76·9	238·9	210·7	2·24
Total non-staple food	390·7	992·7	154·1	1·64
Total food	880·8	1480·3	68·1	0·72

14 Both income and expenditure are taken at constant prices.

15 *National Sample Survey Report No.* 19, p. 13.

16 *Agricultural Situation in India*, March 1954.

the problem, various items have been grouped and presented in Table 2·7. Expenditure elasticity for total food according to this study works out to 0·72 which means that by 1980-85, expenditure of an average citizen on food will not increase by more than 70 per cent in terms of total income and 75 per cent in terms of expendable income, over the base period 1960-61. This would appear to be quite feasible as well as reasonable.

Qualitative Shifts

At present roughly half of the population depends upon fine grains like rice and wheat, about 40 per cent on coarse grains, 6 per cent on gram and 4 per cent on roots like tapioca.[17] Along with a reduction in the total quantity of food grains consumed by an individual, there is likely to be a qualitative shift in the consumption pattern due to socialization in the demand for food. Those who depend upon subsidiary foods may totally shift over to coarse and fine grains. Majority of those who take coarse grains will start consuming fine grains. A portion of those who are already eating rice and wheat would demand out-of-door services and processed foods.[18] While fixing targets for different food grains, all these factors have been taken into consideration.

[17] P. C. Bansil, *India's Food Resources and Population*, p. 214.

[18] For a detailed discussion, refer to P. C. Bansil, "India's Food Consumption Pattern—Present and Future," *Indian Journal of Economics*, Vol. XLI, No. 162.

As for future heads of livestock, it is quite possible that with the introduction of mechanised transport, use of species like horses and ponies may be appreciably reduced. Similarly it may not be necessary to maintain the present strength of 62 million heads of bullocks in spite of increased demand for draught. This

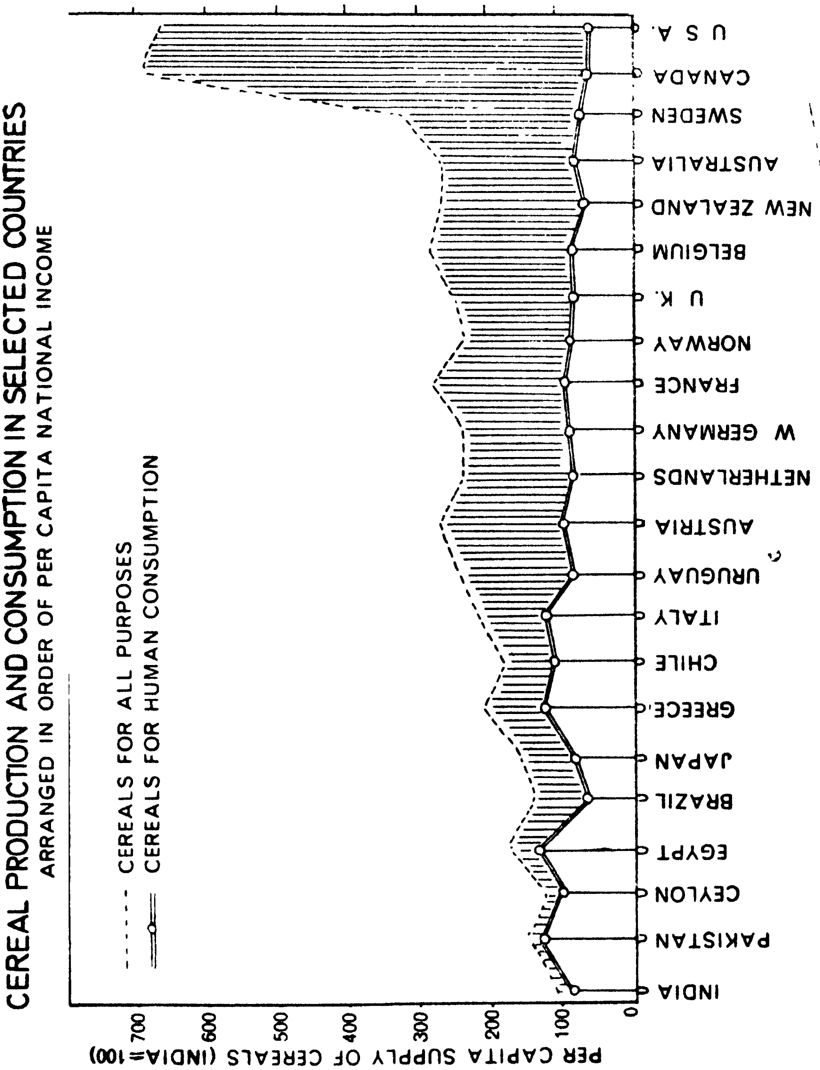


TABLE 3·2

DISTRIBUTION OF BREEDING OR MILCH ANIMALS ACCORDING TO THEIR MILK YIELDING CAPACITY

Group	*Daily milk yield (lb.)*	*p.c. of total population of each species (cow)*	*p.c. of total population of each species (buffalo)*
I	up to ½	28·4	0·1
II	½ - 1	16·2	0·8
III	1 - 2	49·3	18·3
IV	2 - 3	3·0	37·3
V	3 - 4	2·7	24·7
VI	4 - 5	0·1	8·3
VII	5 - 6	0·1	1·4
VIII	6 - 7	0·1	9·0
IX	7 and above	0·1	0·1

Source : Human Nutrition vis-a-vis Animal Nutrition in India, ICAR.

is because wherever possible, mechanisation is entering the field of agriculture. Correspondingly the number of pigs and sheep may have to be increased in response to the growing demand for meat and wool.

It may not be possible to find out the exact number of various types of livestock that India may be needing by the year 1980-85. But since our future policy will be towards an improvement in quality, we have in this study worked on the assumption that the existing population remains constant.[4] Even otherwise it can be imagined that the future agricultural economy of the country will not be able to maintain any uneconomic livestock.

Every cow on an average calves in India after every two years[5] while this period in other countries is not more than 15-18 months. With improved breed and better feeding standard, calving interval may be reduced.

[4] In any case food grains will not be given to any uneconomic cattle.

[5] "Report of the Expert Committee on the Prevention of Cattle Slaughter," p. 61 and "Milk—Symposium," Madras Government, 1956, p. 31.

That would *pari-pasu* increase the effective number of milch cattle.[6] Assuming an increase of the order of 10 to 15 per cent in this effective number, cows and buffaloes in milk by 1980-85 may number about 37 millions.

Requirements of milk by 1980-85 have already been calculated (Chapter 2) at 72 million tons. This would mean that every one of the 37 million cows or buffaloes in milk will have to yield 12-13 lbs. of milk daily. Feed requirements for cows and buffaloes will, therefore, have to be calculated at this level.[7]

As for work cattle, they are said to have no work for a major part of the year. Since different types of food are required for maintenance and work, bullocks will have to be provided work ration only when they are engaged in work. It has been assumed for this study that they will be put to hard and medium work for 60 days, and light work for 150 days and will not be doing any work for the remaining 95 days.

With these preliminary remarks, Appendix 6·1 gives details about various types of rations for different types of livestock. Actual requirements (summarised in Table 3·3), have been calculated in Appendices 6·2 and 6·3. For a proper feeding of our livestock, we will need about 31 million tons of food grains and 14 million tons of oilcakes, besides 6·6 million tons of bran.

Waste Products

It is quite possible that some of the waste products like mango seed kernel, jaman seed and acacia arabica pods detailed below may also be put to use. Experiments conducted on these waste products show that if fully exploited, they can replace a sufficient proportion of concentrates. It may not be possible at this stage to form an exact idea of the extent to which these products can be utilised.[8] Whatever little can be used, they will come in quite handy.

[6] It may be argued that in the absence of cow slaughter, the total number of cattle may also increase. Theoretically this may be true. But, as in the past, unwanted and uneconomic cattle are bound to be eliminated by the cultivator, in spite of his regard for the cow, keeping the total number more or less constant.

[7] For fuller discussion of problems in this respect refer to Chapter 6, *Agriculture and Animal Husbandry Research*, Part II, ICAR, p. 174.

[8] Cf. *Agriculture and Animal Husbandry Research*, Part II, ICAR, p. 174.

TABLE 3·3

FOOD REQUIREMENTS FOR LIVESTOCK BY 1980-85

(Million tons)

Class of livestock	*food grains*	*bran*	*oilcakes*	*dry fodder*	*green fodder*
Cows and buffaloes					
maintenance	—	—	—	76·27	387·22
milk	8·10	1·46	5·29	—	—
Work Cattle					
60 days					
(hard work)	4·07	0·65	1·92	20·90	132·00
60 days					
(medium work)	2·91	0·47	1·37	22·82	—
150 days (light work)	4·37	0·71	2·06	28·52	—
95 days (no work)	—	—	—	12·04	—
Breeding Stock (bulls)	0·10	0·05	0·10	0·96	2·61
Young stock					
maintenance	—	—	—	19·55	97·76
for growth	0·72	—	0·53	—	—
Sheep	4·02	1·04	0·67	12·12	11·44
(i) up to one year	0·49	0·03	0·16	2·03	1·35
(ii) over one year	3·53	1·01	0·51	10·09	10·09
Goat	3·57	2·25	1·96	—	58·21
(i) up to three years	0·82	0·42	—	—	12·47
(ii) over three years	2·74	1·83	1·96	—	45·74
Horses and Ponies	0·82	—	—	1·78	5·50
(i) up to three years	0·15	—	—	0·45	1·50
(ii) over three years	0·67	—	—	1·33	4·00
Camels	0·21	—	—	1·91	—
60 days of hard work	0·13	—	—	0·41	—
60 days of medium work	0·08	—	—	0·50	—
245 days of light work	—	—	—	1·00	—
Mules	0·04	—	—	0·13	—
Pigs	1·61	—	—	—	9·64
	30·54	6·63	13·90	197·00	704·38

Source: Appendix 6.

(a) *Mango seed kernel.* Mango seeds are a rich source of protein and can replace 50 per cent of oilcakes or grain. During an observation period of two months, adult animals gained 30 to 40 lbs. in weight and developed a fine bloom. It compares favourably with oat grain and, if fully utilised as concentrate for livestock, can make available 70 million lbs. of digestible protein and 760 million lbs. of starch equivalent per year. Experiments on rates have shown that 50 per cent of wheat or maize can be substituted by mango seed kernel flour without any ill-effect on their health.

(b) *Jaman seeds.* It is fairly rich in crude protein and calcium contents. Animals maintained excellent health when fed on jaman seeds. It can replace 75 per cent of oilcakes. One tree yields about 182 lbs. of seeds and there may be millions of trees in India.

(c) *Acacia arabica pods.* Babul pods are not utilised economically. The thick seed coat prevents action of digestive juices on the rich inner contents. Metabolic and long-range feeding trials with pods, slightly crushed to break the seed into three or four parts, showed that they can replace 75 per cent of the concentrates.

With all the potentialities of these waste products they have not been taken into account here because it may not be possible to make an organised effort to collect these materials. Even otherwise in a total programme of the order of 31 million tons of food grains for animal feed, the contribution from this source may not be very significant. All of these items will, however, be extremely important as a substitute for oilcakes rather than cereals.

Feed Requirements for Poultry

Feeds given to poultry consist chiefly of cereals, green matter, and other by-products of plant and animal origin. When poultry are kept on free range, they are supplemented by natural feeds, such as insects, weed seeds, etc. picked up by the birds from the ground. Whatever the nature of feeds, their nutritive value is determined by the presence or absence of substances like carbohydrates, fats, proteins, minerals, vitamins and water.[9]

While it is necessary to have a proper combination of all the constituents of food for a balanced growth of the bird, we are concerned here primarily with carbohydrates which serve as a source of heat and energy to the body. Food grains and their by-products are the principal sources of carbohydrates in poultry diet and they constitute as much as 75 per cent of their ration.

[9] Cf. Bose and Iyer, *Feeding of Poultry*, ICAR.

Results of feeding experiments at the IVRI

Best poultry ration has been found to consist of cereals plus green feed and high-calcium limestone, in conjunction with separated milk or meat offal. Feeding of separated milk to chicken materially increased the rate of sexual maturity and the efficiency of feed utilisation. Results obtained with vegetable proteins, such as soyabean meal, groundnut meal, etc. were poorer in all respects than those obtained with separated milk. It has, however, been demonstrated that a very satisfactory growth and egg production could be obtained by replacing 50 per cent of the animal protein by an equivalent amount of vegetable protein such as groundnut meal.

The importance of proper scientific feeding is revealed from experiments carried out on *desi* (indigenous) fowls. Results indicated that egg production of *desi* birds which is at present about 50 eggs per annum, could be considerably improved and an average production of 120 eggs per annum could be maintained under good conditions of management and feeding.

Recent experiments at the Indian Veterinary Research Institute indicate that it is now possible under intensive systems to raise commercially birds having an egg-laying capacity of 180-220 per annum. Research to develop the various lines further not only to raise egg production but also to improve meat quality of birds and efficiency for feed conversion are being continued in its newly expanded division of poultry research. In addition to the pure breeds, a quicker way to raise egg production is also being explored through such genetic tools as exploitation of heterosis by cross-breeding of birds of different breeds.

A tentative programme of poultry population and egg production by 1980-85 is given in Table 3·4. This would indicate the feasibility of raising egg production to levels higher than the required number of 60,000 millions.

Waste Foods

Investigations into proper utilisation of waste materials in poultry rations are of great importance for the poultry industry in India. Experiments on the inclusion of mango seed kernel and 'Jaman' seed meal by replacing 20 per cent of yellow maize meal separately in a normal growing ration showed no detrimental

TABLE 3·4

POULTRY POPULATION AND EGG PRODUCTION—1950 TO 1980-85

(Millions)

	1960	1965	1970	1975	1980	1985
No. of birds	114	115	150	300	750	1200
Laying birds	45	58	75	150	300	600
Av. production per bird	60	75	90	100	110	120
Egg production total	2700	4250	6750	15000	33000	72000
Eggs required for hatching	540	620	900	1800	3600	7200
Available for human consumption	2160	3630	5850	13200	29400	64800

effect. Further experiments revealed that mango seed kernel could also be utilised by replacing as much as 20 per cent yellow maize meal in the ration of laying birds with beneficial results. Cow dung has also been found quite useful as poultry feed. Further experiments are, however, being carried out to find out the extent to which it can be utilised without any adverse effect on birds.

Feed Requirements

It has been estimated that a hen laying 150 eggs will consume about 70 lbs. of the food mixture (column 2 of Table 3·4A) in one year. This means that a 100 lbs. mixture is sufficient to provide roughly 200 eggs.

In the intensive development programme before us, we will not be able to depend much on free range. Food grain requirements for 60,000 million eggs—our target[10]—would work out to about 7·3 million tons as shown in Table 3·4A. Further experiments are being carried out to substitute tapioca for food grains and reduce such quantity in the total ration. No consideration has, however, been given in the above calculations for any such improvement.

[10] Cf. Chapter II.

TABLE 3·4A

ESTIMATED INGREDIENTS REQUIRED FOR THE PRODUCTION OF 60,000 MILLION EGGS

	Food requirements for 200 *eggs*[a]	60,000 *million eggs*
	lbs.	('000 *tons*)
Yellow maize (ground)	45·0	6000
Oats (ground)	10·0	1335
Wheat bran	20·0	2670
Groundnut cake	10·0	1335
Fishmeal	7·0	930
Alfalfa or berseem beafmeal (dried)	4·0	525
Limestone (ground)	3·0	390
Common salt	0·5	66
Fish liver oil	0·5	66
Manganese sulphate	10·0 [b]	0·3

[a] *Feeding of Poultry, op. cit.*

[b] Grams.

INDUSTRIAL REQUIREMENTS OF FOOD GRAINS

Processed Foods

Small quantities of food are consumed by people as processed food in the form of biscuits etc. Total quantity of food grains thus required for the processed food industry has actually to be included in the prescribed cereal allowance. Since the quantity of such food consumed per head is not very significant, food grains required for their manufacture may be assumed to be in addition to the calculations already made. It may also be possible to export some of these foods. Table 3·5 shows the quantity of processed foods (biscuits) available for consumption during the First, Second and Third Plan periods. [11]

The Third Five Year Plan envisaged a target of only 40 thousand tons for the year 1965-66. This target was exceeded in 1965. If all the food industries of nearly 30 types (now existing) are taken

[11] *Programme of Industrial Development*, p. 422.

TABLE 3·5

PROGRESS OF THE BISCUIT INDUSTRY IN INDIA

('000 tons)

Year	*Production and available for consumption**
1951	16
1955	12
1960	22
1965	44

*Since imports were negligible they have been ignored.

into account, their total requirements of food grains were estimated at 39 thousand tons in 1953.[12] It is quite possible that with the rise in the standard of living, demand for processed foods may go up appreciably by 1980-85. Besides biscuits, the production of breakfast and baby foods is also likely to get a stimulus. The total demand for the industry may thus be placed at about 200 thousand tons. This will also include exports which were valued at Rs. 1·13 million in 1964-65.

Starch

Maize and tapioca are used for commercial purposes like the preparation of starch for textile and paper industries. Special varieties of barley are also used in the brewing industry. But quantities used for the latter purpose are not so large as to be of any significance in this discussion.

As for starch, it is mainly used for textile, jute and paper industries. Total requirements of starch depend upon the growth of these industries. Targets for cotton textiles and jute manufactures have already been formulated in the respective Chapters.

Paper Industry. FAO experts believe that[13]

(*a*) growing industrial output (rising at the rate of 10 per cent per year) will augment the demand for wrapping paper and boards by 5 per cent per annum;

[12] *Symposium on Technical Aid to Food Industry*, 1953, pp. 76-77.

[13] Cf. *Commerce*, Annual, 1959, p. A164.

(*b*) paper consumption in general will further expand proportionally with rising population (roughly 1·5 to 2 per cent per year); and

(*c*) increased literacy will account for a 200 per cent rise in demand for writing and printing paper and a 300 per cent rise in demand for newsprint over the next two decades.

These are long-term projections for the world as a whole. They can all the same be taken as rough indications for the growth of the industry in India, too.

From a small beginning in 1832, when the first paper machine was established at Serampore in West Bengal, the industry has never looked back and has maintained a steady progress. The annual production of paper and paper boards excluding newsprint in 1937 was 48 thousand tons. It went up to 93 thousand tons in 1947, 132 thousand tons in 1951, 193 thousand tons in 1956 and 364 thousand tons in 1961. Total quantity of paper available for consumption (production + imports) during the period 1951-52 to 1963-64 is given in Table 3·6.

TABLE 3·6

QUANTITY OF PAPER AND PAPER-BOARD AVAILABLE FOR CONSUMPTION (PRODUCTION+IMPORTS)

('000 tons)

Year	*Paper and Paper Board*	*Newsprint*	*Straw Board and Mill Board*	*Total*
1951-52	168·0	50·0	24·0	242·0
1952-53	176·0	54·0	26·0	256·0
1953-54	179·0	70·0	28·0	277·0
1954-55	207·0	79·0	33·0	319·0
1955-56	237·0	78·3	36·0	351·3
1956-57	242·0	76·4	42·0	360·4
1957-58	260·5	77·9	45·0	383·4
1958-59	276·0	79·0	45·0	400·4
1959-60	330·0	96·0	51·0	477·9
1961-62	389·0	118·9	60·0	597·9
1962-63	411·0	125·8	66·0	602·8
1963-64 (estimated)	493·0	100·0	68·0	661·0

Per capita consumption of paper has risen from about 0·7 kg. to about 1·5 kg. over the last 12 years. The rate of growth of consumption in the first three plan periods has been of the order of 8, 10 and 12·5 per cent respectively. The existing consumption levels in India are very low as compared with nearly 200 kgs. in U.S.A. and 50-100 kgs. in Japan as well as several European countries.

In order to meet the steady rise in the demand for paper and paper board arising out of the rapid progress in the fields of education, industry and the general improvement in living standards, per capita consumption by 1980-85 may be expected to go up to 7 kgs. This would mean an estimated production of over 4 million tons of paper, paper board, newsprint and chemical pulp.

Starch Requirements. According to Tariff Commission estimates, India consumed 45,000 tons of starch in the year 1950-51. Respective shares of textiles, jute and paper industries were 40, 3 and 2 thousand tons. On the basis of the quantity of starch consumed by the industry and the output of various industries in 1950-51, 210 thousand tons of starch may be required by 1980-85 for home consumption as shown in Table 3·7.

TABLE 3·7

STARCH REQUIREMENTS FOR HOME INDUSTRIES

(1950-51 to 1980-85)

		Commodity production			*Starch consumption thousand tons*		
Commodity	*Unit*	1950-51	1960-61	1980-85	1950-51	1960-61	1980-85
Cotton cloth	million yards	4500	8500	17800	40	76	160
Jute manufactures	thousand bales	5650	7270	15000	3	4	8
Paper and paper board	thousand tons	114	350	4000	2	6	42
Total	—	—	—	—	45	86	210

Besides this, glucose, cosmetics and pharmaceutical industries consumed about 10 thousand tons of starch in 1960-61. This demand may easily be quadrupled during the next 20 years so that starch requirements by 1980-85 for these miscellaneous industries may be of the order of another 40 thousand tons.

Recently new export markets have also been found for starch. The new unit set up in Kerala in collaboration with a foreign firm for the manufacture of starch from tapioca has arranged for the export of 75 per cent of its output. When it comes into full production, nearly 7500 tons of starch will be exported.

With the increased demand as well as production of textiles during the coming twenty years, throughout the world, it is quite possible that India may be able to find new export markets for starch in other parts of Asia as well. Fifty thousand tons may be assumed as the tentative export target for starch by 1980-85.

All this would mean a production programme of 300 thousand tons of starch by 1980-85. It is quite possible that tapioca may be used by the industry to a large extent. It may be difficult at this stage to assess the quantity of food grains (mainly maize and jowar) that may be consumed by the starch industry. Assuming that nearly 50 per cent of the total quantity of starch is manufactured from food grains, their requirement for the starch industry, may then be of the order of 150 thousand tons.

Total Industrial Requirements. Putting another 100 thousand tons for miscellaneous uses, the total requirements of food grains for industrial purposes may thus reach a maximum of 400 thousand tons as follows:

	Thousand tons
Processed foods	150
Starch Industry	175
Miscellaneous uses	75
Total	400

SEED

Seed Requirements

Present methods of cultivation under which agricultural yields are pretty low, require very heavy doses of seeds. Improved techniques on the other hand need much smaller quantities. Calculations in this section have been based on the traditional methods.

Table 3·8 gives the existing seed rates and the total quantity of food grains being utilised for the purpose.

TABLE 3·8

SEED REQUIREMENTS OF FOOD GRAINS 1955-56

Sl. No.	*Name of Crop*	*Seed rate (lbs.) per acre*[a]	*Area under the crop (1955-56) ('000 acres)*	*Seed for sowing (Thousand tons)*
1.	Wheat	100	29225	1305
2.	Paddy	80	76253	2524
3.	Jowar	10	42721	191
4.	Bajra	7	27025	84
5.	Barley	91	8145	331
6.	Maize	14	8909	56
7.	Ragi	8	5627	20
8.	Small Millets	16	13095	20
9.	Gram	81	22902	828
10.	Other pulses	20	32198	287

[a] B. L. Sathi and J. N. Sharma, *Field Crops.*

In 1955-56, when the total production of food grains is estimated at 65 million tons, quantity used for seed comes to 5·7 million tons or roughly 8·7 per cent.

This is alright in so far as present conditions are concerned. Improved techniques of agricultural production need much smaller quantities of seed. The U.P. method of wheat cultivation for example, does not require more than 12 to 15 lbs. when sowing is carried out by dibblers.[14] Again the Japanese method of rice cultivation requires only 20 lbs. of seed[15] per acre against 80 lbs. being used now. Rice and wheat alone under improved methods of cultivation would mean a saving of the order of 3 million tons. It would be quite reasonable to assume that a cent per cent perfection even in the case of these two crops may not be possible. Improvements in this regard in so far as other crops are concerned would be still difficult.

Seed requirements for sowing are not in any way related to production. They will, on the other hand depend on the area under

[14] Dr. Deshmukh's Circular letter, Part XXIV, p. 62.

[15] Mayadas, *Between Us and Hunger*, pp. 96-97.

food grains. According to estimates provided in Part II of the study, the total area under food grains is likely to be 293 million acres (a level reached in 1964-65) by 1980-85 as against 266 million acres in 1955-56. With less than 15 per cent increase in the area and improved methods of cultivation requiring a reduced seed rate, the total requirements of seed might not increase by more than 10 per cent over the 1955-56 level. The maximum for this purpose may thus be put at 6·5 [16] million tons.

WASTAGE

A good deal of agricultural crops suffer heavy losses at various stages before reaching the consumer. These are:

1. on the plant before the crop is actually harvested,
2. on the threshing floor,
3. in storage, and
4. during movement of the grain from the producers' field to the ultimate non-producer consumer.

Losses due to the first two categories which take place before the grain is actually removed from the plant have not been discussed here. We are mainly concerned with items 3 and 4.

Storage

Since 70 per cent of the population of India is directly engaged in agriculture and is producing its own food, we may assume that at least 70 per cent of the total production is retained by the cultivators themselves for their own consumption. This is also confirmed by the various Marketing Reports according to which marketable surplus is estimated roughly at 30 per cent.

The cultivators would normally retain with them their annual requirements or even a little more than that and store them in their 'kutcha' store-houses. It can safely be assumed that during the first six months, the loss due to storage will be quite negligible. There may be some weevil and vermin attacks to the grain during

[16] Seed rates now recommended under high yielding seed varieties are also much lower than those in Table 3·8. The rate for rice is only 22 lbs. and wheat 66 lbs. per acre.

the latter six months. True, the cultivator is not equipped with the modern storage facilities, but his old methods of storage are also quite efficient. The Marketing Reports on Wheat, Rice and other coarse grains estimate that maximum losses on account of village storage may be of the order of 2 per cent. The Price Sub-Committee puts this at 2·5 per cent.[16a]

According to Dr. Baljit Singh[17] it is 5 per cent and the Food Grains Investigation Committee estimates this loss as 1·5 to 8 per cent.[18]

The Department of Food, Ministry of Food and Agriculture in their Annual Report for the year 1956-57 have stated that the actual storage loss during the year under review was about 0·35 per cent under Govt. storage. This brings to focus the wide disparity between the earlier estimate and the actual figures arrived at by the Food Department on the basis of their experience with regard to Food in Government storage. Losses under commercial storage would also not increase appreciably. This is because the businessman is more careful about the stored grain.

The Second Five Year Plan had a very ambitious plan for expanding storage facilities. Against the storage capacity of 227 thousand tons owned by the Government at the end of first plan and another 512,000 tons hired one, the Second Plan envisaged to raise Government storage capacity for the imported food grains only to about 2 million tons. Besides this, about a million tons of storage capacity was sought to be provided for during the plan period, under the control of Central Warehousing Corporation. The Central Government had at the end of the Second Plan a total storage capacity of 2·5 million tons (8·2 lakh tons of this was owned by the Food Dept.) and the target fixed under the Third Plan was 5 million tons. Central and State Warehousing Corporation had a storage capacity of another 350 thousand tons which was to be increased to over 1·6 million tons by 1965-66. Total owned capacity with the Dept. was only 2·0 million tons at the end of the Third Plan. Fourth Plan (1970-71) target against this has been put at 4·0 million tons.

Since this later scheme, as recommended by the Rural Credit Survey, is linked with improving the credit-worthiness of the culti-

[16a] Report, p. 101.

[17] *Population and Food Planning*, p. 87.

[18] Report, p. 6.

vator, it is possible that the pace of providing storage facilities during the subsequent Plans may be more vigorous so that a substantial portion of the marketable surplus finds its way to the Government warehouses equipped with modern facilities.

When agricultural production is proposed to be raised to a high level, it is extremely necessary that storage losses should be brought down to a minimum. If they exceed even 1 per cent, there is a case for paying due attention to this matter. Whatever the present level of loss, there is no reason that it should be allowed to exceed a maximum of 1 per cent, although the aim should be to bring it as near the 0·35 per cent level as possible.

Transportation Losses

According to the Food Grains Investigation Committee[19] the losses in transport are as follows:

	per cent
Rail transport	½ to 3½
Road transport	½ to 1¼
River transport	½ to 1

These estimates were based mostly on the data during the war and post-war periods when normal care was not possible. The matter has now been investigated by the Dte. of Storage and Inspection, Ministry of Food & Agriculture thoroughly. According to them, the loss is not more than 0·5 per cent of the quantities transported. As the grain representing marketable surplus would in future be at least 30 per cent, it would mean roughly 0·2 per cent of the total.

Total Wastage

Adding up, various types of losses, the position may be summed up as follows:

	per cent
Storage losses	1·0
Transportation losses	0·1
Miscellaneous	0·4
Total	1·5

19 Report, p. 12.

This would mean that against the total projected target of 153 million tons of food grains, maximum quantity for wastage can be put at about 2·3 million tons.

RESERVE STOCKS

The purpose of reserve stocks is the prevention of disruptive short-term swing in the price level of basic raw materials, a central element in the broader objective of narrowing the trade cycle,[20] avoiding deep depression and maintaining high level of employment.

A United States study, 'Reserve Levels for Storable Farm Products,' categorises three main purposes for such reserves as follows:[21]

1. to offset variations in production;
2. to provide normal working stocks;
3. to stabilise prices and offset variations in demand, including provisions for meeting war or defence emergencies.

In a marginal food economy like that of India where agriculture is subjected to the vagaries of nature, working or 'pipeline' stocks play a very important role for the smooth supply of food grains in lean years and checking a slump in the food market during years of bumper crops. This would represent the quantity that:

(*i*) is likely to be required by the consumers in periods of short supply, and

(*ii*) will need to be taken off the market by the state in periods of excess production.

Even in normal years, during the transitional period, reserve stocks would be extremely necessary to supply the needs of non-producers whose number is increasing every day due to industrialisation and urbanisation. In a developing economy, it is quite

[20] Cf. M. K. Benett, *International Commodity Stock Piling as an Economic Stabilisation*, p. 21.

[21] *Ibid.*, p. 21.

possible that some temporary impediments might be placed on the free flow of marketable surplus as is the case today.[22] Sufficient reserve stocks with the Government are very helpful to bring the market back to normal.

As regards item 3 referred to above, price stabilisation and an off-setting of variations in the demand in the context of Indian conditions, is actually included under item (*ii*) above. A considera-tion for an emergency like that of war has, of course, to be ruled out from a study like this. The present discussion will thus be restricted to only the first two items.

Production variation

Prices Sub-Committee of the Policy Committee on Agriculture, Forestry and Fisheries examined the question of reserve stocks with a view to meeting production variations from year to year. After a study of the production figures of four important food crops—rice, wheat, jowar and bajra—for the period 1919-20 to 1944-45 (in British India only) the Committee gave the following maxima, mode and minima for each crop.[23]

				million tons	
	Rice	*Wheat*	*Jowar*	*Bajra*	*Aggregate*
Maximum	29·1	9·0	8·6	3·0	45·0
Mode	25·0	7·7	5·6	2·2	40·0
Minimum	21·0	5·7	4·7	1·8	36·0

Marketable surplus according to various Marketing Reports in the case of these crops is of the order of 30 per cent. On this basis, the maximum, minimum and mode distributable surplus from the aggregate will be as follows:

	million tons
Maximum	13·5
Mode	12·0
Minimum	10·4

[22] Cf. *Report on Market Arrivals of Food Grains*, Ministry of Food & Agriculture, 1959.

[23] Report, pp. 91-92.

Difference between the maximum and mode comes to 1·5 million tons, while that between the minimum and mode is 1·6 million tons. The Committee on the basis of this analysis, concluded that 1·5 million tons may represent the quantity that has to be taken off the market in bumper years and put into the market in years of lean production.

This problem has also been studied from time to time by other expert bodies. The Foodgrains Policy Committee of 1943 recommended a reserve stock of 0·5 million tons and this was endorsed by the Famine Commission, 1945. The Foodgrains Policy Committee of 1948, raised this limit to 1·0 million tons. The Government of India, in 1954 decided to maintain a Central Reserve of 1·5 million tons of food grains.

This analysis may hold good under the present condition of Indian agriculture which is subject to the vagaries of nature. As is well known, agricultural productivity is largely governed by the timely supply of water in adequate quantities which is not possible at present. In the coming 20 years, however, as much as 160 million acres[24] out of a total of nearly 350 million acres of net sown area is envisaged to be provided with ample supplies of water. Pest as well as rodent control measures are also being planned to reach some stage of perfection during this period. Variability of production from year to year under the circumstances, would be appreciably reduced.[25] If the efforts now being made to control floods are also successful, there is every reason to believe that hazards of floods and droughts may be checked. Such reserve stocks of large quantities which are more or less in the nature of buffer stocks, may not, therefore, be necessary.

Normal Market Stocks

As regards meeting the needs of the non-producer consumers, it is well known that there is at present a surplus of manpower in agriculture. Agricultural families in India are busy hardly for 3 to 4 months in a year. This would mean that every scheme of development will aim at the removal of this idle manpower from

[24] Includes assured rainfall area also.

[25] Cf. N. S. Khrushchev's Report to the Central Committee of Communist Party. Supplement to *Soviet Land*, March 1, 1956, p. 26 for some similar views.

agriculture. Existing population of 70 per cent directly engaged in agriculture may be reduced to 55 per cent by 1980-85.[26] Besides urbanisation, schemes for small-scale and village industries are also trying to syphon off people from agriculture so as to bring a reduction in the number of producers.

During the transitional period of development, the non-producers cannot at any time be left at the mercy of the producers. What is known as 'Scissors Crisis' in the Russian history is a glaring example. Primary responsibility for high prices at the end of Second Plan in the face of a record production of 80·0 million tons of food grains is also indicative of the same situation.[27]

It is not necessary for the Government to keep reserves so as to meet the total demand of the non-producers. In a free economy, when total production does not fall short of the normal requirements of the country, what is needed is only marginal adjustments intended to keep up the market psychology whenever the necessity for it arises. If 45 per cent constitutes the non-producer class, at least 10 per cent out of them will be those living in rural areas. Balance of 35 per cent can be assumed to be living in urban areas by 1980-85.

Reserves with the Government to the extent of 10 per cent of the total requirements of urban population would normally be quite sufficient to meet any crisis. Reserve stocks should not, therefore, be more than 3 per cent of total production. In a production programme of 153 million tons, this would mean about 5 million tons. The Foodgrains Enquiry Committee has recommended a reserve stock of the order of 2 million tons in addition to any amount of buffer stocks that the Government may like to keep. As already stated, it may not be extremely necessary to keep very heavy buffer stocks after a period of about 20 years. But total reserve stocks of the order of 5 million tons by 1980-85 would seem to be extremely necessary.

If the intention is to have 5 million tons of reserve stocks by 1980-85, this would mean a programme of at least 1 million tons being added over every plan so that by the end of the 6th plan we automatically have with us 5 million tons. In a way, this is not the additional requirement for the period 1980-85 because reserves of one year will normally be replenished during the next year.

[26] See Chapter I.

[27] *Op. cit.*, P. C. Bansil, *India's Food Resources and Population.*

Total requirements of food grains for feed, seed and wastage

Summing up the whole position, we can say that the net requirements of food grains for purposes other than human consumption will be roughly 48 million tons as follows:

		Million Tons
Livestock		31·0
Poultry		7·3
Industrial uses		0·4
Seed		6·5
Wastage		2·3
	Total	47·5

4

COTTON

THE INDIAN textile industry is long standing. The increasing demand for raw cotton has, therefore, been primarily determined by its consumption by the ever-expanding industry. Small quantities of raw cotton are also being exported to other industrialized countries, and consumed at home as "extra-factory" consumption. All these factors will thus have to be taken into consideration while estimating the future demand for cotton in India.

Cotton Manufactures

Cotton fabrics in India are either mill made or spun at hand and power looms. Appendix 7 provides the availability of various types of cloth in India during the past fifteen years. As the conditions responsible for the future demand of cloth will depend on home consumption as well as exports we will examine them separately.

Home Requirements of Cloth

Clothing, next to food is one of the primary necessities of man. India will have undergone a period of 30-35 years planned development by 1980-85. It would not, therefore, be too much to expect that every citizen should be having by that time a reasonable standard of clothing. Assuming that by that time sufficient purchasing power will be generated to enable every family to spend for the minimum quantity of cloth,[1] we will have to project our requirements of cotton manufactures on that basis. When the per capita income is doubled over the 1960 level, it is quite natural that an average individual will be able to spend more on clothing.

What is a Reasonable Standard?

Opinions may differ about the quantitative measure of a reasonable standard for clothing. At the same time it should at least be sufficient to keep the body warm and dry and to maintain a modest respectability.

TABLE 4·1

MINIMUM REQUIREMENTS OF CLOTH FOR AN AVERAGE FAMILY

	Number	*Yards of cloth*	*Duration (Years)*
Male adult			
Dhoties (or six pyjamas)	2 pairs	20	1
Shirts	3	9	1
Underwear	3	3	1
Miscellaneous angochha (towel)	2	3	1
Total cloth	—	35	—
Female adult			
Sarees	2 pairs	20	1
Blouse	4	6	1
Bodice	2	1	1
Petticoat	2	6	1
Miscellaneous	—	2	1
Total cloth	—	35	—
Children male and female			
Frocks	6	12	1
Shirts	4	4	1
Miscellaneous	—	2	1
Total cloth	—	18	—

[1] This is rather a big assumption. The actual method would be to draw out a regular demand curve on the basis of income elasticities for textiles. This has, however, not been possible because of the limitations of the existing data required for the purpose.

Scientific studies are not available about the minimum requirements of cloth. They will have to be based on the normal wear and tear of cloth for which reliable data are not available.

Some suggestive standards for the requirements of cloth under tropical conditions are, however, available as shown in Table 4·1.[2]

According to this study, 35 yards of cloth for adults and 18 yards for children is the minimum requirement. As against this, the National Planning Committee laid down 45 yards and the Bombay Plan 30 yards, which must be provided for every individual.

World Comparison

An interesting study of consumption pattern in various countries of the world is available. This information could be put to better use if related to national income. This has been done for some selected countries in Table 4·2 which shows per capita consumption of fibres and income. This would indicate that consumption levels invariably bear a direct relation to income.

TABLE 4·2
PER CAPITA NATIONAL INCOME AND FIBRE CONSUMPTION
(Cotton, wool and rayon)

Country	*National Income* U.S. $(1960)	*Cotton* (*Kilograms*) 1957	*Wool* (*Kilograms*) 1957	*Rayon* (*Kilograms*) 1957
Argentina	378	5·9	1·4	0·8
Australia	1244	5·2	2·1	1·8
Brazil	288	3·7	0·3	0·6
Burma	50	1·8	—	0·1
Ceylon	120	1·3	—	0·7
U. A. R.	111[a]	3·9	0·2	0·4
Japan	341	4·4	0·8	2·3
Pakistan	51[a]	2·2	n.a	0·1
Sudan	85	1·4[b]	—	0·3[b]
Thailand	94	1·8	—	0·2
U.K.	1085	5·8	2·4	3·0
Yugoslavia	480	2·2	0·8	0·8
India	68	2·2	—	0·1

[a] Relate to 1956 (at 1954 prices).

[b] Average for the year (1956-1957 only).

[2] Dr. S. B. L. Nigam, *State Regulation of Minimum Wages*, pp. 226-227.

Future Requirements

Per capita availability of cotton piecegoods in India (Appendix 7) went up from about 11 to 14·7 metres during the First Plan period. This works out to 33 per cent increase in cloth against 11 per cent increase in per capita income. The Second Plan target was for 18·4 yards, a 12 per cent increase against 18 per cent increase in per capita income. Consumption of cloth, however, remained more or less constant against 8 per cent actual increase in per capita income during the Second Plan period. An explanation can possibly be found for this behaviour in the fact that the prices of coarse, medium and fine cloth went up appreciably during the period 1956-61, as shown in Table 4·3. More or less, the same position continued during the Third Plan.

TABLE 4·3

WHOLESALE PRICES OF CLOTH: CATEGORY-WISE

(In paise per lb. of yarn woven)

Year	*Coarse*		*Fine*	*Superfine*
1952	182	248	500	794
1953	204	249	485	812
1954	244	272	427	806
1955	239	274	409	839
1956	279	373	499	1000
1957	284	388	536	1007
1958	275	383	549	1016
1959	259	383	571	1054
1960	316	463	611	1087
1961	311	451	601	1060

The experience of the Second and Third Plan periods cannot, however, be depended upon for estimating the future demand o cloth. According to the National Sample Survey data, the income elasticity of demand for cotton cloth is estimated to be more than one. Since for the purposes of all our future calculations, prices are assumed to be constant, effective increase in the per capita income of an average citizen is bound to result in an increased consumption of cloth which, in the order of priority, comes only next to food.

Per capita income is assumed to increase by 100 per cent during the period under study. This according to the available elasticity calculations should easily place the per capita consumption of cloth at about 32 yards, but if we go by the analogy of the world position as it exists at present we find that in countries like Egypt where the income level is nearly double that of India, per capita consumption of cloth is round about 29 yards. Since we cannot depend very much on the reliability of income elasticity, as calculated from the National Sample Survey, particularly for long-term studies, to be more realistic, we can put the total per capita demand for cloth 15-20 years hence at about 29 yards. Of this, about 3 yards per capita would be of man-made fibres as discussed below. According to minimum requirement standards as already discussed, we need about 35 yards for an adult and 18 yards for a child. Some persons may be consuming more than others. Actual consumption by the well-to-do classes may be much higher than these figures. Taking into consideration all such points, a target of 24 yards per capita for the period 1980-1985 should possibly be quite appropriate,[3] even from the point of view of minimum requirements. This would also indicate an income elasticity of demand as less than unity which can possibly be considered as reasonable.

At this rate, an estimated population of 700 millions by 1980-85 would require 16,800 million yards of cloth.

Artificial Fabrics

Any study of cotton will be incomplete without an examination of the effect of artificial fabrics on its future demand. Taking the world as a whole we find (see Table 4·4) that the total production of cellulosic, non-cellulosic and glass fabrics increased from 3700 million lbs. in 1950 to 6500 million lbs. in 1960. Countries which have contributed most in this increase are the United States, Japan and Europe.

These man-made fabrics aided by modern development in textile technology and refinement in sales promotion have succeeded in carving out a sizeable market for themselves at the cost of cotton. The fact that they continue to oust cotton is reflected in a declining share of the latter in the world fabric consumption from 65 per cent in 1958 to 60 per cent in recent years.

[3] According to the tentative Fourth and Fifth Plan targets, per capita consumption of cloth was assumed at 19·5 and 22 yards for 1970-71 and 1975-76 respectively.

TABLE 4·4
WORLD CELLULOSIC, NON-CELLULOSIC AND TEXTILE GLASS FIBRE PRODUCTION BY COUNTRY
(In Million lbs.)

Year	Nature of Fibre	U.S.A.	Japan	W. Germany	U. K.	Italy	France	India	Others	World total
1950	Cellulosic	1259	253	357	362	227	180	—	908	3546
1950	Non-Cellulosic	1122	251	352	10	1	4	—	13	153
	Glass	23	—	—	—	—	—	—	1	24
1952	Cellulosic	1136	404	318	268	170	164	8	1067	3535
	Non-cellulosic	211	8	9	18	5	7	—	26	284
	Glass	45	1	—	—	1	1	—	—	48
1954	Cellulosic	1086	633	429	423	275	230	18	1396	4490
	Non-cellulosic	285	21	16	26	17	17	—	47	429
	Glass	59	3	—	—	1	2	—	—	65
1956	Cellulosic	1148	917	528	432	326	235	37	1639	5262
	Non-cellulosic	400	63	31	51	25	33	—	74	677
	Glass	96	4	1	—	2	4	—	2	109
1958	Cellulosic	1035	719	475	354	303	278	65	1799	5028
	Non-cellulosic	490	102	53	67	41	52	—	116	921
	Glass	104	8	4	—	3	11	—	2	132
1959	Cellulosic	1167	848	527	427	343	242	81	1929	5564
	Non-cellulosic	645	178	85	88	55	72	—	148	1273
	Glass	147	13	6	—	5	14	—	4	189
1960	Cellulosic	1028	956	543	456	356	261	94	2054	5748
	Non-cellulosic	677	261	116	136	74	100	—	200	1564
	Glass	179	19	10	—	7	20	—	4	239

The position in India is not very different although the production of staple fibre fabrics came down from 14·4 million yards in 1951 and 15·6 million yards in 1952 to 3·6 million yards in 1960, rayon fabrics went up from 176·4 to 414 million yards during the same period. This increase would seem too spectacular (more than 100 per cent), although it plays quite an insignificant role in the total availability of cloth. This is evident from the data given in Appendix 8. During the past 14 years production of all man-made fabrics has increased three-fold but still it is less than 12 per cent of cotton textiles. All the increase in artificials can be attributed to :

(1) the more attractive nature of man-made fabrics;
(2) artificial fibres have some special advantages such as high durability, easy washability, crease resistance, etc.
(3) non-availability of cotton fibres due to the shortage of raw cotton as indicated by the high prices of cotton cloth ruling in recent years.

Progress in the initial stages was slow due to the non-availability of machinery and foreign exchange. This problem will be solved in due course. Even then cotton will continue to have an advantage over man-made fabrics. To enumerate a few of them, we may add :

(1) cotton cloth is much cheaper as compared to the artificial one;
(2) in tropical countries like India cotton is more comfortable on account of its moisture absorption and transpiration;
(3) artificials cannot be used if a person is to work near the fire, say in the kitchen;
(4) artificials are easily susceptible to the attack of moths. Some moth proof varieties of cotton have no doubt been evolved but they will increase the cost further.

With these points for and against cotton, one may conclude that artificials may not succeed in replacing cotton appreciably under Indian conditions, particularly when it is realised that cotton is undoubtedly better all-round application of properties than any of the synthetic fibres. The place of artificials in the future textile industry cannot, all the same, be ignored. Synthetic fibres have initiated an era of 'easy care' fabrics. Still more important are the exceptional 'functional qualities' which render these fabrics increasingly popular with relatively high income consumers. Per capita consumption of these fabrics has already nearly doubled in India during the last 6-7 years to about 2 yards.

TABLE 4·4A
FOURTH FIVE-YEAR PLAN TARGETS
OF ANNUAL CAPACITY FOR SYNTHETIC FIBRES

	'000 *tons*
1. Nylon Filaments and staple	15·0
2. Nylon tyre yarn, Fishing Net Yarn and Industrial Yarn	13·0
3. Polyster Fibre	20·0
4. Polyacrylic Fibre	20·0
5. Polypropylene and Polyvinyl Alcohol Fibre etc.	20·0
Total	88·0

YARN

Sewing and Hosiery

Yarn for sewing and hosiery, etc. accounts for the consumption of small quantities of cotton. The estimated consumption by the end of Second Plan was 50 thousand bales. Fifteen to twenty years hence, this may tentatively be put at 100 thousand bales, just the double of the 1960-61 level.

Export

Small quantities of yarn are also being exported. During the past few years, exports of yarn and thread were, however, influenced by considerations of home demand for the handloom sector. The result was that exports of yarn showed a rather erratic trend as shown in Table 4·5.

Having touched the peak of 31·26 million lbs., yarn exports have hardly recovered to about 28-29 million lbs. in recent yea rs It may not be easy for India to recapture her foreign markets which

TABLE 4·5

EXPORTS OF COTTON YARN FROM INDIA

Year	*Quantity (million lbs.)*
1951	16·0
1955	21·0
1956	12·8
1957	16·55
1958	31·26
1959	21·35
1960	14·15
1961	15·21
1962	23·02
1963	29·94
1964	28·05
1965	28·11

have already been lost to Hong Kong and Pakistan. An improvement is, all the same, noticeable in her exports during the last few years. It is quite possible that we might be able to establish stable trading conditions during the Fourth and Fifth Plans, more so as a result of the devaluation of the Indian rupee. The estimated export target for 1980-85 may be put at a conservative estimate of 40 million lbs. or 100 thousand bales in terms of raw cotton.

EXPORTS OF CLOTH

Next only to U.S.A., India holds second place in the world in the production of cloth. From the export point of view also, she has held the first place in some and second or third places in other years.

The major cotton textile exporting countries at present are Japn, U. S. A., and India. Having touched the all-time peak exports of 1269 million yards in the year 1950-51, Indian exports never reached this figure. India has actually been facing a tough competition from other exporters. Secondly, textiles being a relatively simpler form of manufacture, every importing country is trying to meet as much of her requirements as possible from home manufactures. Textile industry in Japan has also met more or less the same fate. Textile goods exported accounted for 50 per cent of Japan's total exports during the period 1934-36, but their share has been continuously declining after the War, to as low as 30 per cent in 1959 and 21 per cent in 1964.

The number of cotton spinning spindles in various parts of the underdeveloped world is increasing rapidly. It went up from 28·9 millions in 1955 to 42·9 millions in 1960, and 47·9 millions in 1964 in Asia, and Oceania. The corresponding figures for Africa are 970, 1712 and 2435 thousands. All this has affected the cotton textile trade in the world. At the beginning of the twentieth century, for instance, they constituted roughly 40 per cent of total world trade. This declined to 30 per cent by 1929 and 19·5 per cent in 1950.[4] It has further gone down in recent years.

It must, therefore, be remembered that the hinterland of countries with an industrial vacuum is disappearing day by day and it would not be an easy task to maintain textile exports at a high rate.

The possibilities of India increasing her textile exports to Asian and African countries are rather dim. The devaluation of the Indian rupee in June 1966, may, however, change this position. Undoubtedly, it is too early to make any predictions. The position will have to be watched carefully in course of time.

As for the European countries, U.K. is the most important importer of cotton textiles and Indian exports experienced difficulty even there. An agreement was signed in 1960, between India and U.K. on the one hand and U.K. and Pakistan as well as Hong Kong, on the other, under which a ceiling of 175, 38 and 164 million square yards was fixed for export to U.K. by India, Pakistan and Hong Kong respectively. India has been having her due share (see Table 4·6) in U.K.'s imports of cotton textiles.

In order to step up the exports of textiles, a short-term arrangement for the regulation of world trade in cotton textiles was negotiated in July 1961 under the auspices of G.A.A.T. This was followed by the long-term arrangement regarding international trade in cotton textiles. This arrangement which is for a period of five years came into force on 1 October 1962. The Agreement which has been signed by the major exporting and importing countries of the world (including India) recognises the need to take co-operative and constructive action with a view to the development of world trade in textiles, and proposes that these problems should be dealt with in such a way as to provide growing

[4] *Major industries of India*, 1955-56, p. 89.

TABLE 4·6

IMPORTS OF COTTON TEXTILES BY U. K.

(Million sq. yards)

	Total imports into U. K.	*From India*	*From Hong Kong*
1954	267·17	127·76	18·12
1955	299·47	130·28	48·76
1956	305·63	127·48	55·86
1957	416·35	182·09	71·10
1958	386·76	120·95	116·08
1961	731·04	186·36	111·56
1962	575·46	159·57	127·80
1963	636·22	201·29	111·96
1964	767·02	247·50	101·82
1965	588·29	156·90	123·45

Sourc' : Tattersal's Cotton Trade Review and International Cotton Committee Review.

opportunities for the export of these products. The Agreement gives a promise to promote the development of export trade in cotton textiles of less developed countries without causing injury to the importing ones.

India has also signed the articles of Agreement of the International Cotton Institute, established in Washington early in 1966. Other signatories are U.S.A., Mexico, Sudan, U.A.R. and Spain. These six countries account for half of the world's cotton production and exports. The Institute will function as a promotional and research body and study cotton's share in world textile markets. The idea is to check as far as possible the inroads made by man-made fibres in its move forward to prevent the consumption of cotton.

World Situation

Examined in world perspective, the position of internationa trade in cotton textiles is not so bright. Despite all the efforts made under the G.A.T.T., it does not seem likely that textile goods will move much more freely about the world. U.S.A. has shown itself very sensitive to textile imports and has increased tariffs or come to voluntary agreements when threatened. The European Economic Committee has made it clear that it regards harmonisation of social conditions to be a prerequisite for complete free trading. The Communist bloc believes in a managed economy and will certainly not allow its internal markets to be disturbed. The underdeveloped countries, through much trial and error are nearly all building up their own textile industries under close protection.[5]

The next 20 to 30 years as pointed out by C. Henniker Heaton, Director, Federation of Master Cotton Spinners' Association Ltd., "will have entirely a different kind of trade as compared with the one we have had during the last 100 years or so. The international trade of the future will be in finished materials, in made up goods, very largely of a fashion or novelty nature. Blending of cotton with new fibres and the latest finishes will greatly add to the variety available. India may rely for exports not on the cloth production of automatic looms, but on the ever-green appeal of hand woven materials and on the superlative skill of her designers and colourists."

India's Chances

There is one redeeming feature in favour of India in the otherwise gloomy picture. From the manner in which the textile industry has been growing in other parts of the world, it can be inferred that only those countries which have abundant supplies of home grown cotton can flourish in the international export markets. Two clear examples are those of Lancashire and Japan. Exports of the former have declined to about 200 million square yards against 7,000 million square yards 75 years ago.

Similarly a study of the Japanese cotton textile industry says, "If we compare post-war exports with pre-war, the volume has declined to less than one-half of the pre-war freight of 2725 million square yards in 1935, or the 1934-36 average of 3671 million square yards. Recent trend is that the volume of cotton cloth exports had established at a level of about 1200 million[6] square yards and few years back it was 1008 million square yards in 1965."

[5] *Commerce*, Annual No. 1957, p. A 952.

[6] *Capital*, Foreign Trade Spl. 1958, *op. cit.*, p. 43.

Again, the future textile market which is going to be governed more by style and fashion, can be easily captured by the hand and power loom products of India. From an annual output of 917 million metres in 1950-51, production of handloom cloth rose to 2072 million metres (more than double) in 1960-61. Average production per handloom is, however, very low at about three yards per loom per day. Production at the end of the Third Plan was 3146 million metres and Fourth Plan (1970–71) target has been put at 4572 million metres.

The Karve Committee estimated that after the introduction of various technical improvements, daily production may be expected at about 5·5 metres per loom. With 300 working days per loom, the annual production per loom would be about 1650 metres. The Chairman of the Handloom Board recently gave an estimate of the number of handlooms in the country as 25 lakhs.[7] A production of the order of 3600 million yards (3292 million metres) can thus be expected from the existing handlooms alone. This can be further increased if need be. These products should come quite handy in boosting our exports.

If India wants to have full benefits of the changing pattern in textile trade, this has to be accompanied by vigorous salesmanship. It may be of interest to know that the National Cotton Council of U.S.A., spends 1·4 million dollars annually to stimulate demand for cotton. India will have to take definite steps to initiate market research, sales promotion and publicity. Handloom products will have also to be standardised and their quality improved. If India is to attain the leading position among her competitors, her exports must win the approval of her overseas customers for both quality and price.

This is equally applicable to mill-made fabrics that are exported. The major portion of machines in existence in cotton mills today was installed more than 40 years ago and has outlived its usefulness. Our next door neighbour, Pakistan, on the other hand, has a good part of her mill equipment newly acquired and upto date. She has also been making persistent efforts, by means of incentive schemes to increase the volume of her cloth exports. While in the cotton manufacturing countries of the world, out of a total of

[7] Kanungo Commission estimated this number at 12 lakhs and Karve Committee at 20 lakhs.

2·5 million looms, 43 per cent are automatic, the corresponding percentage for India is only 8. The Textile Enquiry Committee has recommended that 3000 automatic looms should be allotted to the Industry.

In the last quarter of 1963, the Government of India made a notable change in its earlier policy by allowing the mill sector to increase its spinning and weaving capacity. There has been a similar liberalisation of policy concerning the installation of looms. Cotton Mills spindleage upto 25000 was again delicensed early in 1967.

While indigenous production of textile machinery is making commendable progress, the magnitude of machinery requirements of the textile industry calls for imports on a sizeable scale. While the requirements of the mill sector have been calculated at about 2 million spindles annually both for purposes of rehabilitation and expansion, the output of spindles in the country is only 0·8 million a year.

Similarly the industry needs 1000 carding engines a year to replace the existing ones and another 4,500 per annum if the plan to increase the spindleage materialises. India as against this produces only 17,000 such engines. The position relating to the supply of looms also needs a lot of improvement. As many as 7000 of them will have to be earmarked annually for purposes of rehabilitation.

In short, either the production capacity of the textile machinery of the country has to be increased appreciably or import allocations will have to be made to meet the shortfall. The need for the modernisation of the industry's equipment is absolutely urgent.

Once India is able to modernise her textile industry, she will be able to reduce her cost of production. It may also be necessary to diversify our textile exports. We may explore new fields like readymade garments, scarves, cravats, stoles and similar other luxuries. 'Bleeding Madras' had once caught the U. S. market but is now losing ground. Some similar new design can be made popular from time to time.

We may have to undertake research in technological developments and sales techniques. This will have to cover all aspects of production and distribution; marketing, producer and consumer research.

All this coupled with the devaluation of the Rupee will enable India to compete in the international market. The industry has otherwise great experience, skill and ability. These are inestimable assets, which a few countries that have set up their own textile industries possess.

India need not thus be disheartened by her experience of the Second and Third Plan periods. Exports of mill-made cloth may not still exceed 600 million yards. But competition in the Indian handloom textiles is likely to be limited. At present they form hardly 10 per cent of the total exports. Strenuous efforts are being made to increase the economic and technical efficiency of the handloom industry. As a part of a big drive to popularise Indian handlooms and handicrafts abroad, the Handicrafts and Handlooms Export Corporation proposes to open 15 retail shops in the U.S., South America, Europe, Australia, Japan and West Asia. To be known as Sona, the shops will be in addition to the five already existing under the same name in New York and Boston in the U.S., Paris, Nairobi and Montreal. As a result of all this India may be able to push up her exports of handloom textiles. But the maximum that can be expected is a total annual target of 1000 million yards (both mill and handloom) by 1980-85.

Extra Factory Consumption

Besides cloth, raw cotton is also being used for purposes like stuffing quilts and pillows, hand spinning in household and in small-scale establishments in rural as well as urban areas. All this is included under the head "Extra Factory Consumption." No reliable estimates are yet available for this.[8] But it is tentatively being assumed that the annual consumption of cotton on this account is 2·7 lakh bales. The future demand for cotton as extra-factory consumption will be determined by the increase in population as well as per capita income. With the stipulated projections of population and income, the demand for cotton for this purpose may rise to about 0·7 million bales.

Exports of Raw Cotton

Table 4·7 shows the imports and exports of raw cotton for the period from 1952 to 1965.

[8] ICAR has now conducted one survey to find out the quantity of cotton consumed as Extra Factory Consumption. Their results have not yet been released. In the absence of any tentative data, the available figures may be used.

TABLE 4·7

IMPORTS AND EXPORTS OF RAW COTTON

(Million bales of 392 lbs. each)

Year	*Imports*	*Exports*
1952-53	0·68	0·41
1953-54	0·69	0·20
1954-55	0·62	0·17
1955-56	0·61	0·69
1956-57	0·62	0·34
1957-58	0·42	0·20
1958-59	0·51	0·40
1959-60	0·94	0·20
1960-61	1·12	0·30
1961-62	0·80	0·30
1962-63	0·87	0·28
1963-64	0·63	0·27
1964-65	0·82	0·26

Imports of long and extra-long varieties of cotton which have for a long time been of the order of 0·6 million bales, crossed the million bales mark in 1960-61 mainly due to a decline in production. Exports of raw cotton (consisting of short and medium staple) have hardly been of the order of 0·3 million bales. This low level of exports is, however, indicative of our inability to export and hence a restricted export policy. There is otherwise no lack of demand for this commodity in the world market.

The only other countries producing short staple cotton of comparable varieties in the world are Pakistan, Burma and China.

As regards China, although her ginned cotton production in 1958 reached 12 million bales—4·7 fold increase compared to 1949—cotton yarn output also went up correspondingly 4·5 times from 1·8 to 8·2 million bales[9] during the same period.[10] We do not have any data for the later years, but trade statistics show that Mainland China has been importing on an average 3 to 4 lakh bales of raw cotton. It may not under the circumstances be possible

[9] Yarn converted into bales (bale = 1500 yards).

[10] *China Today*, No. 42, 1959. Figures regarding cotton production in China do not tally with the data given in "Cotton—World Statistics," Dec. 1961, p. 8, which is about 8·5 million (Indian) bales, as against 12 million bales mentioned here.

for China to enter the world raw cotton export market, particularly in the short staple varieties.

The production of cotton by Burma is rather negligible. She is planning to expand her own textile industry in a very big way. The possibility in that case would be that instead of exporting, she might be required to import raw cotton. The trend is already noticeable as she has already started importing about 6000 bales of cotton in recent years.

The only competitor left in the world market for short staple cotton is Pakistan. Table 4·8 gives an idea of the production, consumption and exports of cotton in Pakistan over the past few years from 1957 to 1966. This gives a very clear indication of the fact that although her total production of cotton had remained more or less constant at about 1·8 million bales, her home consumption has gone up from 0·8 to 1·3 million bales. This has resulted in a shrinkage of Pakistan's exportable surplus from 8 to about 4 lakh bales during this period.

TABLE 4·8
PRODUCTION, CONSUMPTION AND EXPORTS OF COTTON IN PAKISTAN

(1,000 bales)

Year	*Production*	*Cousumption*	*Exports*
1957-58	1,412	860	508
1958-59	1,270	925	385
1959-60	1,360	1,020	376
1960-61	1,405	1,100	334
1961-62	1,510	1,125	245
1962-63	1,700	1,130	301
1963-64	1,945	1,180	685
1964-65	1,750	1,255	692
1965-66	1,930	1,310	487

Source : "International Cotton Advisory Committee," *Quarterly Bulletin*, July 1966.

Pakistan's Second Plan target of cotton for the year 1964-65 was 2·3 million bales and the Third Plan target for 1970 has been put at 3·0 million bales. We do not know how far it would be possible for Pakistan to increase her production to the targeted level.

Assuming that she succeeds in achieving these targets, her target for increasing the production of cotton yarn during the same period is also rather high. Against 38 per cent increase of raw cotton, the cotton yarn production is proposed to be raised by 36 per cent during the Second Plan and another 25 per cent over that in the Third Plan period.

In spite of all this increase, per capita availability of cloth in Pakistan for 1965 was targeted at only 14·5 yards against 16·0 yards in India during 1960-61. This would give an indication that Pakistan will have to expand her textile industry with a greater momentum during the subsequent plans to meet her internal demand for cloth.

Pakistan's Second Plan also gives another indication when it says, that it will be necessary to increase the production of fine qualities, and also to produce cotton with a staple length of 1¼ inches, which is in heavy demand in the domestic and international markets.

All this shows that the future programme of Pakistan is to increase the production of long staple cotton. Supplies of comilla, their short-staple variety, are not assured nor do they have a programme for its expansion. It can thus be safely assumed that India will have more or less a world monopoly in short staple cottons.

The trend is actually already there. A look at the world trade statistics will show that Pakistan's exports of raw cotton to Japan and U. K., are on the decline, while India is maintaining a steady level.

Future Demand of Importing Countries

As against this, the demand of India's chief importers, Japan and U.K., may rise steadily. Some new markets like those of Hong Kong, France and Australia, among other countries which are expanding their textile industry, may also be interested in Indian cottons. Indian varieties with their special character of extreme harsh staple and springy as well as resilient nature of the fibre, are in great demand outside. These cottons are spun into coarse count yarn varying from 2's to 8's by the importing countries, and used for the manufacture of canvas, coarse furnishing materials and surgical dressings.

In the Far East, Japan has a highly developed textile industry and is a net importer of raw cotton from abroad to feed her 9 million and odd spindles. The main suppliers of raw cotton to Japan are India, U.S.A., Pakistan, Mexico and Brazil. From India, mainly the short staples like Bengal Deshies and Comilla spinnable to 20-30's counts are exported. These types are either used in the manufacturing of coarse cloth or in mixing with wool. Generally, for coarser yarns, Indian and Pakistani cottons are used, whereas 20-30 per cent of American cottons are also blended for the 20-30's. To a limited extent, the supplies of raw cotton from Korea, China or Burma also fill this gap. But for higher counts (30-45's), the American variety is used and that for still higher counts normally Egyptians are preferred. The Brazilian or Peruvian cottons are used for the manufacture of both medium and fine yarn and high quality knitted goods. They are also used for blending with wool.

Thus, each quality of cotton imported by Japan has a specific use. Each of them will accordingly have an independent demand.

The data pertaining to country-wise import of raw cotton into Japan during the post-war development era of Japan's cotton textile industry is given in Table 4·9.

TABLE 4·9

COUNTRY-WISE IMPORT OF RAW COTTON INTO JAPAN

(Post-war period)

(Per cent)

Year	*India*	*Pakistan*	*U.S.A.*	*U.A.R.*	*Others*[a]	*Total*
1945	4·0	—	—	—	96·0	100·0[b]
1946	—	—	97·0	3·0	—	100·0
1947	18·6	—	81·4	—	—	100·0
1948	29·5	—	66·9	3·6	—	100·0
1949	5·9	8·5	74·8	6·6	4·2	100·0
1950	3·8	13·1	76·3	0·8	6·0	100·0
1951	2·2	14·5	46·9	3·3	33·1	100·0
1952	7·6	14·8	49·8	3·0	24·8	100·0
1962-63	6.42	8·24	28·94	1·95	54·45	100·0
1963-64	5·13	3·27	36·73	5·25	49·62	100·0
1964-65	4·66	3·44	30·09	3·76	58·05	100·0

[a] Include—Brazil, Mexico, Peru, Burma, Korea etc.

[b] Up to 1945, China used to supply about 80 per cent of the demand.

After World War II, U.S.A. has come to occupy a predominant position because of her control over Japan. India alone used to supply about one-fifth of the requirements of Japan which has been subsequently shared by both India and Pakistan. But from 1950 onwards countries other than India, Pakistan, U.S.A. and Egypt have also started capturing the Japanese market. The share of both India and Pakistan has been appreciably reduced.

The cotton textile industry of Japan which received a heavy setback during the war, has already made a fairly rapid progress, as seen from Table 4·10.

TABLE 4·10
PROGRESS OF COTTON TEXTILE INDUSTRY IN JAPAN

Year	*No. of spindles in operation (1000 spindles in place)*	*Yarn Production (Metric tons)*	*Cloth Production (Metric tons)*
1937 (Pre-war)	12,567	720,000	545,454
1939	11,502	—	—
1950	3,739	—	—
1956	7,961	—	—
1959	11,012	—	—
1960	13,218	—	—
1961	13,319	568,689	150,059
1962	13,332	490,895	162,425
1963	13,353	479,684	148,867
1964	12,715	504,126	134,851

Source : "International Cotton Advisory Committee," *Quarterly Bulletin*, April 1966.

Japan has yet to travel a long way to catch up with her pre-war levels of production in textiles. The present requirements of short staple cotton in Japan are of the order of 5-6 lakh bales. This is likely to increase to 8-9 lakh bales. When India alone is the supplier of these varieties, there should be no difficulty for us to capture the whole of this market. This will practically be the same for countries like France and U. K. which are entirely dependent upon imported cottons. They will also look to India for whatever quantities of short staple cottons they need.

A highly developed textile industry has grown in Hong Kong, and the enclave colony has emerged in recent years as a big importer of raw cotton, especially from India and Pakistan. Here the two countries are at present competing closely with each other—an increased supply from one has an inversely proportionate effect on the other. But here too we can safely have our due share in the required imports of raw cotton from abroad.

Besides Hong Kong and Japan, Mainland China is also an importer of raw cotton. But because of the present political considerations and unhappy relations with India, Pakistan holds almost a monopoly on the supplies of raw cotton. If the relations improve sometime in the future, it may open up a vast scope for exporting Indian cottons to China too.

Production Potential of short staple Cotton

Of our total exports of the order of 2 to 4 lakh bales (all 11/16″ and below), two special varieties, Bengal Deshi and Comilla, constitute a major proportion. The area and production of these two varieties are given below:

TABLE 4·10A
AREA AND PRODUCTION OF ASSAM COMILLA AND BENGAL DESHI IN 1964-65

	Variety	*Area ('000 hectares)*	*Production ('000) bales of 180 kg.*	*Percentage of the total*	
				Area	*Production*
1.	Comilla & Bengal Deshies	501	605	6·1	11·0
2.	All short staple (including Comilla & Bengal Deshi	1240	983	15·3	19·2
3.	Total cotton crop all India	8,154	5,408	100·0	100·0

Source : *Agricultural Situation in India*, Aug. 1966.

Of the total production of about a million bales of short staple cotton, the present production of Assam Comilla and Bengal Deshi is of the order of 5 lakh bales. The present consumption of these varieties in the countryis, however, rather small. A glance at Table 4·11 would show that there is a perceptible fall in the total consumption of short staple cotton in the country. Future demand for these varieties in India can, therefore, be assumed to be not very high.

Even in 1960-61, when the total production in the country was much shorter as compared to the previous years, there was a clamour from the trade for the export of these varieties because they are surplus to the home requirements. There is also the possibility of extending cultivation of these specific varieties in Madhya Pradesh, Madras and Andhra Pradesh. If there is an assured market for short staple cotton abroad, there is likely to be no dearth of these varieties in the future.

In the year 1958-59, India exported 4·5 lakh bales of raw cotton. Sales could not go up in the subsequent years due to shortfalls in home production. If we succeed in increasing production we might expect an export of 7 lakh bales by 1980-85, an increase of nearly 1·5 lakh bales over each of the next plan periods.

Imports of Cotton

India is at present importing extra long varieties of cotton from U.S.A., Egypt and East Africa. Successful experiments have been carried out for the production of Sea Island Andrews (extra long staple) variety of cotton in India. To promote the development of Andrews cotton, a special scheme was implemented by the I.C.A.R. in 1957. Although the progress was slow in the initial stages, there has been a marked improvement lately. Area sown under the variety during 1964-65 was 20,000 acres, and the estimated production 5,000 bales. Exploratory work in Andhra Pradesh and Maharashtra have also proved successful. There should thus be no difficulty for India to produce all her requirements during the period under study.

Moreover, India can follow the example of the European countries like U. K. which have developed special processes during 1950-57 by which raw cotton of short and medium staples could be used for the manufacture of superior varieties of fabrics like drip-dry poplins. This was necessitated by the insistence on the part of Egypt and Sudan to fix the prices of cotton too high. India can also, if required, make use of such processes and do away with the need for varieties of cotton which are not being produced indigenously.

TABLE 4·11

MILL CONSUMPTION IN INDIA OF INDIAN AND FOREIGN COTTONS ACCORDING TO STAPLE LENGTH GROUPS

('000 bales)

Year (ending 31st August)	INDIAN Long Staple (7/8" and above)	Medium staple (25/32" to 27/32")	Short staple (11/16" and below)	Total	FOREIGN Extra staple (1-3/16" and above)	Long Staple (1-1/16th-1-3/16th")	Total	Grand Total
1949-50	491	1,751	302	2,544	443	698*	1,141	3,685
1950-51	503	1,819	201	2,517	410	696*	1,106	3,623
1951-52	740	2,039	208	2,987	236	849*	1,085	4,072
1952-53	1,020	2,340	251	3,611	264	585*	849	4,460
1953-54	1,050	2,600	280	3,890	350	369	719	4,609
1954-55	1,505	2,333	281	4,139	254	376	630	4,769
1955-56	1,815	2,295	256	4,366	315	288	603	4,969
1956-57	2,079	2,327	260	4,666	192	375	567	5,233
1957-58	1,902	2,279	252	4,433	164	402	566	4,909
1958-59	1,898	2,466	252	4,616	176	279	455	5,071
1959-60	2,515	1,678	226	4,419	267	419*	686	5,105
1960-61	1,906	2,149	191	4,246	241	886*	1,127	5,373
1961-62	2,597	1,895	217	4,709	294	685	979	5,688
1962-63	2,478	2,058	253	4,789	331	550	881	5,670
1963-64	1,642	3,385	450	5,475	278	329	607	6,082
1964-65	2,999	2,440	173	5,612	282	477	759	6,371

* Includes cotton below 1-1/16".

But before any such step is taken, it would be necessary to understand the implications of a policy of self-sufficiency in cotton. The stoppage of cotton imports from Egypt, Sudan and East Africa would mean that we will have to lose our valuable exports of jute textiles, tea and coffee, etc. to these countries. Instead of cutting our cotton imports altogether, it would be wiser to reduce them to about two lakh bales.

COTTON TARGETS FOR 1980-85

Net requirements of cloth on the basis of the discussion in the previous pages works out to 17800 million yards (16800 million yards home demand *plus* 1000 million yards exports). After taking the average of all types of manufactured cloth, it has been estimated that one lb. of cotton is sufficient to manufacture nearly 4 yards of cloth. Cotton requirements for the manufacture of cloth

TABLE 4·12
ESTIMATED GROSS REQUIREMENTS OF COTTON DURING THE YEAR 1960-61 TO 1980-85

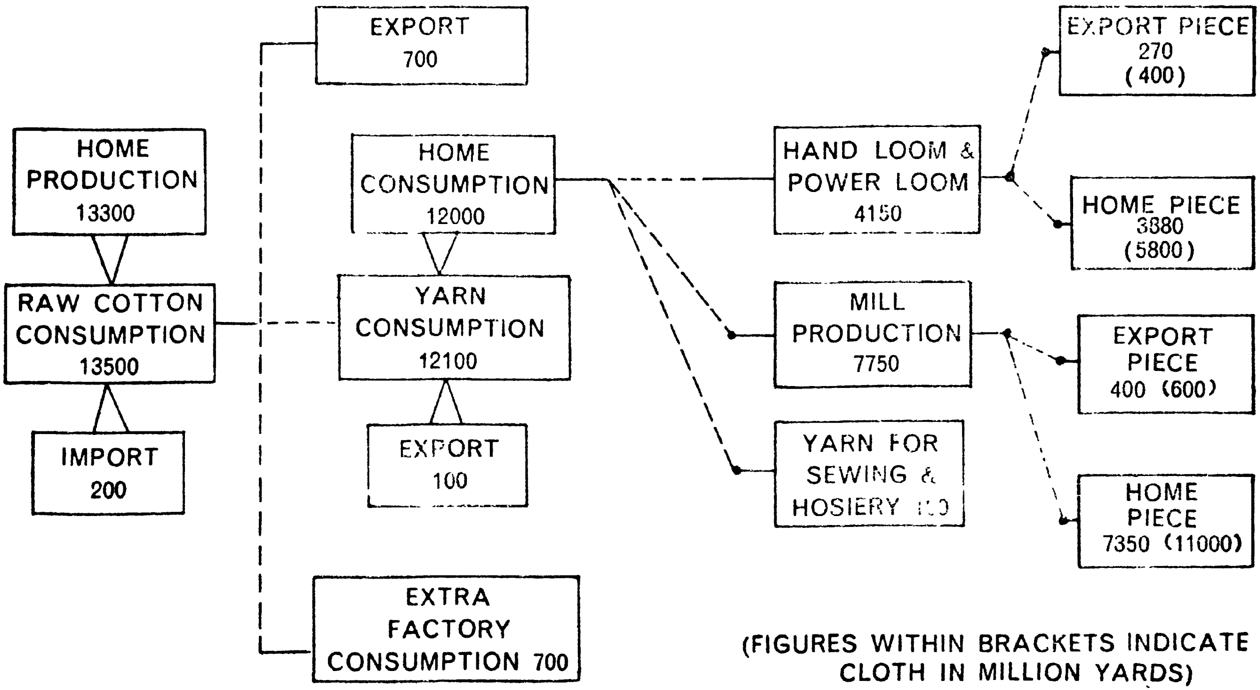
('000 bales)

Items		*Years* 1960-61	1980-85
1.	Net export of raw cotton	820	500
	(*a*) Exports	300	700
	(*b*) Imports	1120	200
2.	Extra-factory consumption	300	700
3.	Export of yarn	40	100
4.	Yarn for sewing, hosiery, etc.	50	100
5.	Export of manufactured cloth	458	870
		(687)	(1000)
6.	Home consumption of cloth	6599	11230
		(–)	(16800)
7.	Net cloth requirement	5373	11900
			(17800)
8.	Total home production of cotton	5400*	13300

* This total will not tally because of changes in stocks of raw cotton as well as manufactured cloth.

NOTE : Figures in brackets represent thousand yards of cloth.

CONSUMPTION (1980-85) FLOW CHART OF RAW COTTON
(In thousand bales) 1 bale=392 lb. 1 lb. raw cotton=4 yds of cloth



(FIGURES WITHIN BRACKETS INDICATE CLOTH IN MILLION YARDS) alone (both for home requirements and export) would be of the order of 11·9 million bales.

Table 4·12 summarises the position and compares the targets of cotton production for the period 1980-85 with that of 1960-61. The accompanying chart would also indicate a sort of rough flow-sheet for cotton for 1980-85. Against the Fourth Plan target of 8·6 million bales for 1970-71, we will thus require roughly 13·5 million bales of cotton by 1980-85.

5

JUTE

THE First Five Year Plan set a target of 5·37 million bales of jute against the production of 3·13 million bales in 1951-52. Actual achievement was, however, only 4·2 million bales. The Second Plan envisaged a production of 5·5 million bales and the emphasis was shifted from quantity to quality. With the 1958-59 crop touching an all-time record of 5·2 million bales, the target was nearly achieved, but the 1960-61 production fell down to 4·0 million bales. The Third Plan target was put at 6·2 million bales. This was exclusive of mesta which may provide an additional 1·3 million bales. These targets have already been over-achieved in 1961-62. The Fourth Plan (1970-71) target has been fixed at 10·0 million bales, of which mesta will constitute 2 million bales.

The jute industry of India has mainly been depending upon the export market. Before Partition, India was the only jute producing country and thus had a complete monopoly; producing nearly 99 per cent of the world's total supply of jute. But after Independence the major jute producing areas having been left in East Pakistan and practically the whole of the jute manufacturing industry being in India, the country was left at the mercy of Pakistan for raw material. Pakistan started organising its own jute industry which further accentuated our problem of supply.

Appendices 9·1 and 9·2 show the world area and production of jute and jute manufactures for the past few years. Jute is one of the few staple commodities which showed slight increase in consumption despite increasing world population, improvement in standards of living, and the progress made in agricultural as well as industrial fields.

Unlike other commodities, there has hardly been any increase in the consumption of jute which remained at around 2 million tons till recently. This may be attributed to a more or less stagnant position in the underdeveloped areas of the world and substitution of jute by cotton and paper in the more advanced countries.

There are already signs of recovery when the world production of jute manufactures touched an all-time record of 2655 thousand tons in 1959-60 and 3 million tons in 1964-65. The modernisation process started by India in respect of the preparing and spinning sections of the mills is now nearing completion. The Third Plan target was put at 1·2 million tons of jute goods production, which was over-achieved in 1963. The target for the Fourth Plan (1970-71) is 1·35 million tons. The Productivity Council is examining the question of increasing the productivity of the industry and reducing cost so as to strengthen her competitive position. Pakistan and other Western manufacturers are also trying to improve their conditions. Indian jute production is quite close to that of Pakistan Mainland China has raised its jute production by about ten times during the past thirteen years to touch 116 thousand tons in 1963-64 against 12 thousand tons in 1950-51.

What has been important in jute manufactures so far is the quantity entering the world market. Nearly one-half of the mill manufactured jute goods, about a million tons enter the international market.[1] Besides India and Pakistan, which are the main exporters, United Kingdom, Japan and some other European countries, are also important. Actual exports of Jute manufactures in 1964 touched an all-time record of 1392 thousand tons.

Appendices 10·1 and 10·2 will give an idea of world jute, raw and manufactured, entering world trade. The Indian industry has been working on the basis of standard lines required by the widest range of export markets, like Australian wool packets, Cuban sugar bags and American hessian requirements. India which exports more than 75 per cent of her jute manufactures, predominates in the world trade where her share is over 70 per cent even today.

[1] *Commerce*, August, 1959, p. 260.

The importance of the export market in the jute economy of India can be judged from the distribution of total production of hessian, sacking and rope and twine between domestic consumption and exports. Nearly three-fourths of the total production of over one million tons of jute goods is exported even today.

The quantity of jute required to be produced in India by 1980-85 will thus depend on:

1. World demand for jute goods.
2. Competing sources from which the total demand can be met.
3. Internal demand.

World Demand

While considering the future world demand for jute and jute manufactures, we have to examine closely the effect of the following factors:

1. Competition from substitutes, and
2. New uses for jute.

Competition from Substitutes

Paper and Cotton Bags. The high price of jute goods in the post-war years coupled with uncertainty about the physical availability of the commodity itself, stimulated the use of paper and cotton as substitutes for jute. This was particularly marked in the U.S.A. Table 5·1 gives an idea of the consumption of cotton, hessian and paper used in U.S.A., for bag making during the years 1940-1963.

This shows that an increasing quantity of paper is being put to use year after year. While the consumption of paper has practically doubled, that of jute has gone up by hardly 65 per cent. Cotton fabrics on the other hand have been reduced to little less than one-fourth. Cement is sold in paper bags and flour is usually sold in cotton sacks.

Increasing use of paper bags is primarily due to their cheapness as compared to jute. Cotton bags under normal conditions are more expensive, but they have technical advantages in certain uses. Along with their high re-use value they are quite useful

TABLE 5·1

ESTIMATED QUANTITIES OF JUTE, COTTON AND SHIPPING SACK PAPER USED IN THE MANUFACTURE OF BAGS AND SACKS IN THE UNITED STATES

Year		Jute (Burlap)[a] million lb.	Cotton fabrics million yards	Shipping sack paper[b] thousand short tons
Average	1940-1950	457	871	436
Average	1951-1955	431	457	790
	1956	526	299	831
	1957	495	265	841
	1958	488	267	796
	1959	574	277	873
	1960	536	260	848
	1962	640	210	871
	1963	760	196	890

[a] Imports of jute burlap (sacking) into the United States. The bulk of the burlap imported is used for bag making; relatively little of the raw jute received is manufactured for such use.

[b] Production *minus* exports.

Source: "Industrial Fibres—A Review," *The Commonwealth Economic Committee*, 1965, p. 193.

as household textiles and work clothes. Paper bags as against all these, though much cheaper, have practically no re-use value.

Re-use Value. Jute being a very durable fibre, its re-use value in the packing field is extensive. Jute bags can be used a number of times, depending on the product carried, the distance and the destination of trips and facilities available for collecting, reconditioning and merchandising used bags. In the United States, cost calculations have been made on the basis of five to seven trips (without specifying the period) for commercial feed bags, and it has been estimated that normally 40 per cent of bags in circulation at a given time are second hand. [2]

Again estimates suggest that used bags may be three times of new bags in circulation in the U. K. and France.[3] Principal users of second hand bags are the potato and animal feeding stuff trades. There is thus a well organised collection, reconditioning and marketing service in Europe.

Their re-use value to the farmer is extensive. Many farmers keep the older bags for their own packing, storing and for an almost endless variety of special and individual purposes. One booklet published by Burlap Council, called *New Uses for Old Burlap Bags*, gives more than 200 ideas in it and still the writers admit that they have just scratched the surface of the problem. It can then be assumed that jute bags may continue to hold the field for specific uses in preference to paper.

It may be concluded that the world demand for jute for bag making may not go up appreciably in the coming 15 to 20 years in the advanced countries. But in so far as underdeveloped (mostly jute producing) countries are concerned paper or cotton bags may not be able to stand in the way of increasing demand for jute.

Other Hard Fibrous Plants. Preliminary studies in the Institute of Science, Bombay, revealed that there are innumerable and hitherto neglected plants, growing in abundance on the waste-lands around Bombay and Salsette Islands during monsoons. A

[2] *FAO Commodity Series*, No. 28, 1957, "Jute," p. 11.

[3] R. Clark, "The Jute Industry and Market for Jute goods in Western Europe," *Jute and Gunny Review*, October 1959.

TABLE 5·2

THAI PRODUCTION OF KENAF

	Planted Areas ('000 *rais*)*	*Harvested areas in* ('000 *rais*)	*Yield per rai* (*kilograms*)	*Washed and cleaned fibre* ('000 *metric tons*)
1950	31	30·0	156·7	4·7
1951	88	85·0	235·3	20·0
1952	67	66·0	198·5	13·1
1953	60	60·0	233·3	14·0
1954	37	36·0	227·8	8·2
1955	53	52·0	188·5	9·8
1956	109	108·0	157·4	17·0
1957	78	77·0	272·7	21·0
1958	127	127·0	233·1	29·6
1959	278	277·0	180·5	50·0
1960	877	870·0	208·4	181·3
1961	1,700	1,700·0	202·0	339·0

* $2\frac{1}{2}$ rais : 1 acre.

physical and chemical analysis of 16 out of them showed that at least 4 yielded quality fibres.[4]

Again, a McGraw-Hill American letter mentions that Cuba will soon undertake the commercial production of 'kenaf,' an excellent substitute for jute. This means that, but for existing political differences, this fibre may compete with Indian jute goods in U.S. markets. This fibre is reported to have been introduced into the American tropics as early as 1941 after having been grown in India, Iran, Java and Russia. It is estimated that Cuba expects to grow 'kenaf,' to supply her 45 million new bags for agricultural products and sugar. Countries like Thailand have already gone in a much bigger way to increase the production of *kenaf* from a mere 4·7 thousand tons in 1950 to 339 thousand tons in 1961 as shown in Table 5·2. Thailand failed to achieve the 1961 production levels in subsequent years but has shown signs of recovery.

The French and Belgian industry has started using *paca* (Urena Lobala) comparable to good quality white jute and to a lesser extent *punga* (Cephalonima Polyandrum), comparable to treats. Their present consumption level is of the order of 80,000 tons. But they are expected to supply one-third of the requirements of the jute industry there. The Spanish industry has also been working largely with substitute fibres such as esparto grass (Slipa Tenacissima).

Then there are hard (cordage) fibres, sisal, henequen, senseveiria, phormium, etc. which although less adaptable, heavier and less easy to handle, are yet being utilised for the manufacture of containers for certain products, notably coffee, cocoa, castor beans and wool which might otherwise be packed in jute. According to an FAO estimate, quantity of such fibres used has been of the order of 50,000 tons.[5]

This would mean that wherever possible, these other hard fibres will also be used in place of jute. None of these can, however, compete with jute in quality. Kenaf, for example, is nothing better than Indian mesta. If jute continues to maintain its quality and is available at moderate price, no substitute will be able to replace it. All the same, it is obvious from Appendix 9·2 that while the production of raw jute has not even doubled during the last 15 years or so, allied fibres have gone up more than four times.

[4] *Jute and Gunny Reveiw*, Vol. VIII, No. 2.

[5] FAO Commodity Series, *op. cit.*, p. 11.

Changes in Handling and Marketing Techniques. As observed by the Indian Jute Mills Association, there is little doubt, that most serious losses suffered by burlap as a container have been due to changing habits in the marketing of commodities throughout the entire field of distribution. Producers and manufacturers have introduced bulk handling equipment which eliminates not only the use of containers altogether, but also saves the handling cost. The system of bulk handling for wheat has already been well-established and there appears to be little doubt that over a wide field of agricultural production, this development is now taking place with alarming rapidity. An estimate of the amount of feed delivered in bulk in U.S.A., is about 10 per cent of the total volume produced and that this may in time level off at around 20 to 25 per cent of the total. Although it is a strong competitor of the jute bag, the growth of bulk handling is difficult to measure, but it has been estimated that about 90 per cent of the grain entering international trade is bulk handled at the port. Wheat imports into most European countries are handled in bulk from ship to mill although generally speaking, the smaller scale of agricultural production provides less scope for the adoption of bulk handling for domestic output. An increase in bulk movement of a number of other commodities has been noted, including animal feed, raw sugar, cereals, oil seeds (displacing jute), cement (displacing paper), and fertilisers while bulk handling and pre-packing techniques are continuing to grow in countries such as the United States and Australia where labour is relatively expensive, the expansion of industry and agriculture in the underdeveloped countries of Asia and Africa is being accompanied by an increase in the use of jute goods, since the widespread development of bulk handling in those regions is not yet economically feasible.

In the second place, there has been a change in the methods and manner in which foodstuffs are prepared for sale to the consumer. An essential feature of this is the disappearance of the large container and its substitution by a smaller package which can be sold direct to the retail purchaser. With the introduction of a 50 lbs. light weight burlap potato bag it has, however, been possible to recapture some of the trade from paper in U.S.A.[6]

[6] Delegation Report, *op. cit.*

Loss of the packaging market by jute due to changes in handling and marketing techniques, involves the installation of expensive equipment or alteration of the whole of the marketing system. Once this change takes place anywhere, whatever the reasons, it must be considered as irreversible in the foreseeable future and thus last for good.

New Uses of Jute

The versatility of the jute fibre is proving to be remarkable as new uses are being found for it. An article in the *Financial Times* (London) states that, of the total production of jute yarn in Britain, about 40 per cent is absorbed by the consuming industries for use in carpets, cables, twines, cordage and ropes. In U.K. and France, floor covering alone absorbs at least one-fourth of the jute yarn and cloth not used in packaging.[7] Jute woven in Britain is used as backing for linoleum and tufted carpets and as foundations for imitation leather, roofing felts and plastic work. It serves as a very useful wrapping material to protect bright steel parts against erosion and rusting. There is an increasing demand for burlap from automobile, furniture, boards and plastics industries.

The British Research Association has successfully produced, as a result of three years work, an acid-resistant jute bag for carrying granular fertilisers. These types of bags are being commercially produced in U.K., and steps are being taken to increase their production to meet all demands.[8] This may enable the jute bag to have its claim on the fertiliser market again.

Fire and acid proof hessian is substituting the conventional walls of solid construction in industrial buildings and factories. Hundreds of thousands of yards of jute cloth are manufactured every year in Dundee for various uses in the film industry, mainly in the construction of sets.

The Rineo Chemicals Ltd., Dacca, have invented a chemical treatment for jute fabrics called 'Skilkofin.' This has been used for the production of felt hats, suit cases, caps, footwear and a number of other items of domestic use.

The largest outlet for jute yarn not used in the weaving industry

[7] Clark, *op. cit.*, p. 255.

[8] *Jute and Gunny Review*, Vol. VIII, No. 7.

is plating for making the soles of alpargatas, a type of footwear produced only in France, Spain and some Spanish speaking countries.

Research on plastics and laminates combined with jute fabrics is opening an entirely new market. At least half a dozen of these new materials have been developed by the Indian Jute Mills Research Institute in Calcutta. One experiment resulted in the using of jute in plastic fenders for trailers.[9]

Experiments are also being conducted in the East Pakistan Government laboratories in Dacca. They hold out hopes for obtaining disinfectants, germicides, paper, silk and sugar from the raw jute plants.[10] If successful, the experiments will help in reducing the cost of jute, hence countering the threat from substitutes. Under the post-war reorganisation production, U. K. has decided to move away from the common business to more specialised products, such as carpet backings, etc. Other European manufacturers are also paying greater attention to speciality jute products.

The production of tufted carpets in the U.S.A. in the coming years has bright prospects due to the following reasons :

(*i*) The average retail price of a machine-made carpet is \$5·9 per sq. yd. compared to \$48·6 per sq. yd. in the case of hand-mades. Moreover, the unit price of machine-made has been witnessing a continuous fall.Thus, between 1950 and 1966, the wholesale price per sq. yd. has gone down from \$56·3 to \$3·7.

(*ii*) Increase in population and households, and a faster rate of growth in the number of individuals entering the marriageable age group of 20-24 years than that of population as a whole.

(*iii*) Buoyant conditions (though not as much as during 7 years to 1966) of the economy as measured in terms of rising GNP, per capita income, consumer disposable income, fall in unemployment and number of poor households.

(*iv*) High rate of growth of instalment credit in general and that of consumer instalment credit in particular.

(*v*) Increase in the rate of growth of construction of residential dwellings and commercial units.

[9] *Ibid.*, No. 7.

[10] *J. & G. Review*, Vol. IX, No. 5, p. 170.

(*vi*) Extended use of carpets in cars, hospitals, schools, colleges hotels, motels, billiard parlour and commercial establishments.
(*vii*) Extensive advertising and other promotional measures.
(*viii*) Sizeable replacement demand.

Net Position

In a long-term perspective, world demand for jute seems to be governed by a number of conflicting trends and their net effect is difficult to gauge with any precision. Increase in population and rising standards of living, however, can contribute in a number of ways to expansion in jute requirements both as containers and as products or components in household and other non-packing uses. Moreover research may well prove the reliability and adaptability of the jute fibre either by itself or in combination with other materials for an extended range of uses, particularly in the industrial field.

Most of the underdeveloped economies have now embarked upon planned economic development. Their living standards, therefore, will rise during the coming 20-year period. Agricultural and industrial production will have to keep pace with the increasing requirements of the people concerned. There are, under the circumstances, better prospects of jute retaining markets against the inroads of paper.

With regard to the consumption of jute goods for about two decades, from 1935 to 1955 (Appendix 10·2), the stagnant position has already shown signs of life and jute goods are likely to command a keener interest even in the advanced countries. Canada, for example, with a population of 16 million as against 150 million in U.S.A. has a vast territory which is now in the process of being exploited. Petroleum on a large scale has been found and minerals of many kinds are being mined and produced. All this is likely to make prospects of jute expansion in Canada quite bright.[11]

Practically the whole of the underdeveloped world constituting three-fourths of the globe, has embarked upon very ambitious

[11] Report published by the Federation of Indian Chamber of Commerce and Industry.

plans of economic development. They are expected to show an annual increase of the order of 4 per cent, a major contribution to which may be coming from the agricultural and industrial sectors. With ever increasing populations and still faster growth of urbanisation, larger quantities of agricultural marketable surpluses will have to be moved from rural to urban areas.

All this will create an additional demand for jute goods. The possibilities of cotton, paper or even bulk handling as substitute to jute in the underdeveloped regions are remote. Under the circumstances, with a sustained annual demand of 2 per cent, a 40 to 50 per cent increase over the existing world demand may be quite possible. This would also include the share of the advanced world which may not, of course, be very significant. The quantity of jute manufactures exported by the chief exporting countries in recent years have been of the order of 1·4 million tons. World demand of the non-producing countries may thus be put at about 2·0 million tons.[12]

COMPETING SOURCES OF SUPPLY

Of the existing world trade of the order of 1·4 million tons, India's share is a little over 70 per cent. The question that needs examination is whether she will continue to have this predominance in the world market or supplies of jute manufactures are likely to be made available by any other country.

In the production of raw jute, Pakistan leads the world. Her share in the total production has, however, fallen from a little over 50 per cent in 1951-52 to 42 per cent in 1964-65. Other countries like China, Nepal, Thailand, Burma, Taiwan, North/South Vietnam and Cambodia have also started growing jute. The contribution of all of these put together is, however, not very significant.

At Partition, there were no jute looms in the territory that became Pakistan and very few baling presses. But the Pakistan Industrial Development Corporation purchased 7,800 looms by March 1955, of which about 3,300 were installed and are operating, mostly on a two-shift basis. Programme for jute loom expansion up to 1959-60 in Pakistan is reflected in Table 5·3.

[12] Third Session of the FAO Study Group on Jute, kenaf and Allied Fibres, held in September 1966, estimated the net import requirements of jute manufactures by 1975 as between 1·84 to 2·28 million tons.

The total number of looms in 1960 was only 8040 against the First Plan target of 12000. Although the Second Plan target was again put at 12000 looms, according to the Third Plan programme, Pakistan will be having an exportable surplus of nearly 0·6 million tons of jute manufactures. She has already started encroaching upon Indian markets.

TABLE 5·3

PAKISTAN JUTE LOOMS EXPANSION PROGRAMME, 1955-60

Trade year	*Looms on hand at end of trade year*	*Looms operating at end of trade year*	*Production capacity of operating looms two shifts*[a]	*Domestic requirements of jute goods*	*Surplus jute goods for export*
	(*In* '000)			(*In* '000 *tons*)	
1954-55	6·8	3·3	106	43	63
1955-56	8·0[b]	5·0	160	46	114
1956-57	9·0	7·5	240	50	190
1957-58	10·0	9·5	304	53	251
1958-59	11·0	10·5	336	57	279
1959-60	12·0	11·5	368	60	308

[a] At the rate of 16 ton/looms/shift/year.

[b] 250 of the additional looms to arrive during 1955-56 had already been ordered.

Source : *Jute and Gunny Review*, Vol. VIII, No. 5.

Besides, the whole of the South African market is being captured by Pakistan. Total exports of Pakistan jute manufactures went up to 190 thousand tons in 1960 and 231 thousand tons in 1964-65 against an export of 13 thousand tons for 1951-55. To step up exports, Pakistan Government have also set up a Jute Marketing Corporation with an authorised capital of Rs. 8 crores. The Corporation is going to pay back to the growers half of the profits earned by it as a result of its business transactions.

Continuing government aid has also been granted to the Jute industry in Pakistan through the export bonus scheme which was introduced in 1959. Exporters are given under the scheme 20-40 per cent of their Foreign Exchange earnings for free imports within a list of 219 items. Pakistan is making every possible effort to increase her exports. A jute Delegation visited several countries in 1966 to find markets for her jute goods. The effect of the devaluation of the Indian rupee on jute and other exports has not shown any beneficial effect so far but the position has to be watched carefully.

Pakistan was producing about 7 million bales of jute at the time of partition on an area of about 2 million acres. From a total cropped area of 56·0 million acres, it may not be possible for her to spare more than this for jute, under the increased pressure of population. Her yield per acre was about 4·5 bales in the year 1955-56. Under most favourable circumstances, it may be assumed that she can grow an average crop of 5 bales per acre from an area of 2 million acres (present area is 1·5 million acres). She can then raise a maximum of 10 million bales or say about 2 million tons of raw jute. The Second Plan target for 1964-65 is only 7·3 million bales and the Third Plan target for 1970 is put at 8·0 million bales.

Out of her present production of 6 million bales, Pakistan is exporting about 4-5 million bales and is manufacturing jute goods from about one million bales of raw jute. Of this, hardly one-fourth is the home consumption and the balance is being exported. Working on exact figures, of her total production of 255 thousand tons of jute manufactures in 1960, Pakistan exported about 190 thousand tons with an estimated home requirement of 60 thousand tons. The Second Plan target is put at 380 thousand tons as production, 290 thousand tons as exports, with home requirements estimated at 90 thousand tons. The Third Plan target of production is put at 720 thousand tons. Of this, 600 thousand tons is intended for export and the balance of 120 thousand tons for internal consumption.

If Pakistan continues to export the present quantity of 4-5 million bales of raw jute, she will be left with not more than 5 million bales of raw jute for jute manufactures. From her estimated internal consumption of 60 thousand tons (340 thousand bales) in 1960, it may go up to about a million bales by 1980-85. This would leave with Pakistan a balance of a maximum of 4-5 million bales (say 0·8 million tons) of jute goods for export.

With the completion of Karnafuli hydroelectric project, power will become cheaper in Pakistan. With the experience of years and labour having turned more industrial-minded, Pakistan may

TABLE 5·4

MAIN ITEMS OF COST AS PROPORTION OF JUTE CLOTH SELLING PRICES

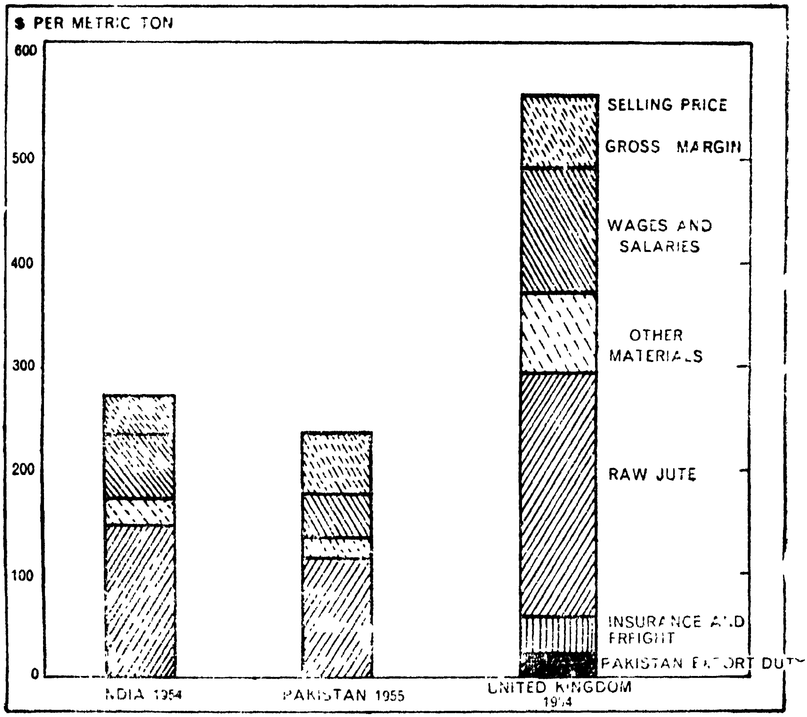
Main cost items	*India* 1954	*Pakistan* 1955	*United Kingdom* 1954	*France** 1951
			Percentages	
Raw jute	56	49	52	46
Other materials, fuels and services	8	7	13	27
Wages and salaries	23	19	23	16
Gross margin (residue)	13	25	12	11
Total (selling price)	100	100	100	100
Selling price (U. S. dollars per metric ton)	265	230	230	

* The French figures are based on returns for jute and hard fibres.

Source : FAO, *Monthly Bulletin of Agricultural Economics and Statistics*, March 1962.

be said to be well set for prosperity in the jute trade. Jute industry in Pakistan suffered at the hands of political instability in the country. But the new regime in that country is already seized of the situation. Along with the rising trend of gunny production during 1958-59, dispatches from Pakistan mills, both for export and inland consumption, have improved during the past years. The Jute Enquiry Commission set up by Pakistan has suggested some suitable measures, to improve the position further. Manufacturing costs in Pakistan as shown in the graph below (for actual figures see Table 5·4) are possibly the lowest in the world. She has, therefore, an advantage over India in her selling price.

COMPARISON OF MANUFACTURING COSTS OF WOVEN JUTE CLOTH IN INDIA, PAKISTAN AND THE UNITED KINGDOM
1954-55



SOURCE :- MONTHLY BULLETIN OF AGRICULTURAL ECONOMICS AND STATISTICS, F.A.O., VOL. 11, MARCH 1962.

Jute industries are also being developed in various parts of the world, viz., Brazil, Belgium, Congo, Argentina, New Zealand and Thailand. Majority of them depend on Pakistan for raw jute. Jute mills in Dundee are India's great competitors. With modern looms and spindles, Dundee is hoping to increase the total output by 30 to 50 per cent. France has already increased her output appreciably by introducing new circular looms and modern spindles. Before the Second World War, France, Germany, Belgium and Italy accounted for 16 per cent of the world's jute goods and after the war, their production came down to 9 per cent with a remarkable recovery after 1950, but was again around 8 per cent in 1964.

Thailand is presently developing her jute manufacturing industry quite fast. Her home production of gunny bags went up to nearly 9 million in 1961 against 3 million in 1955. Total consumption in that year was 34 million bags (Table 5·5). It is quite possible that

TABLE 5·5

THAI OUTPUT AND IMPORT OF GUNNY BAGS

Million pieces	*Imported gunny bags*	*Home manufactured gunny bags*	*Total consumption*
1955	25·1	2·9	28·0
1956	16·5	3·6	20·1
1957	29·2	4·0	33·2
1958	17·7	5·2	22·9
1959	19·7	5·0	24·7
1960	21·2	5·9	27·1
1961	25·3	8·8	34·1
1962 (Jan.-Jun.)	15·7*	4·5	20·2*

* Including 2·4 million bags manufactured from Thai kenaf under special arrangements with Taiwan, India and Japan.

Source : Customs Department and Ministry of Industries, Bangkok.

even if she does not enter the export market, she might try to be at least self-sufficient in gunny bags.[13] Burma has also started manufacturing jute bags and her factory seems to be the most up-to-date one in the whole of South East Asia.

The introduction of new circular looms, high speed draw frames

[13] Thailand's total imports of jute manufactures during 1963-64 were the lowest at 2·6 thousand tons.

and modern type spindles in other countries, are likely to affect India's trade in jute unless she also modernises her equipment. It has been estimated that if she wants to modernise her industry, she will have to spend an additional sum of Rs. 70 crores over a period of nearly 30 years.

The development of the jute industry in these countries will affect India's jute trade in two ways:

(*i*) Supplies which were previously going to these countries will be discontinued;
(*ii*) surplus production of these countries will be able to meet the demand of at least neighbouring countries.

The Share of India

Of the future estimated world jute manufactures trade of 2·0 million tons, the physical possibility of Pakistan is to capture a maximum of 0·8 million tons. If so, Pakistan will have to oust India from some of her traditional markets. In so far as new areas are concerned, the field will be open for both the countries. The final decision of the importer will naturally depend upon the quality and price of the commodity sold.

A recent delegation of the Indian Jute Mills Association to South East Asia points out that a major obstacle for the progress of jute trade in South East Asia is their unfavourable balance of trade with India. Once India can make some sort of a reciproca trade agreement with these countries, Indian jute manufactures will not face any difficulty there.[14]

As for the advanced countries, U.S.A., Canada and U.K. are the important importers of Indian jute manufactures. An Indian Industrial Delegation of the Federation of Indian Chamber of Commerce and Industry, examined the future possibilities of Indian trade in these countries.[15]

In spite of all types of competition, India has fared well both in U.S.A. and Canada. The position is, however, little different in U.K. and the Continent, where although Indian jute goods are

[14] *Jute and Gunny Review*, Vol. XI, No. 2.

[15] Report of the Indian Industrial Delegation, Federation of Indian Chamber of Commerce and Industry.

cheaper in price, the protectionist policy of those Governments is standing in the way of trade. West Germany jute industry has sought protection against India and Pakistan.[16]

From all this, it may be concluded that on the whole although future prospects are not very encouraging, they are not very discouraging either. Indian exports which had slackened during the past few years, have shown an appreciable improvement during recent years. The industry had to unseal a total of 4 per cent of the looms in two instalments.

Once India can offer sacking at competitive prices, the possibility of Australia increasing its purchase is not doubted. Again, there are better prospects of stepping up exports of sacking to South East Asia and West Asia, including Egypt. This may, however, have to be pursued by reciprocal trade agreements, by which these countries may be induced to make purchases from India.

Extreme vigilance and activity are, all the same, essential, first to hold on to the present business and second to seize every opportunity of expansion. The other point which we have to bear in mind in the expansion of our export trade is to improve the quality of our jute manufactures. The retiring Chairman of the U.K. Jute Goods Association, remarked at its Annual Meeting in 1959 that the manufactured goods coming from India have decidedly worn off the ginger. Some of the hessian, far from Golden Fibre, is more like ginger board than jute. Some quality improvement may be possible by the gradual replacement of mesta which is now used in the manufacture of export goods. Foreign markets, especially the U.S.A. are very sensitive to quality.

Having paid due consideration to all these factors, and with the possibility of increased exports to U.S.S.R., Eastern Europe and Latin America, India's prospect for an increase of jute goods exports would not seem to be very bright. What can possibly be expected is that India might be able to maintain the existing level of export with all the tough competition from other manufacturers. This would mean that she may be able to export about 1 million tons or 6 million bales of jute manufactures even at the end of the period under discussion. This would allow to Pakistan a complete exploitation of the maximum potential she has to increase the pro-

[16] *The Indian Express*, February 6, 1958.

duction of jute manufactures and export them. A small share has also been allowed to other producers.

Our target of one million tons of export of jute might look odd against 1·1 million tonnes as the export target fixed for the Fourth Plan (1970-71). It might be mentioned that India is losing ground against Pakistan's onslaughts because Pakistan has full advantage of cheaper raw-jute supplies to extend her manufacturing operations. It has been computed that in sacking alone, Pakistan has a price advantage over India of Rs. 600·00 per tonne. Pakistan mills have a three-fold advantage over India: (*i*) their jute mills are equipped with the latest machinery and production methods; (*ii*) they are ensured of steady supply of raw jute at economical price from domestic sources; and (*iii*) they enjoy the advantage of 'Bonus Vouchers Scheme.'

The effect of all this is already visible in the sense that the over-all export performance of the jute industry during 1966 has been depressing. In the 9 months ending September, exports fell from 695·8 thousand tonnes in the corresponding period of 1965 to 540 thousand tonnes. Export of sacking during the same period fell by 45 per cent from 213·1 thousand tonnes to 117·9 thousand tonnes. The position would have been still worse but for the substantial export of sacking to Russia on barter basis. Devaluation of the Indian rupee, instead of bringing any relief, has also played havoc with jute exports because the country has to pay 57·5 per cent more in the cost of imported raw jute and simultaneously heavy export duties on jute manufactures.

INTERNAL CONSUMPTION

With the increase in agricultural and industrial produce, India is emerging as one of the largest consumers of jute goods and a large demand has been created for wrapping as well as packing purposes. This is evident from a comparative study of increases in the agricultural and industrial production as well as consumption of jute manufactures as shown in Table 5·6.

It was originally estimated that consumption of jute manufactures may go up to 300 thousand tons by the end of the Second Five Year Plan.[17] Estimates of the Jute Enquiry Committee placed

[17] *J. & G. Review*, Vol. IX, No. 5. Also President of Gunny trades Association *vide Commerce*, Aug. 8, 1959, pp. 215, 249.

TABLE 5·6

INDICES OF AGRICULTURAL AND INDUSTRIAL PRODUCTION AND CONSUMPTION OF JUTE MANUFACTURES IN INDIA

Year	*Agricultural production**	*Industrial production*	*Jute manufacture consumption*
1950-51	95·6	100	100
1951-52	97·5	104	129
1952-53	102·0	106	147
1953-54	114·3	113	103
1954-55	117·0	122	121
1955-56	116·8	133	167
1956-57	124·3	137	157
1957-58	115·9	139	173
1958-59	133·5	140	193
1959-60	130·3	130	191
1960-61	142·2	138	238
1961-62	144·8	150·5	229
1962-63	137·5	162·8	299
1963-64	142·6	174·7	296
1964-65	157·8	184·4	321

*Base for agriculture index is 1949-50 as 1950-51 was not considered as a normal year.

it at 330 thousand[18] tons. With the 1958-59 consumption at 220 thousand tons, actual consumption in 1960-61 was 274·1 thousand tons, an annual increase of about 9 per cent during the Second Plan period. During the four years of the Third Plan period, consumption of jute goods went up from 272 thousand to 378 thousand metric tons, giving an annual increase of more than 10 per cent.

Over the 15-20 years period after the Third Plan, agricultural production is to be stepped up by at least 100 per cent. Proportion of the total quantity that may be packed would also increase because of an increase in urbanisation. The pace of industrial development is likely to be much faster. With an improvement in the standard of living, there is every possibility that many of the jute goods may find a place in the homes of the well-to-do in the shape of carpets, roofing felts, plastic goods, etc. The production of "Speciality goods" during the year 1958 amounted to

[18] Report, p. 11.

72·3 thousand tons, the highest on record for the past 28 years.[19] Jute consumption for carpet backing alone went up to 92·2 thousand metric tons in 1964. This indicates a trend towards diversification of jute consumption.

While there is no precise mathematical calculation which can give an answer to the probable quantity of jute manufactures that may be consumed over the coming 15-20 years, it can be expected that with such rapid advance in the economic development of the country,[20] jute manufactures will have to play a prominent role. Their consumption can be tentatively put at little more than three times the 1960-61 level or about 900 thousand tons.

Village Consumption

Along with jute manufactures, village consumption will also increase side by side. For the past many years, village consumption is being taken as constant at 230 thousand bales. The Jute Enquiry Committee also puts the same figures for the year 1960-61. This does not mean that there is no possibility of any increased consumption on this account. There have actually been two different estimates, one by the Indian Jute Mills Association referred to above and the other by Indian Central Jute Committee according to which the figure quoted is 150 thousand bales.

The Committee came to the conclusion that even if the present level of village consumption is less than 230 thousand bales, this target would be reached by 1960-61. For the purpose of this study, we have assumed it to be as 200 thousand tons during 1960-61. Whatever the case, over the next twenty years, a 50-75 per cent increase in village consumption is something which can be reasonably expected. This would mean roughly 350 thousand bales. Total home consumption, comprising of jute manufactures and village consumption, may then be of the order of 6 million bales in terms of raw jute.

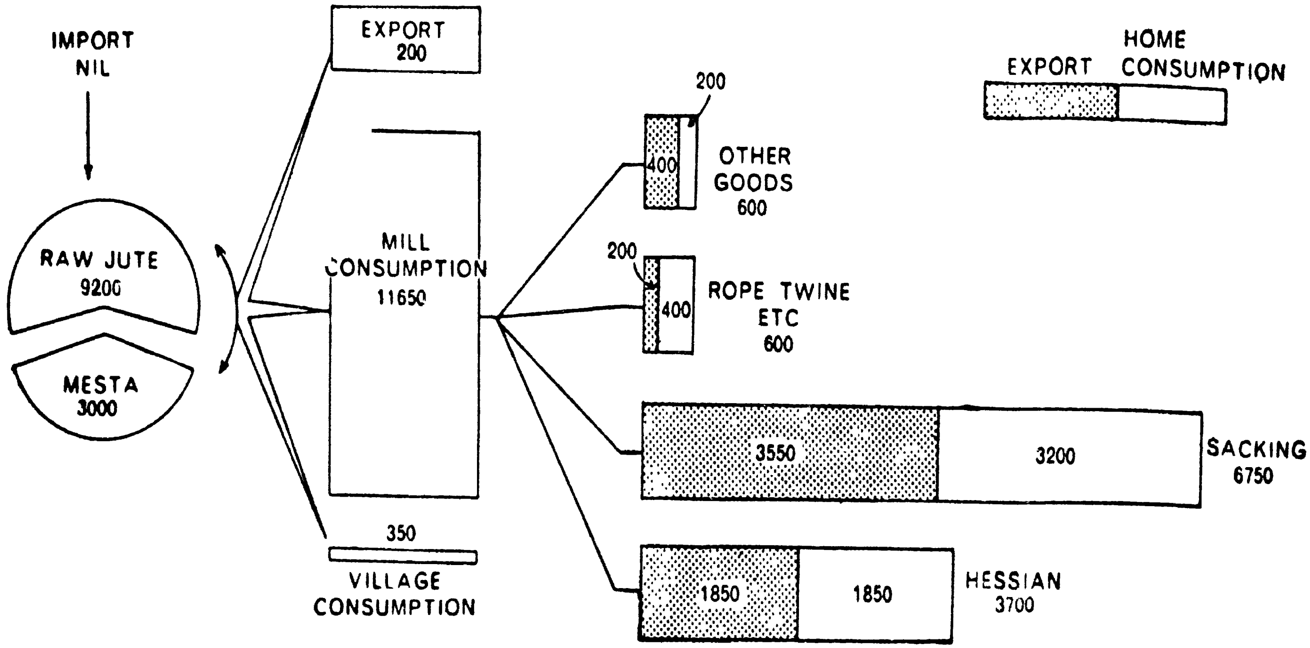
For purposes of self-sufficiency, production targets for 1980-85 can thus be put at 12 million bales, but it would be advisable if some export surplus is also created. The country after about 10 years of

[19] *J & G Review*, Vol. XI, No. 4, P. 144.

[20] At least doubling of agricultural production, doubling of per capita income and more than 100 per cent increase in other sectors.

CONSUMPTION FLOW CHART OF JUTE AND MESTA (1980-85)
(In terms of raw jute)

(THOUSAND BALES)
1 BALE = 400 LBS.



independence entered the export trade in raw jute in 1958-59, although she has again been importing small quantities during subsequent year. Pakistan's exports of raw jute today are of the order of 4-5 million bales. Since Pakistan's future policy is to encourage export of jute manufactures, India could justifiably expect a small share of, say 0·2 million bales in the raw jute trade.

TARGETS FOR 1980-85

A tentative picture along with the break-up is shown in Table 5·7 and the accompanying chart for the year 1980-85.

TABLE 5·7

JUTE AND MESTA TARGETS 1980-81

(In terms of raw jute)

(Thousand bales, 400 lbs. each

	1960-61	1980-85
Village consumption	200	350
Mill consumption	6,250	11,650
Hessian	2,271	3,700
Sacking	3,259	6,750
Rope, twine, etc.	—	600
Other goods	720	600
Exports	Nil	200
Total	6,450	12,200

Out of this total requirement of 12·2 million bales, the share of mesta may be placed at roughly 3 million bales. Assuming that all the jute goods intended for export are manufactured primarily from jute, this much quantity of mesta with its peculiar qualities would come quite handy in the development of new industries as well as for export in the raw form.

6

OIL SEEDS

THERE are five major oil seeds, viz., groundnut, castor, rapeseed and mustard, sesamum and linseed grown in India. Besides these, small quantities of cotton seed, niger, safflower, mahua, neem and karanja are also produced.

The Second Plan target for oil seed was placed at 7·5 million tons. The actual production, however, was only 6·5 million tons. The Third Plan target was put at 9·8 million tons against an actual production of 6·1 million tons in 1965-66, although it touched 8·5 million tons in 1964-65. As for vegetable oils, a tentative picture of the end uses for the year 1957 is given in Table 6·1.

TABLE 6·1

END USES OF VEGETABLE OILS, 1957

(Thousand tons)

Liquid edible oil	1,000
Body and hair	200
Vanaspati	300
Soap and varnishes	200
Lubricants, etc.	100
Total	1,800

HUMAN CONSUMPTION—FUTURE DEMAND

Some information regarding consumption of various edible fats and oils as available for that period is as follows:

A.P...7

TABLE 6·2

CONSUMPTION OF EDIBLE FATS IN INDIA

(Thousand tons)

Ghee (1956)	425
Butter (1956)	79
Vegetable oil (1957)	1,014
Vanaspati (1958)	294

This indicates that the sources of fats between vegetable oils, ghee and butter, and vanaspati were in the ratio of 4 : 2 : 1. Total requirements of vegetable oils and ghee in the year 1980-85 have been calculated by us as 10·0 million tons in Chapter 2. This has to be obtained from either edible oils or animal products like milk.

The production of ghee and butter in the country during 1960-61 was of the order of 0·5 million tons which in terms of milk would work out to nearly 9 million tons (ghee is 5·5 per cent of milk). This means that out of an estimated total production of 20-22 million tons of milk, a little less than half was being converted into ghee.

There is at present a prejudice against the use of vanaspati (hydrogenated oil) among a certain section of the population. Even otherwise, there are many more who prefer buffalo ghee, if they can afford to pay for it. There is, in the circumstances, a greater possibility of an increase in the demand for buffalo ghee in the coming 15 to 20 years when per capita income is envisaged to be doubled. As the resources of the country may not be able to meet this huge demand, there is a great need for finding out a generally acceptable cooking fat for the nation.

There may not be much difficulty in the case of about 70 per cent non-vegetarians for whom something equivalent to margarine, widely used in the West, can be manufactured. As for pure vegetarians, at least 50 per cent of their requirements will have to be met from buffalo ghee. Out of the total of 10 million tons of fats, the share of vegetarians would be of the order of 2·5 million tons. The requirements of this class for pure ghee would be nearly 1·5 million tons.

A section of the non-vegetarians who have sufficient purchasing power will also like to consume ghee and there may also be a general demand for butter. With due consideration to all these factors, a minimum demand of about 2·5 million tons of ghee and butter may be expected by the year 1980-85. We would then need the balance of nearly 7·5 million tons of edible oils for home consumption.

Hydrogenated Oils (*Vanaspati*)

This 7·5 million tons of edible oils will be needed in the form of liquid oils and *vanaspati*. Whatever proportion out of this is consumed in the form of vanaspati, will require additional 7½ per cent to cover the processing loss. Table 6·3 gives the position regarding production and consumption of vanaspati during the past few years.

TABLE 6·3

NUMBER OF FACTORIES WORKING. PRODUCTION OF VANASPATI AND CONSUMPTION IN INDIA
1950-51 TO 1965

Year	*No. of factories Working*	*Production* ('000 *tonnes*)	*Consumption* ('000 *tonnes*)
1	2	3	4
1950-51	—	153·0	—
1955-56	—	275·6	261·9
1958	39	300·9	299·8
1959	40	321·9	321·5
1960	42	340·9	340·6
1961	42	334·0	333·0
1962	40	369·6	368·4
1963	43	383·7	381·5
1964	43	358·7	363·0
1965	48	428·7	—

Source: *Oilseeds in India*, Directorate of Economics and Statistics Ministry of Food and Agriculture.

Both the production as well as consumption of vanaspati is steadily increasing in the country. During the First Plan period, the consumption showed an increase of 20 thousand tons per annum. It was assumed to go up to 25 thousand tons annually during the Second Plan period.[1] It was thus estimated that the home demand for vanaspati by the end of the Second Plan would be of

[1] Programmes of Industrial Development, *Second Five Year Plan*, p. 419.

the order of 330 thousand tons. Production target for the Third Plan was put at 500 thousand tonnes with a capacity of 550 thousand tonnes. Actual production in 1965 was 429 thousand tonnes.

Expenditure elasticity of demand for vanaspati has been calculated as unity.[2] With roughly 60 per cent increase in population over 1960-61 in the period under study, home requirements of vanaspati would work out to about 1·1 million tons.

As for exports, our chief importer at present is the United Kingdom. A demand for vanaspati can also be created in most of the low fat consuming countries in South-East Asia, Mid-East and East Africa. There is actually a great demand for Indian vanaspati in most of our neighbouring countries. West Asia alone has an estimated annual consumption demand for 25,000 tons.[3] With the prospect of a steady rise in living standards in the underdeveloped world and inability of many countries to produce the necessary oil seeds, India stands in an enviable position to expand her exports of vanaspati.

Exports of vanaspati from India have fluctuated in the past, never reaching the 1955-56 level of 14 thousand tons. This was, however, directly related to the prices prevailing in the foreign markets. Suitable steps like rebate of excise duty paid on vegetable oils used in the manufacture of vanaspati for exports, have already been taken. There is every reason to believe that necessary steps will be taken by the Government to make the price of Indian vanaspati competitive. Otherwise there is no lack of demand for it in the foreign markets. In the light of all this, it would not be much for India to put an export target of one lakh tons by the period 1980-85.

If so, the total requirements of vanaspati (including home demand of 1·1 million tons) for the country would be of the order of 1·2 million tons. The production of this quantity of vanaspati would need roughly 1·3 million tons of different oils. The supply of edible fat in the home demand of 7·5 million tons (already calculated) would only be 1·1 million tons. Additional quantity of oils needed would thus be 2 lakh tons. The position may be summarised as in Table 6·4.

[2] National Council of Applied Economic Research, *Demand Forecasts for consumer goods.*

[3] *Commerce*, March 8, 1958.

TABLE 6·4
OIL REQUIREMENTS FOR EDIBLE PURPOSES AND MANUFACTURE OF VANASPATI—1980-85

(Thousand tons)

Liquid oil consumption		6400
Vanaspati		1300
(*a*) Home consumption of 1·1 million tons	1192	
(*b*) Exports of 0·1 million tons	108	
Total		7700

Body and Hair

According to available estimates (Table 6·1) India consumed roughly 200 thousand tons of vegetable oils for body and hair during 1957. The future demand for this may depend on the increase in population alone. Rising incomes may have very little effect because the demand for the purpose is rather inelastic. Per capita consumption may actually decline.

A maximum of 65 per cent increase over the 1957 level can be expected. This would mean that we may require about 320 thousand tons of oil for body and hair for the use of contemplated population of 700 millions.

INDUSTRIAL REQUIREMENTS

Soap Industry

The soap industry accounts for nearly 50 per cent of the industrial uses of vegetable oils. Reliable information about the total production of all types of soaps is not available. The demand for soap is directly related to the available purchasing power with the masses, growth of urbanisation, industrialisation, and improvement in the water supply. A faster rate of expansion in the production of soap is evident from the fact that in the organised sector, its production went up by about 100 per cent during the 10 years—1950-60 (Table 6·5).

TABLE 6·5

PRODUCTION OF DIFFERENT TYPES OF SOAPS IN THE ORGANISED SECTOR IN INDIA 1950-60

(Tons)

Year	*Washing Soaps*	*Toilet Soaps*	*Medicated Soap*	*Other*	*Total*
1	2	3	4	5	6
1950	59,670	11,935	210	885	72,700
1951	67,155	14,895	205	1185	83,440
1952	71,080	13,810	230	1250	86,370
1953	68,370	12,555	225	1050	82,200
1954	70,900	15,500	250	1350	88,000
1955	82,250	15,100	300	1350	99,000
1956	90,530	17,270	450	2050	110,300
1957	91,290	17,700	450	2162	111,602
1958	100,730	18,568	510	2642	122,450
1959	107,158	19,217	460	3165	130,000
1960	113,339	21,057	370	5750	140,516
1963	134,400	24,680	730	4690	164,500

Source: (1) 1950-54. *Programme of Industrial Development*, 1956-61, p. 262.
(2) 1955-60. *Programme af Industrial Development*, 1960-65, Industry Division note on soap and synthetic detergents.
(3) *Foreign Trade of India*, 1963, p. 18.

Expansion in the unorganised sector for which no reliable figures of production are available has been more impressive. For instance, on the basis of the consumption of caustic soda, the production of this sector in 1950 was estimated at about 100,000 tons cheap fill oil, equivalent to about 50,000 tons of soap conforming to standard specifications. Corresponding figures quoted for 1957 were 160-230 thousand tons. Production in the unorganised sector has thus increased by more than 200 per cent. The 1960 production in this sector is estimated at 200,000 tons. This would mean a total production of the order of 340,000 tons in 1960.

Another estimate puts the production of soap in the year 1959 at 380-390 thousand tons.[4] In the light of these varying estimates we

[4] "A Survey of Industrial Self-Sufficiency in India," 1959, *Capital*, p. 71, and *Commerce Annual*, 1959, p. A 142.

would be quite justified in assuming that the total consumption of soap in the year 1960 may be roughly 400 thousand tons.[5] Out of this, toilet, medicated and other soaps being a little less than 30,000 tons (Table 6·5), the balance of about 370,000 tons constituted washing soaps.

For the hygiene and health of the people, soap is a necessity and the low consumption of soap in the country is a problem to be faced. The per capita consumption of soap in India has been increasing steadily but very slowly over the last decade or so. The demand elasticity of soap is estimated by the Soap Panel of the Development Council as 1·7. On this basis, the present per capita consumption of 1·17 kgs. per year is expected to go up to 1·25 kgs. by the end of the Third Plan and 1·53 kgs. by 1970-71. Compared to the consumption figures of some of the advanced countries of the world (Table 6·6) Indian consumption levels are rather low.

TABLE 6·6

PER CAPITA CONSUMPTION OF SOAP IN SOME OF THE SELECTED COUNTRIES OF THE WORLD

Countries	*lbs. per person per year*
U.S.A.	29·5
U.K.	23·3
France	17·4
Mexico	8·2
Malaysia	7·9
Turkey	6·1
Iraq	4·3
Indonesia	3·7
Ceylon	3·6
Nigeria	3·3
India	2·1
Pakistan	1·1

Future plans in the country are likely to be biased in favour of rural development and the existing trends indicate a sufficiently fast growth of urbanisation as well as industrialisation. As a result of the cumulative effect of all these forces, the consumption of

[5] Production of soap in the unorganised sector is being taken roughly as double that of the organised one.

soap in the country might be expected to go up even faster than those calculated by the Development Council. By the end of the stipulated period, it may be put at about 6 lbs. (2·72 kgs.). This is roughly the same as the existing level in a country like Turkey and a little less than Malaysia. Total demand for soap for consumption in the country may thus be of the order of 1·8 million tons by 1980-85.

Soap Exports

Small quantities of soap are also being exported. From the high level of 2·5 thousand tons in 1951-52, the quantity shrank to 500-600 tons during recent years, though the First Plan had envisaged a target of 10 thousand tons for export. The export of soaps, mainly toilet, during 1963, was about 400 tons. The main obstacle in this respect is the high cost of soap produced in India. Unless we succeed in reducing the cost of production, there is very little possibility of increasing exports. Primary responsibility for high costs of Indian soaps is the use of imported material—caustic soda, coconut oil and palm oil. Efforts have been made in the recent past to find out a workable solution for refunding import duties on imported material used in the manufacture of exported soap. But that was not possible due to administrative reasons. With the increasing home production of caustic soda as well as coconut oil, it may be possible to make the Indian soap quite competitive and thus step up the exports.

Synthetic Detergents

Along with this increasing demand for soap for internal consumption as well as exports, synthetic detergents are also substituting the use of soap in most of the advanced countries. They are used for washing costly and special fabrics like rayon, silk, nylon, etc. They are also becoming popular in the textile industries and in established laundries. Table 6·7 gives an interesting picture of the inroads made by synthetic detergents in the consumption of soap in U.S.A.

While the total quantity of washing material used per person in the U.S.A. during the 20 years period studied has remained more or less constant, synthetic detergents account for about 75

TABLE 6·7

PER CAPITA CIVILIAN CONSUMPTION OF SOAP AND SYNTHETIC DETERGENTS IN U.S.A.

(Lbs. per annum)

Year	Soap	*Synthetic detergents*	*Total*
Average 1935-39	24	a	24
1940	25	a	25
1945	25	2	27
1946	20	2	22
1949	19	6	25
1950	19	9	28
1953	14	11	25
1954	12	13	25
1955	10	15	25
1956	9	17	26
1957	8	20	28

Source : *The Fats and Oils Situation*, U. S. Department of Agriculture, March 1959, p. 24.
a=less than half lb.

per cent of the total consumption. They did not figure in the U.S. economy twenty years back.

The experience of U.S.A. and other advanced countries is not, however, likely to be repeated here in India even during the coming 15-20 years. In so far as their use is restricted to costly fibres, it may be in addition to the demand of 1·8 million tons of soap as already calculated.

But whatever use of synthetic detergents is made by the textile industry, laundries and some of the individual consumers in direct replacement of soap, we may, for purposes of broad calculation, assume that it will be equal to exports of the commodity. The net demand for soap by 1980-85 may then be of the order of 1·8 million tons.

Requirements of Oil

Table 6·8 provides details about the consumption of different oils in the organised sector of the soap industry in the year 1957.[6]

[6] Some information is available regarding the consumption of various types of oils for soap in the Programme of Industrial Development—1961-62. But that does not change the proportions between the various oils appreciably.

TABLE 6·8

CONSUMPTION OF OILS BY THE ORGANISED SECTOR OF SOAP INDUSTRY—1957

(Thousand tons)

Coconut oil	21·0
Palm oil	19·5
Groundnut oil	4·5
Mahua oil	4·0
Hydrogenated oil	4·0
Tallow	3·0
Others	4·0
Total	60·0

Total production of soap in the year 1957 was 112 thousand tons. This would mean that the consumption of vegetable oils by the soap industry was a little more than 50 per cent of the total production of soap. The unorganised sector of the industry which manufactures mostly washing soaps and which accounts for nearly two-thirds of the total production of soap, uses certain fillers and thus consumes much less than 50 per cent of oils.

When better quality of soaps will be demanded, the consumption of oil in the soap industry may be taken at 50 per cent of the total production of soap. A production programme of 1·8 million tons of soap would thus need about 0·9 million tons of vegetable oils. Since vegetable oils, particularly edible ones, will be much in demand, it would be desirable to make better use of animal fats in the manufacture of industrial products, like soap. Such use would release considerable quantities of coconut, groundnut and other edible oils. According to the Programme of Industrial Development, 1961-62, use of tallow in the soap industry was 4·5 per cent. Because of the pressure on oils, it would be better if this is raised to, at least, say, 10 per cent. This would mean that the total requirements of vegetable oils for the soap industry should not exceed 0·8 million tons.

Paints and Varnishes

The demand for these arises mainly from railways, building operations, and industries like the automobile, bicycle and electrical equipment. If our prices are competitive, small quantities can also be exported.

During the First and the Second Plan periods, the production of paints and varnishes showed an annual increase of the order of 10 per cent. The Third Plan target was fixed at 140 thousand tons against the 1960-61 production of 52·5 thousand tons. We have discussed the expansion of automobile and bicycle industries in the Chapter on Rubber. Building operations and power schemes are also going to occupy a place of pride in the future plans.

Expansion in all these directions is not likely to be less than 300 per cent during the stipulated period of 15-20 years. This would mean that against the estimated Second Plan demand of 55 thousand tons of oil, this industry by 1980-85 may consume about 220 thousand tons of vegetable oils.[7]

Along with this rate of growth, there have been a number of technological changes in the industry. Barely 25 years ago, the Indian paint industry manufactured products, which were based almost entirely on linseed oil. Today, particularly since the War, the trend has shifted to a large usage of synthetic enamels mainly based on alkyd and special products such as epoxies, plastic emulsions, etc. If so, the demand for oil will have no relation to the increased production of paints in the country. It may then be assumed that in spite of the expansion of the industry, its demand for vegetable oils may even go down from the 1960-61 level of 55 thousand tons. We might put it at around 50 thousand tons.

Lubricants and other Miscellaneous Uses

Lubricants do not depend only on vegetable oils. Mineral oils can also be used for the purpose. It is very difficult to say at this stage what quantities of vegetable oils will be needed for the future production of these products. Requirements of lubricants are directly related to the expansion of the industrial sector and transport industry. A ten per cent annual increase or a total of 200 per cent increase in the demand for vegetable oils under this head is the minimum that can be expected. This would mean that these miscellaneous uses may need roughly 300 thousand tons of vegetable oils as against the 1960-61 estimates of 100 thousand tons.

[7] It would be interesting to note that even in an advanced country like the U.S.A. the production of paints and varnishes went up from an average of 300 million gallons in 1935-39 to 600 million gallons in 1958. *The Fats and Oils Situation*, U.S. Department of Agriculture, March 1959, p. 26.

Total Industrial Uses

The discussion in the last few pages can be summed up as in Table 6·9.

TABLE 6·9

PROJECTED REQUIREMENTS OF VEGETABLE OILS FOR INDUSTRIAL USES BY 1980-85

(Thousand tons)

	1960-61	1980-85	% *increase*
Soap industry	250	800	220
Paints and varnishes	55	50	—9
Lubricants and other miscellaneous uses	100	300	200
Total	405	1150	185

A consumption target of 1150 thousand tons of vegetable oils for different industrial uses gives only 3·7 lbs. of these oils per capita per annum. It would be interesting to know (Appendix 11) that far from high fat consumption countries, India would not be reaching the pre-war consumption level of medium consumption countries like Italy and Cuba which were consuming 8·8 and 6·6 lbs. respectively. Even in Russia, pre-war level was 4·4 lbs.

EXPORTS

India is one of the most important producers of oil seeds, and vegetable oils are India's traditional items of export. It has been the policy of the Government of India to encourage the export of vegetable oils in preference to oil seeds. Export duty on vegetable oils has accordingly been progressively reduced or abolished whereas that on oil seeds has been kept more or less steady. Exports of seeds were completely banned in 1952. Small quantities of groundnut known as H.P.S. are, however, being allowed for export in response to a specific demand from U.K., the Netherlands and Canada.

Vegetable oils exported are mainly of groundnut, castor, and linseed. Small quantities of Mahua, salad, sesamum and other varieties are also exported. The bulk of Indian castor oil is absorbed by the U.S.A., United Kingdom and Australia. Groundnut oil is exported mainly to the United Kingdom, the Netherlands, Belgium, Italy and Burma, while linseed oil goes mainly to the United Kingdom, the Netherlands and Australia.

Exports of vegetable oils in the past years have shown an erratic trend. They have depended on (1) the ability of India to spare oils for export and (2) comparative prices of the commodity in India as well as the world market. In spite of the increased production of oil seeds in India during the past few years, the internal price of groundnut and other oils have shown a stiff attitude. World prices against this have fallen appreciably. Failure of internal prices to fall correspondingly seems largely due to the ever rising pressure of home demand.

Future potentialities of the export of these oils will also depend on these very factors. On the demand side, chances are that the producing countries might not be able to meet the demand of the consuming countries. While world production of all oils went up by about 80 per cent during the period 1938-39 to 1960-61, the quantities entering the world market showed an increase of only 25 per cent during the same period. This may not be taken to mean that there was no demand for the oils. On the other hand, it indicates higher consumption level in the producing countries themselves. Annual additional fat requirements alone for the world (if the rate of population growth continues to be the same as at present) are estimated to be 250 thousand tons at the present level of consumption.[8]

It may be true that the demand for groundnut oil has reached a saturation point in Western Europe and linseed oil may be substituted by synthetic material as a drying agent. But with every improvement in the living standards of low and medium consumption countries (Appendix 12), the level of their fat consumption is also going to rise. It went up practically by 62 per cent in Asia (Table 6·10) during the 20-year period : 1934-38 to 1958.

Future demand of consuming countries for oil seeds is, therefore, likely to be quite high. Asia, Africa and Latin America, accounting for 37 per cent of world demand, would be most significant in determining such future demand. Greatest scope of increased consumption lies within this area. Income elasticity of demand in this region is computed at 0·8 compared with 0·1 to 0·4 for Western Europe.

[8] *Fats and Oils*, Commodity Series, 13, F.A.O., p. 17.

TABLE 6·10

ESTIMATED CONSUMPTION OF OILS AND FATS

(Million metric tons oil equivalent)

Year	*U.S. & Canada*[a]	*Western Europe*	*Oceania*	*Asia*	*Africa*	*Latin America*	*Total*
1934-38	4·2	6·0	0·2	2·9	0·9	1·0	15·2
1950	5·3	5·7	0·2	3·2	1·1	1·3	16·8
1951	4·9	6·1	0·3	3·2	1·1	1·4	17·0
1952	5·0	6·4	0·3	3·4	1·0	1·7	17·8
1953	5·0	6·5	0·4	3·8	1·2	1·7	18·6
1954	5·2	6·8	0·4	4·4	1·3	1·7	19·8
1955	5·4	7·0	0·3	4·4	1·2	1·8	20·1
1956	5·3	7·3	0·3	4·3	1·3	2·0	20·5
1957	5·4	7·7	0·3	4·6	1·3	1·9	21·2
1958(estimated)	5·6	7·8	0·3	4·7	1·5	1·9	21·8

Source : U. S. Department of Agriculture.

Annual Reports of the International Association of Seed Crushers, by J. C. A. Faure, Food and Agricultural Organisation of the United Nations.

[a] Actual consumption.

Castor oil, for example, is in great demand even today. The effective pressing demand is also likely to keep up the world price level for oils. India may not thus be faced with the present price difficulties in the world market during the coming two decades.

But there being a huge potential demand in India itself, it may not be possible for her to profit much from the short supply of the commodity in the world. Vegetable oils are going to be one of those commodities for which there may be a little world competition. India has thus to decide today the direction in which she would like to move. With an assured market, an export target of 100,000 tons of vegetable oils is the minimum that she should aim at the end of the 20-year period under discussion.

TOTAL REQUIREMENTS OF VEGETABLE OILS

From what has been said in the preceding pages, the total demand for oils would work out to 9·3 million tons as shown in Table 6·11

TABLE 6·11

TOTAL DEMAND FOR VEGETABLE OILS IN 1980-85

	(Thousand tons)
Liquid oil consumption	6400
Body and hair	320
Vanaspati industry	1300
Industrial uses	1150
Exports	100
Total	9270

SOURCES OF SUPPLY

Besides the five major oil seeds about which regular statistics are available, there are also a number of minor oil seeds and cotton seed which is at present being fed to the cattle as such. Estimated production of minor oil seeds like *mahua*, *neem*, *tobacco*, *niger*, *karanja* and *tung seed* at the end of the Second Plan was about 350,000 tons in terms of oil. If some organised efforts are made, it should not be difficult to increase their production. An increased demand for oils as already discussed is bound to provide the necessary incentive for the higher production of these oils. Their total net production may be tentatively put at 1·0 million tons by 1980-85.

Cotton-Seed Oil

As for cotton-seed oil, our present production of cotton seed is of the order of 1·7 million tons. Against the projected cotton target of 13·3 million bales (2·2 million tons) by 1980-85, the estimated cotton seed production for that year would be about 4·4 million tons. Allowing 10 per cent of the seed for sowing purposes and taking into account the 14-18 per cent commercial oil extraction ratio, cotton seed alone will have a potential of about 0·7 million tons of oil. Very little of cotton seed is, however, being crushed at present and the total output of oil is estimated at about 30,000 tons in 1960-61. The reasons advanced for this low figure are:

1. There is a popular prejudice against the use of cotton-seed oil for human consumption.

2. Cotton seed is used as such for cattle feeding due to the unsuitability of village mills for cotton seed crushing.
3. Cotton-seed cake is also considered as an inferior cattle feed when compared to whole seed.

As regards the prejudice for human consumption, it would be of interest to note that in the United States, cotton-seed oil is the second most important edible oil and as much as 90 per cent of the seed is crushed. The oil is principally used as a salad oil for frying and also very largely in margarine. It finds a large use for cooking as well as in cakes and biscuits.[9] Foots is used in the U. S. A. for a special kind of ice cream called 'Mellorine.'

The question of any prejudice, under the circumstances, should not arise. The vanaspati manufacturing industry voluntarily agreed to use this oil to the extent of 2½ per cent in 1958 and 5 per cent during 1959 irrespective of price consideration. They were prepared to go up to 10 per cent by 1961 provided the price of cotton-seed oil compares favourably with groundnut oils. The actual consumption of cotton-seed oil in the Vanaspati industry today is nearly 10 per cent. It may be possible to raise it to at least 15 per cent. This would mean that Vanaspati industry alone would be able to consume about 195 thousand tons of cotton-seed oil by 1980-85. With a little more of propaganda, this hurdle can possibly be overcome without much difficulty.

The unsuitability of village mills for crushing cotton seed can also be removed easily because a major portion of 'kapas' goes to the cities for separation of lint from seed. Specialised mills can be set up at such centres. The villager also may not have any difficulty to part with the 'kapas' from which he removes the seed himself, if some reasonable price is offered to him for cotton seed. This would be possible only if some suitable market is found for the by-products of cotton-seed oil. As much as 85 per cent of the seed consists of oilcake, hulls and linters.

Linters are already being put to chemical uses in the form of linters pulp for the manufacture of rayon and acetate, fine writing paper and specialty papers. In the non-chemical uses, they are well-known in making absorbent cotton, hospital bed pads, surgical sponges, sanitary napkins, automobile upholstery, apparel

[9] M. N. Janes, *Commerce*, April 16, 1958.

padding, felt industry and many others. The decorticated cotton cake contains between 48-50 per cent albuminoid and oil combined and the undecorticated one upto 33 per cent. Experiments have shown that the removal of oil from the seed does not in any way remove the nutritive value of the feed. Cotton-seed cake is, in fact, a good substitute for the seed in cattle feed. There should not, therefore, be any prejudice against its use. The cultivator will perhaps need a little education. That should anyway be coming forth with the extension programme. The Indian Oilseeds Development Council has already launched a scheme to propagate the use of cotton-seed cake instead of whole seed for cattle feeding.

As pointed out by Turner,[10] Chairman of the Vanaspati Manufacturers' Association, if these very problems are solved, India should have practically no difficulty in producing a larger quantity of cotton-seed oil. As against the existing production of 75 thousand tons of oil, the Third Plan target for the industry was 100 thousand tons. The rapid progress envisaged to be made is a pointer to the possibilities of the extent to which the potential resources can be tapped. If the recommendations of the Cotton-seed Crushing Committee are accepted, the industry is likely to develop at a rapid pace.

In the light of all these developments, it can be assumed that from the total potential of about 0·7 million tons of cotton-seed oil, India should aim at producing a minimum of 450 thousand tons of edible oils.

Coconut Oil

India is the second largest coconut producing country in the world. But the indigenous production of coconut oil in India is not sufficient at present to meet her own requirements. Our imports have varied between 40 to 50 thousand tons of oil.

India has been producing, during the last 4-5 years, 4300 to 4600 million nuts or about 650 thousand tons (6773 nuts weigh one ton) of copra. At 62 per cent oil extraction ratio, the total production of coconut at present in India is equivalent to roughly 400 thousand tons of oil.

No reliable information is available at present about the actual

[10] *Annual Report of the Vanaspati Manufacturers' Association of India*, 1957.

quantity of copra being crushed and oil produced in India. The production of coconut oil is, however, estimated at about 160 thousand tons.[11] The Chapter on Coconut deals, at length, with the potentialities of coconut and the production of coconut oil by 1980-85 has been calculated as 325 thousand tons.

Soyabean Oil

The production of soyabean in India is practically negligible. But in the total world production of oils, soyabean along with groundnut and cotton-seed is among the first three important sources of the supply of vegetable oils. Experimental data in the different parts of the country show that Indian soils and climate are quite suitable for the growth of soyabean. It would be useful to introduce this legume as one of the catch crops on the residual moisture left in irrigated areas. If the efforts being made by the Government are a success it should not be difficult to produce about 250 thousand tons of soyabean oil in the country by the stipulated period.

Rice Bran Oil

Rice bran is another potential source of oil supply. China has succeeded in extracting oil even from rice husk. A production programme of the order of 55 million tons of rice would yield about 5·5 million tons of rice bran. The oil extraction ratio varies from 10 to 13 per cent. Calculating at 10 per cent (the lower ratio), India should be able to have a potential of 500 thousand tons of rice bran oil. Rice bran contains valuable nutrients, such as starch, proteins and vitamins, besides edible fat. As it contains some ferments, which combine with the fat to increase its acidity, rice bran cannot be preserved for any length of time. Its use for animal feeding is, thus, limited and is normally considered as a waste material. It is easily inflammable also.

If oil is extracted from the bran soon after it comes out of the mill, before it has had time to turn rancid, the resulting material

[11] It is estimated that only 46 per cent of coconut is converted into copra, out of which only 80 per cent is crushed for oil which yields about 62 per cent of oil.

can be stored safely for a considerable time. It gives the following analysis:

TABLE 6·12

CONSTITUENTS OF DEOILED RICE BRAN AND WHEAT BRAN

(Per cent)

	deoiled rice bran	wheat bran	wheat groats
Water	10·4	13·2	13·5
Crude protein	15·0	16·0	12·5
Crude fat	2·3	2·6	1·9
Crude fibre	5·0	9·9	2·9
Ashes	9·8	5·9	1·7
Carbohydrates	57·5	52·4	67·5
Total	100·0	100·0	100·0

The analysis given above would show that rice bran after extraction compares favourably with wheat bran. We have already calculated that about 7 million tons of bran is needed for feeding our cattle. Rice bran which is now being practically wasted should come in quite handy. To reduce freight cost, deoiled bran can be briquetted with the Swiss glomera (Briquetter) requiring no binder at all. This process reduces its volume to one-tenth and the briquettes can be reconverted into cattle-feed without any difficulty as and when required.

The oil (quoted at about Rs. 1,000 per ton) obtained can be put to industrial uses, if unrefined. But it can very well be used as salad oil for human consumption after refining and bleaching. It is an item of excellent food value in Japan and America. The by-products obtained in the process of refining, fatty acids, wax, lecithine and glycerine, are all in great demand for the industry.

With all the potentialities of rice bran, the object should be to make a cent per cent use of the total quantity of rice bran available in the country for the extraction of oil. But 40-50 per cent is the minimum that must be used. This would yield about 0·25 million tons of rice bran oil against 10 thousand tons at present and Fourth Plan (1970-71) target of 50 thousand tons.

It is encouraging to note that special rice bran oil extraction plants are being manufactured in India. The problem of solvent extraction of rice bran having been solved, a new company was registered at Calcutta under the name of Schamtung (India) Ltd. for the extraction of bran oil.[12] The deoiled bran, 80 per cent of which is being exported, will provide a valuable source of foreign exchange.

Total Oil from Miscellaneous Sources

The hitherto unimportant sources of the supply of vegetable oils, if properly tapped, may also play quite a significant role in the coming period. We have not yet taken into consideration other sources like rubber seed oil which is also considered to be of great value for industrial uses.

TABLE 6·13

TOTAL SUPPLY OF VEGETABLE OILS FROM MISCELLANEOUS OIL SEEDS BY 1980-85

(Thousand tons)

Minor oil seeds	1000
Cotton seed	450
Coconut oil	325
Soyabean oil	250
Rice bran oil	250
Total	2275

If we are able to produce about 2·275 million tons of vegetable oils from these miscellaneous sources, we will be left with the home demand of about 7·0 million tons of vegetable oil to be met from major oils.

MAJOR VEGETABLE OIL SEEDS TARGET

The total quantity of vegetable oil seeds required to produce a given quantity of oil depends upon the oil extraction ratio of different seeds. These ratios differ from seed to seed depending upon the method of extraction adopted. Extraction by mills normally yields more oil than by ghani. The existing pattern of oil extraction for the different seeds is shown in Table 6·14.

[12] *Capital*, May 5, 1960, p. 664.

TABLE 6·14
EXTRACTION OF OIL FROM DIFFERENT OIL SEEDS BY DIFFERENT PROCESSES

(Per cent)

	Crushing ratio by different processes		*Oil extraction rate*		
	Mills	*Ghanies*	*Mills*	*Ghanies*	*Weighted average*
Groundnuts*	80	20	29	26	28
Sesamum	17	83	42	38	40
Mustard and rape	63	37	35	31	33
Linseed	70	30	35	31	33
Castor	100	—	40	—	40
Weighted average (all seeds)	73	27	31	28	30

* Nuts in shell. Kernels are 70 per cent of nuts in shell.

According to the existing production pattern of these five oil seeds, weighted average yield for all the five oils works out to roughly 30 per cent. It may not be possible to close down all the village ghanies, but percentage of oil may go up to at least 33 per cent or one-third of the seed. A demand for 7·0 million tons of oil would thus need about 21·0 million tons of oil seeds.

It may be added here that the rate of extraction from the mills is in no way satisfactory at present. Wherever village ghanies have to exist, they must be of improved type like Wardha design.

Research will have to be carried out to improve the efficiency of mills as well. Deoiling of expeller cakes should also be adopted to the maximum extent. Although the solvent extraction industry had its beginning as early as 1905, it is only during the last 10-15 years that it can be said to have established firm roots. There are, at present, about 120 solvent extraction plants in operation, having a total installed capacity of about 3 million tons. Out of the total available cake of 3·5 million tons from the five major oil seeds, as much as 1 million tons is being solvent extracted today.

Besides the rice bran oil, which has been discussed separately, there are available about 1 million tons of minor edible oil and non-edible seeds, such as safflower, niger, mahua, khakhan, karanja, water-melon, neem, tobacco, etc. A large proportion of these are, at present, being wasted; only about 8 per cent being utilised. Production potential of oils as a result of solvent extraction process is quite large but no account is being taken for any addition as a result of these improved practices, so as to compensate any shortfalls in the programme discussed in Part II of the study.

Domestic Consumption and Seed Requirements

Of the total quantity of oil seeds produced in the country, a portion is used for seed and some more is kept by the cultivators for domestic consumption. The information about these two items is rather scanty. The only source of information about the utilisation of oil seeds is the one contained (Appendix 13) in the Marketing Reports on various commodities. They are invariably very old and it is quite possible that conditions might have changed appreciably between this period.

Table 6·15 supplies the necessary data for the year 1956-57[13] as estimated by the Directorate of Economics and Statistics of the Ministry of Food and Agriculture.

TABLE 6·15

UTILISATION OF MAJOR OIL SEEDS IN INDIA 1956-57

(Thousand tons)

Seed	*Production*	*Seed*		*Domestic Consumption*		*Crushed for oil*	
		Qty	*%*	*Qty*	*%*	*Qty*	*%*
Groundnut*	4025	483	12·0	286	7·1	3234	80·3
Sesamum	499	12	2·4	100	20·0	387	77·6
Rape & Mustard	961	14	1·5	76	7·9	871	90·6
Castor	126	8	6·3	—	—	118	93·7
Linseed	382	19	4·9	27	7·1	336	88·0
Total	5993	536	8·9	489	8·2	4946	82·5

* Nuts in shell. 0·6% of Groundnut is exported.

Source: *Oilseeds in India*, 1956-57, Ministry of Food and Agriculture, Dte. of E & S.

These ratios have not changed much.

(*i*) *Domestic Consumption:* On the basis of the existing consumption pattern, nearly 8 per cent of the total oil seeds are being retained by the cultivators for domestic consumption. In absolute quantities, it is of the order of 500 thousand tons. It would not be correct to assume that domestic consumption would constitute a constant ratio at every level of production. The increase in this quantity can be assumed to be in keeping with the rise in population which is about 60 per cent for the period under consideration. In round figures it may be taken as about 800 thousand tons by 1980-85.

(*ii*) *Seed*: The existing seed rate which is 9 per cent for all oil seeds is said to be much below the optimum level in certain cases; particularly so in the case of groundnut. It has been pointed out that one of the methods of increasing production is the use of a higher dose of seeds. In some of the districts of Andhra like Vishakapatnam, and Anantpur, for example, one of the factors responsible for the low yields is the thin stand of plants in the fields, consequent on the use of a low seed rate and longer spacing.[14] Similar is the position in other low yielding areas of India.

The present practice in the case of groundnut is to grow it in rows 1 to 2 feet apart, using a seed rate of about 40 lbs. per acre for the pure crop. This is considered to be very uneconomic. Experiments have shown that a higher seed rate of 75 to 100 lbs. of good hand-picked kernels per acre, depending, however, upon the variety and closer spacing would definitely give better yields. The position is similar in the case of other oil seeds also.[15]

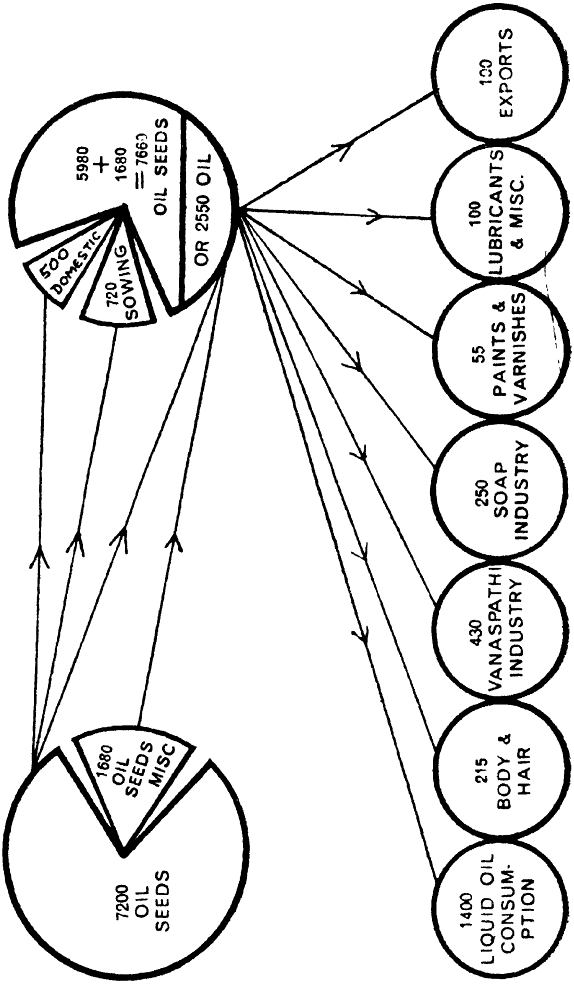
With due consideration to all these facts, it would, perhaps, be reasonable to assume that taking the five major oil seeds together, the seed rate may be put at about 12 per cent.

For a production programme of 21·8 million tons of oil seeds, the gross requirement of seeds would thus be about 25 million tons. The position may be summarised as in Table 6·16 (also see accompanying Charts).

14 K. R. Damle, "Farming Supplement," the *Hindu*, July 22, 1953.

15 *Ibid.*

ESTIMATED REQUIREMENTS OF OIL AND OIL SEEDS BY THEIR END USES IN 1960-61 (THOUSAND TONS)



ESTIMATED REQUIREMENTS OF OIL AND OIL SEEDS BY THEIR END USES IN 1980-85 (THOUSAND TONS)

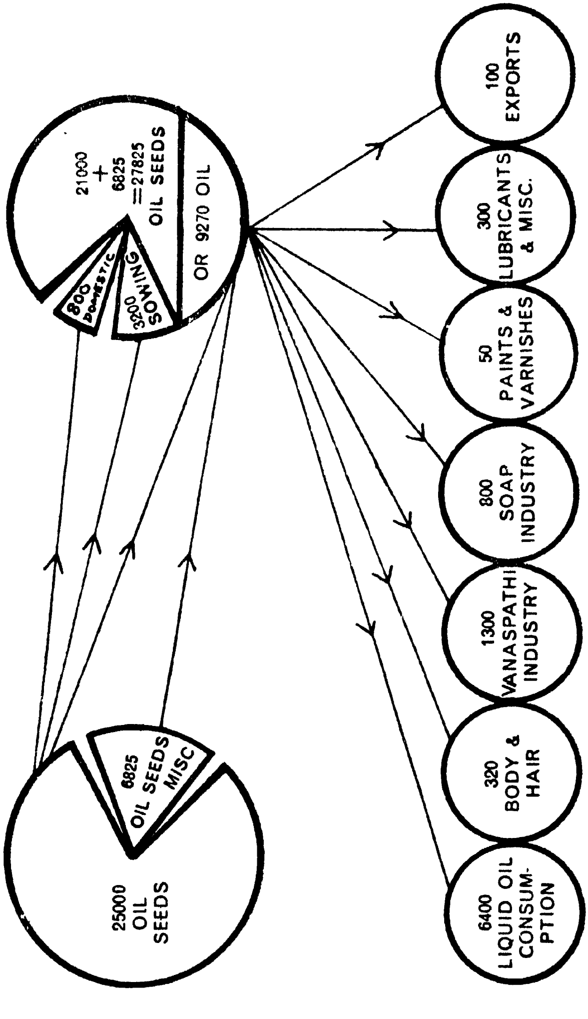


TABLE 6·16

DEMAND AND SUPPLY OF OIL AND OIL SEEDS BY THEIR END USES IN 1960-61 AND 1980-85

	1960-61	1980-85
	(*Oil in thousand tons*)	
Demand		
Liquid oil consumption	1400	6400
Body and hair	215	320
Vanaspati Industry	430	1300
Soap Industry	250	800
Paints and varnishes	55	50
Lubricants and miscellaneous uses	100	300
Total internal requirements of oil	2450	9170
Exports of oil	100	100
Total	2550	9270
Supply		
Minor oil seeds	350	1000
Cotton seed	40	500
Coconut	170	325
Soyabean	—	250
Rice bran	—	200
Major oil seeds	1990	6995
Total	2550	9270
Major oil seeds requirements	*Seeds in thousand tons*	
Major oil seeds for crushing	5980	21000
Seed for domestic use	500	800
Seed for sowing	720	3200
Total oil seeds	7200	25000

7

COCONUT

INDIA has been importing copra-coconut oil and palm oil during the past few years to the tune of about Rs. 15 crores annually (Table 7·1). An idea about the availability of coconut and palm oils during the last 7-8 years is given in Appendix 13.

TABLE 7·1
IMPORTS OF COPRA, COCONUT OIL AND PALM OIL IN INDIA

(Quantity in '000 tons)
(Value in Million Rs.)

Year	*Copra*		*Coconut Oil*		*Palm Oil*	
	Quantity	*Value*	*Quantity*	*Value*	*Quantity*	*Value*
1956-57	99	94	21	29	n.a.	23
1957-58	124	121	14	24	19	25
1958-59	94	106	5	11	20	22
1959-60	86	109	4	4	28	34
1960-61	98	116	nil	nil	31	35
1963-64	—	—	1·4	2	36·4	38·5
1964-65	—	—	0·2	0·3	30·6	34·4

Utilisation of Coconut

Accurate statistics about the production and utilisation of raw coconut and its oil are not available in the country. It is, however, estimated that of the total domestic production of coconut, little less than half (about 46 per cent) is utilised for making copra and the remaining is either consumed or used for raising seedlings, etc. About 20 per cent of copra is used for edible purposes and it is only the remaining 80 per cent which is available for crushing. Coconut oil which is about 62 per cent of copra is used for edible purposes, soap and toilet manufactures, and as an illuminant and lubricant as well as for other miscellaneous uses. Palm oil which is wholly imported, on the other hand, has limited uses. It is used in the preparation of soaps and as a flaxing dip in the manufacture of plates.

As for the quantitative data, the Marketing Report on Coconut in India which relates to the years 1934-35 to 1938-39 gives some information. The panel on Development Council of Soap Industry has also estimated the quantities of coconut oil required for various purposes in 1960-61.

Pooling up the information in these two Reports, which cannot, of course, be considered as comparable, changes in the utilisation and increase in the demand for coconut oil during the 25-year period 1934-35 to 1938-39 and in 1960-61 are shown in Table 7·2. Total consumption of coconut oil in 1960-61 was put at 210 thousand tons.

TABLE 7·2

QUANTITY OF COCONUT OIL USED FOR DIFFERENT PURPOSES

	Average 1934-35 *to* 1938-39 ('000 *tons*)	*per cent to total*	1960-61 ('000 *tons*)	*per cent to total*
1. Soap Industry	30	19	60	29
2. Toilet and toilet preparations	45	29	60	29
3. Edible	75	49	80	38
4. Miscellaneous	4	3	10	4
Total	154	100	210	100

In the pre-war period, about half of the coconut oil was used for edible purposes. The relative importance of this use declined to 38 per cent by 1960-61. There is a corresponding increase of

10 per cent in the share of soap industry. During the two decades an overall demand of coconut oil increased by about 35 per cent. Maximum increase has been in respect of 'miscellaneous purposes' which increased to $2\frac{1}{2}$ times during the period under study.

Future Demand

Coconut, copra and coconut oil are used for human consumption. The oil, however, finds its use to a greater extent in the soap and toilet industries. Future demand for coconut and its derivatives will, therefore, depend upon their need for human consumption as well as industrial uses like soap and the toilet industry.

Human Consumption

According to rough estimates, nearly 54 per cent of fresh coconut is consumed as raw kernel by the people, as religious offerings and seedlings. Again, of the 46 per cent coconut converted into copra, nearly 20 per cent is consumed directly. As regards the oil in the pre-war period, nearly half of the total production was being used for edible purposes. This is now estimated to have fallen to about 38 per cent.

We will continue to use coconut as well as its derivatives in their various forms. Actual consumption will, however, be determined by a number of factors mentioned below.

Coconut in the form of raw kernels is utilised in Kerala and parts of Madras State. If the coconut consuming population increases by about 60 per cent during the coming 15-20 years and consumption habits continue to remain unchanged, the demand for kernels for this purpose will increase by about the same percentage. But urbanisation and rising standards, coupled with opening up of the remote producing areas with the cities and towns, may appreciably reduce the direct consumption of coconut. Consumption of tender coconuts for juice may also decline because of the availability of other drinks.

The likely effect of all these factors will be to bring down the per capita consumption of raw coconut rather than increasing or even keeping it stationary. Table 7·3 will show how the use of coconut oil in selected non-producing 11 countries has fallen for edible purposes during the 7 years period of 1955-61. This phenomenon is likely to be observed in all the progressive countries.

TABLE 7·3

DISPOSITION OF COCONUT OIL IN 11 NON-PRODUCING COUNTRIES[a] 1955-1961[b]

(Per cent)

	dible	*Inedible*	*Total Disappearance*
1955	64	36	100
1956	67	33	100
1957	67	33	100
1958	66	34	100
1959	57	43	100
1960	50	50	100
1961	54	46	100

[a] Denmark, France, Fed. Rep. of Germany, Netherlands, Norway, Portugal, United Kingdom, United States, Canada, Japan, Australia.

[b] Calendar years except for Federal Republic of Germany and Australia with split year starting in 1955-56.

Source : *Coconut Situation*, F. A. O., No. 8, 1962, p. 4.

Religious offerings and seedlings which hardly account for 2-3 per cent of the total production may, however, continue to remain unchanged. Total increase in the demand for this purpose may thus be put at a little more than 40 per cent as against a 60 per cent increase in population. This would mean that the demand for direct consumption of coconut may be of the order of 3550 million nuts as compared with 2500 million in 1960-61.

According to the existing utilisation pattern, of the total number of nuts converted into copra, nearly 400 million nuts are eaten as such. All the factors working against the increased consumption of coconut as already discussed, are also likely to operate in the case of copra. There are, however, better techniques of dehydration being evolved. The poorer classes of people, in spite of their rising incomes, may continue to use copra because of its comparative cheapness. If so, the demand for this item may go up according to the increase in population. Thus working at a 60 per cent increase, the consumption of coconut in the form of copra may be placed at about 640 million nuts.

Table 7·4 would give an idea of the per capita availability of coconut oil in the areas where it is directly being consumed for edible purposes. Per capita consumption of oil in the natural form is estimated to have gone down from 8·6 to 6·4 lbs. per annum in the consuming areas.

TABLE 7·4

PER CAPITA AVAILABILITY OF COCONUT IN OIL EATING AREAS

	Total availability ('000 tons)	*Population of the region (million)*	*Per Capita availability per annum (lbs.)*
Average			
1938-39	75	19·38	8·58
1960-61*	80	27·93	6·38

* Estimated.

This is quite understandable. With every improvement in the living standards of the people and the availability of vanaspai ghee at competitive prices, consumption of coconut oil in its raw form is likely to decrease in a growing economy, particularly when people move to the urban areas. With due consideration to all these factors, the per capita availability of coconut oil for the consuming population which may grow to 45 millions, may be put at about 5 lbs. per annum. The total demand for oil for direct consumption would, then, be of the order of 100 thousand tons. This would work out to 1100 million nuts on the basis of the existing conversion ratio.

Industrial Uses

These constitute soap, toilet and toilet preparations and other miscellaneous uses. Coconut is also used in small quantities as an illuminant in the coconut producing areas and in some of the temples in South India where hundreds of small earthen lamps (each consisting of wick immersed in a small shallow pan) are kept burning day and night. Inferior quality oils are generally used for this purpose. In several temples of South India, however, coconut oil was found to have been replaced by the cheaper groundnut oil. The use of coconut oil as a lubricant is, however, very limited.

As regards soaps and toilet preparations, the demand for all types of soaps by 1980-85 has already been calculated at 1·8 million tons. An attempt is made here to calculate the requirements of coconut oil for toilet and laundry soaps separately.

Toilet Soaps and Toilet Preparations: Toilet soaps and toilet preparations are mostly manufactured in the organised sector. Though these account for a small proportion as compared to total production of soap, so far as the consumption of oil is concerned, they take away large quantities. It is thus essential to treat them separately. The rapid growth in the production of toilet soap will be evident from the fact that during the last 10 years it has increased by about 7 per cent [1] per annum. This was due to the import restrictions imposed in the country. Since production has only substituted imports, the tempo is not likely to slow down in the coming two decades.

The consumption of toilet preparations at present is mostly confined to the urban areas, whereas laundry soaps find use in rural areas as well. Toilet soaps in future will be in equal demand in the rural areas, when per capita income of a rural resident will be more or less equal to the per capita income of the urban resident at present. Assuming that out of the present production of 27,000 tons of these soaps, roughly 20,000 tons is consumed by the 20 per cent (urban population is 17·6 per cent) of the higher income group, the remaining 80 per cent of the existing population alone will demand another 80 thousand tons. Then a 60 per cent increase in population and the higher consumption levels of the urban population which is estimated to be 37 per cent of the total by 1980-85 would demand another 70 thousand tons. The total demand for these soaps may thus be put at 150,000 tons.

The old idea of using 100-150 per cent of oil (with a larger proportion of coconut oil in it) in relation to the quantity of toilet soap produced has changed now. The use of coconut oil for the preparation of various types of soaps in a few countries is given in Appendices 14·1 to 14·3. Lever Brothers, the largest manufacturers of toilet soaps in the world use only 80 per cent of oil and would prefer to use not more than 25 per cent of coconut oil in the total quantity of oil used. The production of 150 thousand tons

[1] Refer to Chapter 6 'Oil seeds,' Table 6·4.

of toilet soaps would then need roughly 120 thousand tons of oils of all types. The share of coconut oil in this should not be more than 40 thousand tons.

Laundry Soaps : Of the total demand of 1·8 million tons of all types of soaps when the share of toilets is 150 thousand tons, the estimated production for washing soaps may be put at 1·65 million tons. The quantity of oils and fats required for producing a certain weight of soap varies depending on the type and quality of soap manufactured, the method of manufacture and the quality of filler added.

In the case of laundry and industrial soap, oils and fats may be from half to two-thirds or even less for inferior washing soap. Requirement of oils and fats in the preparation of soap may be taken as 50 per cent or about 675 thousand tons. Main oils and fats used for soap making in India as revealed by the Marketing Report on Coconut in India, are coconut oil, mahua, cotton-seed oil, castor oil and tallow. The Report further adds that besides these, groundnut oil, palm oil, gingelly oil, linseed oil, etc. also find use in soap making. Hardened groundnut oil has also begun to be used lately.

Coconut oil is almost indispensable for soaps made by the cold process. The proportion of this oil in the manufacture of soap by this method varies from 70 to 100 per cent. In the case of soaps made by 'semi-boiled' or 'boiled' process several oils and fats are usually blended together; the choice between the different oils and fats being influenced by the quality of soap required and the relative prices of various oils.

In regard to oleaginous material for soap manufacture, technical considerations call for a balance between the use of coconut oil and soft oils on the one hand (these give higher solubility and free lathering properties to the soap), and hard oils which have more efficient cleansing properties, on the other hand. From the economic point of view, the main question is the extent to which coconut, the most expensive oil, can be replaced by cheaper oils like palm oil. The Soap Panel of the Development Council for Oils, Soaps and Paints recommended that the consumption of coconut oil should be brought down to a level of about 25 per cent of the total requirements of the oils in the case of toilet soaps, and about 20 per cent of the total oils used in the case of laundry soap. The panel has recommended the proportion of various oils as follows:

TABLE 7·5

REQUIREMENT OF VARIOUS OILS FOR THE TOILET AND SOAP INDUSTRIES

(Per cent)

		Toilet	*Laundry Soap*
1.	Coconut oils	25	23
2.	Hard oil such as palm oil, tallow, hydrogenated vegetable oils	60	50
3.	Soft oils, mostly groundnut oils	13	25
4.	Rosin	2	2
	Total	100	100

It is natural that an oil which is cheaper and contains an equal quantity of fat will be preferred by the manufacturers. The following table shows the prices of coconut, palm and groundnut oils in the country during 1958-61.

TABLE 7·6

PRICES OF COCONUT, PALM AND GROUNDNUT OILS IN INDIA (AVERAGE FOR 1958-61)

		Rs. per ton
1.	Coconut oil	2397
2.	Palm oil	1193
3.	Groundnut oil	1633

The relative importance of palm oil is due to its cheapness. The country is not self-sufficient even in respect of coconut oil which costs practically double as compared to palm oil. Imports of coconut oil cannot, however, be completely stopped, since in the preparation of certain toilets it is indispensable. Its use can all the same be restricted to some extent if other oils are made available at competitive prices. Availability of hard oil, which is a by-product of the vanaspati industry, at cheaper rates in the country may replace the use of coconut oil to some extent. This oil is already being used a good deal in the unorganised sector of the soap industry in place of tallow. It is not much difficult to expand the production of milling copra in India, whose low production is mainly due to a huge quantity being used for edible purposes. Data regarding utilisation of various oils are available for the organised sector only. These relate to the year 1957 and are given in Table 7·7.

TABLE 7·7

CONSUMPTION OF OILS BY THE ORGANISED SECTOR OF SOAP INDUSTRY, 1957

	Quantity ('000 *tons*)	*Per cent to the total*
1. Coconut	21·0	32
2. Palm	19·5	30
3. Groundnut	4·5	7
4. Mahua	4·0	6
5. Hydrogenated	4·0	6
6. Tallow	3·0	4
7. Others	10·0	15
Total	66·0	100

Since nothing is known about the unorganised sector, which produces more than 50 per cent of soap in the country, it will not be realistic to assume that these percentages hold good in actual practice. It is observed that the unorganised sector, which produces mostly washing soaps, uses more of mahua and other oils. Thus

TABLE 7·8

PROPORTION AND QUANTITIES OF VARIOUS OILS REQUIRED FOR THE SOAP INDUSTRY IN 1980-85

	Percentage of the total	*Quantity* ('000 *tons*)
1. Coconut	20	165
2. Hard oils, such as palm oil, tallow, mahua, hydrogenated vegetable oils	50	412
3. Soft oils, mostly groundnut	25	206
4. Rosin	5	42
Total	100	825

the future increased production of soap in this sector as well will call for a corresponding increase in the demand for these oils. Taking all these factors into account, it may be assumed that the proportion of various oils required for the manufacture of soap may be as detailed in Table 7·8.

Against this, the Panel of Development Council on Soap Industry has prepared the following estimates of the requirement of oils both for the organised and unorganised sectors of the soap industry for the Third and subsequent plans:

TABLE 7·9

CONSUMPTION OF OILS IN SOAP INDUSTRY AT THE END OF II, III, IV AND V PLAN PERIODS

('000 tons)

		at the end of			
	Name of the oil	*II Plan*	*III Plan*	*IV Plan*	*V Plan*
1.	Coconut oil	40·6	60·0	90·0	135·0
2.	Hard oils, mahua, palm, neam, hydrogenated other oils	107·4	161·1	238·7	358·0
3.	Soft oils, groundnut, castor, soft linseed, sesame	32·0	48·0	71·3	107·0
	Total	180·0	269·1	400·0	600·0

No estimates were given for the Sixth Plan and subsequent periods. Even otherwise, the two estimates are not comparable, since the Panel has included toilet soaps, whereas here we have treated them separately. Moreover, production targets of soap as given by the Panel for the Second and Third Plans are 377 and 559 thousand tons respectively, whereas corresponding estimates given in the Plans are 370 and 500 thousand tons. The Panel has not given any target of soap for the Fifth Plan, but that is bound to be much higher than the one worked out here as would be clear from the total consumption of oil for the soap industry.

As far as possible, it is essential to conserve the supplies of coconut oil and minimise the imports of palm oil. More emphasis will thus have to be placed on the use of other oils. Panel on soaps has already recommended developing other oils such as mahua, neam and other minor seed oils like cotton-seed, Kusum oil, and solvent extracted oils. These could substitute palm oil to some extent. Besides the technological possibility of substitutability, the other obstacle relates to the prices. In order to ensure that people use more of other oils, it is imperative to bring down the prices of these oils in line with palm oil. The use of oils other than coconut will otherwise be in keeping with the prevailing practice in U.K. and U.S.A.

Miscellaneous Uses

About 10 thousand tons of coconut oil were utilised for miscellaneous uses at the end of Second Plan. No doubt there is an urgent necessity to conserve the limited supply of this oil, but it will not be possible to have any control over these uses. The future demand may be assumed to go up by about 100 per cent in this case and the total requirement may be put at about 20 thousand tons. Those miscellaneous uses will also include synthetic detergents which use small quantities of coconut oil and tallow.

TABLE 7·10

BALANCE SHEET OF COCONUT AND COCONUT OIL

	Unit	1960-61	*% to the total*	1980-85	*% to the total*
1. For human consumption					
(*a*) tender nut	million nuts	2500	54	3550	46
(*b*) copra for direct consumption	,,	400	9	640	8
(*c*) coconut oil	,,	874	19	1100	14
2. For soaps and other uses in the form of oil	,,	826	18	2475	32
Total (1+2)		4600	100	7765	100
3. Utilisation of coconut oil					
()*a* human consumption	'000 tons	80	38	100	30
(*b*) toilet soaps and preparation	,,	60	29	40	12
(*c*) laundry soap	,,	60	29	165	52
(*d*) miscellaneous uses	,,	10	4	20	6
		210	100	325	100

Total Requirements

Adding up the total demand for coconut oil, we would require about 325 thousand tons of oil against the present indigenous production of about 160 thousand tons. In terms of raw nuts it would need 3575 million nuts. Besides this another 4190 million nuts will be needed for other purposes as already discussed. Total requirements of coconuts would then work out to 7765 million nuts. Table 7·10 presents a summary of the utilisation pattern of coconut and its oil in the country.

PRODUCTION PROGRAMME

Having estimated the demand it is necessary to examine the possibilities of achieving self-sufficiency in the domestic production of coconut. Statistical data about the acreage and production, however, are incomplete. Table 7·11 gives an idea of the available information pertaining to area and production of coconut in India from 1952-53 to 1964-65.

TABLE 7·11
AREA, PRODUCTION AND YIELD OF COCONUT IN INDIA

Year	*Area* ('000 *acres*)	*Production* (*million nuts*)	*Yield* (*nuts per acre*)
1955-56	1579	4297	2721
1956-57	1581	4216	2667
1957-58	1631	4498	2758
1958-59	1690	4613	2730
1959-60	1693	4617	2727
1960-61	1700	4638	2738
1961-62	1787	4478	2506
1962-63	1972	5017	2544
1963-64	1972	4725	2396
1964-65	2021	4919	2427
Average	1763	4601	2622

The progress made by the coconut industry during the past 10 years is rather discouraging. While there is a slight increase in the total area under the crop, yield per acre has never reached the 1953-54 level of 2838 nuts per acre. The result is that there is no improvement in the production of coconut in the country.

Yield Data in India and Abroad

The yield of coconuts per tree is a highly variable factor. Variation is from year to year and from tree to tree in the same plot of land. One would seldom come across a palm grove or an estate where the bulk of the trees are uniformly high yielders. Again, it is not only the number of nuts which is important; one has to take into consideration the weight of copra or better still the weight of oil that could be obtained per tree. Yields in terms of copra depend on the palm density, the output of nuts per palm, the size of nuts and to some extent on processing methods. While calculations are made in India on the basis of the number of nuts per tree, Ceylon, Philippines and Malaya calculate yields in terms of the output of copra.

In India the average number of nut bearing trees (consisting of 90 per cent of the stand) in the immediate pre-war period was estimated at 62 per acre for the country as a whole; but with wide variations in the main coconut growing areas in Madras, average density was 75 bearing palms to the acre, in Travancore-Cochin 62 and in Mysore only 40, but the yield of nuts per bearing tree was twice as great in Mysore as in Madras or Bombay.

The average yield of nuts per tree in India is estimated at 35-40 per annum. On the Government farm at Baddur, however, the largest number picked in one year was 250 nuts per tree and growers can point to individual species in their gardens producing over 300 nuts per tree per year.

The coconut industry as a whole is not very well developed anywhere in the world and inter-country comparisons will even otherwise not be very meaningful. This is because of the wide variations in output per acre within each country. Thus in Malaya, estates produced 27 quintals of copra per acre[2] in 1956 on the average, including some old plantations with very low yields. A typical figure in estates in full production is considered to be 37 quintals per acre; an estate of 15,000 acres in Perak for instance, has an average yield of 40 quintals per acre. Average yields on small holdings in West Johore were only half as large in the same year. This indicates the most staggering differences within the area.

Average yields of the order of 2700 to 2800 nuts per acre in India

[2] Equivalent to over 7000 nuts per acre.

are quite comparable with those in other parts of the world. There are, however, examples of specific areas in Ceylon yielding about 3500 to 4000 nuts per acre. Raising Indian yields to some such levels may not be a difficult task if the research Institutions are directed to tackle problems facing the crop.

The Indian Central Coconut Committee which was set up in 1945 has now two Central Coconut Stations. The one at Kasaragod in Kerala State tackles problems on fundamental research concerning coconut cultivation. The other at Kayangulam in the Quilon district investigates problems connected with pests and diseases of coconut. Besides this, regional coconut research stations have been set up to undertake cultural and manurial experiments of local importance. Future improvements in coconut yields will depend upon the results thrown out by these research stations.

Some of the successful manurial trials conducted in India indicate that a properly cultivated and manured tree would yield about 65 nuts, while the same tree without manure may give hardly 40-45 nuts. Experimental data in Ceylon indicates that as much as 90 nuts per tree can be obtained from a properly manured tree and yield per acre raised to nearly about 5000 nuts per annum.

In Madras State a large number of subsidized fertiliser demonstration plots have been arranged since 1959-60 to demonstrate the beneficial effects of fertilising coconut trees. In all cases substantial increases in coconut yields have been recorded.

One such demonstration was started in 1959 in Tanjavur district. One hundred coconut palms of uniform growth and bearing were selected for the demonstration. Fifty trees were manured at the rate of 50 lbs. cattle manure or compost and 10 lbs. of a 6 : 6 : 12 NPK mixture per tree. Fifty trees were not manured to serve as control. Manuring was continued during 1960, 1961 and 1962.

Remarkable changes were observed during the first year itself. The leaves changed their pale colour to dark green, and the crowns appeared more compact. In the second year the yield was almost three times that of the previous year and during the third year it was a little over four times.

Nuts obtained from 50 coconut trees were 1960—527 (control); 961—841 (control); 2,521 (manured); 1962—494 (control); 3,511 (manured).

The average yield of nuts per tree, which was only 17 nuts at the commencement of manuring, rose to 70 nuts per tree. Taking an average number of 80 trees per acre, the yield in the third year increased to about 5,600 nuts per acre, which was 3,240 nuts more than the yield obtained during the first year. The increase in income rose to Rs. 683·20 per acre, giving a net profit of Rs. 483·20 per acre.

Experimental data so far thrown out are rather scanty. There is a need for more scientific experiments so as to recommend the optimum quantity, quality and time, etc. for the application of a specific manure/fertiliser in a specific area. No doubt such manurial experiments in the case of coconut suffer from a number of handicaps as compared to other crops. Ways and means have got to be found to overcome these difficulties.

Pests and Diseases

The Coconut plant suffers from a number of pests and diseases. If we are not able to reap full benefits from the best species of the plant which is properly manured, it is completely a waste of the good work done. Annual loss caused by pests in the State of Kerala alone has been estimated to exceed Rs. 10 million.[3]

One of the most serious pests of a coconut tree is the 'rhinoceros beetle' (Oryctes rhinoceros). The attack is most serious when the plants are young. The beetle breeds in manure heaps, under trash and decaying vegetation of all kinds.

There are a number of methods popularly believed to be effective in warding off the attack. They range from the physical removal of the beetle, tying of thorns round the base or of a sheath of wild date leaves tightly from the bottom to almost the top, to spraying Bordeaux mixture over the leaf bases. But no effective remedy has so far been found.

There are a number of other destructive pests like Phynchophorus Ferrugineus, Pseudococcs, Aspideotus, destructor, S. white ants and rats. The tree is also subject to a number of diseases like the 'stem bleeding' disease, the 'bud-rot' and 'leaf-rot' diseases.

All this will show that there is a need to investigate the matter further, conduct research in doing away with the menace of pests and diseases and reducing the annual recurring loss to the maximum extent possible.

[3] *The Coconut Palm*, A monograph, p. 208.

It should not be difficult for India to raise her yield if all the necessary steps such as selection of trees, proper manurial treatment and pest control measures are taken. The merger of Goa, which is an important area for the production of coconut, will undoubtedly further help India's cocpnut economy.

Extension in the Area

The future demand for coconut may possibly not be met by intensive methods alone. Area under the crop will also have to be increased. While extending the area, we have to see that the new areas fall in those regions which are agro-climatically most suited for the growth of the palm.

A survey conducted in this respect shows that in Madras State an overall increase of about 50 per cent in the acreage is possible. Large areas fit for raising the coconut are available in the interior of South Kanara and Malabar districts, especially in the lower slopes and at the foot of the hills. Marked expansion is also possible in Tanjore and East Godavari.[1] Sandy areas like Ramanathapuram district are also fit for the extension of coconut cultivation. Survey conducted in this area has revealed that about 28 thousand acres could be brought under coconut cultivation. Seedlings can also be planted on canal banks in Madras. Besides this, the whole of the Andaman Islands lie unexplored as yet with regard to the extension of coconut and rubber plantations. There would appear to exist an urgent need for an exhaustive survey of these areas including Goa.

In Kerala State, the area that can be brought under cultivation consists of low-lying lands in which paddy cultivation is uneconomical but cultivation of coconut on bunds would be profitable. It is also possible to reclaim about 4000 acres of shallow backwater area and cultivate coconut on bunds. Some 5000 acres of coastal land can also be brought under coconut by providing suitable irrigation facilities. In Mysore, cultivation is possible on canal banks and certain areas now lying fallow.

In Andhra Pradesh, canal banks and suitable waste lands can be planted up. Surveys conducted in Andhra Pradesh have shown that 2,700 acres of waste land suitable for coconut cultivation is

[4] *Memoirs of the Department of Agriculture*, Madras, pp. 260-61.

available. In West Bengal and Assam suitable waste lands can be brought under coconut. In the Laccadives also shallow lagoons can be reclaimed for the purpose.

Development Programme

The discussion in the preceding pages shows that coconut has not so far received adequate attention it needs. The immediate question which has to be tackled now is to undertake, assist and encourage agricultural, industrial, technological and economic research on coconuts; to supply technical advice to growers on coconut and to persons engaged in the coconut industry; to encourage the adoption of improved methods in coconut cultivation; to improve marketing of coconut and coconut products in India and abroad and suggest suitable measures to prevent unfair competition, to promote and encourage co-operative effort among coconut growers and the coconut industries; to fix grade standards of copra and its products; to collect statistics from growers, dealers, millers and other sources on all relevant matters bearing on coconut industry, etc.

Coconut development programme did not find place in the First Five Year Plan. The Second Plan, however, made a departure in this respect. It provided an outlay of Rs. 6•41 lakhs for coconut research in the States of Mysore, West Bengal, Orissa and Andhra Pradesh. Besides, the Central Plan of the Ministry of Food and Agriculture also contained a provision of Rs. 30 lakhs. The State Plans of Kerala. Madras, Mysore, Andhra Pradesh, West Bengal, Assam and Bombay contained a total provision of Rs. 30·73 lakhs. One of the most important programmes of coconut development is the setting up of nurseries.

The Third Plan for the first time laid a definite target of 5275 million nuts for 1965-66.[5] The establishment of nurseries was to provide further impetus during the Plan period. A sub-committee of the Indian Central Coconut Committee considered the requirements of seedlings for underplanting and new plantings and estimated that the number of seedlings required per annum for underplanting was of the order of 9·53 lakhs at the rate of 1 per cent replacement. This number of seedlings per annum was required

[5] Actual achievement, however, was only 4999 million nuts.

for each of the 5 years of the Third Plan. Besides, 2·35 lakhs of seedlings were required per annum for planting up a new area of 3,920 acres per annum for the Third Plan. The total number of seedlings required per annum for the Third Plan period was thus calculated as 11·88 lakhs against the base level production of 7·84 lakhs per annum from the existing nurseries.

An Appraisal

The production of coconut in the country can be increased in a short period by the distribution of manures/fertilisers, providing irrigation facilities in the coastal sandy type of soils and reducing the loss from pests and diseases.

History of the past 5-7 years, indicated by the production of nuts depicts a rather sad story and much has not been done so far. The first question, therefore, is to find out the bottlenecks which have stood in our way for the implementation of the above programmes. Fertilisers have been in short supply, but with the new factories being established, this will possibly be remedied. The country cannot afford to starve any crop from fertilisers.

Irrigation wherever needed and pest control measures should be a simpler affair. Spraying of the diseased palms is at present done under the auspices of the State Governments concerned. It could also be considered whether this work can be handed over to private agencies. Once a particular line of action is decided, responsibilities should be pin-pointed and action taken in the desired direction.

There would appear to be an urgent need for the development of proper marketing facilities. Whether this objective is desired to be achieved by co-operative marketing, the establishment of regulated markets or any other form is again a matter for decision. But this aspect is as important as that of increasing production.

As regards long-term measures, we have to increase the area under coconut. The progress in this respect is also rather discouraging. We have already suggested the need for a survey of potential areas where coconut cultivation can be extended. Thereafter a regular programme for the supply of requisite seedlings will be necessary. We must stress that what is most important in coconut or for that matter in any other agricultural programme is the proper implementation of the schemes.

The estimated demand of coconut by 1980-85 comes to about 8000 million nuts, against the present production of about 5000 million nuts. This represents 60 per cent increase in production. By taking into account the present and future production of coconut in Goa, the extension of area as suggested above and the contemplated increase in average yield per acre, it should be within our reach to attain self-sufficiency in the domestic production of coconuts in the coming 15-20 years. There should in fact be no need for imports by then. In view of these considerations, an attempt has been made in the following table to chalk out a production programme for the time perspective we have in view:

TABLE 7·12

PRODUCTION PROGRAMME FOR COCONUT IN INDIA

Unit	*Average* 1952-53 *to* 1959-60	1980-85	*Increase per cent*
1. Area (million acres)	1·7	2·5	47
2. Yield (nuts per acre)	2650	3200	21
3. Production (million nuts)	4500	8000	78

8

TEA

THE INDIAN tea industry is more than a century old. It has had a chequered career during this period, passing through many vicissitudes and hazards. Now it has carved for itself not only a popular place among the beverages throughout the world, but also a unique position in our national economy.

A major part of the tea produced in India is exported, though internal consumption has also been progressively increasing. Appendix 14 supplies the basic data regarding production, consumption, and export of tea during the past twenty-five years. The requirement of this commodity at any future date would depend on internal demand as well as the potentialities of export.

INTERNAL CONSUMPTION

Present Position

Accurate information is not available about internal consumption of tea from year to year because no one knows precisely about the stock position. It is, however, presumed that carry-over stocks are cancelled from year to year. Some rough estimates have been formulated by the International Tea Committee as shown in Appendix 14. This shows wide variations in the consumption of tea from year to year. Though total annual consumption (ranging between 100 to 140 million kgs.) in the country, considered by itself, is substantial, per capita consumption in India, about 0·5 lbs.

per head, is very small as compared to 10 lbs. in U.K. and about 3 lbs. in Ceylon. This is explained in Table 8·1 which gives an idea of the per capita consumption of tea in some of the important countries.

TABLE 8·1

ANNUAL CONSUMPTION OF TEA PER HEAD OF POPULATION

(Kilograms)

Country	*Average* 1934-38	1962-64	*Percentage change*
HIGH-INCOME COUNTRIES			
United Kingdom	4·19	4·31	+ 3·1
Ireland	3·49	3·82	+ 33·2
New Zealand	3·03	3·60	+ 6·6
Australia	3·08	2·64	— 14·6
Canada	1·56	1·04	— 32·1
Netherlands	1·23	0·75	— 44·7
United States	0·29	0·31	+ 3·4
Denmark	0·15	0·30	+ 66·7
NEAR EAST AND NORTH AFRICA			
Iraq	0·77	3·04	+ 272·7
Saudi Arabia	0·10	0·56	+ 460·0
United Arab Rep. Egypt	0·44	0·91	+ 88·6
Sudan	0·43	0·73	+ 58·1
Iran	0·51	0·79	+ 68·6
Algeria	0·20	0·23	+ 15·0
Turkey	0·10	0·38	+ 280·0
PRODUCING COUNTRIES			
India	—	0·31	—
Pakistan	0·10	0·24	+ 150·0
Ceylon	0·74	1·29	+ 83·8
Japan	0·45	0·81	+ 84·4
Indonesia	0·17	0·08	+ 53·0
Federation of Malaya	0·46	0·45	— 2·2

Source : *Tea Statistics of India*, 1965 and *Annual Bulletin of Statistics*, International Tea Committee.

Future demand

Consumption levels of such beverages as tea, coffee, etc. are determined by the following factors:

1. population growth,
2. increase in national income,
3. fall in prices,
4. urbanisation, and
5. other factors.

Increase in National Income

One pound of tea yields about 150 cups. On this assumption, the consumption of tea in India is less than a quarter of a cup per head per day, as against roughly 1·5 cups a day in Ceylon. Working and middle class family budget studies in India reveal that only 1 per cent of the family income is spent on tea. Income elasticity of demand for tea and coffee may be more than unity under Indian conditions. In the absence of any reliable information, we may, however, take it as unity.

With the per capita income doubling during the period under discussion, it should be possible for an average Indian to increase his per capita consumption of tea by about 100 per cent over the 1960 level. Per capita consumption of tea by 1980-85 would thus be roughly 1·0 lb. annually or a total of 700 million lbs. for an assumed population of 700 million. This will provide only one cup of tea per head on alternate days. Even this assumed level after twenty years, is lower than what is being consumed in Egypt and Ceylon at present which have similar climatic and other conditions.

Fall in Prices

The price of a commodity in the market is normally determined by the forces of demand and supply, but in the case of tea the working of these forces in the internal market in India is being hindered by State interference in the form of various imposts levied by different authorities. The demand for tea, which is, to some extent, not a necessity, is quite elastic. It is highly responsive to price fluctuations.

The Indian consumer has always clamoured for lower prices. This was echoed by the Plantation Inquiry Commission, long back, which held that prices charged for tea consumed internally are high. These prices, the Commission suggested, should be lowered, if the internal market is to serve as a cushion against fluctuations in the foreign market. Moreover, if this is somehow achieved, it will ensure a stable home market for a significant proportion of the total output.

The cost of tea production, as shown in Table 8·2, actually went up by about 11 per cent during the years 1950 and 1953 for which data are available. It might have gone up further in the subsequent years. The corresponding figures for Ceylon in recent years are over Rs. 140 per 100 lbs. of tea. Table 8·3 gives breakdown of the cost of producing 100 lbs. of tea in India in 1953.

TABLE 8·2

COST OF PRODUCTION OF TEA

(1950-1953)

(Rs. per 100 lbs.)

Year	*Exclusive of commission to managing agents, etc.*
1950	118
1951	130
1952	140
1953	131
1950-1953 (average)	130

Source : *Plantation Inquiry Commission Report, Annexure* XXXV, 0·510.

Increase in costs is largely due to increased selling expenses, crop gathering and manufacture charges and wages. A major item, however, is the general charges which include management, salaries and remuneration of managing agents. Steps should be taken as early as possible to undertake a study of the cost structure of the industry with a view to reducing costs. This was also recommended by the Export Promotion Advisory Council in August, 1958. A number of new schemes are being thought of under which the plant population per acre is being increased wherever new planting is being done with very marked effects on crops. Work organisation in the field is moving towards changes

TABLE 8·3

HEAD-WISE ANALYSIS OF COST OF PRODUCTION OF TEA IN INDIA IN 1953

(Rs. per 100 lbs.)

Head of costs	*Average*
1. Cultivation	21·55
2. Gathering	20·38
3. Manufacture	20·29
4. General charges	49·54
5. Packing	10·82
6. Selling expenses	15·50
7. Commission to agents	7·07
8. Freight charges	10·25
9. Marine insurance	5·00
10. Taxes	27·00

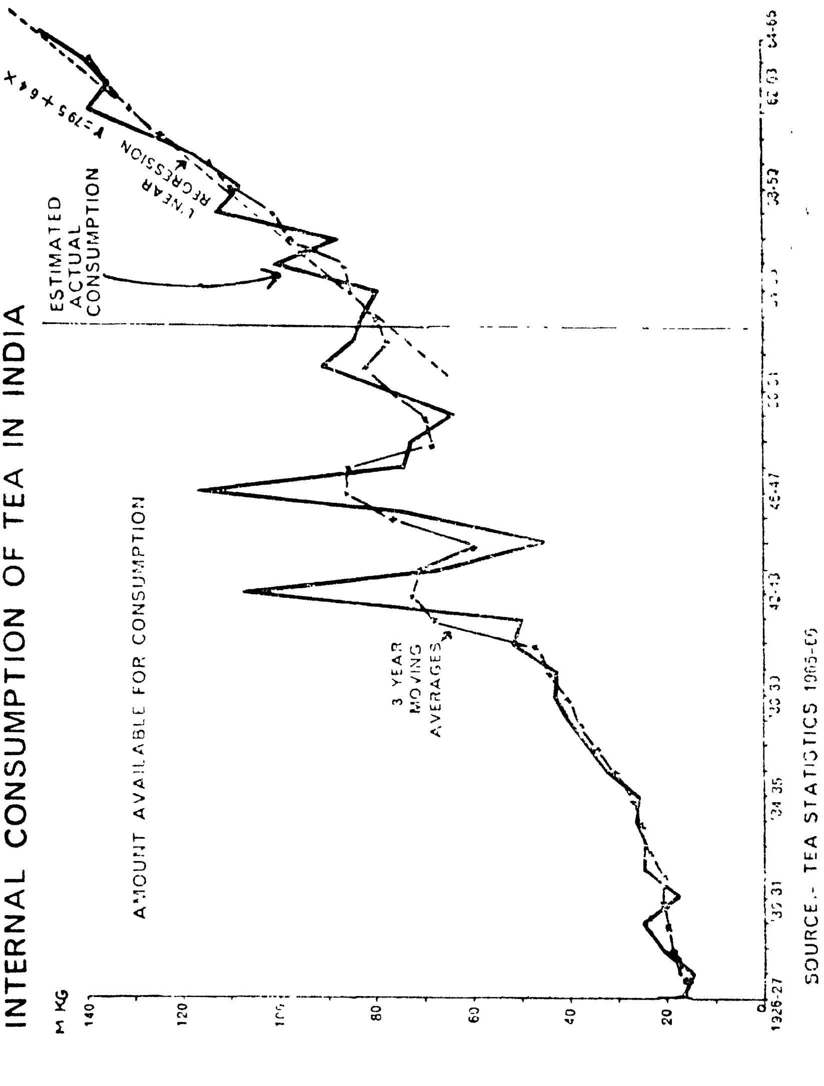
that will place more people directly in crop gathering than in the other field operations. The plucking process for tea is likely to undergo great changes in the country and some simple mechanical aids for the harvesting of large leaf crops are in sight. Transport of the crop from the field to the factory has already been mechanised. In the factory itself there have been more changes in the layout, in the equipment and in different processes of manufacture. All these efforts should help reduce the cost of production.

But the general price level in the country is also rising every day. In the light of this upward trend in prices, it is rather doubtful if a real reduction in tea prices can be made. What may be possible is that tea prices might be checked from going up as a result of reduction in the cost of production. If so, it might be assumed that the price factor may not affect the consumption of tea in the country.

Urbanisation

It is common knowledge that tea drinking is more popular in urban than in rural areas. With the rapid process of urbanisation as assumed in this study, it is logical to assume that more tea may be required indigenously.

No data are available on the consumption pattern of tea in urban and rural sectors separately. If we assume that urban consumption was 1·25 times the rural, urban per capita weighted average consumption in 1959 comes to 0·58 lbs. On the other hand all-India per capita consumption is roughly 0·5 pounds. By multiplying this differential (0·58—0·5 = 0·08 lbs.) with the urban population by 1980-1985, viz: 245 millions, we get an addi-



tional quantity of about 19 million lbs. of tea, which may be required because of urbanisation.

Other Factors

Besides these factors, the prohibition policy of the Government may also help stimulate internal consumption of tea. In the absence of native liquor, the working classes generally take to tea as the next best alternative.

If this potential domestic market is successfully tapped, it may not only ensure a stable market, but may also help the industry in clearing stocks of common tea which is inferior in quality and cannot hold its head in foreign markets.

While estimating the likely increase in the internal consumption of tea, due to all these factors, an increased consumption of milk, and coffee, which competes with tea, will also have to be reckoned with. As already discussed elsewhere, we are aiming at increasing the supply of milk by about four times, during the stipulated period. There exists a traditional preference for milk particularly in North India. This additional supply of milk may not, however, affect the position of tea very much in the urban areas as well as in the South. But here coffee is preferred more.

There is no scientific basis available with us to eliminate the effect of this substitution. It may, however, be estimated that the total reduction in demand may approximately counter-balance the additional demand created for tea as a result of urbanisation and the prohibition policy, etc.

Net Position

Taking into account all these factors the following position would emerge.

TABLE 8·4

INTERNAL REQUIREMENTS OF TEA BY 1980-85

(Million lbs.)

Increase in income and population	700
Fall in prices	- 00
Urbanisation, etc.	19
Total	719
Substitution	— 19
Net requirement	700

TABLE 8·5

IMPORTS OF TEA IN SOME SELECTED COUNTRIES AND INDIA'S SHARE IN IT 1957-1961

Country	*Total imports*			*India's Share* *Million lbs.*			*Percentage Share of India*		
	1957	1960	1963	1957	1960	1963	1957	1960	1963
United Kingdom	594	526	563	348	257	283	59	49	50
Irish Republic	28	22	29	24	13	18	86	59	62
U. S. A.	102	115	126	27	25	27	26	22	21
Canada	47	44	48	20	18	12	43	41	25
Egypt U. A. R.	35	45	59*	17	30	41*	49	67	69
U. S. S. R.	46	50	54	20	25	38	43	50	70

* Relates to 1962.

Source : International Tea Committee, *Annual Bulletin of Statistics*, June, 1964.

EXPORTS

Tea is an important commodity of international trade. In the world export of tea, India's contribution is considerable. In the five-year period ending 1957, Indian exports amounted to 43·2 per cent of the total from all the producing countries. This fell to 40 per cent for the period ending 1963. Table 8·5 gives an indication of the proportion of tea taken from India by some of the principal importing countries of the world.

U.K. is the largest market for Indian tea followed by Egypt, U.S.S.R., U.S.A. and Canada. In case of U.K., India's share came down from 67 per cent in 1947 to 59 per cent in 1957 and about 50 per cent in 1963. During the year 1965, when the total tea exports declined by 11 million kgs. as compared to the previous year, there was an appreciable fall in tea exports to the biggest buyer—the United Kingdom. Exports to other commercial markets such as the United States, Canada, Australia, Iraq and Afghanistan also declined. One explanation for this situation may be that the total availability of tea for exports was reduced by a fall in tea production and seizure of some seven million lbs. of North-east Indian Tea by Pakistan during September, 1965. Fall in the export to the United Kingdom is, however, significant in the background of a recent survey according to which the British youth is taking less to tea than the older generation. He seems to prefer alcoholic drinks though costlier than tea. There would be an urgent need for more vigorous campaigns in the United Kingdom to halt this trend.

While off-take by the traditional markets fell during 1965, a significant increase was recorded by the U.S.S.R., U.A.R., the Irish Republic and Iran. One of the main reasons of the present state of affairs is that prices in Calcutta auctions are higher than those of other world markets, particularly London. The Tea Board has been urging the Government to streamline the tax credit scheme to enable the industry to be more competitive.

World Production

Table 8·6 gives the production of tea in the world, exclusive of China and Russia. It shows an increase of 85 per cent as compared with the pre-war average and 21 per cent since 1955-57 production level. One of the significant developments is the rapid increase in African production from 8 to 45 thousand metric tons during the period 1934-38 and 1965.

TABLE 8·6

WORLD PRODUCTION OF TEA

1934-38 to 1965

(Thousand kgs.)

	1934-38	1955-57	1961	1962	1963	1964	1965
India	178·0*	309·1	354·4	346·7	346·4	372·5	346·9
Ceylon	103·9	174·4	206·5	211·9	219·8	218·5	228·2
Pakistan	25·6*	22·8	26·5	23·4	24·6	29·2	26·6
Indonesia	74·8	62·8	43·7	47·2	38·5	44·8	N.A.
Japan	49·3	72·0	81·4	77·5	81·0	83·3	77·3
Total	454·0	671·1	712·5	706·7	710·3	748·3	—
Africa	8·2	32·8	36	46	41	43	45
Total World†	463·0	705·8	748·5	746·7	—	—	—
China	—	113·3	157·9	158‡	158‡	158‡	158‡
U.S.S.R.	5·1	26·4	38·0	38	N.A.	N.A.	N.A.

N. A. = Not available.

* 1936-38.

† Excluding China and U.S.S.R.

‡ Estimated.

Source: *Tea Statistics*, Tea Board of India.

Plantations already raised or prepared could increase Africa's output to about 75,000 tons within the next few years unless there is a set-back. China's production and exports have not risen as rapidly as forecasted a few years ago, but the potentialities for expansion are there.

World production of tea will continue to increase. In countries like Ceylon where acreage yields are also rising, there is a tendency to stimulate small holder plantings. In Africa, a large percentage increase is almost certain. During the past few years there has been an annual increase of 6 per cent in area and 10 per cent in the production of tea in Africa. It is significant to note that most of the increases in Asia were due to higher yields and not to expansion of the area. An extrapolation of the rate of growth of the past few years may indicate a production of about 925,000 tons in 1965 excluding the U.S.S.R. and China, over a million tons in 1968 and about 1·5 million tons by 1980-81. World exports of tea have, however, increased only 50 per cent of the increase in production since 1955-57.

Appendix 15, which shows the trend of Indian tea exports, reveals sharp fluctuations in the quantity of tea exported from India during the past 10 years. Indian exports reached the peak of 528 million lbs. in 1956. They declined to 443 million lbs. in 1957, marked a slight recovery to 506 million lbs. in 1958, but again came down to 426 million lbs. in 1960, rose to 493 million lbs. in 1963 and have again declined in 1965. They primarily depend upon competition from other tea producing countries and high costs of our tea.

Ceylon and East Africa are India's main competitors in so far as world supply of tea is concerned. Argentina has also succeeded in recent years in selling considerable quantities of tea in the Dutch market.

The Government of Ceylon has launched a scheme of replanting 3,000 acres under tea annually. The tea replanting subsidy there has been raised to Rs. 3750 per acre, with effect from 1st January, 1963. This will give a further stimulus to production. As the scope of internal consumption there is limited, additional produce will be dumped in the world market. Ceylon is also trying to concentrate on quality tea which will come in direct competition with India. Then there is the competition from China. Besides increase in production, quality of African tea is now showing such a marked improvement that it will soon be competing with Ceylonese and Indian teas. Formosa and Iran, though not of much significance, are also planning to increase their output.

As a result of all these factors, the share of Indian exports to her traditional markets like U.K. and U.S.A. is likely to decline. The Indian Industrial Delegation of the Federation of Indian Chamber of Commerce and Industry which visited U.S.A. in Sept., 1957, held the view that "comparative share of India in America's imports is not only small but has also shown a sharp decline in the last few years." We have already lost ground in both the countries a little further.

In the coming years India is likely to face a keener competition in the American markets. Annual consumption of tea in U.S.A. and Canada amounts to about 150 million lbs. Of this, India and Ceylon account for 40 and 70 million lbs. respectively. With the additional area brought under cultivation in Argentine, Brazil and Peru, likely to yield 75 million lbs., the South American supplies will face a triangular contest in the American market. The result will be that South American tea which will probably be cheaper due to the proximity of the source of supply, will price out India and Ceylon from the American Continent.

The Tea Delegation (1962) Report concluded that India can only improve her exports to the United States and Canada primarily by being able to offer the required teas at fully competitive prices; by fullest co-operation with the trade through the Tea Councils; by personal visits and contacts at all levels by the representatives of the Industry and Trade in India; by the appointment of a knowledgeable Indian tea expert in New York and by continuing to take all steps to improve the quality of her products.

New Markets

Against the tough competition which India is meeting in her traditional markets like U.K., a redeeming feature of tea exports is that new countries, especially U.A.R. and U.S.S.R., have started taking larger quantities of Indian tea as shown in Table 8·7.

The Trade Delegation headed by the Deputy Minister for Commerce which toured U.S.S.R. and Eastern Europe in 1964, holds out bright prospects of increased exports of tea to U.S.S.R.

TABLE 8·7

QUANTITY OF TEA EXPORTED FROM INDIA TO U.S.S.R. AND EGYPT DURING 1954 TO 1965

(Million kgs.)

Country	1957	1958	1960	1964	1965
1	2	3	4	5	6
U. S. S. R.	7·2	11·5	11·2	23·0	27·3
U. A. R.	7·6	11·6	13·5	17·1	17·8

Propaganda for expanding sales of tea can also be directed successfully in North America, Continental Europe, Australia and the Middle East. The Tea Delegation to Australia, New Zealand and Singapore, 1962, observed that the per capita consumption of coffee has risen sharply in Australia whilst that for tea has, if anything, declined.

Several factors have combined there to produce the sharp rise in coffee drinking as opposed to tea. A large number of Americans served in Australia during the last War and many Australians served in those areas of conflict where American influence was prominent—this gave an impetus to the habit of drinking coffee. Since the War, nearly half the emigrants arriving in Australia have come from countries on the Continent of Europe—they are habitual coffee drinkers and play a very large part in the catering trade. About ten years ago, "Instant Coffee" was launched in Australia with powerful advertising and promotion; it has been a considerable success and it is estimated that 70 per cent of total coffee now drunk in Australia is "Instant." Since it is a post-War development, coffee suffers none of the price consciousness, so marked in the tea trade, and it is understood that its manufacture and distribution is also more profitable than that of tea. Most packers deal in both tea and coffee. This is probably the reason why more money is spent on advertising coffee than tea. It is estimated that overall advertising budget for coffee reaches £(A) 500,000 per annum, whilst the equivalent figure for tea may not exceed £(A) 300,000.

It is not only the emigrant who continues with the coffee drinking habit. The Australian public at large have acquired the habit and, particularly among teenagers, coffee is considered a smart thing to drink. The big cities have a large number of *Espresso* coffee bars in which tea can be obtained; but it is not pushed and seldom asked for. This is also true in the case of New Zealand.

The Delegation has made a strong recommendation that if the habit of tea consumption is to be made popular in these countries, there is an urgent need for not only a joint propaganda by the important producing countries for tea as a beverage, but also for India for Indian tea. It was reported that Ceylon's consistent uninational campaign over the last ten years has created an impression amongst the Australians that much of the world's tea comes only from Ceylon. India will have to take specific measures like supplying pure Indian packs, establishing public relations for Indian tea, introducing sampling service for the Australian trade and making Indian tea more attractive, before she can expect to have her due share in tea trade in this part of the world.

Another Indian Trade Delegation to Western Europe states that tea has yet to find a place in West European homes. It is already making encouraging progress in countries like West Germany where there is a tendency to discourage the use of alcohol. Other regions where standards of personal consumption are rising and the use of milk is being popularised, also create significant possibilities for tea, according to the delegation.[1]

Efforts will have to be made to increase our exports of tea to these countries. If we are successful in tapping these markets, we may be able to compensate the loss which we may suffer at the hands of Ceylon and Africa in our conventional markets.

U.S.S.R. and U.A.R. alone took about 45 million kgs. of tea in the year 1965 as against 3·2 million kgs. in 1954 and 14·8 million kgs. in 1957. During a period of 10-11 years, exports of tea to these two countries have increased by more than three times. There will be no surprise if the next 15-20 years witness the same trend and these two countries alone import about 250 million lbs.

The remaining countries are importing at present about 33 million kgs. of tea. India can thus hope to export more than double or say about 150 million lbs. in these countries as well. The main question in most of these countries is that of making tea popular. With the efforts now being made by India and other tea producing countries in the joint promotion programme and uni-national

[1] K. Murti, "Present Position and Prospects of Indian Tea," *Commerce*, November 21, 1959.

promotion activities by India alone, there is every reason to believe that the consumption of tea in these countries should increase. India, Ceylon and the United Kingdom, along with the United Republic of Tanzania agreed to have such joint promotional activities at the FAO Ad Hoc Meeting on Tea held at Nuwara Eliya in Ceylon in May 1965.

Conventional Markets

We have already examined the position of our conventional markets. True, we are losing our hold in some of them. What is needed here is a consolidation of the position. Some 50 to 55 per cent of tea production in India consists of medium quality of what is called "common" teas. We have to maintain and improve our quality.

These conventional markets happen to fall in the category of the advanced countries. In these markets, the only factor which will lead to some increased demand will be population growth, since income and other factors will not have much influence in increas-

TABLE 8·8

PRESENT POPULATION RATE OF GROWTH AND POPULATION PROJECTIONS FOR 1970, 1975 AND 1980-85 FOR TEA-CONSUMING COUNTRIES

Country	1958[a]	1970[b] (*millions*)	1975[b]	*Annual Rate of increase between* 1970-75 (*per cent*)	*Population by* 1980-85 (*millions*)
U. K.	51·68	53·70	55·50	0·7	57·45
Ireland	2·89	2·91	2·99	0·6	3·07
U. S. A.	174·06	204·00	217·00	1·3	231·50
Canada	17·05	20·80	22·80	1·8	24·91

NOTE : Population for 1980-85 has been estimated by assuming that per annum rate of increase between 1970-75 for these countries will hold good. These figures would if at all, be underestimates for 1980-85, as they have been calculated for 1980.

Source : (*a*) *U. N. Demographic year book*, 1958,

(*b*) *U. N. and the Future Growth of World Population*, New York, 1958, p. 72-75.

ing the consumption of this beverage. Population projections for these countries are attempted in Table 8·8.

In Table 8·9, an effort has been made to estimate imports and consumption of tea in these countries, which account for about two-thirds of the total exports of tea from India. The requirement has been calculated on the basis of the 1956 per capita consumption of tea.

TABLE 8·9
IMPORT AND CONSUMPTION OF TEA IN A FEW SELECTED COUNTRIES

Country	*Per Capita consumption (lbs.)*	*Total imports in* 1956	*Total consumption in* 1956	*Estimated total imports by* 1980-85
		(*thousand*	*tons*)	
U. K.	9·5	229	218	255
Irish Republic	4·5	6	6	7
U. S. A.	0·6	45	65	65
Canada	1·9	20	20	27
Total	—	300	309	354

Since the present study pertains to the period around 1980, the total consumption of tea in these four traditional markets may be of the order of 350 thousand tons, by that date. In the past, India has been meeting about 55 per cent of the total demand in all these countries. We may assume that in the coming 15-20 years, the share of India in these markets is reduced to about 50 per cent which would mean an export target of say 175 thousand tons per annum or a round figure of 400 million lbs.

Targets for 1980-85

Summing up the discussion in the last pages, we find that the total requirements of tea by 1980-85 would work out to 1500 million lbs. as detailed in Table 8·10.

Estimates made above are less than double the actual production of 781 million lbs. achieved during 1961 and are in keeping with the contemplated targets of 1000 million lbs. for 1970 and

TABLE 8·10

TOTAL TEA REQUIREMENTS

(Million lbs.)

Home consumption		700
Exports		800
(*a*) New markets	400	
(*b*) Conventional markets	400	
Total		1500

1200 million lbs. for 1975. Actual production in 1964 was 821 million lbs.

PRODUCTION PROGRAMME

While the production of tea has gone up from 394 million lbs. for undivided India in 1935 to 781 million lbs. in 1961 and 804 million lbs. in 1965 for the Indian Union alone, there has actually been a reduction in the area from 840 thousand acres in 1938 (both for India and Pakistan) to 818 thousand acres in 1960 and 835 thousand acres in 1964. Estimates for 1965 put it at 844 thousand acres. Extension in area was controlled in India

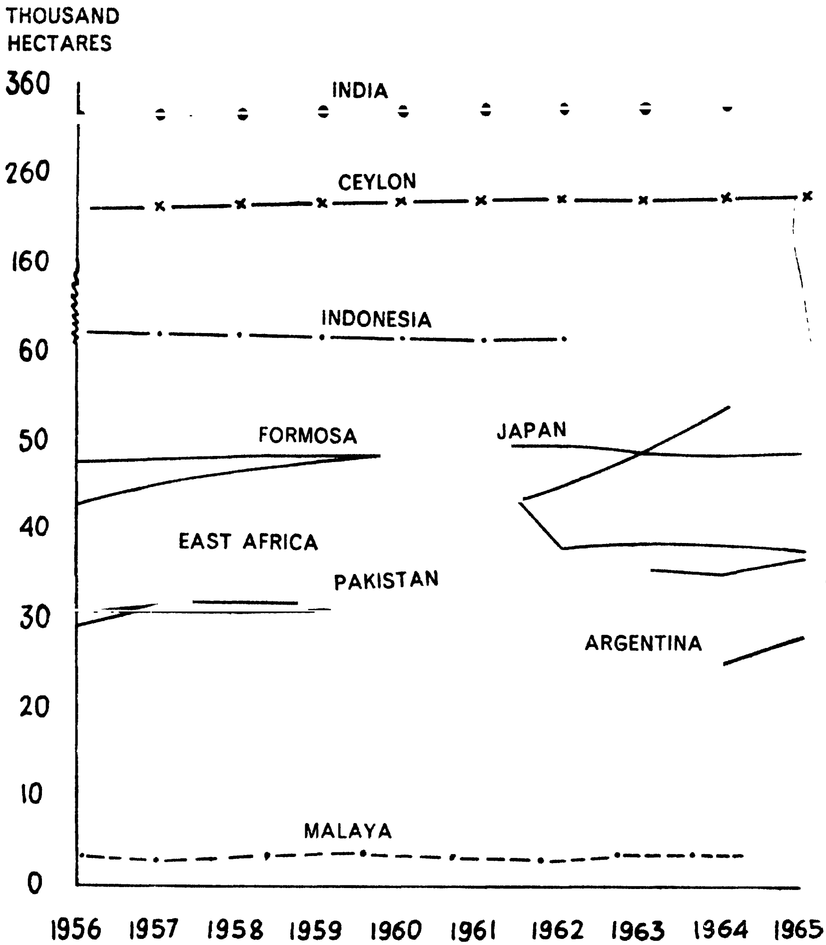
TABLE 8·11

INDIA'S SHARE IN WORLD ACREAGE AND PRODUCTION OF TEA

Year	*Acreage*		*Percentage of*	*Production*		*Percentage of*
	World	*India*	(3) *to* (2)	*World*	*India*	(6) *to* (5)
	(*thousand acres*)			(*million lbs.*)		
1	2	3	4	5	6	7
1933	2094	841*	40	888	384	43
1939	2188	840*	38	1072	466	43
1947	1718	772	45	1021	561	55
1952	1944	788	41	1281	614	48
1953	1962	790	40	1277	614	48
1958	2360	807	34	1920	717	37
1960	—	817	—	—	707	—
1964	—	834	—	—	820	—

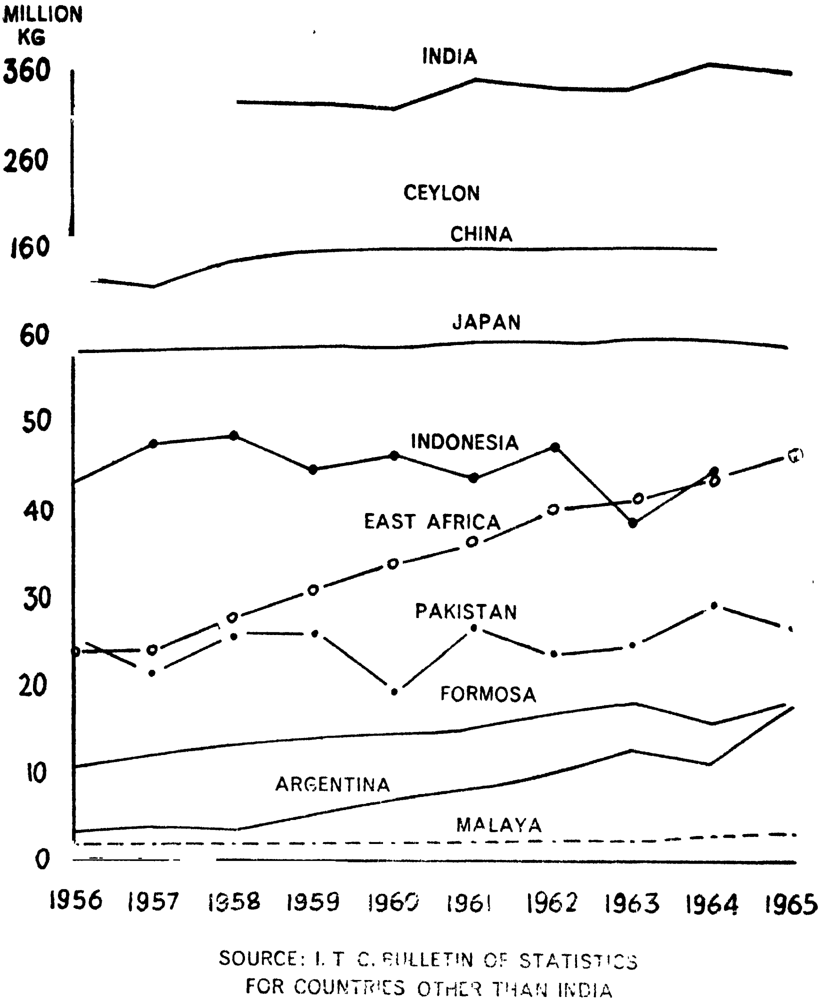
* India and Pakistan combined.

and Ceylon by the International Tea Regulation Scheme which remained in operation from 1933 to 1955. Table 8·11 shows India's share in the world acreage and production of tea.



ARGENTINA—30TH. APRIL OF EACH YEAR
INDIA, PAKISTAN AND CEYLON—31st MARCH OF EACH YEAR
OTHER COUNTRIES—31st DECEMBER OF EACH YEAR
SOURCE: I. T. C. BULLETIN OF STATISTICS FOR COUNTRIES OTHER THAN INDIA

AREA PLANTED WITH TEA
IN PRINCIPAL PRODUCING COUNTRIES



PRODUCTION OF TEA IN PRINCIPAL PRODUCING COUNTRIES

Regional Variation

Table 8·12 gives area, production and yield per acre of tea in various regions of India, during 1953-54.

TABLE 8·12

AREA UNDER TEA, TOTAL PRODUCTION AND YIELD IN EACH OF THE TEA REGIONS IN 1965

Region	*Tea area* in ('000) *hectares*	*Production in million kgs.*	*Yield per hectare in kgs.*
Assam	169·7	181·4	1069
West Bengal			
Darjeeling	18·4	9·5	519
Dooars	56·8	67·7	1192
Tripura	5·5	2·6	468
Terai	9·9	9·1	921
Bihar			
Purnea, Ranchi	0·5	0·05	101
Uttar Pradesh			
Dehra Dun, Almora & Gharwal	2·0	0·6	319
Punjab			
Kangra	3·8	1·0	269
Himachal Pradesh			
Mandi	0·4	0·07	167
Madras			
Kanya kumari	0·5	0·3	526
Tirunelveli	0·4	0·6	1282
Madurai	0·8	1·1	1344
Coimbatore	10·1	16·9	1673
Nilgiris	21·3	28·3	1324
Mysore			
Chikumagalur	1·2	1·5	1297
Coorg	0·2	0·2	1274
Hasan	0·4	0·5	1060
Kerala	39·9	43·6	1094
All India	341·6	364·9	1068

Source: Tea Statistics, 1965-66, September 1966, pp. 15-16.

There were wide variations observed not only in different regions but also in the same State. In West Bengal, for example, yield per hectare in Dooars, was 1192 kgs. whereas in Darjeeling it is only 519 kgs. Coimbatore in South and Dooars in West Bengal were, however, the highest |yielding areas in the country and Kangra and Mandi in North India were the lowest; yield per hectare being 269 and 167 kgs. respectively.

Latest information about yields in the different parts of the country shows that Trichur in Kerala State yields over 1550 kgs.per hectare, Lakhimpur in Assam accounting for about 20 per cent of the total area in North India produces more than 25 per cent of the tea in that part of the country and average yield during 1964 worked out to about 1360 kgs. per hectare. There are other areas like Kozhikode in Kerala and Coimbatore in Madras which yield more than 1300 kgs. per hectare.

The yield levels of tea plantations have more or less direct relationship with the size of the respective units. Tea estates of sizes up to 100 hectares account for 6·75 per cent of the total area under tea in North-east India and only 4·10 per cent of the production. In South India, the share of such holdings is 20·56 per cent of the area and 11 per cent of the crop. Estates of 100-200 hectares in South-east India have a share of 14·12 per cent but only 13·2 per cent of the crop is produced there. South Indian estates within this size group account for 13·67 per cent of the area and 15·02 per cent of the crop, thus showing a better performance in yield. Estates of more than 200 hectares form 79·04 per cent of the area under tea in North-east India and account for 82·18 per cent of the North Indian output. In South India 65·57 per cent of the area under tea falls into this size group which produces 78·20 per cent of the total crop.

This shows that the industry's advance towards higher productivity is most pronounced where the producers are organised well and where they take to producer organisations for mutual service and common benefit of the larger units most readily. Since the future land policy of the country is aimed at not disintegrating the larger holdings under plantations, we can expect better performance in this respect.

Research on tea in the country is also undergoing a revolution. Every possible effort is being made to exploit to the full the yield propensity of the plant and the efficiency of productive operations. Planting material has undergone a steady and continuous process of improvement and high-yielding material is being developed and introduced in estates everywhere. With expert care and bush management, tea is being bred up and plantations established with selected vegetative propagated material, are confidently expected to yield upward of 3000 lbs. of made tea.[2] The plant population per acre is also being increased wherever new planting is done with a marked improvement on the crop.

TABLE 8·13

WORLD-AREA UNDER TEA, PRODUCTION AND YIELD PER ACRE

Country	*Area (thousand acres)*			*Yield per acre (lbs.)*			*Production (million lbs.)*		
	1948	1958	1962	1948	1958	1962	1948	1958	1962
1	2	3		4	5		6	7	
1. India	772	804	826	736	884	924	568	711	763
2. Pakistan	73	76	80	600	737	650	44	56	52
3. Ceylon	555	573	591	539	721	790	299	413	467
4. Indonesia (estate only)	179	183	193	84	500	487	15	93	94
5. Kenya	17	33	49	588	758	735	10	25	36
6. Uganda	6	12	21	671	641	667	4	10	14
7. Tanganyika	6	13	20	179	452	550	1	8	11
8. Nyasaland	21	27	30	681	852	867	14	23	26
9. Mozambique	18	34	38	227	382	553	4	17	21
10. Japan	63	116	122	905	1414	1402	57	164	171
11. Formosa	99	118	93	192	277	462	18	35	43
12. Iran	20	42	NA	500	235	NA	10	10	28
13. Turkey	7	28	38	45	169	474	N	7	18
14. U.S.S.R.	NA	151	163	NA	304	558	NA	70	91
15. Argentina	4	76	74	60	284	297	N	7	22
16. Brazil	4	11	10	381	139	NA	1	2	NA
17. Peru	NA	6	6	NA	365	NA	N	2	NA

N = Negligible; NA — Not available.

Source : International Tea Committee, *Annual Bulletin*, 1964.

NOTE : Yield-per-acre figures relating to Uganda and Brazil are misleading. Large areas have been recently brought under cultivation in these countries and have not yet started full yields. Thus the yield per acre worked on total planted area (both bearing and non-bearing) shows a decline. Owing to the same reason, the increase in per acre yield does not reflect the actual which must be much larger.

[2] V. I. Chaco, "Plantations in the Lead," *Commerce*, Annual, 1965, p. A112.

World Comparison

Table 8·13 gives comparative figures of area, production and yield per acre of tea, for the years 1948, 1958 and 1962, in the principal tea producing countries of the world.

India with 983 lbs. per acre in 1964 had the second best yields in the world, next only to Japan where average yield was 1414 lbs. per acre. But this does not mean that there is no scope for any further improvement. Japan has recently reached the high level from around 900 lbs. per acre only 10 years back. India can also increase her yields by rehabilitation of existing estates, improved manuring and cultural practices.

Replantations

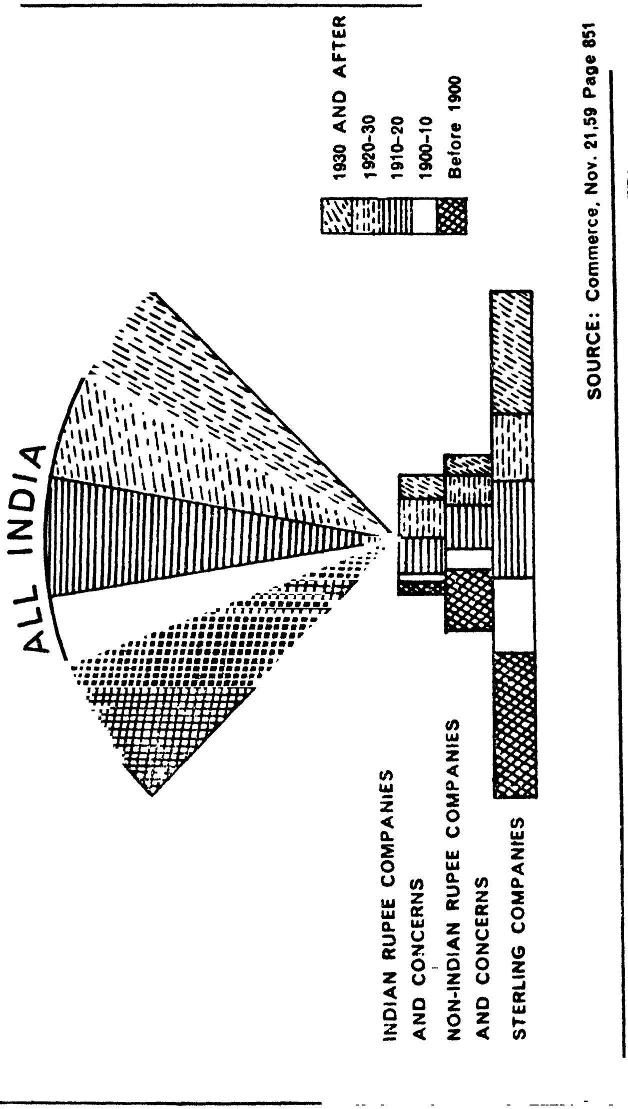
According to the Plantation Inquiry Commission, over 2 lakh acres or 40 per cent of the area which is more than 50 years old stands in immediate need of replanting. Of this, a major portion belongs to sterling companies and non-Indian rupee companies (see chart on page 164). Percentage of area planted before 1900 is the highest in the Darjeeling region; accounting for 80 per cent of the total.

Against this it is observed that a little less than 1 per cent of the area has been replanted annually. Thus a greater rate of progress in replanting would appear to be necessary for the achievement of the targets. Replanting schemes are estimated to cost Rs. 60 crores. An expenditure of this order spread over a period of, say, 10 years should be certainly worth the investment.

Production Potential

Along with the intensive measures proposed, there are possibilities of increasing the area under tea as well. Total area in the possession of tea plantations at present is of the order of 2 million acres. Of this, the area actually under tea during 1964 was only 0·83 million acres. From the balance, as much as 0·2 million acres is immediately available for new plantings. Extension programmes already projected for the Fourth and the Fifth Five Year Plans envisage bringing a major portion of this area under tea. This would mean that according to the plantation programmes already contemplated, area under tea would exceed one million acres before 1975. With an average expected yield of about 1500 lbs. per acre, we need only an area of one million acres. If so, there is hardly any problem of achieving the target. Actual production by 1980-85 should, under these circumstances, exceed 1500 million lbs. unless steps are taken, if so required, to restrict an increase in the area. It would be in the interest of the country to take every possible measure to increase yields as much as possible and produce more tea at a lesser cost.

TEA PLANTS IN INDIA ACCORDING TO AGE GROUPS



9

COFFEE

CONSUMPTION of coffee varies considerably from one country to another. It is influenced mainly by the creation of a preference for the commodity among consumers. Once this hurdle is crossed the familial growth in habit serves as a multiplication factor in the expansion of coffee consumption. If parents get used to consuming the beverage, their children and grand-children normally get into the same habit.

This is obvious from the fact that countries like Australia and New Zealand, with high incomes, drink very little coffee. Poor people in South India, on the other hand, will drink coffee but not tea which is cheaper.

This does not mean that increased purchasing power has no effect on the demand for coffee. The preference factor is no doubt superior, but once tastes have been created, the demand is limited by the length of the consumer's purse.

The demand for coffee in India for home consumption has been steadily increasing since 1947-48. Quantities available for the purpose in 1958-59, were 37 thousand tons as against 15 thousand tons in 1947-48.

Appendix 17 gives quantities of coffee available in India for home consumption during the period 1936-39 to 1958-59. There has been a more than 150 per cent increase in the consumption of coffee during the past 15 years. This may be attributed to the propaganda drive launched by the Coffee Board. The potential market of North India, however, still remains untapped.

In the discussion that follows it is assumed that efforts will be made by the interests concerned to popularise the use of coffee so that all those who can afford to purchase it will go in for it.

Internal Demand

Future internal demand for the beverage will depend upon the following factors:

1. Increase in national income.
2. Population growth.
3. National policies like prohibition and increasing milk production.
4. Market promotional efforts and efficient distribution.

National Income

In the initial stages of economic development, the impact of increased purchasing power, accruing to the masses manifests itself in the purchase of more consumption goods. The demand curve for tea and coffee is also quite elastic. Income elasticity of demand may be more than unity for cheaper beverages like tea and coffee in underdeveloped areas. Allen and Bowley, for instance, while adopting linear relationship in their study of working class budgets, estimated the income elasticity of tea and coffee as 1·3. Appendices 18·1 and 18·2 give per capita national income and estimated per capita consumption of coffee and tea in some selected countries. Taking coffee alone, it may be said that national income and consumption of coffee do not go together. However, if we take the consumption of coffee and tea together, we find that the increased per capita income is invariably accompanied by an increased consumption of tea and coffee. This is brought out in Table 9·1.

There are, however, a few exceptions like those of Japan, West Germany and New Zealand where income is by no means a limiting factor. They may actually be considered as few of those potential markets in the advanced countries where more of tea and coffee can be sold with some initial efforts by the producing countries.

With these few exceptions here and there, it may be reasonable

TABLE 9·1

INDEX OF PER CAPITA NATIONAL INCOME AND CONSUMPTION OF TEA AND COFFEE, WITH CEYLON = 100

Country	*National income*	*Consumption of tea and coffee*
India	50	35
Ceylon	100	100
Japan	182	89
Netherlands	525	510
West Germany	578	297
Denmark	668	777
U. K.	756	631
New Zealand	957	401
U. S. A.	1716	827

Source : Appendix 18·1.

to assume that in a country like India, where coffee is quite popular at least in certain regions, consumption of coffee may follow income movements. Income elasticity of demand for coffee may thus be assumed as unity, just like tea.

No reliable information on the consumption of coffee is available in the country. It is assumed that the difference between production and exports is domestically consumed and opening as well as closing stocks more or less balance each other. With this assumption, per capita consumption of coffee in India during the period 1934 to 1961 is shown in Table 9·2.

TABLE 9·2

PER CAPITA CONSUMPTION OF COFFEE IN INDIA

(Lbs.)

1934-38	0·06
1948-52	0·12
1954-58	0·16
1958-61	0·20

Per capita consumption of coffee is steadily increasing in India. With an expanding economy after Independence, the habit is growing fast. A doubling of the per capita income during the coming 15 years or so, would mean that the per capita consumption of coffee by 1980-85 may reach the level of 0·4 lbs. If a lb. of coffee is taken to yield about 90 cups,[1] an average Indian would be consuming hardly 40 cups per annum or a cup of coffee after every 9 days at the end of the projected period. This should in no way be considered to be on the high side.

Price Factor

It must, however, be borne in mind that our basic consumption level, 0·2 lbs., for the purpose of this projection, is the one when internal price of coffee was kept lower than the return to the producer for a number of years under a set Government policy. All this was possible because external price was high and the internal market could be subsidised from excessive export profits. Increasing world production relative to consumption has now caused huge surpluses of coffee to accumulate and depressed the prices. From 78·7 U.S. cents per lb. in the U.S. market in 1954, it fell to 48·4 cents in 1958. The average quoted for 1960 was 36·6 cents per lb. There is hardly any possibility of recovery in the world market in the near future. It may, therefore, not be possible for India to continue the subsidy. If the internal price has to be raised, it would offset the effect of a portion of the increase in income.

It may under the circumstances, be reasonable to assume that per capita consumption of coffee by 1980-85, may be of the order of 0·35 lbs. instead of 0·4 lbs. as calculated earlier. For a population of 700 million, it would work out to about 130 thousand tons.

Competing Drinks

As already stated elsewhere, milk production will increase by about 200 per cent during this period. The consumption of both milk and coffee or tea is very high in a number of Western countries. Conditions there are, however, different as compared to India. The habit of drinking tea or coffee in India has percolated in the country-side mainly because of their cheapness and the non-

[1] Based on personal inquiries from canteens serving coffee. The figure, according to the Coffee Board is 40-45 cups per lb.

availability of milk. In keeping with the Indian traditions, there is otherwise a general preference for milk. When milk is available in large quantities, a section of the people may substitute it for coffee. It may not be possible for us to be precise about this shift, but this may be taken to account for about 10-15 thousand tons. The net demand for home consumption in other words may thus be put at about 120 thousand tons.

It may be argued that with the prohibition policy being followed more vigorously, additional demand may be created for tea and coffee. They are likely to take the place of national drinks. The prohibition policy has already been implemented to the extent possible. Those who are addicted to hard drinks will invariably find ways and means to circumvent the provisions of the law so that there is hardly any further effect on the demand for soft beverages.

Market Promotion

Market promotion and efficient distribution can also serve as a big lever for future increase in the consumption of coffee. The big leap forward in consumption during the past 7-8 years is primarily attributable to this single factor. All this happened when the Government took a decision in 1952 to feed the internal market, even if it meant suspending exports. This policy has since been reversed from 1957. Exports are now of major significance for the nation, perhaps for all time to come. Every effort is now being made to earn foreign exchange for the development plans and to meet the emergency created by China in 1962 and Pakistan in 1965. All this may affect adversely the existing propaganda in favour of coffee.

A further spurt in demand on this account may not be significant. But the market promotion service and an efficient distribution system now being adopted by the Coffee Board is likely to succeed in completely off-setting the adverse effects of the removal of subsidy, etc. if required. This effort, if intensively made, may create an additional demand for about 10 thousand tons.

To conclude, it may be said that internal demand for coffee may be of the order of 130 thousand tons by 1980-85. This would work out to roughly 35 cups per capita per annum or a cup of coffee every day for one-twelfth of the total population of India.

EXPORTS

Indian coffee is of good variety and has not suffered from any lack of demand. Yet Indian exports of coffee have hardly been 0·5 to 0·8 per cent of world exports as shown in Table 9·3.

TABLE 9·3
WORLD EXPORTS OF COFFEE

Year	*World Exports*	*India's share*	*Percentage (Col. 3 to Col. 2)*
	(thousand tons)		
1929-33*	1519	7·6	0·6
1934-38*	1634	8·9	0·5
1948-50	1933	2·5	0·1
1951-52	1940	2·2	0·1
1952-53	1960	3·0	0·2
1953-54	2100	9·8	0·5
1954-55	1797	3·6	0·3
1955-56	2022	8·1	0·4
1956-57	2341	15·5	0·7
1957-58	2240	14·3	0·6
1963-64	4000	33·0	0·8

Source : Coffee Board.

* The Commonwealth Economic Committee, " Plantation Crops, " *A Review*, London.

This small share of India in the world export of coffee might be attributed to a deliberate policy of the Government to give a second preference to the foreign market earlier but reversed since October 1957. The results are quite obvious.

With the advantage of quality, India could in future normally expect a much larger share in world exports. But the international sale price of coffee has now fallen appreciably so that the gap between internal sale and average export prices, narrowed down from about 90 per cent in 1953 to hardly 17 per cent in 1958 as shown in Table 9·4. In the year 1959, it actually disappeared.

A FAO Study[2] concludes that world imports in 1965 are not likely to account for more than 60 per cent of world production.

[2] FAO Commodity Series No. 33, *op. cit.*

TABLE 9·4

INTERNAL AND EXPORT PRICES OF COFFEE

Year	Internal sale price	Average export price
	Plantation A (Rs. per 50 kgs.)	
1953-54	216	389·8
1954-55	202	249·5
1955-56	214	375·4
1956-57	210	309·14
1957-58	219	242·01
1958-59	214	236·99
1959-60	236	241·18

Source : Statistical Volumes of Coffee Board.

Allowing for the estimated growth of consumption in producing countries and for greater industrial uses of coffee (as fertilisers, oil, feed, etc.), total disappearance may then account for about 80 per cent of current production. As shown in Table 9·5, and stocks may actually go up in 1965. According to U.S. Dept. of Agriculture released early in 1966, the World Coffee Crop during 1956-66 is estimated at 78·8 bags, and exportable output at 63·8 million bags. The 1965-66 crop represents an increase of 53 per cent over the previous year but is still lower than 78·9 million bags at 1959-60.

This situation has arisen because of excessive world production in relation to the estimated demand. Brazil, which alone accounts for bulk of the supplies, had stocks of 57 million cwts. by the end of June 1961 as against 16·7 million cwts. in mid-1958.

An International Coffee Agreement was brought into force in 1964 for the restriction and regulation of exports. Such an agreement can, at most, serve only as a temporary solution. The permanent one is naturally the expansion of the coffee market.

Despite these difficulties, long-term prospects for Indian coffee may seem to be somewhat bright. The world coffee trade has recently developed the habit of stocking-in for greater volume as compared to the last 20 years. At lower prices, the stocking-in process would become less imbalanced and importing countries would hold larger stocks and reduce the weight of financing stocks

TABLE 9·5

SUPPLY AND DISAPPEARANCE 1957–59, AND ESTIMATES FOR 1965

(Million metric tons)

Item	1951-53	1954-56	1957-58	1959	1965
Beginning stocks	0·30 [a]	0·62	0·84	1·42	5·8—5·9
Production	2·40	2·61	3·33	4·58	4·4—4·7
Total supply	2·70	3·23	4·17	6·00	10·2—10·
Net Imports	1·90	2·14	2·34	2·52	2·7—2·96
Domestic consumption [b]	0·18	0·25	0·42	0·51	0·70
Industrialisation	—	—	0	0·13	0·20
Total disappearance	2·08	2·39	2·75	3·16	3·6—3·8
End stocks	0·62	0·74	1·42	2·84 [c]	6·6—6·8
End stocks as proportion of production (percentages)	26	32	45	62	145—150

[a] Brazil only.

[b] Estimated.

[c] Of which 2·66 million tons held by Brazil on 1 July, 1960.

Source: FAO Commodity Bulletin Series, 33, *The World Coffee Economy*, 1961.

on exporting countries. A fall in prices and increasing crops would also compel both the grower and the trade to launch a more vigorous promotional campaign than they have conducted so far. Lower prices might simultaneously encourage improvement in off-take. To these may be added the two factors of improving economic conditions generally among the masses everywhere and increased population of the coffee-consuming community.

Export potentialities at the end of the stipulated period will have to be examined in the light of the present situation as discussed above.

World Demand

Future export level of Indian coffee will depend upon the potential demand for the commodity and her competitive position in the world market. World consumption or effective demand for coffee has been rising at approximately 2 per cent per annum for some time past. The rate of population increase against this has been of the order of 1·6 per cent per annum. This is illustrated in Table 9·6.

TABLE 9·6

WORLD PRODUCTION, ESTIMATED CONSUMPTION OF COFFEE AND POPULATION FROM 1950 TO 1956

Year	*Production* ('000 *tons*)	*Estimated Consumption* ('000 *tons*)	*Population* (*millions*)
1950	2062	1910	2471
1951	2032	1851	2499
1952	2250	1945	2533
1953	2230	2034	2634
1954	2440	1673	2652
1955	2810	2195	2916
1956	2560	2191	2727
1957	3129	2141	2794
1958	3465	2320	2857
1959	4566	2458	2926
1960	3833	—	3000

Source : 1. *Report of the Plantation Inquiry Commission*, 1950, Pt. II.
2. *Statistical Volume of the 17th Annual Report*, Coffee Board.
3. *Demographic Year Book*, U.N. Statistical Office, Dept. of Economic Affairs, New York.

But for the two years 1951 and 1954, there has been a steady increase in the consumption of coffee during the entire period. In 1951, following the Korean War, the producers tried to withhold supplies in Brazil and elsewhere and create a boom in prices. Similarly there was a severe attack of frost in Brazil during 1954, reducing output in that country. Its effect on world trade was a reduction in volume.

This is not really reflective of a reduction in actual consumption, because considerable amount of coffee comes from carry-over stocks during such periods. Commodity statistics published from New York indicate a decline in stocks rather than reduction in consumption in the year 1954.

This steady increase in the world consumption of coffee may be due to the ever-increasing population and active market promotion measures adopted by the producing countries to create a preference for the commodity. Per capita consumption of coffee in the U.S.A. during 1943, for instance, was only 12·55 lbs. It went up to 16 lbs. in 1959.[3] This rise of about 50 per cent during the 15-year period 1943-59 is a clear indication of the result of effective propaganda in favour of a beverage like coffee. It is constant at this level in the U.S.A. But in Sweden it is rising steadily (Table 9·7).

TABLE 9·7
ESTIMATED CONSUMPTION OF COFFEE PER HEAD (LBS. PER ANNUM)

	Average 1951-55	1956	1957	1958	1959	1960	1961	1962
United Kingdom	1·4	1·5	1·6	1·7	1·9	2·1	2·1	2·7
Canada	6·9	8·1	8·4	8·6	9·4	9·0	9·0	8·8
Australia [a]	0·9	1·3	1·2	1·2	1·6	1·7	1·7	2·0
United States	16·1	15·5	15·7	15·9	15·9	15·8	15·9	15·8
Western Germany	7·7	5·7	6·4	6·3	7·2	7·6	8·3	8·6
Netherlands	5·0	8·2	7·7	8·6	8·6	9·9	10·6	11·5
Belgium	12·0	14·3	11·4	11·6	13·1	14·8	13·8	12·7
France	8·4	9·3	9·1	9·3	9·6	9·5	9·5	9·8
Italy	3·0	3·5	3·5	3·5	3·7	4·0	4·2	4·6
Sweden	14·8	17·2	17·4	18·3	19·3	20·5	21·5	24·1
Switzerland	8·1	9·3	8·8	7·9	10·4	11·2	11·9	10·6

[a] Figures relate to years ending June of the respective calendar years.

Source : Commonwealth Economic Committee, *Plantation Crops*.

Coffee would seem to have very bright prospects in so far as its consumption in the coming 20 years is concerned. Besides the annual increase of 2 per cent witnessed in the past, there are a number of new potential markets. Japan, for example, has recently become one of the big coffee-consuming countries. According to a survey by the Indian Embassy in Tokyo, potential demand for coffee is estimated at 6000 tons a year with an annual increasing rate at 10 per cent or more. Both New Zealand and Australia, from among the well-off nations, are at present consuming very little of coffee or tea. They also need to be tapped by effective market promotion measures. On the basis of 2 per cent increase in

[3] *Indian Coffee Statistics*, Coffee Board, 1959-60.

the consumption of coffee during the coming twenty years, world consumption of the commodity may well cross the 3 million tons mark. It would, however, be no surprise if with the new markets coming in, the total world consumption comes to near about 3·5 million tons.[4]

It might be of interest to note that world production of coffee like that of tea is rapidly going ahead of consumption. The current annual production level has been estimated at between 75 and 80 million bags. The major producing countries are, therefore, once again discussing joint action to prevent a world slump and to maintain a reasonable price level. Brazil, the world's largest coffee producer, has already launched a comprehensive plan aimed to cut back production, and hopes to bring production to balance with demand by June 1968. The scheme aims at an average production of 24 million bags, which would cover the country's requirements for domestic consumption and meet the export quota under the International Coffee Agreement. The pursuance of this plan assumes that three hundred million coffee trees are to be eradicated within the next two years, bringing down the annual output by 3 to 4 million bags. At the same time, the Government has taken steps to discourage coffee production and encourage farmers to grow alternative crops like rice, maize, beans, sunflower, soya and groundnut.

If production is curtailed by a major producer like Brazil, Indian coffee would have a better chance. Firstly, because the existing surpluses would be wiped out and secondly, because India can have the benefit of quality.

Share of India

The question that needs further examination is the position of India in the effective world demand. Our present share in the world market although small touched the peak of 1·2 per cent in 1961. Table 9·8 provides details about the quantity of coffee exported by India to some of the important countries during the past few years.

[4] Mr. J. R. S. Hafers, U. S. representative of the Brazilian Coffee Institute (*Indian Coffee, ibid.*) forecasts that coffee producing countries of the world may be required to supply the world with 80 million bags (4·7 million tons) of green coffee by 1980.

TABLE 9·8

EXPORT OF INDIAN COFFEE TO VARIOUS COUNTRIES

Country	1945-46	1949-50	1955-56	1960-61	1961-62	1963-64
United Kingdom	1700	1240	494	394	1968	1933
Italy	—	210	582	2756	2854	1386
Germany	—	189	2798	4921	738	2824
Switzerland	—	100	20	—	—	25
Belgium	—	—	341	984	1378	1282
Other countries	3667	2155	3719	10335	15651	—
Total	—	3894	7954	19390	29232	—

The pattern of trade has been erratic. Prior to 1947-48, U.K. was the only steady buyer and this was perhaps due to conditions brought about by the war, which persisted even when the war was over. From 1949-50, our exports to U. K. have not shown any steady trend, but on the whole, Indian coffee appears to have lost its hold on this market. Italy, Germany and Belgium have emerged as our good customers, with West Germany leading in recent years. Purchases by the U.S.A. which had been few and far between, also improved to 4580 tons in 1963-64 as compared to 1280 tons during 1962-63. But an encouraging feature is that Indian coffee has already found its way to practically every country, though in only driblets to most of them.

Roughly 80 per cent of India's total coffee exports are absorbed by West European Countries, though this accounts for only about

TABLE 9·9

QUANTITY OF COFFEE IMPORTED BY SOME EUROPEAN COUNTRIES AND INDIA'S SHARE IN THEIR TOTAL IMPORTS IN 1960-61

Country	*Total Imports*	*Imports from India*	*% of Col. 3 to Col. 2*
	(Million lbs.)		
1	2	3	4
Belgium	—	2	—
West Germany	352	9	2·6
Italy	219	6	2·7
Netherlands	121	5	4·1
U. K.	122	1	0·8

2 per cent of the total imports of coffee there. Table 9·9 shows the respective shares of India in the imports of these countries during 1960-61.

India has improved her position in some of these countries during the past decade. In the Netherlands, for example, her share has gone up from 0·6 per cent in 1956-57 to 4·1 per cent in 1960-61. The corresponding figures for Italy are 1·0 and 2·7 per cent.

In such a situation, with its superior quality and having alréady made its appearance in most of the coffee-consuming countries, there should be no difficulty for Indian coffee to gain a little more ground in most of the existing markets. In addition to this, it is possible that in view of our friendly relations with all the countries, particularly U.S.A., the Arab nations and U.S.S.R., India may be able to capture a few of the new markets as well.

What we need is to cultivate markets nearer India in the Far East, say Japan, and the Middle East, while not abandoning our traditional markets in Europe. The following steps would be advantageous for the promotion of coffee exports:

1. The system of export sales should be liberalised and exporters and buyers should develop closer contacts. The importance and value of personal approach cannot be over-stressed.
2. Better care should be taken in the preparation of coffee.
3. India's place in the world markets has, in the past, not been on the basis of quantity. She has subsisted on the basis of quality. Too much reliance should not be placed in the future on the legend of the superiority of Indian coffee. Besides making prices competitive, a supporting public relations programme and promotional activities will be necessary. With increasing competition from Africa and some of the Latin American countries, customers will have to be wooed. Advertising techniques will have to be developed which vary in developed economies from country to country and even region to region.
4. Robustas and some cheap coffees could be sold in some markets if their actual requirements are carefully studied.

Nearly three-fifths of the world's imports are for the United States and Canada. India has already started capturing the

American market by exporting over 4000 tons in 1963-64. Prospects for negotiations seem to be good provided a continuity in supplies can be assured. Price is, no doubt, an important consideration. Nevertheless, building up a quality image direct with the consumer by advertising could create long-range marketing potentialities for our washed Arabicas. This will aid the trade to a great extent. Again soluble coffee has come to stay in these markets. Indian Robustas could compete with Africans for this portion of the market. This would apply equally to United Kingdom and Australian markets.

India is also a member of the International Coffee Agreement which fixes export quotas to the traditional markets such as U. K., Western Europe, U.S.A., Canada, Australia, and New Zealand, etc. While Indian quota for 1963-64 was 18·8 thousand tonnes, it was raised to 20·4 thousand tonnes for 1965-66. But export to the non-quota countries like the U.S.S.R., etc. is through bilateral trade agreements. Both the systems will help to increase the exports of coffee from India.

Whether it is the United States or the NATO countries of Western Europe which have been the main outlet for Indian coffees, other considerations which seem to weigh with the trade are the ambiguity about supplies and a lack of proper classification. India will have to pay due attention to these factors as well.

All this having been done, it may not be difficult for India to raise her share in the world market from the existing 0·8 per cent to at least 1·5 per cent in the coming 15-20 years. If so, India should be able to export a minimum of 50-55 thousand tons of coffee.

TOTAL DEMAND

With about 130 thousand tons required for internal consumption and another 50 thousand tons—the likely export target—production target for Indian coffee for 1980-85 may be put at 180 thousand tons. This represents 150 per cent increase over the 1960-61 actual production of 67 thousand tons.

PRODUCTION PROGRAMME

Having formed a tentative idea about the likely requirements of coffee, both for home consumption as well as export, it would be reasonable to draw out a tentative programme for the achievement of those targets.

Cultivation of coffee is mainly confined to three States, viz., Mysore, Madras and Kerala. This crop occupies only 8 per cent of the total area under plantation crops in India. Quantitatively, India's position in the world, so far as this commodity is concerned, is not important. India accounts for about hardly 2 per cent in world acreage and 1 per cent in the total production.

Both production and yield in India have no doubt increased. Yet the fact remains that one of the important problems of Indian coffee is that of improving the standards of production so as to obtain a higher yield per acre. Table 9·10 gives area, production and yield per acre of coffee in India. Appendix 19 gives the acreage and production data since 1941-42 separately for Arabica and Robusta varieties.

TABLE 9·10

TRENDS IN AREA AND PRODUCTION OF COFFEE IN INDIA

Year	*Area (thousand acres)*	*Production (thousand tons)*	*Yield per acre (lbs.)*
1	2	3	4
1948-49	221	22	226
1950-51	229	19	181
1955-56	254	14	217
1956-57	260	42	264
1958-59	268	46	300
1959-60	295	49	372
1960-61	300	68	508
1963-64	320	69	483

Coffee yields vary widely from country to country and from one plantation to another in the same country. On the best managed farms, yields of 1350 to 1800 lbs. per acre have been obtained and yields of 900 to 1350 lbs. per acre are fairly frequent. However, mainly as a result of inefficient production, average yields are well below 500 lbs. in the majority of producing countries.[5] In spite

[5] *FAO Commodity Series*, No. 33, "The World Coffee Economy," 1961.

of the progress made by India during the last few years, she is still one of the low yielding countries.

Yield in India varies not only from region to region but also from estate to estate, though situated in contiguous blocks. A study of area, production and yield of coffee in the various States of India would show that yields vary from 900 to 1120 lbs. per acre to less than 56 lbs. of the two commercially important species of coffee grown in India, viz., Arabica and Robusta. The latter generally yields a better crop.

One of the reasons for low yield of coffee in India is the small size of the estates; about 81 per cent of them being below 5 acres. It is observed that yield of coffee increases progressively as the size of the estate increases. This view is supported by data given in Table 9·11.

TABLE 9·11

COFFEE YIELD PER ACRE ACCORDING TO SIZE OF HOLDINGS (Kg. Per Hectare)

	1950-51		1958-59	
Between	*Arabica*	*Robusta*	*Arabica*	*Robusta*
5 and 10 acres	91·64	53·98	133·36	416·96
10 and 25 acres	121·67	75·32	194·70	441·12
25 and 50 acres	143·11	102·94	460·49	592·30
50 and 100 acres	159·43	131·81	493·06	637·12
100 and 150 acres	204·62	146·88	458·19	703·00
150 and 200 acres	204·62	236·00	456·44	670·98
200 and 250 acres	342·71	219·68	391·92	733·07
250 and over	*	*	566·65	675·20

* Included in the 200-250 acres group.

Source : *Commerce*, 1965 Annual, p. 112.

Increase in yield in the groups below 100 acres is not as significant as it is in the group over 100 acres. This is attributable largely to the fact that larger estates can afford to have improved methods of cultivation, ample manuring, pest control and such other measures.

In order to increase the yield, it is necessary to enlarge the size of estates. Steps may have to be taken to bring them in the co-operative fold, if possible. Moreover, the need for organising intensive cultivation on existing areas cannot be over-emphasised.

The other factor which tends to lower the yield of this crop in India is the aging of plants & Plantation Inquiry Commission was of the view that yield begins to decline when the trees cross forty years of age. According to their estimate, 30 per cent of the reported area had trees over 40 years old, having been planted before 1900 (Appendix 20). In other words, these trees had stopped giving economic returns. In order to check this tendency of declining yield, the Commission suggested that a good estate should always make a provision for an average replanting of 2½ per cent per annum. Since it takes five years for the coffee plants to bear fruit, the aforesaid estates should have 15 per cent of area under the immature plants.

On the contrary, it is estimated that during the last decade only 28 per cent of the area has been[6] replanted. It is thus important that a faster rate of replanting be undertaken in future if coffee trees are to be maintained in a state of economic productivity.

In the past, improved cultural practices have been adopted only on a small scale. The Research Department of the Coffee Board has estimated that increased application of manure and fertiliser and operations like spraying and use of disease-resistant plant material will cost Rs. 150 to Rs. 200 more per acre. These measures, if adopted successfully, will ensure an increased yield of 2 to 4 cwt. per acre during the coming few years. If the price of coffee be taken as Rs. 180 per cwt., a farmer will get a net profit of Rs. 150 per acre. This proves the economics of adopting such practices.

Productivity in coffee has been advancing at a rapid pace, securing for India a place within the first five in the world in terms of yields which more than doubled during the period 1949-64.

The industry has been undergoing a quiet revolution in the development of planting materials, in the methods of field operations and the wide range of equipment that have come into use. Remarkable yields have been obtained from selected planting materials, and planting standards are changing.

The Coffee Board is also considering several schemes for bringing new areas under coffee cultivation as well as to facilitate replanting of existing areas estimated at over 120,000 acres. The Board is envisaging a scheme for the grant of loans to the extent

[6] Report, p. 85.

of Rs. 2,000 for every acre needing replanting. The scheme will also include the sinking of bore wells, tube wells and ordinary wells under the loan scheme. Another scheme which is under consideration by the Board is the grant of subsidies to the extent of 50 per cent for the purchase of fertilisers by small holders of less than 25 acres.

With all these improvements, there is no reason that coffee yields should not be able to follow during the next 15 to 20 years period the pattern witnessed during the past 15 years. From 226 lbs. per acre in 1949-50, coffee yields went up to 508 lbs. in 1960-61. An average yield of 750 lbs. per acre by 1980-85 should then be quite a reasonable projection. To achieve the projected production target of 180,000 tons, the country will need about 0·5 million acres of area at 750 lbs. per acre. The total area under coffee during 1963-64 is estimated to have gone up to 320,000 acres from just 190,000 acres in 1936-37. A further increase by about 55 per cent during the coming 15-20 years should be quite within the reach of the country. Coffee targets of 180,000 tons may thus be achieved both by the application of intensive and extensive methods of cultivation.

The estimated production for 1965-66 was only 60,000 tons although it touched 70,000 tons in 1963-64. This was not a happy situation but the steps taken should serve as an answer to the problem in the future. The 5th Plan target already put at 100,000 tons would seem to be quite conservative. India can definitely produce more coffee and reach the target of 180,000 tons by 1980-85 for home consumption and exports.

10

RUBBER

RUBBER forms the basic raw material for the manufacture of a great variety of industrial goods which have become indispensable in modern life. These goods may be broadly classified into (1) tyres and tubes of all kinds, (2) footwear, (3) miscellaneous uses like water-proof rubberised fabrics, ebonite rods and sheets, latex foam cushioning and sponge, hoses of all types, V-belts and foam belts, rubber conveyor belting, and mechanical rubber goods.

Though rubber is used for manufacturing various goods, listed above, it is principally the transportation industry such as motor vehicles, bicycles, etc. which has been responsible for placing a heavy demand on it. It is estimated that 65·60 per cent[1] of the total consumption of raw rubber in India is accounted for by this industry alone.

Rubber footwear industry probably comes next in importance, its share being 15 per cent of the total consumption. These two industries combined, thus take away a major portion of the produce. The remaining 15-20 per cent is consumed for the manufacture of miscellaneous goods mentioned above. The demand for rubber being thus a derived one, estimates of its future requirement will depend upon the industrial development of the country in general and the transportation as well as the footwear sectors in particular.

[1] *Programme of Industrial Development*, 1955-61, Planning Commission, p. 277.

Present Position

Having started in the 1920's, the rubber manufacturing industry in India is of recent origin. Till that time, rubber was primarily raised as an export crop. Average annual consumption of rubber, in the years 1937-39, was only 7 thousand tons against the total annual production of 14 thousand tons[2] for the corresponding period. Internal consumption of rubber has risen steadily. Table 10·1 shows quantities of rubber produced in India and internal consumption for the last few years.

Table 10·1

PRODUCTION, IMPORTS AND CONSUMPTION OF NATURAL, SYNTHETIC AND RECLAIMED RUBBER IN INDIA, 1950-1965

('000 tons)

	1950	1955	1960	1965
1. Production of natural rubber	15·6	22·4	24·8	49·4
2. Imports				
(a) Natural rubber	1·1	3·8	22·7	17·8
(b) Synthetic rubber	—	0·6	8·7	3·3
(c) Reclaimed rubber	—	2·6	3·1	0·2
(d) Total	1·1	7·0	34·5	21·3
3. Consumption				
(a) Natural rubber	17·7	27·5	45·2	64·7
(b) Synthetic rubber	—	0·1	6·4	20·4
(c) Reclaimed rubber	—	2·5	5·2	9·7
(d) Rubber content of net imports of rubber manufacture*	(—)1·7	(—)0·1	2·3	N.A.
Total	16·0	30·0	59·1	94·8

* Figures are for fiscal years.

The position has undergone a considerable change. Whereas prior to 1939, India was exporting 50 per cent of raw rubber out of a meagre production of 14,000 tons, she is today importing more

[2] "Plantation Crops," *Commonwealth Economic Committee Review*, 1956.

than 24 thousand tons against the home production of nearly 50 thousand tons of natural rubber, another 10-15 thousand tons of synthetic[3] and about 8 thousand tons of reclaimed rubber.

The demand for raw rubber in recent years has shown such a high rate of growth that the original Second Plan target of 40 thousand tons[4] was reached in 1957. Actual consumption in 1961 crossed the 60 thousand tons mark. For 1960-61 we may assume the consumption of rubber at 60 thousand tons. This may be broken up for various end-uses as shown in Table 10·2.

TABLE 10·2

RUBBER CONSUMPTION IN INDIA, 1960-61

	Quantity (thousand) tons)	*Per cent Share*
Transport Industry; Cycles*	10	17
Automobiles etc.	30	50
Footwear	9	15
Miscellaneous	11	18
Total	60	100

* Total share of the transport industry is 65-70 per cent. Since the weight of a cycle tyre is 0·99 lbs. and tube 0·35 lbs. (Tariff Commission Report on fair prices for Rubber, 1952-55) and the estimated production for each of them is put at 16 millions in 1960-61, rubber consumed by the cycle industry in 1960-61 works out to 10 thousand tons. The remaining transport industry has been assumed to consume 50 per cent so that the total comes to 67 per cent.

The original estimate of consumption of 100 thousand tons of rubber by the end of the Third Plan was revised by the Working Group on Plantation Industry to 110 thousand tons. Actual consumption in 1965 against these estimates was only 94·7 thousand tons. This will not, however, represent a correct picture of the situation. The normal deficit of rubber was estimated by the rubber industry at about 25 thousand tons. This went up to 35 thousand tons as a result of the break-down of the SBR plant at the end of 1965. Against this deficit, the Indian Rubber Industry has not received import licences for raw rubber since April 1965.

[3] Actual production of synthetic rubber in 1964 was 11·8 thousand tons and for 1965 only 1·6 thousand tons due to the break-down of the plant.

[4] *Plantation Inquiry Commission Report*, Part III, p. 134.

The evidence of this acute shortage of raw rubber in the country has manifested itself in rising prices of natural rubber to unprecedented levels. It touched Rs. 7 per kg. as against the minimum controlled price of Rs. 3·23 per kg.[5] All this means that the real demand for rubber in 1965 is to be taken as much higher than 94·7 thousand tons. In the presence of liberal imports, one would not wonder if it had touched the Third Plan revised target of 110 thousand tons. This is because there was a heavy pressure on rubber as a result of the emergency created due to China's threat in 1962 and the Indo-Pakistan conflict in 1965.

A review of the first two Plan periods indicates that the demand for transport has risen at a substantially faster rate than the increase in national income or the growth of production in any major sector of the economy over the period. While national income increased by about 42 per cent, the index of industrial production went up by 94 per cent and that of agriculture by 41 per cent, the traffic on railways measured in ton miles doubled and that on road transport increased nearly three times. According to the Preliminary Report (1961) of the Committee on Transport Policy and Co-ordination, India's experience over the previous decade was in line with that of several industrially advanced countries in their early stages of growth and these trends may well be expected to continue during the next few plans.

While industrial development of the country may give a broad indication of the consumption of rubber at any given time, to be a little more precise, we may examine the position separately for various end-uses of rubber.

FUTURE DEMAND FOR RUBBER

Automobile Industry

In India, there exists a vast scope for road transport. Even if we assume that by 1980-85 the country may be able to have a well-spread out network of railways, there is hardly any competition between the two.

During the first two Five Year Plans, an exceptionally accelerated growth in traffic in the basic industries like steel, coal, cement and mines was generated. This unprecedented growth posed stu-

[5] *Rubber India*, February 1966.

pendous problems for the transportation system, particularly the railways. Mid-way during the Second Plan it was noticed that the major trunk routes, particularly the Bengal–Bihar coal and steel belts were working to near saturation limits. It was felt that unless quick steps were taken to meet this challenge, transport bottlenecks which would be inevitable, would very seriously hamper the implementation of the Plans, particularly in the heavy industry sector. Naturally with over-loaded railways, pressure has to fall on the road transport system. Table 10·3 would give an idea of the total goods and passenger traffic between 1950-51 and 1965-66 and the targets upto 1975-76.

TABLE 10·3

GROWTH OF TRAFFIC IN INDIA, 1950-51 TO 1975-76

	Railways	*Motor transport*	*Other means of transport*	*Total*
Goods Traffic				
1. 1950-51	44	6	8	58
2. 1955-56	60	10	9	79
3. 1960-61	88	17	10	115
4. 1965-66	114	33	13	160
5. 1970-71	170	60	20	250
6. 1975-76	250	115	25	390
Passenger traffic				
7. 1950-51	67	26	—	93
8. 1955-56	62	38	1	101
9. 1960-61	78	56	2	136
10. 1965-66	98	80	3	181
11. 1970-71	122	120	5	247
12. 1975-76	153	195	10	358

NOTE : Goods traffic in billion tonne-kms. and passenger traffic in billion passenger kms.

Source : Draft Fourth Plan, Material and Financial Balances, 1964-65, 1970-71, 1975-76, September, 1966, Perspective Planning Division, Planning Commission, Government of India.

Motor transport has been increasing very fast. There has been a noticeable expansion in this respect during the last decade, particularly in the case of goods vehicles. The number of goods vehicles in undivided India (excluding Princely States) increased from 12·4 thousand in 1938-39 to 40·1 thousand in 1946-47. After the partition of the country, this number in the Indian Union grew almost four-fold in a period of ten years to about 130 thousand in 1960-61. There was not much of increase in the number of passenger vehicles during the War period but after 1948-49 they have also been increasing steadily from 27·3 thousand in 1948-49 to 50 thousand in 1960-61, an increase of about 85 per cent.

The pace on which future demand for automobiles increases would depend on the growth of incomes and employment. The additional purchasing power expected to be generated during the coming decades is likely to make a heavy demand both on goods and passenger transport. Road Development Plan for India envisaged that by 1980-81 the long-distance traffic would grow more than four times the 1960-61 level.

According to the Third Plan estimates, the total number of commercial vehicles was to increase from about 200 thousand in 1960-61 to 365 thousand in 1965-66, an increase of 82 per cent. The actual number on road during 1965-66 was 320 thousand. Projected figures for 1970-71 and 1975-76 by the Planning Commission were put at 525 and 990 thousand respectively as detailed in Table 10·4.

TABLE 10·4

REQUIREMENT OF COMMERCIAL VEHICLES IN INDIA : 1970-71 AND 1975-76

	Volume of traffic (billion tonne-km./pass-km.) 1970-71	1975-76	*Traffic carried by a vehicle per annum (thou. tonne-km./pass-km.)*	*No. of vehicles in service (thousands)* 1970-71	1975-76
1. Long distance traffic	27·0	48	300	90	160
2. Feeder and local traffic	33·5	67	100	335	670
3. Total goods traffic	60·5	115		425	830
4. Passenger traffic	120·0	195	1200	100	160
5. Total	—	—	—	525	990

NOTE : 1. Annual rate of growth of traffic during the Fourth and Fifth plan periods is estimated at 12·5 and 14 per cent respectively in respect of goods and 8·5 and 10 per cent in case of passengers.

2. Vehicle-utilisation assumed is as follows:

	Average capacity	*Annual kilometres*	*Load factor per cent*
Goods truck in long-distance traffic	7 tonnes	60000	70
Goods truck in feeder and local traffic	4 tonnes	40000	65
Passenger bus	40 seats	45000	66

3. Production of commercial vehicles (in thousand nos.)

1966-67	1967-68	1968-69	1969-70	1970-71	*Total Fourth Plan*	1975-76	*Total Fifth Plan*
40	50	60	70	80	300	150	600

Source : Draft Fourth Plan, Material and Financial Balances, *op. cit.*

Taking into consideration the total increasing demand for road transport which will be generated as a result of the higher tempo of development, it was estimated by the Road Development Plan (Table 10·5) that by 1980-81 India will require about 2·6 million automobiles as against 35,000 required by the end of the Second Plan.

TABLE 10·5

ESTIMATED REQUIREMENTS OF AUTOMOBILES (1961-81)

(Thousands)

Year	*Passenger buses*	*Motor cars & cabs*	*Goods vehicles*	*Miscellaneous*	*Total*
1960-61	79	263	225	68	635
1965-66	115	353	400	104	972
1970-71	151	459	660	152	1422
1975-76	187	593	1000	214	1994
1980-81	222	754	1375	282	2633

Source : Road Development Plan, *op. cit.*, p. 48.

The actual figure in 1961 against this estimate was 665 thousand and on 31 March 1966, this had gone up to 1005·2 thousand. Estimates of the Road Development Plan are rather old. They would now need a revision upward. The actual number of vehicles for 1960-61 and 1965-66 has exceeded the plan targets as already mentioned. Since annual rate of growth of traffic during the Fourth and Fifth Plan periods is estimated at 12·5 and 14 per cent in the case of goods and 8·5 and 10 per cent for passengers respectively by the Planning Commission, we would not be far wrong to assume that these rates are likely to increase faster in the subsequent plans and the total number of vehicles on road may go up to about 3 million by 1980-85.[6] This would mean roughly a 500 per cent increase over the 1960-61 level.

An increased demand for motor transport will indicate a corresponding increase in the demand for rubber required in the manufacture of tyres and tubes. In addition to the increased income and employment, the rapid pace of urbanisation and spread of metalled roads in rural areas may also help in expanding the demand for road transport and increasing the number of vehicles. This trend may be further accentuated by the commercialisation of agriculture.

To cope with this increasing pressure, India's Road Development Plan put a target of 657 thousand miles for 1980-81 against the expected 379 thousand miles in March, 1961. Actual length of surfaced and unsurfaced roads in 1960-61 was 394 thousand miles (595 thousand kilometres) and in 1965-66, 595 thousand miles (958 thousand kms.) Of this, surfaced roads were 284 thousand kilometres[7] and others 674 thousand kilometres. A recent Report of the Committee on Transport and Co-ordination has recommended a further expansionist approach to road transport. According to them, "Road Transport facilities will be needed on a much larger scale than ever before to open up new and less developed areas, to carry economic development and social services to the farthest villages, to promote the growth of agriculture and the rural economy and to provide for inter-city transport services." The Road Development Plan target may, if at all, be an under-estimate,

[6] According to an estimate by K. M. Philip (*Rubber India*, April 1966), total vehicles by 1970-71 would be 1662·3 thousand. Estimates for 1975-76 are being put at around 2·0 million. Motor cycles and Scooters will be in addition to this.

[7] Increase in surfaced roads is more important from the point of motor transport. Even with the addition of 50 thousand kms. of surfaced roads over the Fourth Plan period. India will have only 0·18 miles of surfaced road per square mile against 3·0 in France, 3·2 in Great Britain and 1·0 in the U. S. A.

particularly when we are considering for this study 1980-85 as our target period.

According to the estimates of the Road Development Plan, road density would increase from 26 to 52 miles per hundred square miles of area. The corresponding figures for U.S.A., U.K. and France are 100, 200, and 300. The distance of any place from any type of other road according to the Development Plan will be as shown in Table 10·6.

TABLE 10·6

MAXIMUM DISTANCE OF ANY PLACE FROM A ROAD IN 1980–81

(Miles)

Description of area	*Maximum distance of any place from a metalled road*	*any road*	*per 100 sq. miles of area*
Developed & agriculture area	4	1·5	70
Semi-developed area	8	3·0	30
Undeveloped and uncultivable area	12	3·0	19

Source : Road Development Plan for India, *op. cit.*, p. ii.

Having examined the future position with regard to the development of roads as well as automobiles, a comparison of mileage-vehicle ratio for India and other countries would be of interest as shown in Table 10·7.

Kilometre-vehicle ratio, which gives an index of effective use of the road system, indicates the underdeveloped state of motor transport in India. The ratio in India works out at 1·1 kilometres per motor vehicle. This shows that India lags much behind other countries where this ratio is rather high. The programme as shown in the preceding pages would raise the mileage-vehicle ratio for India to 4 which will be just close to the present level of a sparsely populated country like Australia.

With the number of automobiles increasing by nearly 500 per cent, goods traffic going up by 10 times and the mileage-vehicle ratio by about four times during the period under study, the demand for rubber would multiply by a minimum of 7 times for

TABLE 10·7

NUMBER OF MOTOR VEHICLES IN DIFFERENT COUNTRIES IN RELATION TO ROAD LENGTH, AREA AND POPULATION—1964

Country	Number of motor vehicles (thousands)	Number of vehicles per kilometre of surfaced road	kilometre of roads (all types)	100 sq. kilometre of area	million population
India	906	3·5	1·1	28	19
Burma	71	4·9	2·8	10	23
Ceylon	146	3·6	7·1	222	137
Japan	5287	—	5·4	1430	551
Pakistan	201	6·6	5·1	21	20
Switzerland	1380	—	27·4	3342	2392
United Kingdom [a]	10586	31·0	31·0	4338	1967
Canada	6075	12·8	7·5	61	3209
U. S. A.[b]	86965	20·1	14·9	929	4592
Australia	3451	10·1	4·0	45	3162
New Zealand	924	11·1	10·0	344	3641

Source : [a] *U. N. Statistical Year Book*, 1964.
[b] *International Road Federation Staff Report*, 1964, Washington.

automobile industry. Tractors for agricultural purposes during this period may have to go up by more than 500 per cent. According to 1961 census, the total number of tractors in the country went up from 21 thousand in 1956 to 34·3 thousand in 1961. The rate of progress in the coming years will have to be much faster.[8]

Similar may be the position with regard to animal driven vehicles. Out of an estimated number of 10 million bullock carts in the country, about 1 million are at present engaged in road transport. Hardly 10 per cent of them are equipped with pneumatic tyres. Considering that there are 1 million bullock carts, each carrying an average load of 1 ton, four miles a day for 200 days in a year, we arrive at a work load figure of 800 million ton miles. If all these iron-tyred carts were equipped with pneumatic tyres, the

[8] B. P. Singh Roy *et al.*, *Suggestions for Agricultural Self-sufficiency* pp. 18-20.

potential work load may be at least doubled to 1,600 million ton miles.[9] Less damage to the roads will be an additional advantage.

Ministry of Transport once considered a proposal for subsidising the conversion of about 1 lakh professional type (public carrier) bullock carts with iron tyres, into pneumatic tyre carts.[10] Nothing specific has been decided so far. But such a measure would be extremely necessary during the period under study for increasing the work load efficiency of these carts. If even half of the existing 9 lakh iron-tyred carts are converted to pneumatic ones, the demand for rubber on this account will show a 500 per cent rise.

With all this anticipated expansion in the automobile industry, tractors and carts, etc., an increase of 600 per cent in the consumption of rubber, as calculated above, can be expected during the period 1960-61 to 1980-85. In absolute terms, the total consumption of rubber for these items during 1980-85 may thus be of the order of 200 thousand tons.

Bicycle Industry

Rapid progress of urbanisation since the war, accentuated by refugee rehabilitation after Partition, has focused attention on the expansion of urban transport. Bicycle, the cheapest means of personal transport, has provided a handy and economical means in these areas.

Internal production of bicycles has been increasing at a steady rate. With the increased number of bicycles on roads, replacement demand for tyres and tubes is also going up. Home production of bicycles in India during the 10 years of post-independence decade has multiplied 13 times, and the total number of cycles on road by the end of 1957 was estimated at 5 millions.[11] Production of bicycles at the end of Second Plan was 1·04 millions and the Third Plan target was put at 2·0 millions[12] originally which was revised to 2·5 millions later. Actual production in 1965 was 1548 thousand.

This pertains only to the larger units. Total production inclusive

[9] "Capital," *Industry Special*, June 1959, pp. 54-55.

[10] "Programme of Industrial Development," *op. cit.*, p. 282.

[11] Taking the average life of a cycle as 10 years.

[12] "Programme of Industrial Development, Third Five Year Plan," *op. cit.*, p. 100.

of the small-scale sector is estimated at 1·14 million in 1962 and the potential demand for new cycles was put at 2 million.[13]

As for bicycle tyres, the 1961 production was 11·35 million. Domestic demand for these tyres and tubes was estimated at 16 million keeping pace with the steady increase in the output of bicycles.[14] The Third Plan target was accordingly put at 38·6 million assuming an internal demand for 31 million. Actual production in 1964 overshot this target by 0·3 million.

For purposes of projecting the future demand for cycles, we may examine the cycle-population ratio in India and some other countries as shown in Table 10·8.

TABLE 10·8

NUMBER OF BICYCLES & POPULATION PER BICYCLE

Country	*No. of bicycles* ('000)	*Population per bicycle*
Japan	12,000	7·2
U. S. A.	20,000	7·5
U. K.	14,000	3·6
France	11,915	3·5
West Germany	15,000	3·2

Source : "A Charted Survey of Japan," 1955, *Tsunetsano Memorial Society*, p. 330.

As for India, roughly one out of every 80 persons used a bicycle in 1958.[15] The Tariff Commission estimated that by 1960-61, this ratio would rise as high as one bicycle for every 58 persons. Actual position at the end of Second Plan was quite near that. Even then we will be nowhere near those countries detailed in Table 10·8.

The Road Development Programme as given in Table 10·6 shows that no village will be more than 1½ miles from one or other type of road. A bicycle being the cheapest means of transport, it would be quite convenient for most of the village people to possess one for their daily use.

A cycle in urban areas is more or less a necessity. In a city like

[13] "Capital," *op. cit.*, p. 53.

[14] "Presidential speech of Mr. K. N. Mookerjee," National Rubber Manufactures Ltd., *Commerce*, June 27, 1959.

[15] "Capital," *op. cit.*

Delhi there was a cycle for about 10 persons a few years back which meant that practically every other family owned one.

The demand for cycles on both of these accounts, urbanisation and road development, must rise high during the period under discussion. Minimum that may be expected is that the man-cycle ratio in India may reach near about 16 by 1980-85. This would mean that there would be about 44 million cycles on the road by 1980-85 as compared to the estimated number of 8 million at the end of Second Plan. With the number of cycles on road increasing by five and a half times, the demand for rubber tyres and tubes will correspondingly increase by about 6½ times. India has also entered the export market for these goods. Total exports of all types of tyres and tubes increased from Rs. 1·7 million in 1960-61 to Rs. 6·5 million in 1963-64. Putting all these together, requirements of rubber for the bicycle industry would go up at least 7 times the 1960-61 level of 10 thousand tons only. This would mean that the total production of tyres and tubes would go up to 75 million each against the Third Plan target of 38·6 million and actual production of 31·3 million during 1964.

Footwear

Another item which is of importance from the point of view of consumption of rubber is the rubber footwear. Table 10·9 shows the manufacture of such goods from 1951 to 1965 in India.

TABLE 10·9
PRODUCTION OF RUBBER FOOTWEAR IN INDIA FROM 1951 TO 1965

Year	*Million pairs*
1951	23·1
1955	34·9
1956	36·1
1957	37·0
1958	36·7
1959	39·2
1960	44·0
1961	45·1
1963	46·5
1965	53·1

Source : *Indian Rubber Statistics*, 1966.

The production of footwear at the end of the Second Plan was 45·1 million pairs. This would mean an increase of about 100 per cent during the first two Plans. With more of purchasing power being made available to an average Indian, an upward trend can be expected. If the masses are enabled to purchase footwear, the first preference is no doubt for durable and economical but also fancy material. In spite of this, the market for cheaper goods such as rubber footwear is likely to expand appreciably; more so in a country like India where most of the people do not have any type of shoes at all. Prejudice of some people against the wearing of leather footwear may also favourably affect the production of rubber footwear.

It may then be expected that the demand for rubber shoes in the coming twenty years may go up by about 10-15 per cent per annum or about 300 per cent by 1980-85.

Rubber footwears are also exported in large quantities while imports are negligible. Export of all varieties of rubber footwear during the last few years as shown in Table 10·10 are quite encouraging.

TABLE 10·10

EXPORTS OF RUBBER FOOTWEAR

(Thousand pairs)

	1956	1957	1958	1960	1961	1962
All rubber	240	240	260	608	241	216
Rubber soled canvas uppers	200	180	140	2011	2134	2603
Leather uppers	80	780	510	1057	837	939

The whole of South East Asia, Middle East, and East Africa, is a potential market where larger quantities can be exported. Some exports were also made to Norway and Belgium in recent years. It may not be possible to lay down any specific target for export of footwear by 1980-85 but the possibility of a sufficient expansion in this direction cannot be ruled out.

As in the case of home consumption, exports of rubber footwear may also go up by about 300 per cent. This would mean that against 9,000 tons of raw rubber consumed by the footwear industry in 1960-61, the demand by 1980-85 may be of the order of 40 thousand tons.

Miscellaneous Rubber Goods

This head which accounts for the manufacture of various types of rubber goods, detailed in the opening paragraph of this Chapter, is estimated to consume (Table 10·2) 11,000 tons or 18 per cent of raw rubber in 1960-61.

The demand for these items is directly related to the industrial progress of the country. Huge expansion in the development of major industries, particularly steel and coal is going to enlarge the scope for the production of conveyor and transmission belting, V-belts, and other mechanical products. Expansion in the automobile industry will put a corresponding demand for latex foam cushioning and sponge. Several specialised items which are not manufactured in India at present are also likely to be taken up.

The country today has reached a stage of self-sufficiency in most of the rubber products. The industry will now have to turn its attention increasingly to exports, although the value of the latter went down from Rs. 17·6 million in 1953-54 to a mere Rs. 1·6 million in 1958. The rubber Panel of the Chemicals and Allied Products Export Promotion Council tentatively suggested a target of Rs. 15·7 million for 1959-60. Actual exports in 1960-61, however, were worth Rs. 1·9 million and Rs. 3·2 million in 1965-66.

Since India has the geographical advantage of having no other advanced manufacturing country near by, her cost of distribution of the finished article will be much lower as compared to consignments from U.S.A. or Europe. The supply of labour here is also cheap which may help in reducing the cost of production. Now that the Indian factories are replacing worn-out and out-of-date machinery, the industry will be well set for any competition.

In the light of these factors, 5 to 6 hundred per cent increase in this sector is the minimum that can be expected. This would mean that the demand for raw rubber for the manufacture of these miscellaneous items may go up from 11 to 70 thousand tons during the 20-year period under study.

Rubber Target for 1980-85

The discussion in the preceding pages can be summed up as in Table 10·11. India would need about 370 thousand tons of rubber.

Rubber industry estimates put this figure at 300 thousand tons for the year 1980[16] sometime back. Rubber consumption estimate for 1970-71 is being put at 172 thousand tons. Demand for rubber has, more or less, been doubling every five years. The estimates made above would, if at all, necessitate an upward revision. A consumption target of 400 thousand tons of rubber should then be something which can be considered as reasonable.

TABLE 10·11

RAW RUBBER TARGETS FOR 1980-85

	1960-61	1980-85	*Per cent rise in* 1980-85
	(*thousand*	*tons*)	
Transport industry			
Bicycle	10	70	600
Automobile & others	30	200	600
Rubber footwear	9	40	300
Miscellaneous	11	70	600
Total	60	370	500

PRODUCTION PROGRAMME

Production of natural rubber will have to be increased both by intensive and extensive measures. We have tried to examine here the technological possibilities of increasing the production of natural rubber and also the economics of natural/synthetic rubber. Average yield of rubber in India on the basis of total area under rubber calculates to 267 pounds per acre.[17] This is quite low as compared with the major rubber producing countries of the world (Table 10·12).

Rubber plantations in India have made good progress during the last 5-10 years. Against the target of 45,000 tonnes in the final year of the Third Plan, the actual crop of natural rubber was 50·5 thousand tonnes. The annual rise in production during the entire 5-year period was 14·5 per cent and this was reported to be the highest in the world. By comparison, well-established

[16] "Plantation Supplement," *Hindu*, August 24, 1959.

[17] For calculating appropriate yields of rubber, it is only proper to take the tapped area. Yield data on that basis are discussed in the subsequent section.

TABLE 10·12

AREA, PRODUCTION AND YIELD OF NATURAL RUBBER IN MAIN PRODUCING COUNTRIES

Country		Year	Area in acres	Production in long tons	Yield per acre (lbs.)
	Malaya *	1965	4162500	860656	463
Malaysia	Sarawak	1965	406736	39863	220
	Sabha†	1965	251473	23848	212
	Total	1965	4820709	924367	430
Indonesia		1961	4469000	671399	336
Thailand		1954‡	839600‡	130181‡	347
Ceylon		1965	671487	116442	388
India		1965	407014	48607	267
Nigeria		1958	288000	41062	319
Vietnam		1962	260000	74031	638
Liberia		1962	244724	44675	409
Congo		1959	229897	39511	385
Burma		1961	136714	—	—
Cambodia		1961	123500	39348	714
Philippines		1964	48828	—	—
Cameroon Fed. Republic		1963	46898	—	—
Rest of the World†			169000 §		
Total			1275500 §	2327500	4087

Source: Rubber Statistical Bulletin of the International Rubber Study Group.

* Includes Singapore and States of Malaya.

† Estimated.

‡ In the case of Thailand, area is for the year 1954 & production for 1955.

§ These Figures include unspecified areas not included in other columns.

countries like Malaysia and Ceylon had only obtained an average increase of between 3-4 per cent.

Despite all these impressive advances in production, the yield per acre of Indian rubber is still low and, in fact, much lower than that of Malaysia and Ceylon. Compared with the average yield of about 400 pounds an acre in India,[18] Malaysia claims an average of 820 pounds and Ceylon 560 pounds.

Rehabilitation of Existing Plantations

It is a well-established practice that a rubber plantation which has crossed its economic life of say about 30 years[19] and which is of poor quality has to be replanted. A rubber tree takes 7-8 years to become productive, reaching full maturity at 15-17 years. After 25 years their yield begins to decline, and they become due for replacement between 30-35 years, depending on the relationship between replanting costs and current rubber prices. While ordinary seedlings yield hardly 200 lbs. per acre, improved varieties give 5 times this quantity. On this basis all the area (about 171 thousand acres) which was planted in 1951 or earlier will stand in need of replantation. Voluntary efforts in this direction are too slow.

The rubber growing industry has been interested in replanting ever since 1924. The progress was, however, limited by the non-availability of suitable planting materials and practically nothing could be done during the war. Excessive tapping on the other hand exhausted or damaged large areas. Falling prices at the end of the war left little incentive for the cultivator to take to replanting work.

This stalemate continued for about 7-8 years after the war. In June 1950, the Government of India appointed a Development Committee for the rubber plantation industry. The Report of the Committee gave a 16-year plan for replanting or new planting of 6 thousand acres annually from 1952 and 8 thousand acres from 1957, completing a programme of 120 thousand acres by 1967.

No action, however, was taken for some years. A modified

[18] On the basis of tapped area.

[19] *Rubber in India*, 1955, p. ii. New improved varieties evolved in Malaya put it at about 40 years.

scheme was accepted by the Government in 1956, which provided for the grant of subsidy at varying rates for replanting 70 thousand acres with better yielding varieties in 10 years. Although the rates of subsidy were revised in 1958, the response from the cultivator has been rather poor.

Slow progress with regard to the replanting programme is possibly due to the reluctance of small growers to uproot the aged plants because of loss of income for some years and heavy expenses involved in planting and maintenance of young ones. While it takes only half an hour to cut a rubber tree, another in its place takes 7-8 years to grow and provide a return. A rubber grower has, therefore, to be provided a sufficient incentive for cutting down his tree whatever its yield.

While large estates have the practice of setting aside a rehabilitation fund for which purpose replanting element has been included in the control price of rubber, a replanting subsidy scheme was evolved with a view to providing an incentive to planters, especially small holders. Table 10·13 shows the rates of subsidy offered to growers in India, Malaysia and Ceylon.

TABLE 10·13

RUBBER SUBSIDY TO GROWERS IN SOME SELECTED COUNTRIES

(Rs. per acre)

Category of holders	*India*	*Malaya*	*Ceylon*
Below 10 acres	400	960	1200
100 acres and below	350	870	1100
Above 100 acres	275	625	1000

As compared with other countries, the rates of subsidy given so far in India have been quite low. It has recently been raised to Rs. 1,000 per acre on a flat rate. This subsidy given by the Rubber Board is extended out of the resources built up from the levy of a cess of 6 cents per pound which is the maximum leviable under the Rubber Act. New proposals are now under consideration to double the cess so as to encourage subsidised replantation. Besides the subsidy in cash, small holders with holdings less than 5 acres are supplied with manure at half the market prices along with some other concessions. There is bound to be a good response from the cultivators as a result of this increased subsidy rate which even now falls much below the estimated cost of the order of Rs. 2,000 per acre involved in planting one acre.

The scheme for replantation is important not only from the point of view of removing the old plantations but also introducing improved clones in the existing area. Important rubber growing countries like Malaysia, Indonesia and Ceylon have already launched upon very comprehensive schemes to bring practically the whole of their rubber area under improved clones. The future of natural rubber has for a very long time in Malaysia been considered as dependent on the replanting of old trees with better material. They started on this campaign as early as 1940. It is now universally accepted that rejuvenation is a continuous process and it is only with ever increasing use of improved techniques of exploitation and planting materials that yields can be increased.

Table 10·14 gives the distribution of total area under rubber according to different age groups in 1957.

TABLE 10·14

AGEING OF RUBBER PLANTS IN INDIA

('000 acres)

		Estates	*Holdings*	*Total*
1.	Total area	51	72	123·0
2.	Area older than 30 years	25	12	90·0
3.	Area replanted up to 1959	9	2	27·0
4.	Replanted area under ordinary variety	1	0·4	1·4
5.	Area with trees aged 30 years and less but under low yielding material	8	37	45·0

Of the 90 thousand acres under rubber plantations which had crossed the economic age, only 27 thousand acres were replanted in 1959. A phased programme in respect of replanting this area in each plan period is the goal which the country has to keep before itself.

The balance of 63 thousand acres and other areas which were planted between 1930 and 1951 will also cross their economic life by 1981. Both with regard to new plantations and replantations, an effort has to be made so that cent per cent of this area is put under improved varieties. Although total area replanted during the last 25 years is rather small, most of it is under improved varieties. Of the total of 30 thousand acres, only a small area of 3·5 thousand acres has been replanted under ordinary seedlings.

On the other hand, the tendency of putting new area under ordinary material continues unabated. For instance, during the last decade, as much as 28 thousand acres have been put under ordinary material against 150 acres brought under new plantation. This tendency has in any case to be checked. Table 10·15 will give an indication that at the end of 1965-66, out of a total of 407 thousand acres as much as 203 thousand acres (just 50 per cent) were under ordinary clones.

The whole programme has suffered in the past from administrative, organisational, technical, attitudinal and financial problems. Now that the magnitude of the problem has changed its complexion because of a much heavier demand for rubber in the future, the whole matter needs a re-examination. Since the growers of rubber can be assured of a specific demand for rubber in the future, a proper replanting scheme will have to be worked out. The Rubber Board has recently considered a suggestion to liberalise the replanting rules so that a subsidy could be paid not only for replantation of old and dying trees, but also for developing other low yielding areas. The Rubber Research section has also turned its attention to various schemes designed to protect the plants from diseases and to improve yields.

Extension of Area

Table 10·16 shows the tapped, untapped and total area, total production and yield per acre of tapped area under rubber during the last 10 years in the country. We have today 407 thousand acres of total area under rubber, of which the tappable area is about 280 thousand acres. Average yield has steadily gone up to 400 lbs. from 315 lbs. per acre during the decade.

The rubber tree is found to grow most satisfactorily in the humid, tropical, rain forest regions with a rainfall of 70 to 120

TABLE 10·15

NEW PLANTED AND REPLANTED AREA, AT THE END OF EACH YEAR UNDER DIFFERENT PLANTING MATERIAL—INDIA

('000 acres)

Year	New planted area				Replanted area				Total area			
	ordinary	*budded*	*clonal*	*total*	*ordinary*	*budded*	*clonal*	*total*	*ordinary*	*budded*	*clonal*	*total*
1955-56	161·2	17·0	13·8	192·0	2·7	10·7	1·8	15·2	163·9	27·7	15·6	207·2
1960-61	201·8	31·7	57·3	290·8	4·2	16·4	9·6	30·2	206·0	48·1	66·9	321·0
1961-62	209·9	35·5	70·8	316·2	4·1	17·2	10·6	31·9	214·0	52·7	81·4	348·1
1962-63	211·9	37·7	77·8	327·3	4·2	17·5	12·0	33·8	216·1	55·2	89·8	361·1
1963-64	209·8	40·6	89·0	339·4	4·2	18·9	15·4	38·5	214·0	59·5	104·4	377·9
1964-65	206·0	42·5	92·1	340·6	4·4	20·3	18·5	43·2	210·4	62·8	110·6	383·8
1965-66	198·2	49·3	104·1	351·6	4·7	23·7	27·0	55·4	202·9	73·0	131·1	407·0

Source : *Indian Rubber Statistics*, Vol. 9, 1966; The Rubber Board, Kottayam, Kerala.

TABLE 10·16

TOTAL AREA, TAPPABLE AREA, PRODUCTION AND AVERAGE YIELD OF RUBBER—INDIA

Year	Total area (thousand acres)	Tappable (thousand acres)	Production long tons	Production metric tonnes	Average yield (lbs. per acre)
1955-56	207	166	23356	23730	315
1960-61	321	174	25292	25697	326
1961-62	348	184	27014	27446	330
1962-63	361	208	31731	32239	342
1963-64	378	236	36897	37487	350
1964-65	384	268	44898	45616	375
1965-66	407	279	49734	50530	400

Source : *Indian Rubber Statistics*, Volume 9 (1966), *op. cit.*

inches evenly distributed throughout the year and on equable warm temperature of 80° to 90° F on deep, well-drained and fairly fertile soils up to an elevation of 800 feet from sea level.

Kerala, Kanya Kumari Dist. of Madras State and Andaman and Nicobar Islands are the only important areas where most suitable agro-climatic conditions are in existence for the cultivation of rubber. Table 10·17 gives the land utilisation pattern for these three areas. In Kerala alone there are more than 400 thousand acres classified as cultivable waste and another 188 thousand acres non-reporting area. According to some rough estimates, there are at least 200 thousand acres out of this total area which can immediately be put under rubber plantation.

In Kerala, there are 2·4 million acres of forests. Rubber cultivation develops forests on scientific lines and also prevents soil erosion. The entire forest policy in that State calls for a re-examination. It is quite possible that vast tracts of land may be available for rubber plantations which may serve the dual purpose of forests as well.

Andaman and Nicobar Islands, it may be pointed out, are also potential areas for rubber and coconut plantations. Lands there are extremely suitable for the purpose. Rainfall is evenly distributed and generally the climate is more akin to the fertile rubber areas of Malaysia. According to tentative estimates nearly 200 thousand acres are immediately available in these Islands for rubber plantations. This group of Islands is, however, rather underdeveloped and considerable developmental activities will have to be undertaken before plantations on any large scale can be started. It would perhaps be necessary to undertake a comprehensive survey of the area before resorting to any large-scale deforestation. The Rubber Board has already started investigations in this respect.

It may also be added that a proper plantation scheme for this area will call for huge investment. Labour and heavy capital equipment will have to be transported to the place, quarters built for labour and staff and roads and buildings constructed. This is a job which can be undertaken either by the Government or big corporations having sufficient resources of their own. These are rather urgent matters which need an immediate decision.

TABLE 10 17

LAND UTILISATION PATTERN IN KERALA, ANDAMAN AND NICOBAR ISLANDS AND KANYA KUMARI DISTRICT OF MADRAS STATE, 1956-57

('000 acres)

Classification	Kerala	Andaman and Nicobar Islands	Kanya Kumari District
I. Total geographical Area According to			
(1) Surveyor-General of India	9605	2058	413
(2) Village papers (Reporting area)	9417	86	413
II. Forests	2439	35	124
III. *Not Available for Cultivation*			
(1) Land put to non-agricultural uses	504	5	27
(2) Barren and unculturable land	497	12	54
Total	1001	17	81
IV. Other Uncultivated Land Excluding Fallow Land			
(1) Permanent pastures and other grass lands	121	12	2
(2) Land under miscellaneous trees and groves not included in net area sown	509	2	17
(3) Culturable waste	437	1	7
Total	1067	15	26
V. Fallow Lands			
(1) Fallow lands other than current fallows	207	1	5
(2) Current fallows	156	1	17
Total	363	2	22
VI. Net area sown	4527	20	163
VII. Total cropped area	5385	20	230
VIII. Area sown more than once	857	[a]	67

[a] Less than 494 acres.

Yield per Acre

Production of rubber in India is confined to a narrow belt along the South-west Coast where the distribution of rainfall is not ideal for maximum production. Variations in climate and rainfall from among the natural factors are thus responsible for our low yields.

Rubber trees in India are also subjected to several diseases and low yielding clones account for 80 per cent of the total area.

The industry consists of 53,000 holdings of less than 100 acres accounting for 60 per cent of the acreage and only 244 estates of 100 acres or more. Difference in yields between the small and large holdings is markedly wide; large holdings have an average yield nearly three times as great as that of small holdings. An analysis of yield rates between sections of holdings made by the Rubber Board shows that during 1965-66, average yield of large estates was 624 pounds per acre against 262 pounds of small holders and 400 pounds for the whole of the country.

If replanting schemes, discussed in the previous section, are to be vigorously followed and the rubber growing industry is to be put on sound lines, this very large number of small growers will have to be persuaded to change their traditional method of cultivation, estate management, processing and marketing practices. This will be no small a task in extension service. But that is extremely necessary.

The Plantation Inquiry Commission recommended the setting up of co-operatives to form supply and distribution organisations, to maintain smoke houses where the small holders can process their latex and to supply long-term credit to small growers. A move in these directions would be necessary. Small scattered growers, as at present, can in no way bring about the desired changes by their individual efforts.

Till recently, there was no research department to look into the matters of this industry. This was primarily because the industry was small and it could not afford to have such a department. This lacuna has been filled by establishing a Research Institute and Experimental Station near Kotayam in Kerala.

It would now be possible to make full use of modern techniques for the development of the industry. Countries like Malaysia have already made big strides in research on rubber. Some 20 years back in 1940 Malaysia considered a yield of 1,000 pounds per acre as the optimum from large-scale plantings of the material then available. Latest material now in commercial planting in that country has given yields from large acreages of more than 2,000 pounds per acre in many cases. Trials which are statistically equivalent to large-scale planting have given nearly 2,500 to 3,000 pounds per acre of dry rubber. From work still in the experimental stage, it is clear that a ceiling for yield has not yet been reached.

A number of estates in South Travancore are already giving yields of over 1,000 pounds per acre. New areas in the Andaman and Nicobar Islands now recommended for being put under rubber plantations are ideally suited for the cultivation of high yielding planting material now available. This area has potentialities of yielding more than 2,000 pounds of dry rubber per acre.

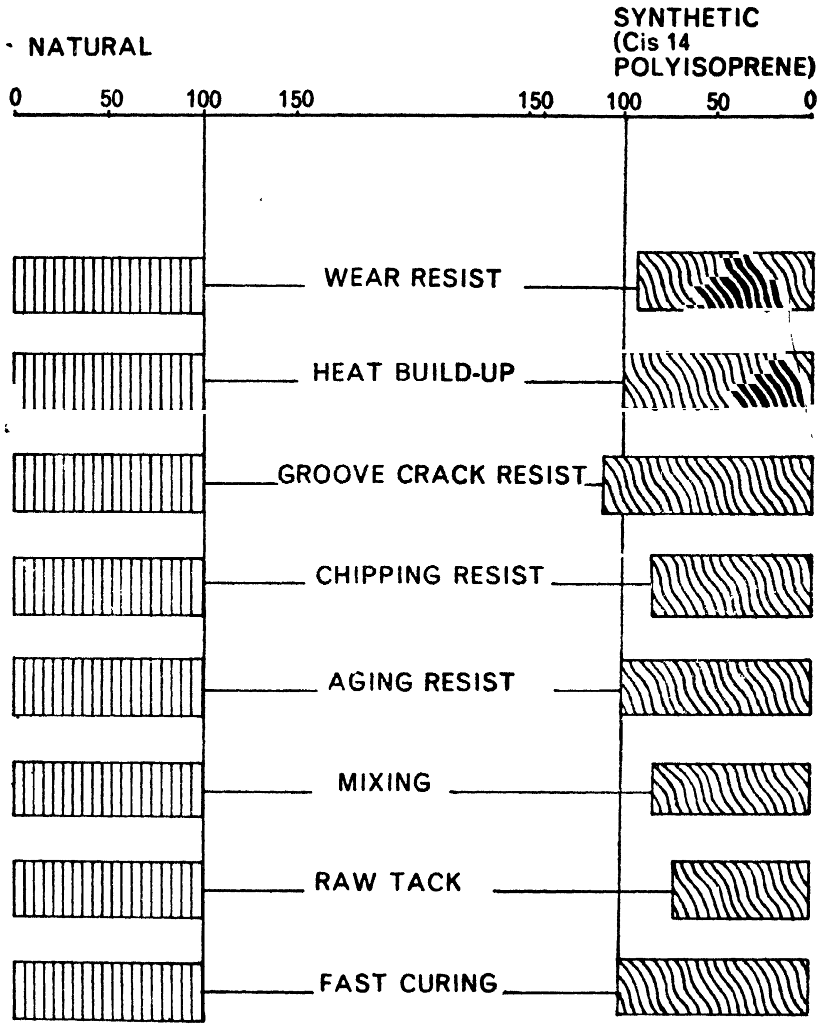
In the light of what has been stated above it should not be difficult for the country to increase the total area under rubber to about 650 thousand acres by 1980-85. Tapped area by 1980-85 should then be of the order of 500 thousand acres. Even at a conservative estimate of 1,000 pounds[20] per acre, it should be quite within our reach to secure a total production of more than 200 thousand tons of rubber.

Competition with Synthetic Rubber

There was a time when natural rubber held the field. This uniqueness of natural rubber has disappeared. It can no longer generate "the sellers' market." The buyer can very well turn to other directions and the extent to which he does so is determined (political and fiscal controls apart) by just those factors which determine the choice of everything in the same situation—price, availability, presentation and quality. The marketing of competitive synthetic rubbers has and will continue to set standards for these factors which will increasingly fashion the buyer's outlook and can only be ignored with penalty by the natural rubber industry.

[20] Yields of over 1000 lbs. per acre have already been obtained from the Rubber Board's subsidised replanting scheme. (*The Economic Times*, February 7, 1969).

RUBBER



Source:–'The Future of Natural and Synthetic Rubbers' Proceedings of a Symposium organised by the International Rubber Study Group, in Washington, D. C., on the 29th and 31st May and 1st June, 1962.

But the problems for a country like India are not so acute in this direction. She has to import large quantities of natural rubber for her own consumption. The decision for the substitution of natural by synthetic rubber will not depend so much on the price of natural rubber as on the technical possibilities of substituting the synthetic with natural.

Synthetic rubbers during recent years have shown tremendous improvement in so far as various qualities of rubber needed for use in the transport industry are concerned. Until 10 years ago practically the only considerations in this respect were whether the tyre wore well and would still stand up under the impacts encountered on bad roads or rough railroad crossings; or to the hot weather, high speed operations, or under high over-loads. These are still the predominant quality considerations. But new factors like those of skid resistance to the tyres, etc. have also been added. The graph shows qualities of rubber, but still there are possibilities of making further improvements.

In spite of all this, there would appear to be a limit beyond which it might not be possible for synthetic rubbers to substitute the materials. One of the advanced countries, U.S.A., which consumes the highest percentage of synthetic rubber in the world is still using some 25 per cent of natural rubber, while such a percentage in other parts of the free world is about 45, as shown in Table 10·18.

Against a total estimated consumption of the order of 400 thousand tons, there should be no need left for India to import natural rubber. She should be able to attain self-sufficiency in rubber, the gap between production and consumption should be filled by synthetic and reclaimed rubber.

With a production target of 200 thousand tons for natural rubber, its share in the consumption will be reduced to about 50 per cent from as much as 90 per cent during 1955-56. (See graph on page 212).

A study of the comparative cost of production of two types will all the same be of interest. This question was thoroughly examined by the Tariff Commission. According to them, the cost of production of latex in India works out to Rs. 65·86 for 100 lbs. at the then prevailing prices (Table 10·19).

Of this total cost of Rs. 66 per 100 lbs., as much as 80 per cent represents wages and other general expenses. Again, the biggest

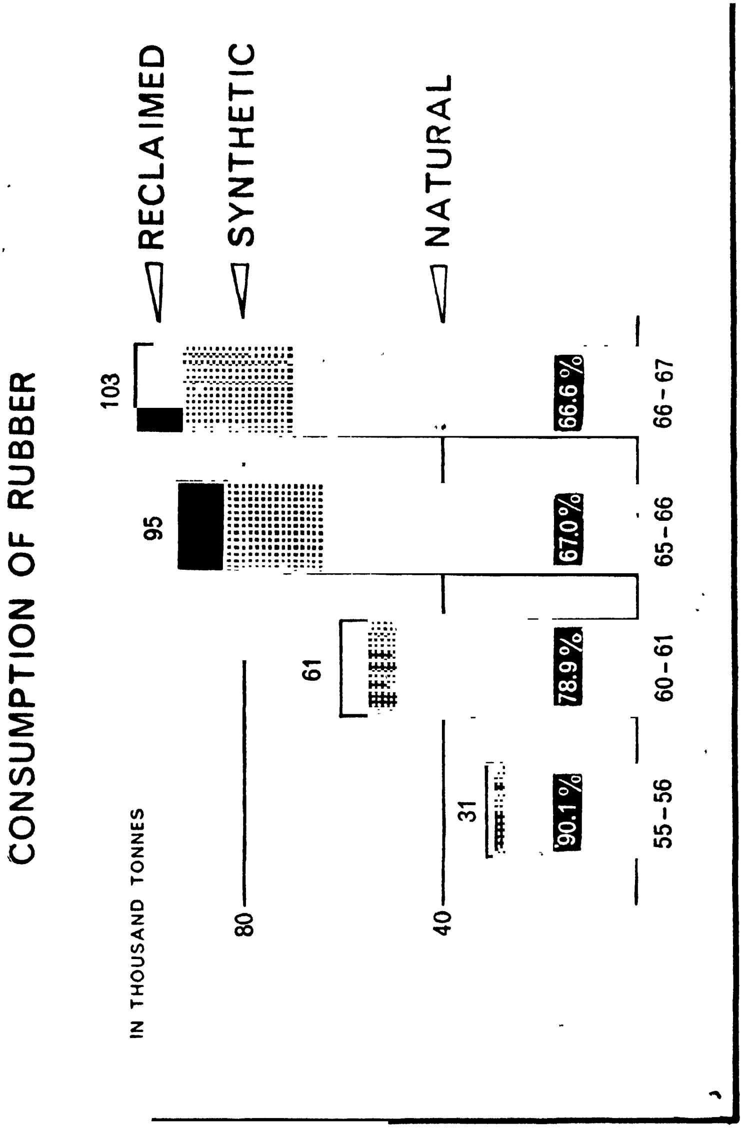

CONSUMPTION OF RUBBER
IN THOUSAND TONNES
RECLAIMED
SYNTHETIC
NATURAL
80
40
103
95
61
31
66.6 %
67.0 %
78.9 %
90.1 %
55–56
60–61
65–66
66–67

TABLE 10·18

CONSUMPTION OF NATURAL AND SYNTHETIC RUBBER AND PERCENTAGE OF SYNTHETIC RUBBER TO NATURAL RUBBER FOR WORLD AND U.S.A.

('000 Long Tons)

Year	*Natural Rubber consumption*		*Synthetic Rubber*		*Total Rubber consumption*		*Percentage of synthetic to total Rubber*	
	World	*U. S. A.*	*World*	*U. S. A.*	*Col 2+4 World*	*Col 3+5 U. S. A.*	*World*	*U. S. A.*
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1955	1890	635	1063	895	2953	1530	36·00	58·50
1960	2065	479	1798	1079	3863	1558	46·54	69·26
1961	2128	427	1920	1102	4048	1529	47·43	72·07
1962	2220	463	2175	1256	4395	1719	49·49	73·07
1963	2233	457	2360	1307	4593	1764	51·38	74·09
1964	2260	482	2745	1452	5005	1934	54·85	75·08
1965	2355	515	2975	1541	5330	2056	55·82	74·95

TABLE 10·19

CULTIVATION, UPKEEP AND COLLECTION CHARGES FOR 100 LBS. OF RUBBER

(Rupees)

A.	*Cultivation and Upkeep*		7·37
	Weeding and pruning	2·84	
	Forking and manuring	0·14	
	Spraying, dusting & other pest control measures	1·99	
	Cover crops, shade trees, etc.	0·12	
	Fences and boundaries	1·08	
	Maintenance of tools	0·08	
	Miscellaneous	1·12	
	Stores		4·74
	Manuring	0·77	
	Spraying, dusting & other pest control measures	3·65	
	Miscellaneous	0·32	
	General expenses		6·61
	Total of 'A'		18·72
B.	*Collection*		47·14
	Wages	24·50	
	Stores	1·07	
	Transport	0·33	
	General expenses	21·24	
	Total charges		65·86

item in labour costs relates to tapping which may be described as the task of a skilled worker. While a tapper in India taps hardly 250 trees a day, the corresponding figure for Malaysia is 350-400 trees. With improvements in labour efficiency and higher yields per tree, it can be reasonably assumed that the cost of production of latex may be reduced to some extent. The objective before Malaysia is to reduce the cost of production to about Rs. 45 per 100 lbs. Some of the best managed and high yielding estates in Ceylon are producing rubber at this cost even now. During the coming twenty years India should also be able to reduce the present cost to at least Rs. 50-55 per 100 lbs. when acre yield is expected to rise more than three-fold.

According to a FAO Study[21] the principal element affecting the cost of growing rubber is the annual yield per acre and it has been shown in Malaysia that doubling the yield per acre can reduce tapping charges per pound of rubber produced by 35 per cent, general charges by 60 per cent and cultivation cost by as much as 65 per cent.[22]

But for determining the future cost we have also to take into consideration some of the new factors like amenities for labour,

TABLE 10·20

PRICE OF RAW RUBBER RMA GRADE I

(Rs. per 100 lbs.)

		As in 1955	*Estimated future*
1.	Cost of latex	65·17	55·00
2.	Processing charges including packing	15·29	15·29
3.	Provision for gratuity	—	2·00
4.	Contingencies	4·00	5·00
5.	Freight & handling f. o. b.	3·45	3·45
	Total (1) to (5)	87·91	80·74
6.	Depreciation on plantation cost	6·82	9·00
7.	Grade differential to equate cost of production to RMA Grade I	2·20	3·19
8.	Cost of RMA Grade I	96·93	92·93
9.	Return at 12·5 per cent on employed capital	38·57	40·25
10.	*Ad hoc* increase in 1955	12·00	
11.	Total price for RMA Grade I to be retained by the growers	147·50	133·18
12.	Cess	6·25	13·05*
13.	Sales tax	2·04	2·04
14.	Price for consumers	155·79	148·47

* Includes Rs. 7 as additional cess recommended.

[21] Monthly Bulletin, *Agricultural Economics and Statistics*, FAO, March 1962.

[22] *Report of the Mission of Inquiry into the Rubber Industry of Malaya*, 1954.

provision of gratuity and bonus, depreciation or the cost of existing stand of rubber trees, provision for replanting, new planting and return on capital employed etc. Taking all these factors into consideration, the price at which rubber may be available to the consumer may be a little cheaper than today. Table 10·20 will give an idea of the present and future estimated price of rubber.

As against the future cost of about Rs. 1·48 per pound for natural rubber, rough calculations for synthetic rubber also indicate that the product from Brailly may be available at about Rs. 1·5 per lb.

Besides the cost to the consumer, we have also to take into consideration the initial investment. The authorised capital for the Brailly plant with a target production of 20,000 tons is Rs. 15 crores. Foreign exchange element in this is Rs. 7·5 crores. When the plant is geared to raise its production to about 30,000 tons, total capital investment may be of the order of Rs. 20 crores.

As regards natural rubber, it has been estimated that a new plantation in a most congenial area, like that of the Andamans, would call for an investment of about Rs. 20 crores for a plantation of 100 thousand acres. Production from such a plantation would be roughly 44 thousand tons of natural rubber on a conservative estimate of about 1000 lbs. per acre.

According to the calculations, natural rubber will have a clear advantage over synthetics. True, the gestation period in the case of synthetics is only 4 years as against 8 years for natural rubber, but for an equal investment natural rubber gives nearly double the production. Besides this, the latter is a labour intensive programme with practically no foreign exchange investment.

If due consideration is paid to all these factors, natural rubber industry in India could look forward to a bright future without fear from synthetics which for all time to come are likely to fill, at least in India, only the gap between the total demand for rubber and the availability of natural rubber.

PART TWO

SUPPLY PROJECTIONS

11

LAND UTILISATION

LAND Utilisation is a comprehensive expression connoting the use of land, inland water and mineral resources of a country in such a manner that it provides for a:

(*a*) maximum exploitation of land area available,
(*b*) rational distribution of that area among the various uses of land by reference on the one hand to the use for which a block or tract of land is best fitted, and on the other, national urgency and demand for the products of a particular use.

Negative aspects of land utilisation are the:

(*a*) prevention of misuse,
(*b*) prevention of over-exploitation with a view to quick and large returns, to the detriment of long-term conservation.

This definition indicates the direct objectives of land utilisation and also suggests the method for their attainment. Ultimate objective of a land utilisation policy is to improve the standard of living of the population, for the present as well as future generations. To secure this, it is necessary to pass the resources of the nation on to future generations as nearly unimpaired as possible.[1] The soil of a country is one of its vital resources.[2]

[1] Dr. G. D. Agarwal, "Planning of Land Use in India," *Rural India*, October, 1948, gives the example of U.S.A. where within 300 years when white man's plough first pierced the soil, 100 million acres of good land were gone.

[2] *Soils and Men*, U. S. Department of Agriculture, 1938, pp. 3-4.

This planned land use or what is also termed as 'Soil Conservation Farming,' refers to the use of each piece of land for the purpose for which it is best suited in a manner that the soil improves in fertility or at least a balance is maintained between the annual loss of soil and its replacement from sub-soil.

Along with this soil-climate complex there is still the question of optimum utilisation of the factors of production. This brings us to the problem of productivity of land itself. This in the narrower sense would mean the output per unit of an input factor.[3]

India, so far. has not thought of planning agriculture on such lines. In times of stress, she has simply patronised policies like indiscriminate deforestation and reclamation of lands irrespective of their suitability for cultivation.

Years back the Central Land Utilisation Sub-Committee, 1945, recommended the establishment of a Central Land Utilisation Authority which may be called the Indian Council of Land Utilisation. Functional aspects of the central authority were to fall under the following heads:[4]

1. Land use survey, mapping and statistics.
2. Planning and co-ordination of State plans.
3. Technical help and advice which goes with Planning.
4. Propaganda, publicity and publications which should be based on carefully tested results and done in a manner that the common man understands them.
5. Information bureau and library.

Since land is the most precious treasure of a nation, time has now come when a concerted action has to be taken for a proper land use planning. This would mean that each type of land is apportioned between different uses and such a combination is evolved with other factors of production as would yield optimum results in terms of the accepted objectives. If so, there should normally be no clash between the individual and national interests and the pattern of land use already evolved as a result of long experience should be an ideal one.

[3] Black *et al.*, p. 407. For various methods to calculate productivity of land, see paper by S. Thotepali at the Seminar on Rationale of Regional variations in Agrarian structure of India, Oct. 1956, pp. 144-156.

[4] *Report*, pp. 21-24.

But in actual practice we find that while the existing pattern of land use in different regions may be in some sort of harmony and adjustment with the other main characteristics of the regional economy, there do exist some maladjustments from the national point of view.

Production of a particular crop in a region from an individual's point of view is determined by two economic factors; (*i*) arithmetic or absolute advantage, and (*ii*) relative or comparative advantage.

The arithmetic or absolute advantage refers to the arithmetical size of the margin between costs and returns from the use of resources. If this margin is larger from the product in one area than in another, the first area has an advantage in producing the commodity. This necessitates the study of yield per acre, cost per unit of production and price of the product in various regions of the country. The comparative or percentage advantage on the other hand refers to comparative gains from various crops in the same region. For example, a region may have an absolute advantage over the other in producing a particular crop and produce a greater arithmetic margin per acre; and still not produce that crop on a wider scale because it may be having a comparative or percentage advantage in some other crop.

In our future land utilisation and cropping pattern, we will have to take into consideration all these factors. An attempt has been made here to examine these issues briefly.

Area under Forests

Appendix 23 shows the land utilisation pattern as at present. For purposes of comparison, a similar pattern in some of the other countries is also given in Appendix 24. Of the total 806 million acres, area under forests is only 138 million acres. This works out to about 17 per cent of the total area of the country. But according to the unanimous verdict of all the forest authorities throughout the world, at least 20 to 25 per cent of the area should be under forests, if a country is to be self-supporting in timber and fuel and has to maintain a proper balance in land utilisation.

Statistics regarding area under forests are at present being released in the Forest Statistics as well as Land Utilisation Statistics—both issued by the Ministry of Food and Agriculture. There is a discrepancy of 52 million acres in the two publications, in the sense that the latter gives the lower figures. Since the data given by Forest Statistics are computed by the Forest Department, it should be considered as more reliable. There is at present a gap of 67·5 million acres in the area according to village records when compared with the total geographical area as computed by the Surveyor-General. If the data released in the Forest Statistics are to be accepted, the uncovered gap of village records will also be reduced appreciably. There is, all the same, no reason why we should not be able to remove this discrepancy during the next 15-20 years whether it is definitional or otherwise. Some little increase in the forest area may be necessary for practical considerations as well. Area under forests—173 million acres by 1980-85 which works out to about 22 per cent of the total geographical area—would then seem to be of the right order.

Since specific steps have to be taken now for a proper utilisation of the total area of the country, gaps in Land Utilisation Statistics will have to be bridged at the earliest possible time. Many further recommendations, particularly with regard to the future forest policy will depend on the position of this uncovered 67·5 million acres.

Land not Available for Cultivation

This covers two heads—land put to non-agricultural uses and barren lands. Housing needs of the growing population, industrial sites and expanding network of roads and railways are all non-agricultural uses of land. While figures for the area put to non-agricultural uses are not available for 1950-51, it stood at 32·9 million acres in 1955-56 and 35·7 million acres in 1963-64. This would indicate an annual increase of about 1 per cent in the area. During the next 20 years when housing activity as well as industrial development is likely to increase in tempo, minimum land required for the purpose may be of the order of 43 million acres, an increase of about 23 per cent during a period of 20 years.

It is important to note that most of the extension in this respect will be at the cost of existing cultivated lands. A reduction in the barren lands may, however, be possible if some of them can be put under tree crops and pastures. This has accordingly been assumed to be reduced to 72 million acres.

Miscellaneous Tree Crops

With every increase in the population and likewise rising standards, larger quantities of wood will be required for fuel and other minor domestic purposes. This would necessitate the raising of village plantations, nearer the homes of the cultivators. Area under such trees has accordingly been assumed to go up to 20 million acres, an annual increase of about 3 per cent.

Grazing and Pastures

Permanent pastures at present cover an area of only 35·7 million acres. With a livestock population of over 400 million heads, a proper place has to be found for these dumb creatures on the land. Our targets of food from animal origin will nowhere be near realisation if the cattle remain underfed or even starved as at present.

A major portion of the existing forest areas is open for grazing for the whole of the year. A proper forest policy has to be evolved in keeping with the requirements of the country. If it is ultimately decided that keeping the forests open for grazing for the whole of the year does not go well with the development of forests, some sort of a rotational system will have to be found. In that case more of pasture lands will have to be developed.

Even otherwise, in a programme of full utilisation of the cattle wealth of the country, a meagre area of just 36 million acres under permanent pastures is not sufficient. True, a major portion of the 47 million acres of cultivable waste and another 56 million acres of fallow lands, may not be suitable for intensive cultivation. But nothing should stand in our way to convert them into pasture lands wherever possible.

The Royal Commission on Agriculture had estimated that three-fourths of culturable waste and one-fourth of the unculturable waste can be considered as fit for grazing. Without depending much on the findings of the Commission, the possibilities of extending pasture lands in this direction have to be explored. We require something like 700 million tons of green fodder[5] for a proper feeding of our livestock.

Even a developed pasture land would yield not more than a ton

[5] See Chapter 3.

of green grass per acre. If we have simply to depend on pastures for green fodder, we will require 700 million acres for the purpose. This is, however, not the case. We have already about 15 million acres under fodder crops. Under good conditions. a crop like 'Barseem' for fodder will yield 100,000 lbs. or 40-45 tons per acre. Only 30 million acres would be sufficient if put under regular fodder crops. It may not be difficult to raise the area under fodder crops to say 20 million acres, if required.

The whole of the fodder economy has to be carefully examined. We must first of all assess the potentialities of green fodder from non-cropped area. This relates to forest grazing, pastures already in existence and others which may be possible to develop on waste lands like road sides, etc. This having been determined, the real requirements of the area under fodder crops may be much less than the existing 15 million acres. It has to be borne in mind that the question is not merely one of allocating a specific area for fodder crops. It would be wrong to assume that the per acre yield of area under fodder crops is anywhere near 40-45 tons. We will have to find the most suitable fodders and grasses for different regions and determine their yields under optimum conditions. Some research may also be necessary on dual purpose crops, which besides providing fodder in the first one or two cuttings, can also give a full grain crop when allowed to ripen. The cultivator will have to be educated to make necessary changes in the existing practices, if and when needed. Fodder planning will actually have to be done practically on the same lines as regular cropped area. A good deal of green grasses are now being wasted. They will have to be first fully utilised and requirements of other regions met from suitable fodder crops on the basis of livestock population in the region concerned. Area under pastures may have to be increased to about 40 million acres as against 36 million acres in 1958-59.

Culturable Waste

The term culturable waste is defined to include all lands available for cultivation but not taken up for cultivation or abandoned after a few years for one or the other reason. Lands which were classified as "culturable waste" at the time of settlement some years ago still continue to be shown as such in the revenue records even though they cannot be made culturable after incurring any reasonable expenditure. Similarly, some of the lands, which are culturable, continue to be classified as barren and unculturable or pasture lands. In some other cases, pasture lands have been included in the category of culturable waste.

Theoretically all the 47 million acres classified as culturable waste should be available for cultivation. But in the light of the findings of the Waste Lands Survey and Reclamation Committee not more than a million acres of land may be available for cultivation in blocks of 250 acres and above in the 7 important States surveyed by them. The matter needs to be thoroughly investigated by all the States before any definite idea about lands actually available for cultivation can be formulated. On the basis of available information we cannot be very optimistic about the usefulness of this category of land. It may not be possible for us to reclaim more than 7 million acres from the culturable waste which may be reduced to 40 million acres at the end of 15-20 years.

Fallow Lands

This head accounts for about 56 million acres of land, comprising 28 million acres of 'current fallows' and the remaining 28 million acres of fallows other than current fallows. Current fallows are those which are not cultivated for one year and are given rest. The primary object is to restore fertility of the depleted soil. They are left fallow to disintegrate and aerate. The introduction of new crops, intelligent crop rotations, technical improvements and above all the use of fertilisers, may reduce the necessity of letting lands fallow. It may, however, still pay the cultivator to leave some of the lands fallow under conditions of extreme drought in dry areas. These may then be reduced to say 16 million acres from 28 million acres as at present.

As for other fallows, they are those lands which are left fallow for periods from one to five years for various reasons. This may be due to the poverty of the cultivator, inadequate supply of water, malarial nature of climate, unremunerative nature of farming, or even the fear that if land is let out to tenants, they may acquire permanent rights. It should be possible for us to do away with most of these problems. It might then be possible for us to reduce these areas to 15 million acres, nearly half of the present size.

Gross Cropped Area

Gross cropped area in 1960-61 was about 376 million acres and 390 million acres in 1964-65. Changes in this area will depend upon increases in

(*a*) net sown area, and
(*b*) double cropped area.

(*a*) Of the 806 million acres of geographical area, India's net sown area in 1960-61 was about 328 million acres (40 per cent). As compared to other countries of the world, this in itself is a high percentage. Besides there has been a steady increase of the order of 2·3 million acres in the net sown area during the past few years. This addition has been possible because of:

(*a*) land reclamation operations,
(*b*) reduction in fallow lands, and
(*c*) virgin lands coming under cultivation as a result of new irrigation projects.

It is quite possible that net sown area may continue to increase as a result of the operation of these factors. But the upper limit can be placed at a maximum of 400 million acres.[6] With all the changes envisaged in the land utilisation pattern as discussed above, the net sown area by 1980-85 may be of the order of 345 million acres.[7]

(*b*) In north India and major portion of southern plateau main crop season is the south-west monsoon period, extending from June to September. When the monsoon crop is not taken, rabi crop is raised on land kept fallow for the purpose. Principal cereal crops thus raised are rice, wheat, millets, sorghum, maize and barley. Pulses are normally mix-cropped with cereals in rabi season. When sown pure in summer on monsoon rain, they serve as catch and cover crops. Appendix 25 would give an idea of important double cropping systems in different parts of India. In the areas where water is available either through rains or by irriga-

[6] P. C. Bansil, *India's Food Resources and Population*, pp. 75-83.

[7] It touched 340·5 million acres in 1964-65 which was, of course, a very good year. Our estimate above may, if at all, be an underestimate.

tion, double cropping is practised. In the coastal regions of the Madras State, second crop is made possible by the prevalence of equitable temperature and occurrence of north-east monsoon.

Column 4 in Table 11·1 shows the double cropped area which touched 45 million acres in 1955-56. The corresponding figures for 1956-57 and 1960-61 were 46 and 48 million acres respectively.

TABLE 11·1

ALL INDIA CULTIVATED AND IRRIGATED AREA

(Million acres)

Year	Cultivated area			Irrigated area			Unirrigated double cropped
	gross sown	net sown	double cropped	gross	net	double cropped	
1947-48	278	246	32	50	47	3	28
1948-49	277	243	34	50	47	3	31
1949-50	321	283	38	54	50	4	34
1950-51	326	293	33	56	52	4	29
1951-52	329	296	33	57	52	5	28
1952-53	340	305	35	58	53	5	31
1953-54	352	313	39	60	54	6	33
1954-55	356	316	40	61	54	7	33
1955-56	363	318	45	63	56	7	38
1960-61	376	328	48	69	60	9	39

Double cropped area in India has varied between 12-14 per cent as against 34 per cent in China. This difference is, however, primarily due to completely different climatic, topographical, and rainfall conditions as well as the nature of irrigation available in the two countries.

A second crop on a particular piece of land can be raised only if sufficient water is available for the crop. Irrigated double cropping as seen from Table 11·1 is quite negligible as compared to unirrigated double cropping. Double cropping in the unirrigated areas is primarily linked with natural factors. Man-made efforts would play, if at all, only a negligible part in increasing or decreasing this area.

The responsibility for such a situation would appear to lie in the fact that but for the areas commanded by private tube wells, sufficient water is not available to raise two irrigated crops from the same field. What happens is that one crop is raised with the help of irrigation and the other with rain. This would mean that additional supplies of irrigation will have a direct effect on even unirrigated double cropped areas according to the condition of rainfall in the region. Table 11·2 which divides the double cropped area into different rainfall zones shows clearly that there is a significant correlation between the double cropped area and irrigated area in the different rainfall regions of the country.

TABLE 11·2

RELATION BETWEEN NET IRRIGATED AREA AND UNIRRIGATED DOUBLE CROPPED AREA

(Million acres)

Region	*Cultivated area*			*Irrigated area*			*Unirrigated-double cropped area*	*Ratio between Col. 6 and Col. 8*
	Gross	*Net*	*Double cropped*	*Gross*	*Net*	*Double cropped*		
1	2	3	4	5	6	7	8	9
Heavy rainfall above 75″	17·1	14·7	2·4	3·0	2·7	0·3	2·3	1 : 0·9
Assured rainfall (45″ - 75″)	68·3	58·2	10·1	10·8	10·2	0·6	9·6	1 : 0·9
Medium rainfall (30″ - 45″)	169·8	151·8	18·0	29·2	27·5	1·7	16·7	1 : 0·6
Dry rainfall								
(*a*) 20″ - 30″	68·6	62·8	5·8	13·4	10·7	2·7	3·4	1 : 0·3
(*b*) Less than 20″	28·3	25·9	2·4	3·9	3·0	0·9	0·5	1 : 0·2
All India total	352·1	313·4	38·7	60·3	54·1	6·2	32·5	1 : 0·6

If we want to have a sound estimate of the double cropped area, it would be necessary to conduct a proper study of the data presented in Table 11·2 for a number of years and also form a correct idea of the future irrigation facilities in the various rainfall zones. But in the absence of such a study we can form a rough idea from the all-India picture where we find that unirrigated double cropped area has varied from 54 to 70 per cent of the net irrigated area depending upon the condition of rainfall. In a normal year, this can be taken as 60 per cent for purposes of rough calculation. If gross irrigated area in 1980-85 is taken as 136 million acres, net irrigation may be of the order of 106 to 110 million acres. Unirrigated double cropped area in that case may be 63-66 million acres. Adding 25-30 million acres of irrigated double cropped areas, total double cropped area would work out to 91-93 million acres.[8] Taking a round figure of 90 million acres, gross cropped area in India by 1980-85 would be roughly 435 million acres. Last column of Appendix 23 provides necessary details in this respect.

Cropping Pattern

With due consideration to the targets for various agricultural crops as already arrived at, Table 11·3 attempts to give an idea of the cropping pattern by 1980-85 along with a comparable picture for 1955-56. Such a distribution at an all-India level, which at best can be considered as only a rough exercise, may seem to be arbitrary on the face of it, but the guiding principle in each case has been the achievement of objectives as discussed in Part I of this study.

Future land use planning will, all the same, have to think in terms of:

1. detailed regional distribution of crops, and
2. diverting better lands to high yielding crops both in the case of food grains as well as cash crops.

It has not been possible to discuss the first point in a study like this which takes only a telescopic view of total agricultural economy of the country. This does not mean that it is less important or it has no priority at the moment. The position is just the reverse. The only apology for leaving it out is that it would be better to tackle it at regional levels. Experts in various regions are fully conversant with local agricultural conditions. They will be in a better position to look to the most advantageous use of land in their region.

[8] The breeders of today are evolving short duration varieties. How far this trend would increase the double cropping area further may be difficult to assess at present. Limitations of adequate and timely availability of water will in any case have to be reckoned with. The introduction of short duration crops is likely to encourage multiple cropping so as to raise the intensity of cropping.

TABLE 11·3

CROPPING PATTERN IN 1955-56 AND 1980-85

(Million acres)

Sl. No.	Crops	Gross area under the crop 1955-56 irri-gated*	unirri-gated	total	1980-85 irri-gated*	unirri-gated	total
1	2	3	4	5	6	7	8
1.	Rice	41·5	34·8	76·3	50	13·0	63·0
2.	Wheat	10·4	18·8	29·2	20	13·0	33·0
3.	Maize			8·9	5	5·0	10·0
4.	Barley			8·2	4	8·0	12·0
5.	Jawar	9·7	95·8	42·7	4	40·0	44·0
6.	Other coarse grain			45·7	5	65·0	70·0
7.	Total cereals	61·6	149·4	211·0	88	144·0	232·0
8.	Pulses	7·0	48·1	55·1	17	44·0	61·0
9.	Total food grains	68·6	197·5	266·1	105	188·0	293·0
10.	Sugarcane	3·3	1·1	4·4	7	—	7·0
11.	Potato	0·7	—	0·7	2	—	2·0
12.	Cotton	2·1	18·1	20·2	11	21·0	32·0
13.	Jute and mesta	2·0	0·2	2·0	4	—	4·0
14.	Groundnut	0·8	11·8	12·6	8	15·0	23·0
15.	Other oil seed	—	16·9	16·9	—	22·0	22·0
16.	Vegetables	3·5†	—	3·5	7	—	7·0
17.	Fruits	2·5†	2·0	4·5	3	2·0	5·0
18.	Miscellaneous	4·5	26·9	31·4	23	17·0	40·0
Grand total		88·0	274·0	362·5	170	265·0	435·0

* Includes 35 million acres of assured rainfall area also.

† Tentative.

It would, perhaps, be in the interest of the country if such studies are taken up at state or even regional levels. All such studies when examined together are sure to bring out very interesting results of far reaching importance. The crop map of the country can then be redrawn.

As for the other point of diverting better lands to more productive crops, due attention has been paid to this factor here. The whole of sugarcane and major portion of rice, for example, are supposed to be grown on irrigated areas. Nearly 1/3rd of the gross area under cotton and a sizeable portion under groundnut will have irrigation facilities. From among the remaining food crops, wheat, maize and barley—the three most responsive crops—have been allocated the maximum irrigated areas. A crop like potato, a very heavy yielder, is supposed to have four to five times the existing area under it.

Fruits and vegetables at present have about 5-6 million acres. They have been given 12 million acres in the 1980-85 cropping pattern. It may not be possible to grow vegetables without irrigation. They will not, therefore, be required to be grown on dry lands. It is quite possible that the country may require more of fruits. If so, there is a scope in the proposed cropping pattern to make any adjustment in the desired direction.

Total area under the remaining crops which include plantations like tea, coffee, rubber, coconut, spices, including chillies, and tobacco, etc., is about 5-6 million acres at present. More than 21 million acres of irrigated area is set apart for these crops. In the future economy of the country, these miscellaneous crops are going to play a very important role. They are the major source of foreign exchange earnings—so very important for the developmental programmes.

The Cashew and Pepper Export Promotion Council, has recently succeeded in securing a flourishing market in Russia for cashewnuts. Tea, coffee, chillies and a number of other so-called minor crops like cardamom, etc., are also valuable from the point of foreign exchange. An effort has thus been made here to work out a tentative framework which may be able to meet the agricultural requirements of the country in the coming two decades.

12

AGRICULTURAL POTENTIAL

OUR discussion in the preceding pages has enabled us to formulate targets for the major agricultural commodities (summarised in Table 12·1). While drawing up these targets, care has been taken to give due consideration to the technological possibilities of agriculture so that we remain within the feasible limits. Table 12·2 provides the necessary details for the achievement of targets arrived at in Table 12·1.

It has been assumed that all the irrigation projects started during the first three Plans will be successfully completed and utilised and full benefits will be derived from minor irrigation projects that can be implemented. Necessary arrangements will have to be made for the supply of requisite quantity of manures and fertilisers. Practically the whole of the country will be covered with improved seed and adequate pest control measures. The Third Plan has already broken new grounds with regard to the so far neglected but all important aspects of soil conservation, drainage and improved implements. As a result of the emergency created by the conflict with China, some of these targets in respect of these items were actually raised in the beginning of 1963. These matters will no doubt be pursued with vigour in the subsequent Plans. All these technical aspects of the problem have been discussed in subsequent chapters.

Floods and droughts have also been responsible to wipe off a sizeable portion of our food crops. They may be due either to excessive rainfall, or deforestation and consequent silt denudation which causes the gradual rise of river beds. Table 12·3 shows

TABLE 12·1

AGRICULTURAL PRODUCTION PROGRAMME
1960-61 TO 1980-85

(Million tons)

	1955-56	1960-61	1980-85
	Actual		*Targets*
Food grain	65·8	79·7	153·0
Roots	4·7	5·8	17·5
Sugarcane (in terms of gur)	6·0	10·2	21·0
Fruits	4·0	6·0	35·0
Vegetables	6·0	9·0	50·0
Milk	17·0	24·0	72·0
Fish and Meat	1·6	2·2	10·0
Vegetable Oils and Ghee	1·7	2·0	8·5
Oil seeds	5·6	6·5	25·0
Cotton	0·7	0·9	2·6
	(4·0)	(5·4)	(15·5)
Jute and Mesta	1·0	0·9	2·5
	(5·4)	(5·1)	(14·0)
Tea	0·3	0 35	0·75
	(680)	(777)	(1500)
Coffee	0·033	0·067	0·18
	(74)	(150)	(404)
Rubber*	0·023	0·025	0·175
	(52)	(56)	(392)

* Excludes synthetic rubber.

NOTE : Figures in brackets represent million bale in the case of cotton, jute and mesta and million lbs. for tea, coffee and rubber.

areas affected by floods during the past few years. On an average, nearly 12 million acres of cropped area suffer from floods. Practically the whole of this is under food grains. Assuming that about 50 per cent of the crop is lost as a result of these floods, annual loss on this account may be put at about 2 million tons.

According to the Interim Report of the High Level Committee on Floods, but for periodical damage from floods, national income would be higher by Rs. 100 crores a year. Losses of cattle and human lives and breakdowns in transport and industry are besides this.

Considering the importance of the programme, every effort will have to be made to adopt various flood control measures. The techniques may be improved, and more research conducted if

TABLE 12·2

AGRICULTURAL POTENTIAL OF INDIA 1980-85—ASSURED WATER SUPPLY AND DRY AREAS SEPARATELY

	Gross area (M. acres)			*Production (M. tons)*			*Yield per acre (lbs.)*			
	*Irrigated**	*Unirri-gated*	*Total*	*Irrigated*	*Unirri-gated*	*Total*	*Irrigated*		*Unirrigated*	
							Present	*future*	*Present*	*Future*
1	2	3	4	5	6	7	8	9	10	11
Rice	50	13	63	56	4	60	1034	2509	500	689
Wheat	20	13	33	20	5	25	945	2240	514	862
Maize	5	5	10	4·5	2·5	7	1056	2016	657	1120
Barley	4	8	12	3·5	3·5	7	910	1960	609	980
Jowar	4	40	44	4	10	14	952	2240	391	560
Other Coarse Grains	5	65	70	4	11	15	800	1792	300	379
Total cereals	88	144	232	91	37	128	—	2316	—	576
Pulses	17	44	61	14	11	25	800	1845	300	560
Total Food Grains	105	188	293	105	48	153	—	2240	—	572

TABLE 12·2—(*Contd.*)

1	2	3	4	5	6	7	8	9	10	11
Potato	2	—	2	11·5	—	11·5	6000	13000	—	—
Sugar cane (Gur)	7	—	7	21	—	21	4300	6720	—	—
Cotton	11	21	32	10 †	5·5 †	15·5 †	200	350	75	103
Jute	4	—	4	14 †	—	14 †	965	1400	—	—
Groundnut	8	15	23	8	7	15	1000	2240	700	1045
Other Oil seeds	—	22	22	—	10	10	—	—	550	1018
Vegetables	7	—	7	50	—	50	—	16000	—	—
Fruits	3	2	5	27	8	35	—	20160	—	8960
Miscellaneous	23	17	40	—	—	—	—	—	—	—
	170*	265	435	—	—	—	—	—	—	—

* Includes assured rainfall areas.

† Million bales.

need be. This will automatically add something like a million tons of food grains annually, even if 50 per cent is saved from damage.

A saving of one million ton from this source may look to be quite insignificant in a production programme of 153 million tons of food grains. But the importance of the programme lies in its humanitarian aspect and the stability that such measures will impart to the agricultural economy of the region concerned.

Extension Services

Our cultivator by virtue of experience which has been passed on to him from generations, is fully conversant with many of the improved practices. But there is nothing static in any science, nonetheless so in agriculture. All countries like Japan, Taiwan and U.S.A., with advanced agriculture, have opened a network of research centres throughout their countries in order to find out a scientific solution to the day to day problems facing the cultivators.[1]

Research for the sake of gathering information is a luxury that India cannot afford. It has to be conducted to find answers to existing problems and difficulties holding down agricultural production. The results have then to be vigorously and effectively demonstrated wherever applicable. Research and technology are otherwise well nigh useless in themselves unless they reach the people and until farmers adapt the new knowledge to their needs. Two things are needed to carry the results of research to the farmers. One is the agency through which information is carried and the other is provision of assistance at the community level in order that he may adapt the information to his immediate situation.

The connecting link is the village level worker who is in a strategic position to study the problems and serve the needs and interests of farm families. His duties are legion and he has to be constantly alert to the economic, social and cultural changes vitally affecting the lives of the farm people. His concern is the people as against the narrow precincts of a paddy or a wheat field.

[1] *Cf*. Report of the Agricultural Personnel Committee, Planning Commission and Manpower Studies No. 4, Planning Commission, for details in different countries.

TABLE 12·3

AREA OF CROPS AFFECTED BY FLOODS IN VARIOUS STATES OF INDIA DURING 1955-56

(Thousand acres)

Name of State	*Area affected*							*Total area affected*	*Average area affected annually*
	1950	1951	1952	1953	1954	1955	1956		
Uttar Pradesh	2600	252	N. A.	2251	3335	10100	6183	24721	3531
Bihar	335	7	99	7300	6195	4378	2645	20959	2994
Bengal	64	0·3	54	6	1050	851	6541	8556·3	1223·7
Assam	300	835	600	207	7776	3462	1480	14660	2094
Orissa	N. A.	N. A.	N. A.	N. A.	N. A.	1639	806	2445	349·3
Andhra Pradesh	110	141	116	433	324	497	3434	5055	722
Punjab	N. A.	10	N. A.	N. A.	3	6350	333	7296	1042·2
Jammu & Kashmir	N. A.	N. A.	N. A.	N. A.	112	N. A.	N. A.	112	16
Total	3409	845·3	869	10197	18795	27277	21422	83814·3	11972·2

Agriculture in India as elsewhere is a complex problem.[2] As there is a strange mix-up between the home and the business, the matter has got to be tackled from a humane point of view. Those charged with the task of increasing agricultural production have to realise that farm home is an independent social unit and the farmer a master of his own decisions. Nothing is to be imposed on him. No effort should be spared to build in him ability towards right decision making. The key to the nation's success on the agriculture front is an efficient extension service.[3] India will also have to keep pace with the other advanced countries in this respect. A mere covering of the whole country with the existing community development programme would not be sufficient. Our extension services will have to be further strengthened and enthused with life. Future plans may, thus, have to emphasise more on quality than increasing the number.

An allied problem is that of agricultural education. Prof. Revelle, Member of the Education Commission, suggested that India should have by 1981, 20 Agricultural Universities, each having 6000 members on the staff including about 5000 as extension staff. Each University will have about 6000 students for the Degree and 5000-8000 for the diploma courses. This type of extension programme in agriculture will, possibly, have to be undertaken.

Other Exogenous Factors

Agricultural production is not only a function of physical inputs and improved practices, known as technological possibilities. Just like any other industry, economic factors—mainly exogenous ones—also play an important role. The institutional framework of rural economy can be analysed broadly in relation to land policy, manpower resources, credit, marketing, distribution and accompanying price relationships. It is not proposed to discuss these and many other allied problems[4] here. But we are fully conscious of their importance in any plan of agricultural development.

[2] Dr. B. N. Ganguli, "Complexities of Agricultural Production," *Kurukshetra*, January, 1960.

[3] C_f. *Ford Foundation Team Report*, pp. 107-139.

[4] For a detailed discussion of these factors, refer to author's *India's Food Resources*, *op. cit.*, pp. 69-74; "Dynamism of Indian Agriculture," *Modern Review*, August and September, 1958; and "Consolidation of Holdings," *Agricultural Situation*, November, 1959.

The Government in India is at present up against these problems. Institutional changes now being sponsored are intended to create, say, by 1980-85 essential conditions for a tremendous development of agriculture. Our achievements in the short period may not be significant. But because of heavy demands of the country on the future agriculture, lethargy of the past will have to give place to action. It would not be too much to assume under the circumstances that during the coming 20 years, necessary institutional changes will be brought about in keeping with the needs of a developing economy.[5]

Administrative Lacuna

Last but certainly not the least is the efficiency of the administrative machinery responsible for carrying out these programmes. The existing organisational machinery charged with the task of agricultural development is not geared to the needs of a developing economy. The Foodgrains Policy Committee pointed out long back that "Grow More Food" efforts have suffered in the past from red-tape and delays inherent in departmental work. The position has not so far improved even about after 15 years.

Findings of Reports of the Ford Foundation Team and Agricultural Administration Committee would be of interest in this connection.

The Ford Foundation Team, for example, pointed out that action is required at the highest level to meet the crisis.[6] Urgency of the problem and the need for clear-cut organisational adjustments to meet it have to be understood at State level. The organisational problem does not stop at the State level. Appropriate changes, redirecting efforts at district, bloc, and village level must also occur. Similarly the Administration Committee was strongly of the opinion that a streamlined agricultural administration is an urgent necessity. The position according to them is bleak enough to justify that drastic measures be taken, not merely to retrieve the situation but to make up for the time already lost.[7]

[5] Cf. Tarlok Singh, "India's Rural Economy and its Institutional Framework," *Studies in Indian Agricultural Economics*, edited by J. P. Bhattacharjee, pp. 300-315.

[6] Report on India's Food Crisis and Steps to meet it, 1959, pp. 20-21.

[7] Report of the Agricultural Administration Committee, p. 4. Also pp. 12, 13, 21, 49, and 50.

This view is also shared by Dr. Ensminger when he says that the administration and staff of agricultural departments needs to be thoroughly reorientated, on a vigorous and broad scale. India has the know-how for food production. The crux of the problem now is one of gearing up its administration.[8] A critical survey of the Food Production Programme in Madras State points out in the same tone that increasing agricultural production in India is more an administrative problem than a technical one.[9]

From all that has been stated above, it would be obvious that these miscellaneous factors are of fundamental importance for any programme of agricultural development. Since the Government is already fully seized with the problem, it can be confidently assumed, for the purpose of this study, that all the existing obstacles[10] of this nature will be removed during the stipulated period of two decades.

All this having been done, short notes on the major commodities as given below will also be necessary.

Food Grains

Rice and wheat production has been placed at a little more than two and a half times the 1955-56 level, while envisaged increases in the case of other crops are not so high; mainly because, there is bound to be a socialisation of demand for food grains like rice and wheat.

Since water is a limiting factor in agricultural production, it becomes extremely necessary under the circumstances to allocate a major portion of the irrigated area to only those crops which are more responsive to it. Among the food grains, a major portion of wheat and rice as well as maize have to be put under irrigation.

While the gross area under food grains remains more or less constant, a sufficient reduction in the net area allocated to food grains may be possible. It may also be easy to have a good deal of the area under pulses as a second crop. Average yields on the basis of existing estimates may appear to be quite high when compared

[8] *Ibid.*, p. 4.

[9] Report by P. P. I. Vaidyanathan, p. 11.

[10] Cf. P. C. Bansil, *Obstacles in the Agricultural Production Programme.*

with the present level, yet they are quite low as compared to the achievements of the "Krishi Pandits." (Table 12·4). Even otherwise, the potentialities of high yielding varieties now being introduced have not been taken account of. If successful, they might usher in a biological revolution.

TABLE 12·4

AVERAGE YIELD PER ACRE—IN LBS. DURING 1960-61 TO 1965-66 AND UNDER CROP COMPETITIONS

Crop	*Under crop compe-titions**	Average all India yield					
		1960-61	1961-62	1962-63*	1963-64*	1964-65*	1965-66*
Rice	11164	904	917	815	924	957	780
Wheat	5870	759	794	707	652	815	748
Jowar	6935	476	393	476	454	484	389
Bajra	2401	255	288	321	309	339	281
Gram	3777	601	540	519	428	580	505
Potato	60319	6469	5981	7242	5626	7598	7340

Average of 1953-54 to 1957-58

The secret of the success of the Krishi Pandits in crop competitions lies only in the adoption by them of improved techniques of farming. True, every cultivator in the country may not be able to put the amount of interest and labour involved for the purpose, yet they should serve as a sufficient incentive to all farmers.

Viewed in the light of these high achievements, the projected programme for food grains as visualised in this study would seem to be quite a modest one. As for other important crops besides what has been discussed already, some further explanation would perhaps be necessary for a proper understanding of the "how and why" of Table 12·1

Sugarcane

Sugarcane occupies the field for nearly twelve months. In the Southern States of India it may extend from 12 to 18 months. This is one of the most consuming crops and higher yields are possible only under irrigated conditions and intensive cultivation.

Area under sugarcane has varied from about 4 to 4·8 million acres during the past few years and average yield (in terms of gur) per acre has remained round about 3,000 lbs. But there are wide variations in yields in different parts of the country. Uttar Pradesh which accounts for more than half of the area under the crop, has yields less than half of those attained in Maharashtra, Madras and Andhra Pradesh.

In the high-yielding Southern States, sugarcane is grown mostly under irrigated conditions and by the factory owners more or less on a plantation scale. The yield is consequently high. It is very interesting to observe that where there are corporations operating their own sugar land, performance when viewed on an acre yield basis invariably is at least twice that of the small planter. Sociologically also, Madras, Andhra Pradesh and Maharashtra have the most favourable conditions for the growth of sugarcane in India. A suggestion is often made that sugarcane production should be restricted to the Southern region. But before any major policy decision can be taken even from a long term view, it would be necessary to examine all the pros and cons of the matter. The area under sugarcane in Madras, Andhra Pradesh and Bihar can be increased either by reclaiming virgin soils or by shifting the areas from under some other crop. Possibilities in both these respects are rather limited.

Almost all the cane required by sugar factories in Maharashtra and Madras is delivered at the factory gate, the corresponding percentage for Bihar and U.P. being only about 60. Factories have thus to be within quite a reasonable distance from the cane fields. But it may not be a feasible proposition to shift the existing factories from the North to the South due to economic and political reasons.

Assuming that it is decided to start all the new sugar factories in the South, there is also the need to study the physical possibility of shifting areas under sugarcane in U.P., to some other crops. Despite its low yields, sugarcane is the most profitable crop even in U.P.[11] It has been calculated that the cost of raising a ton of sugarcane is only Rs. 5 to 6 in Upper India as against Rs. 9 in

[11] Dr. Vidya Sagar, "Cost and Return in Farming," 1930-48. (Unpublished Ph.D. thesis).

Mysore and Rs. 10-11 in Bombay and Madras.[12] These data are old, but the proportions between North and South may hold good even today. It would thus be rather an impossible task to persuade the U.P. cultivators to change their existing cropping pattern.

Since U.P. occupies more than half of the existing area under the crop, solution of the problem would lie in raising the yields in that region alone to near about the South Indian level. An agro-economic survey of sugarcane cultivation was conducted by Dr. G. D. Agarwal, in the various tracts of U.P., with the help of his post-graduate students. His conclusion is that per acre yields can easily be doubled there.[13] The study showed that factors responsible for depressed yields there are:

1. Extension of cultivation to unsuitable lands.
2. Inadequate tillage and manuring.
3. Inadequate irrigation facilities.
4. Improper drainage.
5. Lack of finance.
6. Pressure of population.
7. Complete neglect of ratoon crops.
8. Pests and diseases.

If sugarcane yields are to be raised in U.P., the obvious course would be to remove all the defects mentioned above. Weedy fields in North India or even the practice of inter-planting other early maturing crops lead to higher fibre content and hence inferior juice quality.

Some of the progressive cultivators in U.P. and Bihar have produced more than double the average for Maharashtra and Madras. A study of yields on State farms in U.P. (1929-50) revealed that the highest yield per acre on all the farms was more than 1,100 mds. or about 40 tons which is much above the average yield per acre, about 26 tons, for the period 1929-50.

Under the Sugarcane Development Scheme, where area under the Scheme is progressively increasing year after year, yields are going up (Table 12·5) in Northern States as well.

This would mean that even natural conditions in North India are quite favourable for the growth of sugarcane. In Bihar and U.P.,

[12] A. K. Yagna Narayan Aiyer, *Field Crops of India*, p. 209.

[13] Dr. Vidya Sagar, *op. cit.*

TABLE 12·5

AREA AND ACRE YIELD OF SUGARCANE IN THE WHOLE STATE AND IN THE DEVELOPMENT ZONES FOR THE MAJOR SUGARCANE STATES—DURING THE YEARS 1961-62 TO 1964-65

(Area—'000 acres
Acre yield—tons)

State	1961-62				1962-63				1963-64				1964-65			
	Whole State		*Dev. zone*		*Whole State*		*Dev. zone*		*Whole State*		*Dev. zone*		*Whole State*		*Dev. zone*	
	Area	*Acre yield*	*Area*	*Acre yield*	*Area*	*Acre yield*	*Area*	*Acre yield*	*Area*	*Acre yield*	*Area*	*Acre yield*	*Area*	*Acre yield*	*Area*	*Acre yield*
Sub-Tropical region																
U. P.	3367	14·98	2431	15·01	3118	13·63	2136	14·00	3036	15·41	2006	16·09	3433	16·12	2428	16·41
Bihar	487	12·79	216	18·97	400	12·00	182	15·88	348	14·61	210	18·45	412	16·50	—	—
Punjab	668	13·02	182	17·45	644	12·90	140	16·33	576	15·26	140	18·75	667	16·72	75	18·15
Tropical region																
Maharashtra	349	23·15	164	N.A.	349	32·31	172	47·70* 40·04†	346	33·72	172	50·63* 40·65†	365	26·76	10	30·99
Andhra Pradesh	228	30·07	150	31·87	225	31·30	121	31·93	316	31·18	168	32·60	359	33·40	267	32·26
Madras	187	30·71	89	40·23	180	31·30	89	33·74	201	30·50	133	34·26	206	30·96	—	—
Mysore	163	29·39	100	34·40	177	32·26	100	37·70	191	34·18	130	36·00	195	30·25	130	36·92

* Deccan Canal area. † Kolhapur area.

areas which are not subject to frost, cool, bright and dry weather prevailing from December to April, creates practically ideal conditions for ripening.[14] Nothing should then stand in our way to raise sugarcane yields in North India.

Unsuitable lands in U.P. will, all the same, have to be withdrawn from sugarcane wherever possible. New extension of the area should be encouraged only in Southern States where the existing trend is also in the same direction. Since all the area under sugarcane is supposed to be under irrigation, an average acre yield of about 3·0 tons of gur or 30 tons of cane fibre is in fact lower than the existing average for southern states of Madras and Mysore. With concerted efforts on various improved techniques, this would not be difficult to achieve on an all India basis when the present yields are already nearly 20 tons an acre.

There is, however, another direction in which India will have to devote much attention and care. The present cost of production of sugar in the country is very high as compared to other parts of the sugar producing world. Actual production in 1960-61—104 million tons of cane was higher than the Third Plan target of 100 million tons. Sugar is today being exported at subsidised rates. By raising acre yields and sucrose content, India will have to make every effort to reduce the cost of production if she has to compete in the world market.

Cotton

Production of cotton at the close of the First Five Year Plan was nearly 4·0 million bales. Against the Second Plan original target of 6·5 million bales, actual production was only 5·4 million bales which fell down to 4·5 million bales in 1961-62. Although actual production during the First Plan showed a tremendous increase, a study of acre yields over the past 40-50 years would show that we have not been able to make any appreciable improvement in cotton productivity. We have so far been playing a tool to natural forces. Changes in area have not been the result of any planned or well-directed effort. One of the main factors responsible for increase in the area is the removal of restrictions on the area

14 Henry E. Clements, "Report on Sugarcane Production in India," *T.C.M* p 2.1

to be sown under cotton, imposed during the war and the remission of land revenue on all the new acres brought under cotton sometime in 1951 and the area which shot up in the succeeding years. It touched the peak of 20·7 million acres in 1955-56 and declined slightly thereafter during the Second Plan period. It came upto those levels during the Third Plan by going over to 21 million acres in 1963-64 which is being maintained.

It would be of interest to learn that area under cotton before 1940-42 in the territory now constituting the Indian Union was about 20 million acres. It even touched 21 million acres during 1936-37 to 1938-39. An area of 20 million acres or so would then represent the normal position in India. Slight variations of a million acres higher or lower may be governed by the prices of cotton prevailing at the time of harvesting. Since the ceiling price of cotton (Jarilla Fine) was raised from Rs. 620 per candy in 1949-50 to Rs. 770 in 1950-51 and to Rs. 820 thereafter, it hastened the process of bringing the area under cotton to its normal level. If the ceiling was not changed during the Second Plan, area under cotton showed a slight decline.

Does it mean that future changes in total area under cotton will invariably be in response to price incentives? This might appear to be a little difficult question to answer. But what is certain is that there has got to be a price parity between cotton and groundnut which are competing crops. We have, however, to pay due attention to the fact that groundnut is an equally important crop, where very little achievement has been made in the past. Nobody can afford to have a diversion of the area from groundnut to cotton unless it is to be recommended purely on agronomic grounds in a particular region.

There is nothing to feel alarmed about the situation on the basis of this analysis. What is, however, important is that we must take a realistic view of the whole situation. Problems facing the development of cotton are quite challenging, but not insurmountable. Average yield in India, 130 lbs. or so, bears no comparison with those obtaining in other parts of the world as shown in Table 12·6.

For the achievement of our targets, a two-way attack will have to be made. Total as well as irrigated area under the crop will have to be increased. This would be possible in Tungabhadra, Hirakund, Kakrapara, Chambal project areas and also those served by a

TABLE 12·6

YIELD OF LINT COTTON IN CERTAIN PRODUCING COUNTRIES

(Lbs. per acre)

	Average 1947-48 to 1951-52	*Average* 1952-53 to 1955-56	1956-57	1957-58	1958-59	1960-61*	1963-64†
India	95	101	100	106	101	118	128
Pakistan	157	198	176	183	184	207	253
Uganda	88	88	95	87	80	98	76
United States	280	341	409	388	466	446	517
Egypt	470	463	417	473	497	542	576
Mexico	278	371	396	445	442	449	517
Brazil	158	171	145	174	184	186	175
Turkey	222	209	225	192	254	243	365
Sudan	323	314	269	151	315	267	196
Peru	446	441	395	430	438	449	447
Syria	333	308	304	371	330	468	467
Argentina	213	206	171	237	180	219	172
Nicaragua	315	416	536	694	562	476	667
Soviet Union	394	537	656	633	621	604	585

* Provisional.

† Revised.

Saurce: International Cotton Advisory Committee.

number of minor irrigation projects.[15] Successful efforts have already been made in the Cauvery Delta to grow cotton as a profitable off-season crop and also improve the yields of paddy even where two crops of paddy are grown on the same field from July to January. This was possible by the introduction of cotton varieties like 216-F (Punjab-American) which could be grown in January and February and harvested in July when the field has got to be ready for the first crop of paddy. This is only one example of additional area being provided for cotton from the existing current fallows without affecting any other crop. Careful research may bear many more similar fruitful results.

According to a survey conducted under the auspices of the Indian Central Cotton Committee, there are possibilities of growing a second crop over an area of about 4·5 million acres in rice fallows in the States of Andhra, Orissa, Maharashtra, Madras and Mysore alone. Of this, the share of cotton is roughly put at 1·0 million acres. Such 'on the spot' surveys will be necessary before any firm recommendation can be made.

Similarly, a survey of the areas under the new River Valley Projects shows that about 2·0 million acres may be available for cotton from Hirakund, Bhakhra, Chambal and Nandikonda projects alone. A full development of the major and minor irrigation projects when the gross irrigated area has been estimated at 135 million acres, will make available more areas for cotton so as to enable us to have all the additional areas needed for cotton.

Since irrigated yields are already much higher and long staple cotton thrives well only under irrigated conditions, as much as 10 million acres are supposed to be getting an assured supply of water by 1980-85. Nearly 60 per cent of the targeted production can be achieved from these irrigated areas.

These higher yields are possible. But there is an immediate need to probe into the whole problem of improved seeds, fertilisers and improved practices etc. We do not know how we can say with certainty that the coverage under these intensive measures has increased or decreased, if our dependence on natural factors remains more or less the same.

[15] Dr. M. S. Randhawa, Presidential speech, 81st session of the Indian Central Cotton Committee, February, 1960.

There are very heavy yielding pockets like Avanashi Taluka in District Coimbatore (1000 lbs. per acre), Madura, Ramnad and Tinnevelly Districts in Madras, certain areas in the Punjab and Andhra, spread over the country. During recent years, average yield per acre at Sirsa (Punjab) was 670 lbs. lint while at Coimbatore, it was 588 lbs. lint. We should thoroughly examine the practices followed by the cultivators in these areas, and see for ourselves how the cultivator has succeeded in overcoming the natural hazards. Effort should then be made to spread those very practices to large areas. Research problems which have still to be tackled will have to be given top priority before any worthwhile results can be obtained.

Dr. Pal, President of the Indian Central Cotton Committee, while addressing the 92nd meeting of the Indian Central Cotton Committee early in 1966, indicated his dissatisfaction on the cotton breeding programme in the past. According to him cotton breeding in the past had mostly proceeded on the basis of established practices in each tract without paying adequate attention to the specific agro-climatic conditions in each zone. The actual dispersal of rainfall in each tract had not received the required emphasis in the evolution of different varieties. Future research will be directed to find an answer to these problems. The varieties recommended for cultivation in each tract will be those which are adaptable to the expected rainfall pattern. Research will also be directed to evolve pest-and disease-resistant varieties. "Black arm," for example continues to be a menace almost in all the areas growing American cotton.

The Cotton Package Programme introduced in the country has already shown encouraging results. Future development will also extend areas under this Programme and according to Dr. Pal, a crash programme for cotton will be initiated during the Fourth Plan so as to raise the unit yield by at least 50 per cent.

The results secured from the cotton development scheme sponsored by the Indian Cotton Mills' Federation have been equally encouraging. In the Tufislur development centre in the South, average yield per acre in Village Vellakinar rose from 4·29 quintals in 1964 to 6·16 quintals in the next season. Similar results were obtained at Mumsapuram near Srivilliputhur in the South.

Separate yield data for irrigated and unirrigated areas are not available at present. Since total area under cotton in the Punjab is irrigated, a yield of 200 lbs. per acre in that region has been taken as representing irrigated areas.[16]

Another 21 million acres of the area under the crop is taken to contribute the balance of 40 per cent. This would involve an increase of about 12 million acres in the area under cotton. A portion of this may be possible by the substitution of Jowar, Bajra or Maize in Maharashtra, Madhya Pradesh and Punjab.

Inter-cropping cotton with groundnut in the rain-fed areas would also serve as an insurance against the risk of crop failure to the farmer, and also help to augment the production of cotton as well as oil seeds both of which are a bit of a tough problem.

As already discussed elsewhere, it might not be possible for India to achieve complete self-sufficiency in extra long varieties. But all other types of cottons can definitely be produced in India. It might, however, become necessary to take some stringent measures in the matter. Irrigated areas in Rajasthan are ideal for growing cotton. It would be in the interest of the country if early steps are taken to allocate the maximum of this area to cotton. Some sort of regional specialisation in this respect is possibly the only answer to the existing stalemate position in respect of this crop.

Jute

Existing position with regard to the production of jute and mesta during the First and Second Plan periods is given in Table 12·7.

TABLE 12·7

PRODUCTION OF JUTE AND MESTA 1951-52 TO 1961-62

(Million bales of 400 lbs.)

	1951-52	1955-56	1956-57	1957-58	1958-59	1960-61	1961-62
Jute	4·7	4·2	4·3	4·1	5·2	4·0	6·3
Mesta	N. A.	1·1	1·5	1·3	1·6	1·1	1·7
Total	—	5·3	5·8	5·4	6·8	5·1	8·0

The performance of jute during the first two Plans was not very encouraging. Against the First Plan target of 5·37 million bales,

[16] Same is the figure given by W. Burns, *Technological Possibilities*, p. 89 for irrigated areas.

actual achievement was only 4·2 million bales. The Second Plan target was put at 5·5 million bales and actual production having touched 5·2 million bales in 1958-59, fell down to 4·0 million bales. Third plan target was accordingly put low at 6·2 million bales. The first year of the Third Plan, however, exceeded all expectations when it gave a production of 6·3 million bales. Area under jute has also touched an all time record of 2·3 million acres.

Some increase in area under jute may be possible by cultivating jute earlier in lands producing 'aman' crop without hampering the cultivation of rice. Both area and yield per acre of mesta can also be increased appreciably. As envisaged by the Jute Inquiry Committee, there are potential regions in Bihar, Tripura, Orissa, West Bengal and Andhra where new areas can be brought under mesta without affecting the position of rice or jute. Area under the crop has already increased from 484,000 acres in 1952-53 to 851,000 acres in 1958-59 and 0·9 million acres in 1964-65.

A new approach to the production of jute and mesta is being considered for the Fourth Plan period for which a production target of 10 million bales comprising 8 million bales of jute and 2 million bales of mesta has been fixed. Additional production is sought to be achieved particularly through an addition of 2 lakh acres under jute by double cropping in canal and tube well irrigated areas but mainly through an increase in the unit yield from 2·8 bales estimated at the end of the Third Plan period to 3·3 bales per acre by the intensification of development measures in selected jute growing areas. Jute is grown in India in 73 districts but instead of diffusing efforts and investment over all the jute growing areas, the objective in the Fourth Plan will be to concentrate attention on 14 districts each of which has a fairly high spread and all of them together account for over 80 per cent of the total production.

The envisaged yield of 1400 lbs. per acre by 1980-85 would actually be below the existing Pakistan level. West Bengal which alone accounts for nearly 50 per cent of the total home production, has shown average yields about 2,000 lbs. an acre in good years. With the Fourth Plan target having already been fixed at over 1300 pounds per acre, the yield of jute by the end of the stipulated period might go up much higher than the 1400 lbs. as already mentioned. It might then be possible to reduce the area under jute from

4 million acres as the projected target given in Table 12·2 or even to increase the production of jute over and above the targets set in this study if so required.

If self-sufficiency is the objective, a mere achievement of the production target will not be enough. The country is, at present, importing cuttings of white and tossa and long jute of "White jat" variety. After a thorough investigation of the problem, the Jute Enquiry Committee concluded that, but for the long variety, maximum requirements of which are about 100 thousand bales, all other types are already being produced in the country. There is no difficulty according to the Committee, to produce even this variety which resembles those grown in Tripura and other areas.[17]

Oil Seeds

The achievement of targets in this respect would necessitate undertaking the following measures:

(1) *Change in the present cropping pattern*:

(*a*) By increasing the cropped area under oil seeds.
(*b*) By introducing short-duration groundnut in potential areas like Punjab, U.P., Rajasthan etc.—mainly to serve as a "brief-period catch crop" and also to recuperate the soil fertility level.
(*c*) Replacement of low yielding oil seed crops either with the high yielding ones or by substituting high yielding varieties of the same crop—as far as possible.

(2) *Intensive cultivation measures* :

(*a*) Irrigation.
(*b*) Improved seeds.
(*c*) Fertilisers and manures.
(*d*) Plant protection.
(*e*) Improved technique of cultivation.

(3) *Exploiting the possibilities of oil extraction from the oil bearing shrubs and trees.*

[17] *Vide* Report, p. 46.

(1) *Change in the present cropping policy*

(*a*) At present about 31 million acres are occupied by oil seed crops. This is expected to go to 45 million acres by 1980-85. Groundnut out of this is to account for 23 million acres.

(*b*) Exploratory breeding and experimental trials conducted in Punjab, U.P., and Rajasthan have shown a great progress. In these areas, sufficient acreage is left fallow for wheat. With timely irrigation, it is possible to grow short duration groundnut crop from April-May to July-August. Groundnut crop would give extra income to the farmers and help in recuperating soil fertility.

In West Bengal, in the areas commanded by D.V.C. and Mayurakashi Canal systems, it is possible to raise a groundnut crop after paddy which is harvested by the end of September or early in October. Similar is the case of Telangana regions of Andhra Pradesh. An agro-economic and land-crop utility survey of these potential areas would be necessary. In the projected survey, areas of such zones can be mapped out for immediate introduction or replacement of certain crops of one region with the other. Land-crop utility survey should also help in basing our future policies of evolving suitable cropping patterns with a view to make full utilisation of soil-climate-variety complex for each crop.

Oil bearing plants, like castor, could even be grown along the field and canal bunds, tanks, railway lines and roads, etc. The only danger is that castor plants often serve as a secondary host for the survival of larvae of some insect pests attacking the main crop. Castor plants will, therefore, have to be either sprayed occasionally with tobacco decoction or be burnt down after the harvest.

Some of the edible oil seeds like rape and mustard can be grown mixed with wheat. But here again, we have to bear in mind the greater susceptibility of these crops to pests and diseases. Cloudy weather of the North during February may spoil not only mustard, but also wheat. The cultivator will be rather happy to introduce such mixtures if we can assure him reasonable returns.

(*c*) Most of the breeding work on oil seeds has been conducted mainly on groundnut and linseed. There is yet a vast scope for evolving high yielding strains of sesamum and castor. Introduction of these newly evolved strains for simple acclimatisation from one area to another may possibly result in better yields.

(2) *Intensive cultivation measures*

At present, practically all the oil seeds are grown under rain-fed conditions. Groundnut out of them is very responsive to irrigation. From the newly acquired irrigation facilities, groundnut has accordingly been allocated an area of 8 million acres and is expected to contribute something like 7·0 million tons. Location of such areas where cultivation of irrigated oil seeds, particularly groundnut may be possible, is not quite an easy task. The whole matter needs a careful examination.

Indian Central Oilseeds Committee has been carrying out certain schemes of production and distribution of good quality seed. Results of some of the schemes have been promising. Production of Spanish varieties of groundnut was 1081 lbs. per acre in the Punjab against the existing production of 400 lbs. per acre from old varieties. Comparative figures for linseed and castor are given below.

(Lbs. per acre)

	Production		*Per cent increase*
	old varieties	*new varieties*	
Linseed	400	740	85
Castor seed	290	790	147

Improved varieties of oil seeds besides giving higher yields also raise the oil content. Coupled with better manuring and pest control measures, possibilities of increasing the yields per acre are bright in India.

(3) *Exploring the possibilities of oil extraction from the oil-bearing shrubs and trees*

Such oil bearing plants can be cultivated along the bunds of cultivated fields, village common lands, borders of tanks, roads, railway lines, canal banks and alike. Seeds of some of these like Mohwa, Neem, Tobacco, Cotton, Kardi, Karanja, Tung are used for this purpose. But still other plants and trees, which are unexplored in the forests and groves, can be made use of. Some of these trees are:

Pisa (Actiondaphine rookeri)
Kokum (Garcinia India)

Kamala (Mallotus phillipinensis)
Undi—Punna (Calophyllum inophyllum)
Marotti (Hydnocarpus wightiana)
Dhupa (Vateria indica)

Root crops

Main root crops which deserve any consideration in a study of this type are, potato, sweet potato and tapioca. Total target of 17·5 million tons can be conveniently split up as follows:

	Production 1980-85	*during* 1955-56
Potato	11·5	1·8
Sweet potato	2·5	1·2
Tapioca	3·5	1·8
Total	17·5	4·8

Tapioca and sweet potato occupy at present about one million acres and potato another 0·7 million acres. All these three root crops are heavy yielders. The future economy of the country may not have much use for tapioca and sweet potato. If some commercial uses can be found for them, their demand may go up. Tapioca in this connection has good potentialities of being used for the manufacture of starch and synthetic rice. It is also quite possible that those persons who are using it in specific areas may continue to use it for some time but a portion of it may be diverted to feed the cattle. Whatever the case, these two crops are not going to be of much significance in future.

As against this, potato is bound to occupy a place of prominence in the Indian dietaries. All the advanced countries of the West are consuming large quantities of the commodity. Against India's per capita consumption of one ounce, Netherlands, U.K., and Germany consume 10, 10 and 15 ounces respectively.

Potato yields in India have been around 6,000 lbs. per acre and have touched 9,000 lbs. in pre-war years. It was nearly 7,400 lbs. during 1964-65. When compared with 23-25 thousand lbs. per acre in Belgium, 16 thousand lbs. in U. K. and 14 thousand lbs. in Egypt, there should be no difficulty to increase Indian yields to near about 13,000 lbs. per acre which will still be lower than that of many other countries. No doubt, in most of the places, potato is already grown with sufficient care, but we would simply be covering the ground already lost in so far as all India yields are concerned. Even then, the area under the crop will have to be increased appreciably to achieve our targets.

Since potato is a 3-5 months crop, it can be easily fitted into a number of rotations in the different parts of the country. Even now it is being grown under all types of climates. But it has so far been a neglected crop. An important point which needs investigation is, how far it would be possible for us to increase the area 4-5 fold during the 20 years period. Because of the newly introduced short duration crops and multiple cropping, required area under potato can be found.

Under Indian climatic conditions, refrigeration facilities would be extremely necessary near the place of production. But this would be purely a question of finance, which in any case will have to be found.

On the demand side it can be assumed that once we can produce potato in plenty (which would in turn make them much cheaper also), an average person will definitely like to consume the estimated quantity of 2 ozs., per day.

Fruits and Vegetables

There are no reliable estimates of area or production of fruits and vegetables. Available figures about the area under these crops for the years 1951-56 do not indicate any increase. There is on the other hand a slight decrease in the area under vegetables from 1·7 to 1·6 million acres during the year. (We have excluded potato, sweet potato and tapioca from vegetables). As for production, per acre yield is being assumed as 2 tons for fruits and 3 tons for vegetables. How far this represents the true picture in the country or how far it has changed from year to year is anybody's guess. First and foremost need, therefore, would be to evolve a system by which we can have regular forecasts for these crops. In the absence of this, it would become rather impossible to assess the progress made in this respect.

It is quite possible that the present yield estimates may be quite low. In the absence of any reliable information on the subject, we can assume that given proper facilities for water, manure and fertilisers etc., it would not be difficult to achieve per acre yields of fruits and vegetables at 9 and 7 tons respectively in the irrigated areas.

Area under vegetables will have to be increased from 1·6 million acres in 1955-56 to 7 million acres in the coming 20 years. As for fruits, required increase in the area may not be much. What is necessary in this case is the further intensification of cultivation. Mangoes and bananas contribute mostly towards the total production of fruits today. There is sufficient scope with regard to the improvement of yield in their case. Papaya is another promising fruit which flourishes well practically in every part of the country. Area under this fruit can definitely be increased. There is a possibility of encouraging such fruits and other vegetables as kitchen gardens. If people become garden minded, in the rural area, major problem of preservation and transportation etc., will be automatically solved. Bulk of the people in rural areas will in that case be able to consume these items at practically no extra cost to them.

In so far as the cities are concerned, it would be advisable to have a green belt around the townships for dairying, fruits and vegetables to meet the high demand of urban population for these commodities. All the new townships should be planned on these lines and an effort made to do so in the case of existing towns and cities as far as possible. Specific fruits like apple and grapes will in any case have to be grown in the areas most suited for the purpose and transported to the consuming centres. Himachal Pradesh is already going in a very big way to increase the production of apples.

Fodders

Green fodders will play an important role in the development of dairy industry. If milk production is to be raised to 72 million tons from the present level of 22 million tons and a tentative fifth plan target of 48 million tons, our cattle will have to be well fed. A programme of mixed farming will be extremely necessary. There are states like Punjab even today where 16 per cent of the total cropped area is under fodder. The all India figure against this is 4 per cent.

There are huge potentialities of getting green grasses from forests, pasture lands, canal banks and road sides which have to be properly developed for the purpose. The problem of fodders has so far been practically neglected. The land utilisation statistics indicate that area under pastures have gone up from 21 million acres in 1951-52 to 32 million acres in 1958-59. We do not know, what proportion out of this represents the real increase. Whatever the real increase in the area under pastures, it is most welcome.

Royal Commission estimated that 3/4ths of the culturable waste and 1/4th of the uncultivated area can also be considered as contributing towards the grass resources of the country. We do not know how far this assumption is correct today. But what seems to be plausible is that India has huge potentialities of developing her resources of green grasses. This should be carefully examined at the State level or even below it. Since transportation of green fodders over long distances is a big problem, we have to draw up a sort of a balance sheet of the requirements at optimum level of feeding and availabilities of green grasses on a regional basis. Wherever the gap, it can be filled up by the development of the existing grass resources. But in places where there are no such possibilities, the only alternative left would be the growing of fodder crops. Another possible solution may be the shifting of the dairy industry to areas where grasses are available in abundance. Arrangements will have in that case to be made for the transportation of milk and other products to the consuming centres in refrigerated trucks.

In the perspective plan discussed, we have allocated only 6 per cent of the total area to fodders. This may be the minimum required. But it is based on the assumption that during the coming 20 years, our attention will be focused on the proper development of all other resources discussed above. Otherwise whatever good work we can do as a result of our breeding policy, will prove to be a complete waste in the absence of a proper feeding programme.

Animal Husbandry Products

An achievement of higher levels of animal husbandry products may also be another difficult matter. Raising the production of milk, meat and fish to the desired levels would call for an integrated effort to tackle the problem. The speed with which work has progressed so far would be quite inadequate to meet the demands placed on animal husbandry.

A co-ordinated breeding, feeding, disease control and management policy will have to be evolved. Rather than increasing the number, future emphasis will have to be laid on improving the quality. Fewer animals kept under proper nutritional standard would not only provide more milk and *drought*, but also more food from the land. This may be considered as somewhat difficult in the presence of existing agitation against cow slaughter.

But it has to be realised that according to the existing cost structure facing the cultivator under which there is practically no rea marginal cost associated with feeding a cow, larger numbers result much more from economic considerations than religious motives. In the changed condition, when cattle will have to be properly fed and the marginal cost of feeding the cow is thrown back on the owner, economic factors will work against keeping a larger number.

What is needed is a policy of mixed farming under which a proper place will have to be found for our cattle or the farm. Once a start is made in the right direction, it should be possible to do the rest of the job by the automatic forces. Politicians, economists, agronomists and veterinarians will have to sit together and decide the future line of action right now.

Conclusions

Present crop yields in India, being very low, there should be no difficulty in achieving the desired targets. Agriculture, like modern physics, is said to have fourth, fifth, sixth or even seventh dimension. U.S.A. could show an annual increase of 2 per cent in agricultural production during the decade 1917-21 and 1927-31, with a stationary crop acreage.

This was possible by,[18]

1. Reducing the number of horses and mules.
2. Shifts from less productive to more productive crops.
3. Shifts from less productive to more productive classes of farm animals, per unit of feed consumed.
4. Increased production of meat and milk per unit of feed consumed within each class of farm animals.

[18] *Soils and Men*, U.S. Department of Agriculture, 1938.

This four-fold attack as conducted in U.S.A. is just an example to show the extent to which well directed research in agriculture can go. It may neither be desirable nor possible to copy exactly what was done in the U.S.A. But with a proper planning of agriculture, there should be no difficulty for us in achieving the modest targets discussed in this study.

13

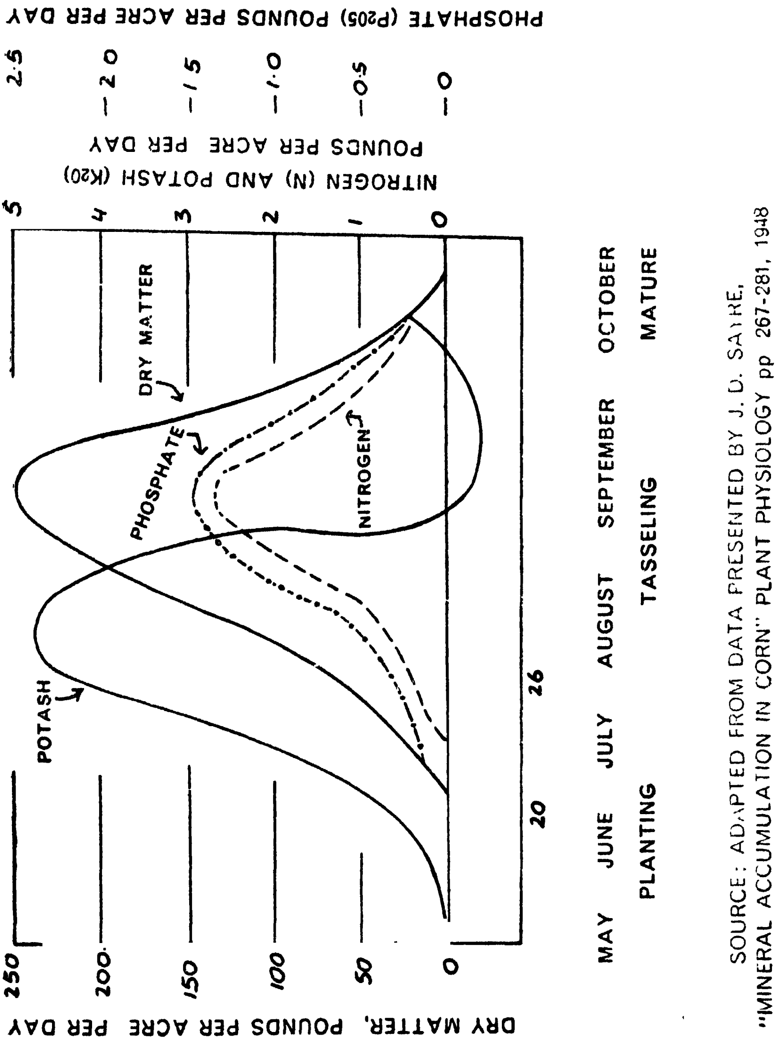
MANURES AND FERTILISERS

THE secret of good farming is really how to manure in order to raise the best crops at the lowest level of manuring. It must be accepted as an axiom in agriculture that what is taken off the land by the crops must in some way be put back into the soil or else soil will suffer exhaustion, and starvation of the soil is said to be the root cause of our own starvation.

Plants require a number of essential elements. Carbon, hydrogen, oxygen, nitrogen, phosphorus, potassium, calcium, magnesium and sulphur are termed as major, while iron, copper, zinc, manganese, molybdenum and chlorine as minor elements. Carbon, hydrogen, and oxygen, the elements used in large quantities are obtained from air and water. All the other plant foods are normally obtained from the soil.

Nitrogen, phosphoric acid and potash are, however, the chief nutrients required for nourishing the plant. Their requirements depend on the nature of crops raised as well as soil conditions. The graph on page 262 gives an idea of daily production of dry matter and daily consumption of NPK during the growing season of a 113 bushels (one bushel = 60 lbs.) per acre maize crop.

Bulk of nitrogen supply of any normal soil is present as a constituent of the decayed or decaying plant and animal materials, including microbes, all of which are grouped together under 'organic matter.' Organic matter originates from the plant roots left in the soil, the above-ground parts of the plants left on the soil, animal manures or composts applied to the soil and the remains of animals living in the soil.



In addition to the nitrogen of the organic matter, the soil contains small amounts of nitrogen in inorganic form, mainly nitrates and to some extent as ammonium compounds.

Quantities of both organic and inorganic nitrogen found in the Indian soils vary greatly from soil to soil. A great majority of Indian soils fall within the range of 600 to 4,000 pounds of total nitrogen per acre. The average Indian soil has a nitrogen content much nearer the lower of these two limits, being in the neighbourhood of 1,000 pounds. Of this total nitrogen, ten pounds or less are in the inorganic form. This also varies with the season.

This small amount of inorganic nitrogen is immediately available for plant use; the larger supply of organic nitrogen is not. But, the two are linked through a biological process by which the latter is transformed into the former. This change is brought about through the action of soil microbes and is going on continuously at rates which vary according to environmental or other conditions. Because of this process, it is the total nitrogen content which is most important in evaluating the nitrogen fertility status of the soil. Even though only a small part of the total nitrogen is available to plants at any given time, eventually, most of it becomes available.

Total nitrogen values of Indian soils given above are low, compared to those of many other regions of the world. For example, soils of the mid-western United States or of England average considerably higher, perhaps twice or thrice as high. The relatively low total nitrogen content of Indian soils is due partly to climate and partly to differences in regional agricultural practices. It is almost impossible to maintain as high a content of organic matter in the soil of the tropics as of temperate zones due to climate. The fact remains that an average Indian soil is low in total nitrogen and is likely to remain so. While improvement is possible and is to be desired, the probable magnitude of permanent increase is small.

There are in India four broad categories of soils—red, laterite and lateritic, black and alluvial. Red, black and alluvial soils are deficient in N, P_2O_5 and humus while in lateritic soils the major deficiency is of P_2O_5. The remaining three types, however, have sufficient potash and lime, although some red soils also have high requirements of these. A major portion of cultivated areas in the country is deficient in N and P_2O_5.[1]

More work on systematic lines has, however, to be done to find out the full utility of P_2O_5 and K_2O. Some inconclusive data shows that phosphates and potassic fertilisers, besides increasing the yield and improving the quality of grain, also help to maintain the fertility of the soil. There is yet an urgent need for an exhaustive

[1] Voelcker, p. 50.

soil study in the country. The Royal Commission on Agriculture recommended a comprehensive soil map of India. It is high time that concrete steps are taken in this direction.

Difficulties for Estimating NPK Requirements

On the basis of existing data, it is rather difficult to estimate correctly the exact quantities of these nutrients required for a higher level of crop production as envisaged under our future agricultural targets. ICAR has been conducting a number of experi-

TABLE 13·1

COMPARATIVE PERFORMANCE OF GREEN MANURE, AMMONIUM SULPHATE AND OTHER ORGANIC MANURES

(Yield of paddy per acre in lbs.)

Location	*no manure* (control)	*green manure*	*ammonium sulphate*	*oil cake*	*farm-yard manure*	*dose of 'N' in lbs. under each type*
1	2	3	4	5	6	7
C.R.R.I Cuttack	1961 (100)	2228 (113·6)	2162 (113·2)	2347 (119·7)	2073 (105·7)	20
Madras Pattambi	1318 (100)	1869 (141·8)	1875 (142·3)	—	1574 (119·1)	30
Orissa Cuttack	1916 (100)	2389 (124·7)	2374 (124·0)	—	—	30
Brahampur	2072 (100)	2300 (111·0)	2373 (114·5)	—	—	30
Bihar Sabour	2756 (100)	3147 (114·2)	3010 (109·2)	—	—	20
Uttar Pradesh Nagina	2177 (100)	2936 (134·8)	2743 (126·0)	—	—	50
Kashmir	1625 (100)	2504 (154·1)	2209 (135·9)	2081 (128·1)	1818 (115·8)	75

Figures in brackets indicate index with control (column 2 as base).

Source : Dr. S. B. Singh, Proceedings of the Ninth Meeting of the Crops and Soils Wing of the Board of Agriculture and Animal Husbandry in India, 1954, p. 238.

ments over a long period throughout the country. Nothing conclusive can still be said about the optimum requirements of these nutrients for maximum yields.

The other difficulty is the difference in responses from the same quantity of the nutrient made available from different sources. Nitrogen, for example, can be supplied from farm-yard manure, compost, night soil, green manures, or chemical fertilisers like ammonium sulphate and urea.

Experiments so far conducted show that 'N' from green manures or fertilisers is equally efficient in its performance on the field. But nothing definite can be said with regard to other organic sources. There is all the same no doubt about the residual value of organic manures. Application of compost (at 40-120 lbs. 'N per acre) to maize in the rotation of maize-wheat showed an increase of 20-29 per cent in organic carbon content of the soil after

TABLE 13·2

PERFORMANCE OF ARTIFICIAL AND ORGANIC MANURES

Crops	*Artificial*			*Organic*		*Organic and inorganics*[a]	
	N	*P_2O_5*	*N P*	*Cakes*	*F.Y.M*	*G. M.* *	*Mixed*
	(1) Average response per lb. of plant nutrient						
paddy	15·4	13·0	32·0	14·4	13·2	15·9	21·8
wheat	7·3	5·1	14·2	7·2	6·9	15·9	8·0
sugarcane	102·4	56·0	107·5	172·0	67·6	15·9	276·0
cotton	6·8	0·9	10·8	4·2	6·6	15·9	6·8
pulses[a]	Negative	7·7	12·8	6·4	8·6	15·9	*b*
oil seeds	6·9	8·8	13·3	9·5	3·0	15·9	*b*
	(2) Percentage increase over no manure yields						
paddy	23·2	20·4	30·0	42·3	39·9	31·5	10·3
wheat	27·8	23·6	69·4	43·7	58·8	29·1	28·9[c]
sugarcane	47·4	30·3	43·6	62·7	22·3	18·0	144·0
cotton	27·2	19·2	54·4	39·6	41·5	15·5	98·5
pulses	Negative	99·8	128·0	57·7	120·5[d]	15·2	179·0
oil seeds	49·4	19·0	44·0	47·9	39·9		48·1

* Green Manure.

[a] Related mostly to Pusa manurial trials (Pusa, Bihar).

[b] Could not be calculated due to lack of analytical data of green manure crops.

[c] Excluding one result where the figure is 42·7%.

[d] Excluding one result where the figure is 644.

Source : Report of the Expert Committee on Manures & Fertilisers, P. 21.

one year as compared to 10 per cent increase with ammonium sulphate at 80 lbs. 'N'.[2] Table 13·1 shows the comparative performance of green manure, ammonium sulphate and other organic manures.

These experiments were performed in different parts of the country and comparative results from organic sources are available from only a few of the centres.

Table 13·2 would also give an idea of the comparative performance of these various sources on different crops.

These and other experiments are not sufficient to enable us to come to any definite conclusion.[3] Some further experiments are in progress. It can, all the same, be broadly said that crop responses to fertilisers and green manures are somewhat better as compared to F.Y.M. from equal doses of N.P.K.

Future NPK Requirements

Estimates for the future requirements of three major crop

TABLE 13·3

NUTRIENTS REMOVED BY AN ACRE OF HARVESTED CROP

(Pounds)

Crops	*N*	P_2O_5	K_2O
	Rabi		
wheat	50	21	61
barley	37	18	31
gram	70	20	44
oil seeds	18	10½	25½
	Kharif		
paddy	30	20	60
maize	32	21	35
jowar	50	16½	65
bajra	32	20	59
ragi	32	20	59
groundnut	70	20	40
sugarcane	90	180	300
cotton	55	30½	82
sesamum	20	10	80

Source: P. C. Raheja, *Fertilisers—The Answer to Falling Fertility*, Indian Farming, July 1955.

[2] Summary of the Manurial Results of Research, IARI, 1953-54.

[3] Experiments at the 3 research stations in Orissa were also not statistically significant (*Rice in Orissa*, p. 65).

nutrients—nitrogen(N), phosphoric acid (P_2O_5) and Potash(K_2O)—at a given level of crop production can be calculated if we know the optimum dose of N.P.K. required for the production of various crops under different climatic and soil conditions. As already pointed out, such information is not available in a form which can be depended upon for calculations referred to above.

Other approach, on general considerations, is based on restoring plant nutrients removed by various crops. Table 13·3 shows the quantities of nutrients removed by an acre of harvested crop.

This does not give an indication of the quantity of crops responsible for removing these nutrients. Some reliable data in respect of important crops is available for U.K., U.S.A. as well as India, giving removals of these constituents for specific quantities of the grain and the straw. They are presented in Appendices 26-A to 26-D, and Appendix 26-E summarises the same information.

Working on this basis, Table 13·4 would give an idea of the total quantity of N.P.K. removed from a cropped area of 226 million acres at the 1955-56 level of production.

Nitrogen removed from 226 million acres is 1·9 or say 2·0 million tons. Gross cropped area in 1955-56 was 363 million acres, out of which pulses occupied about 50 million acres.[4] Assuming that nitrogen removal from the remaining 90 million acres was of the same order as above, total removal in that year would have been about 2·9 or roughly 3 million tons.[5]

Working on the basis of data in columns 2 to 5 of Table 13·4 relative weights of plant nutrients removed by principal crops have been calculated in Appendix 28. With the production targets as already fixed, an attempt has then been made (Table 13·5) to calculate total removals of nitrogen by 1980-85. This would mean that additional requirements of nitrogen during the period, 1955-56 to 1980-85, would be of the order of 6 million tons. This can be considered as only a broad indication of Nitrogen

[4] These crops utilize nitrogen from the air in amounts as high as 50 to 100 pounds per acre per year under favourable conditions and do not remove any nitrogen from the soil (*Soil Fertility*, *op. cit.*, p. 13). Appendix 27 explains the culture of legumes.

[5] An estimate of C. R. Ranganathan (Eastern Economist) August 1957, places this figure at 2·7 million tons.

TABLE 13·4

NUTRIENTS REMOVED BY MAJOR CROPS AT THE 1955-56 LEVEL OF PRODUCTION

Crops	Yield per acre in pounds	Nutrients removed—grain straw (lbs. per acre)			Area in 1955-56 (million acres)	Total nutrients removed (thousand tons)		
		N	P_2O_5	K_2O		N	P_2O_5	K_2O
1	2	3	4	5	6	7	8	9
1. Paddy	1040	28·1	11·4	43·2	78	978	397	1504
2. Wheat	632	15·8	7·2	19·0	30·5	215	98	259
3. Jowar	346	9·0	5·5	24·9	43	173	106	478
4. Barley	735	22·1	8·8	21·1	8·4	83	33	79
5. Bajra	270	7·8	2·7	24·3	28	97·5	34	304
6. Cotton	78	3·9	1·4	2·8	20	35	12·5	25
7. Jute	966	40·6	—	—	1·7	31	—	—
8. Sugarcane*	2934	45·8	137·5	28·4	4·6	94	282	58
9. Groundnuts	671	29·1	5·4	17·0	12·7	165	31	96
Total	—	—	—	—	226·9	1,871·5	993·5	2,803

* Juice and baggasse, in this case.

requirements, because it would be rather difficult to equate removals and supplies in a precise arithmetical equation.[6]

Actual requirements of the plant may be more than what is removed. This is because some of the nutrients supplied are lost by leaching and erosion,[7] and in case of nitrogen through denitrification, etc. also. But correspondingly plants also get sufficient quantities of nitrogen by atmospheric fixation, by rain, etc. In the absence of precise information on these two points, it is very difficult to say whether or not these losses and supplies equal each other under all conditions. This assumption has been considered as valid for the purposes of this study.[8] In any case 6·0 million

TABLE 13·5

MANURIAL REQUIREMENTS FOR THE YEARS 1980-85

Commodity	*Weight*	*Agricultural Index of Production* 1955-56	1980-85
Rice	5·0	100·0	214·3
Wheat	5·0	100·0	280·9
Coarse Grains	5·0	100·0	218·3
Oil seeds	8·0	100·0	446·4
Sugarcane (Gur)	29·0	100·0	350·0
Cotton	9·0	100·0	371·4
Jute & Mesta	8·0	100·0	250·0
Tea	9·0	100·0	250·0
Coffee	10·0	100·0	545·0
Tobacco	12·0	100·0	134·0
Weighted Index	100·0	100·0	295·7
Actual Nitrogen* Requirements		3·0	8·87

* Million Tons.

[6] An objection might be raised that crop nutrient requirements may not follow an arithmetical equation beyond a certain level of yields when larger doses of nutrients would be required to achieve the same increment. It is, however, considered that consumption levels considered in this study will not be so high. Further the introduction of high yielding varieties of seeds, recently introduced in the country, are said to have a better absorbtive capacity; hence our assumption of a linear trend.

[7] Cf. Appendix 29 for details.

[8] Layon and Buckman, *Nature and Properties of Soils*, have concluded that such an assumption is valid.

tons of total nitrogen may be considered as the minimum needed in addition to the 3·0 million tons already being supplied.

It is rather difficult to make similar calculations for phosphoric acid and potash because the removal formula will not work in their case. We do not know the existing stocks of these nutrients in the soils of the country. Maybe there are no marked responses at present to 'P' and 'K' in certain areas where the yields are rather low. There is all the same no dispute about the need for these nutrients as well, along with nitrogen, at higher levels of production assumed in the study. Organic manure will automatically supply both 'P' and 'K' along with nitrogen. Table 13·11 summarises it clearly. Corresponding to the quantity of nitrogenous fertilisers used we have, however, to use inorganic phosphorous and potash as well. These targets will be discussed in the section dealing with chemical fertilisers.

Existing Sources of Supply

Since agricultural production in the country had reached a sort of equilibrium stage sometime back over a long period, it would be wrong to say that our soils are being depleted by about 2 million tons of nitrogen at the then level.[9] Having exhausted the soil nutrient of the country over a number of years, a balance had been established, which means that whatever is being removed from the soil is being replenished in one form or the other. If this was not so, a constant drain of such a heavy magnitude would have brought our average yields toppling down. They, on the other hand, have shown some increase even during the First Plan period when the supply of fertilisers was quite insignificant.

The supply of crop nutrients to the soil is either from tangible sources like cow dung, manure, green manure and fertilisers or a number of miscellaneous sources which cannot be precisely accounted for.

Cattle Dung: According to a pilot survey conducted by the Economic and Statistical Adviser to the Government of Madras in 150 villages of Chingleput District, farm-yard manure which supplied by far the largest quantity of manures, provided only 26 per cent of the manurial requirements of the District. It was held that this was true of other districts as well. Recently some

[9] Ranganathan, *op. cit.* Relates to 1955-56.

work has been done on Economics of Farm Management in various parts of the country under the Research Programme Committee. These studies also give some idea of the use of organic manures. In the case of West Bengal, the Districts selected were Hooghly and 24 Parganas where the average annual rainfall is about 50 inches. The area accordingly falls in the zone of assured water supply.

Average quantity used per acre was about 30 maunds of farmyard manure or roughly 9 lbs. of nitrogen per acre. It is a matter of common knowledge that the use of manures in areas of scanty rainfall or without irrigation, is very little. And such areas for the country as a whole are even more than two-thirds. The use of manures in the Bengal region under study can be considered as quite above the all-India average.

It would have been very useful if similar studies were available for the country as a whole. But in the absence of any such data we may assume that on an all-India basis, some 20 to 25 per cent of nitrogen requirements of the soil were being supplied from farmyard manure. If total requirements of nitrogen in 1955-56 were roughly 3 million tons, the share of cow dung etc. would be of the order of 0·7 million tons of nitrogen. This works out to just 5 lbs. per acre for the total cropped area, which should not in any way be considered as an over-estimate.

Other Sources: As for the balance of 2·3 million tons of nitrogen, 0·15 million tons were supplied by chemical fertilisers and roughly another 0·15 million tons by tangible sources like city compost and green manures etc. Remaining 2 million tons can then be considered as the contribution of sources like:

(*i*) Urine and excreta of cattle while on the field, as well as sheep penning etc.

(*ii*) Human urine and excreta from rural areas where open field latrine system exists.

(*iii*) Plant roots and other vegetable matter left in the field.

(*iv*) Atmospheric fixture of nitrogen from the air and rain.

(*v*) Miscellaneous sources like oil cakes,[10] 'rab' system, fish manure etc.

[10] According to the Seed Crushing Enquiry Committee, 1956, over a million tons of groundnut cake is being used as manure.

Net position with regard to the existing supply of nitrogen would thus be somewhat as shown in Table 13·6.

Cattle and human population of the country should normally come quite handy for providing crop nutrients to the soil. On cent per cent utilisation, they alone can supply (Table 13·7) about 14 million tons of nitrogen, 5 million tons of P_2O_5 and 14 million tons of K_2O. All these calculations have been made for a total livestock population of 306 million and poultry population of

TABLE 13·6

POSSIBLE SOURCES OF NITROGEN SUPPLY—1955-56

(Million tons)

Source	*Quantity of N Supplied*
farm yard manure	0·70
fertilisers	0·15
city compost	0·08
green manure etc.	0·07
miscellaneous	2·00
Total	3·0

94·7 million as in 1956. According to 1961 census, the livestock population went up to 335 millions and poultry to 114 millions. A slight fall is indicated in some states according to 1965 census although the total number of livestock went up to 344 millions. In spite of any effort to restrict the livestock population, this number is increasing every year. Our calculations in Table 13·7 would, therefore, indicate only the minimum available and are in any case most conservative.[11]

Of the potential source of 14 million tons of nitrogen, according to our earlier calculations, we are already utilising 0·7 million tons from cow dung and another 2 million tons from miscellaneous sources. Most of the cow dung which provides us the 0·7 million tons, comes from the cattle and buffalo excreta which has a total potential of 3·5 million tons of nitrogen. Of the remaining 2·1

[11] Even the quantity taken as per animal may be an underestimate because the quantity of dung excreted by well fed cattle will increase by about 100 per cent. An adult cow in Aarey Colony yields 75 lbs. of dung (Energy in India, Burmah Shell, p. 25) against 40 lbs. assumed in Table 13·7.

million tons (total from all livestock is 5·6 million tons—Table 13·7), the share of stable livestock like horses, camels, etc., may be assumed as 0·5 million tons. This would give a total of 4·0 million tons of nitrogen, of which 0·7 million tons was already being utilised in 1955-56.

For an estimate of the quantity of nitrogen which can be easily tapped from these tangible sources, we have before us the example of countries like China and Japan where the use of organic resources is superb. They have succeeded in utilising more than 70 per cent of their night soil and 60 per cent of stable manure.[12] It would be an achievement if we can succeed in utilising a total of about 50 per cent or 2 million tons of nitrogen from these potential sources. The additional quantity of nitrogen that can be tapped from these sources would then be of the order of 1·3 million tons.

Livestock urine is also a potential source of 6 million tons of nitrogen and 10 million tons of K_2O. But for small quantities which go to the fields when these cattle are grazing there, practically the whole of this is being wasted now. With the use of sand/leaf litter, etc., a serious effort will have to be made to stop this wastage. Without being very optimistic we can put a low target of 10 per cent or 0·6 million tons of nitrogen and 1 million ton of K_2O which should be available from this source.

No country with a better standard of agriculture is wasting these valuable sources of plant food. Our village organisations will have no place in the future set up if they cannot succeed in achieving these conservative targets during the coming 20-25 years of planned development.

Appendix 30 shows that even in the Western countries where livestock unit per hectare is hardly 0·87 and where fertilisers play a major role in the agricultural economy of the country, as much as 64 per cent of the plant nutrients are supplied by manures.

True, our efforts so far to conserve cow dung have not met with success. It would, however, be wrong to assume that what has not been done so far, cannot be done in the future also. There are always initial difficulties and hurdles when a particular way of life has got to be changed. The very fact that our cultivator is already conscious of the usefulness of cow dung for his crops, is one of the most encouraging features. Only thing we have to do is to remove

[12] The Report of the Indian Delegation to China, p. 146.

TABLE 13·7

MANURIAL POTENTIAL OF LIVESTOCK AND HUMAN BEINGS

Source	*Number (million)*	*Quantity per unit per day (lbs.)*	*Total annual quantity (million tons)*	*Percentage constituents*			*Total constituents per year ('000 tons)*		
				N	P_2O_5	K_2O	N	P_2O_5	K_2O
Cattle	158·6	33	891	0·3	0·5	0·2	2673	1336	1782
adult	114·8	40	748	0·3	0·15	0·2	2244	1122	1496
young stock	43·8	20	143	0·3	0·15	0·2	429	214	286
Buffaloes	44·9	39	287	0·3	0·15	0·2	861	431	574
adult	28·8	50	235	0·3	0·15	0·2	705	353	470
young stock	61·1	20	52	0·3	0·15	0·2	156	78	104
Total Cattle & Buffaloes	203·5	35	1178	0·3	0·15	0·2	3534	1767	2356
Sheep & goats	94·6	15	231	0·8	0·6	0·3	1848	1386	693
Horses & ponies	1·5	40	10	0·5	0·4	0·3	50	40	30
Other livestock	6·8	25	28	0·6	0·5	0·5	168	140	140
Total livestock	306·5	29	1447	—		—	5600	3333	3219
Poultry	94·7	25	0·8	1·6	1·5	0·9	13	12	7
Total	401·2	—	1447	—	—	—	5613	3345	3226
Livestock urine	307·1	15[a]	751	0·8	0·01	1·4	6008	75	10514
Cattle bones	30[b]	30[c]	0·401	3·0	23·5	—	12	942	—
Human excreta & urine	600	4[d]	390	0·7	0·3	0·2	2740	1160	711
Grand Total				—	—	—	14373	5522	14451

a Quantity of urine per cattle per day.

This has been calculated at 15 per cent cattle mortality.

Quantity of bones per cattle.

Quantity of human excreta & urine per man per day.

some of the hindrances standing in his way at present. Major hurdle is the provision of alternative means of fuel for releasing the required quantity of cow dung.

Wood Required to Replace Dung

If 1·3 million tons of additional nitrogen is to be procured from cow dung, that would mean an organised effort not only to educate the cultivator for the proper conservation of farm-yard manure and farm waste, but also to provide an alternative source of fuel for him.

Quantity of dung (sun dry) being burnt at present has been estimated from 80 to 260 million tons.[13] Since fuel requirements will be increasing with the increase in population, possibility is that pressure on cow dung for burning will be increasing. Assuming that additional demand will be met from what is being wasted at present, we will have to chalk out a programme for replacing 1·3 million tons of nitrogen or say 90 million tons of sun dry dung. This can be done either by setting up cow dung gas plants in the areas concerned or providing fuel wood at a reasonable price.

Cow Dung Gas Plant

Experiments have been conducted by the Indian Institute of Agricultural Research for the utilisation of cow dung gas (methane) under rural surroundings, in the houses of cultivators themselves. It has been estimated that a daily production of about 40 c.ft. of gas is obtained by the regular addition of dung, about 40 lbs. from one animal.[14] Normal daily requirements of an average family of 5 members are estimated at 100 c.ft. of gas, sufficient to release about 100,000 British thermal units (BTU) of heat.

Cost of each plant has been worked out at Rs. 500.[15] Gas can be used for cooking as well as lighting purposes. Blue flame of the

[13] *Domestic Fuels in India*, National Council of Applied Economic Research, 1959, pp. 3-4.

[14] This is the average. In winter it is less and is more during summer.

[15] For details refer to Appendix 31. This was calculated at Rs. 350. Due to price increases, it has been calculated at Rs. 500 and may have gone up further now.

gas is hot and smokeless which makes cooking more neat and quick.

It would not perhaps be correct to assume that cow dung gas plant is an answer to all the rural fuel problems. It has got its limitations, which are,

1. initial cost is high,
2. majority of our villages being in compact blocks, in most cases it would not be possible to find any place near the residential area for setting up the plant,
3. no suitable device has so far been found for heating of milk under village conditions, [16]
4. dung gas cannot become popular in North India where wheat, bajra or jowar is the staple diet and the gas heat is not enough for preparing *chapaties*.

So long as these defects cannot be removed, the success of cow dung gas plant is doubtful. It is quite possible that our research workers may be able to improve the plant with regard to items 3 and 4 above. If so, it can at best be considered to replace about 10 per cent of dung that is being burnt at present.

Village Plantations

This would mean that village plantations will have to be planned for replacing at least 80 million tons of cow dung out of 90 million tons which is burnt at present.[17] As 4 lbs. of sun dry cow dung is equivalent to 3 lbs. of wood for purposes of heat, additional wood required would be about 60 million tons.

One tree yields about 10 maunds of firewood.[18] Required quantity of wood would thus need the growing of 180 million trees. This is

[16] One answer which suggests itself is the setting up of cream separators, which are becoming popular in rural areas of the Punjab.

[17] *Domestic Fuels in India*, *op. cit.*, p. 21. Also refer to K. P. Sagreiya, *Forests and Forestry*, pp. 50-52, for the future demand for fuel wood. It has been argued that because of the availability of 'alternative fuels' after 1980, demand for fuel wood and charcoal is likely to decline.

[18] *Land Transformation*, Dr. B. N. Pal, ICAR. Also in FAO/ECAFE Timber Trends Study for the Far East, 1958 for other Technical details.

possible if 1·8 million acres are put under forests. There being normally a 15-year rotation in a forestry programme, an additional area of about 30 million acres will have to be afforested.

This may appear to be a difficult task under the existing land utilisation pattern. But when it is realised that existing forests are in a rather delapidated condition, their rejuvination may be able to meet a major portion of this additional requirement of wood.

It may also be necessary to conduct further research in growing species yielding more of firewood and taking a lesser period of growth. Fuel wood is said to be available from a number of trees, after about 7 years.[19] If so, additional area that needs to be afforested will be reduced to 10-12 million acres (as against 30 million acres already calculated). Cities where practically whole of cow dung is burnt may have [20] to be provided with cheap types of soft coke or even briquettes manufactured on a commercial scale from coke dust and mud. This will reduce pressure on wood. Question of domestic fuel even otherwise calls for immediate attention and will have to be tackled on a scientifically planned programme.

Town and Village Compost

As regards sewage and sullage, legislation has been passed by various State Governments compelling all Corporations, Municipalities and Town Committees not to waste urban refuse. Table 13·8 shows the potential capacity of compost from this source.

TABLE 13·8

MANURES AVAILABLE FROM SEWAGE AND SULLAGE—1955-56

Source	*Population (millions)*	*Compost* (thousand tons)*
Corporations	10	1000
Municipalities	32	3200
Town committees	20	2000
Total	62	6200

* Normally 1 million population is assumed to produce 100 thousand tons of compost.

[19] *Domestic Fuels, op. cit.*, p. 21.

[20] Delhi, for example, burns 60 thousand tons (70 per cent) of dry dung according to *Domestic Fuels, ibid.*

This estimate of 6200 thousand tons of city compost is based on the population of 62 millions. Potential city population available for compost by 1980-85 may be about 210 millions.

Besides this, efforts are also being made to educate bigger Panchayats for the use of night soil. Some programme in this direction can also be expected during the coming 20-25 years. It can then be assumed that with some additions from Panchayats and short-falls from cities, total potentialities from city compost etc. may be at least 210 thousand tons. Working at 0·8 per cent of both 'N' and P_2O_5,[21] plant nutrients released may be 160 thousand tons each. The Third Plan fixed a target of 5 million tons for urban composts.

Town sewage and sullage water is the other potential source which is being tapped and can most conveniently be utilised for the supply of necessary plant nutrients. Report of the Expert Committee on Manures & Fertilisers calculated that 40,000 tons of 'N' and 16,000 tons of P_2O_5 could be harnessed from this source by the end of the First Plan period. Sewage and Sullage can be assumed to provide soil nutrients approximately equal to city compost. The progress made so far in this respect is not so very significant, but due attention will have to be paid to this programme in the future plans.

Other Waste Products

There are a lot of other village waste products,[22] which can be utilised. Sources of specific waste-organic materials exist in different localities which can be turned into compost manure.[23] Forest areas in India cover about 100 million acres which can yield leaf litter for producing 10-15 million tons of compost per annum. About 4 million acres under sugarcane in India can provide sugarcane trash for 12-15 million tons of compost. It is estimated that nearly 100 thousand acres of tanks, canals, and pond areas in West Bengal, Orissa, Bihar, U.P. and Travancore alone are infested with water hyacinth and it would be possible to make nearly 1 million tons

[21] Expert Committee on Manures, *op. cit.*, p. 34.

[22] Howard, *The Waste Products of Agriculture—Their Utilisation as Humus* Also see Bulletin, "The Use of Waste Materials," and G. I. Fowler, *Wealth and Waste.*

[23] Report of Expert Committee on Manure, *op. cit.*, p. 57.

of good quality compost by utilising this weed. Other waste materials of this type like groundnut husk, tea and coffee wastes, tobacco waste, dried blood meal, etc., where available could be usefully put into compost pits.

Potentialities from some of these sources are shown in Table 13·9.

TABLE 13·

MANURIAL POTENTIALITIES FROM SOME WASTE PRODUCTS

Source	*Compost (millio n tons)*	*Constituents* N	P_2O_5	K_2O
		(thousand tons)		
Forest leaf litter	12	120	84	120
Sugarcane trash	13	13	13	18
Water hyacinth	1	3	3	5
Dried blood meal (sheep and goats slaughtered)	0·02	25	—	—
Total	26·02	161	100	143

If we can use about 50 per cent of these tangible waste products, this works out to something like 80 thousand tons of 'N', 50 thousand tons of P_2O_5 and 70 thousand tons of K_2O.

A number of experiments have been carried out at the Sheilla Dhar Institute of Soil Science, Allahabad, for the utilisation of other waste materials like coal and basic slag as manure. It has been shown that besides supplying nutrients which they themselves contain, they help to fix atmospheric nitrogen and also release locked up phosphates of the soil.[21] It may be difficult to assess the total potentialities of such like sources on the basis of limited experiments conducted at one institute. But they cannot be ignored. Further experiments may be conducted and if found useful, these resources may also be tapped for actual utilisation.

Green Manuring

In a country like India, where nitrogen and organic matter content of the soils is very low, full potentialities of organic sources

[24] Cf. Paper by Prof. N. R. Dhar, "Nitrogen Fixation and Land Fertility Improvement," *Indian Agriculturist*, Vol. 1, N. 2, pp. 6-18.

have got to be developed. Green manuring plays an important role in this respect.[25] Besides fixing nitrogen from the atmosphere and improving physical conditions of the soil, they also release locked up phosphates of the soil.

Crops raised for green manuring also serve other useful purposes with certain other objects, i.e., they act as catch crops, shade crops, cover crops or forage crops.[26]

Although rich in Nitrogen, green manures also supply sufficient quantities of P_2O_5 and K_2O (Table 13·10).[27] Data regarding green matter available from the various green manure plants are provided in Appendix 32.

TABLE 13·10

COMPOSITION OF VARIOUS GREEN MANURE PLANTS ON AIR DRY BASIS

(Per cent)

Materials	N	P_2O_5	K_2O
Dhaincha	3·5	0·6	1·2
Sunn-hemp	2·3	0·5	1·8
Wild indigo plant	1·8	0·2	0·6
Wild indigo leaves	3·2	0·3	1·3
Indigo refuse	1·8	0·4	0·3
Avari (Tephrosia Candida)	2·0	0·7	1·0
Prickly pear	0·3	1·2	1·1
Forest leaves	1·2	0·6	0·4
Tea prunings	2·4	0·5	1·3
Green weeds	0·8	0·3	0·2
Sea weeds	1·1	0·3	3·0
Fern weeds	3·1	0·5	3·0
Redgram plant	2·8	0·4	2·0

Growing a crop *in situ* and incorporating it with the soil is called 'Green manuring.' This can also be done by growing the crop on a separate field. Opinions differ with regard to the superiority

[25] Cf. M. S. Sivaraman, Green Manuring, Some Mistaken Notions, If Each Field Grows its own Manure, etc., Planning Commission.

[26] Mudaliar, *op. cit.*, pp. 516-18.

[27] "The Use of Manures in the Madras Presidency," Madras Government Pamphlet No. 9.

of raising the green manure crop *in situ* and at a different place. Experiments conducted at Delhi and Bombay are in favour of growing *in situ* though it becomes difficult for the paddy crop if the land is water-logged.[28] The advantage of growing the crop outside is the transfer of moisture and soil nutrients of one field to the other but it involves the cutting and transfer of a huge quantity of green crop materials.

There is yet another method known as green leaf manuring. Green leafy material in this case is gathered from shrubs and trees growing in waste lands and forests or brought from other fields and is buried in the field needing green manuring. Common shrubs growing on waste lands are Cassia auriculata Linn., Dodonia viscosa and Calotrpis gigantea (Wild) R. Br.

Practice of growing pungam (Pengamia glabra Vent.) in waste lands, specifically for providing green leaves for manuring rice fields, is common in Mysore State. Lands which cannot be cultivated economically alone, are planted to pungam. It is a leguminous tree, which comes up well and provides heavy loppings year after year.

Leguminous trees like *pungam* and *Cassia Siamea Lam*, can be planted in waste lands, for the production of green leaves for manurial purposes.[29] Tree crops do not require any attention after they get established and start growing vigorously. Suitable species of trees provide some fuel, light timber and leaves for fodder during periods of scarcity of fodder and straw.

The Technique: Maximum benefit from green manuring cannot be derived without knowing when to grow and when to bury the green matter under the top soil. There is a great need for providing correct time gap between burying a green manure crop and sowing the next crop. Otherwise, nourishment provided by the manure would not be available in full, and there may be competition between soil microbes of the crop for nutrients and moisture. This period should normally be eight weeks. Decomposition of green matter must complete before the next sowing.

Green manuring, thus practised, keeps the field occupied for a period of 4 to 5 months. Studies about the economics of green

[28] "Green Manuring," *ICAR Review Series*, No. 6.

[29] V. T. Subbiah Mudaliar, *Common Cultivated Crops of South India.*

manuring under this method when one crop has to be lost, show that the practice is still economical.[30]

There have recently been some advances in the theory and practice of green manuring in keeping with the needs of the hour. Green manure crop is now sown in rows between the actual crop of paddy etc. as the case may be. It can also be grown around the cultivated fields. In about a month's time, 'Green manure' crop grows up pretty high and is buried in the ground. As the green crop does not grow to full maturity under this method, total quantity of organic matter would be less. This is, however, advantageous in the sense that green plants being very tender and succulent take very little time to decompose. Nitrogen is thus made available to plants immediately. There is no need to lose one crop under this method.

Limitations

With all the advantages of green manuring, there are some limitations which must be given due consideration.

1. It is not possible to green manure dry lands. A minimum of 30 inches of rainfall or irrigation is necessary.[31]
2. It is reported that in certain places the growing of a green manure crop did not pay. In the heavy deltaic paddy soils, it did distinct harm to the soil. There have been instances in which such growing of green manure crops, absolutely inhibited subsequent crop growing and it took nearly two to three years for the land to recover.[32]
3. Similarly it has been stated that the question of growing green manure crops on the field and burying it in the soil was rather impossible in many localities in Kerala because of the very heavy rainfall which begins from early June to the middle of September; total rainfall being about 80 to 90 inches on an average.[33]
4. Availability of seed at the proper time.

[30] Proceedings of the Crops & Soils Wing of the Board of Agriculture and Animal Husbandry, 1937, pp. 185-196.

[31] M. S. Sivaraman, *Potentialities of Green Manuring*, p. 7.

[32] Proceedings of the Second Meeting, *op. cit.*, p. 13.

[33] Proceedings of the Second Meeting, *op. cit.*, p. 35.

Some of these problems are now being satisfactorily solved. Orissa Government, for example, launched a very comprehensive scheme for the supply of 'dhaincha' seed packets to each cultivator. The two ounce seed packet sufficient for sowing one acre is sown on the borders. This is capable of providing sufficient seed for 3 acres at the end of the crop. Supply of seeds having been assured, area under green manuring in Orissa has already shown a tremendous improvement.

Green manuring is very popular in Andhra and Madras. If Orissa also demonstrates its feasibility, we would be in a better position to gauge the potentialities of green manuring. The Third Plan put a target of 41 million acres against an estimated area of 12·0 million acres under green manuring at the end of Second Plan.

Potentialities of Green Manuring

Since rainfall in India is not well distributed and there are surprisingly large variations in the amount of precipitation received from year to year, we would be restricting ourselves to only those areas where annual rainfall is around 50 inches and above. With about 72 million acres of unirrigated assured rainfall area and 135 million acres of other irrigated areas, green manuring should technically be possible on all this 207 million acres of cropped area. But practical limitations, as already discussed, will always be there. Since the results of our first experiments in this regard are not very encouraging we need not be very optimistic about it. There is, however, no doubt that once the idea catches the imagination of cultivators, the advantages of green manuring may themselves serve as a great incentive. The scheme may then provide its own momentum without any governmental help. But when that stage is likely to be reached is a crucial point. If the Fourth Plan target is achieved, we would have really passed the initial stage and can look forward to the cultivator patronising the programme.

In a perspective of 15-20 years, it can be assumed that many changes may take place in the rural areas. We may under the circumstances fix the target at a minimum of 80 million acres which may be green manured at the rate of 20-30 lbs. per acre, which would make available nearly 1 million tons of nitrogen. Green leaf manure can be resorted to in addition to this. A major portion of this may be done by growing such types of plants on the borders of the fields, but such trees can even be grown on any waste land away from the field and green leaf put in the desired field. We are not taking any account of the contribution made by this source.

As far as phosphoric acid and potash are concerned, green manures add an equal quantity of potash but very little of phosphorus. Actual addition of phosphorus may not be more than 15-20 per cent of nitrogen but they help to release nearly equal quantities of locked up phosphates of the soil. Green manures can then be considered to supply about 1·0 million tons of Nitrogen along with other nutrients.

Total Organic Sources

Table 13·11 summarises the total additional potentialities from organic sources.

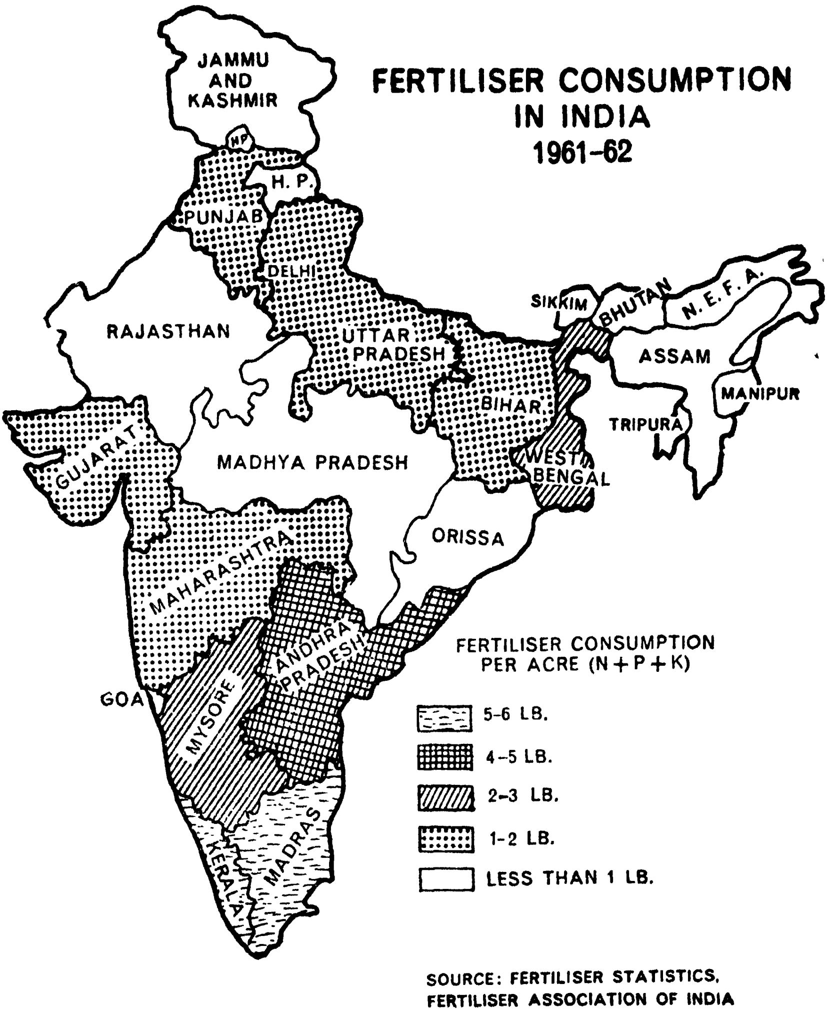
TABLE 13·11
ADDITIONAL POTENTIALITIES FROM ORGANIC SOURCES

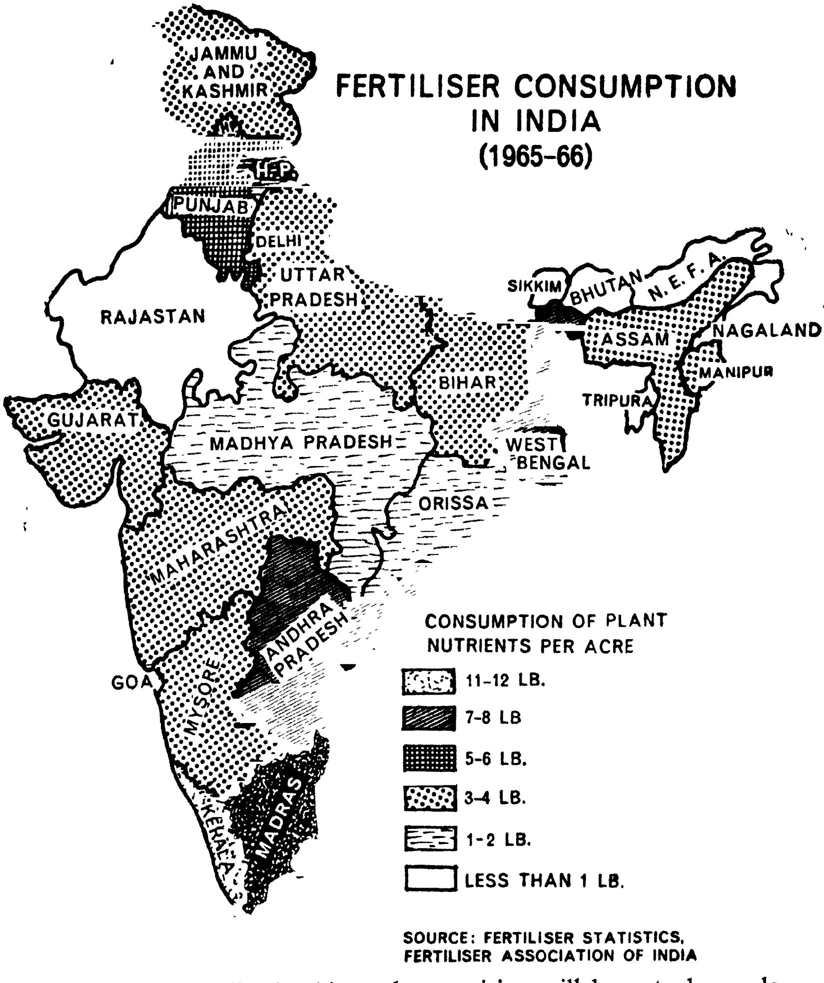
(Thousand tons)

Source	*N*	P_2O_5	K_2O
dung etc. from stabled livestock	2000	1000	1300
livestock urine	600	—	1000
sewage and sullage compost	160	160	100
sewage and sullage water	160	160	100
other waste products	80	50	70
green manure	1000	500	500
Total	4000	1870	3070

CHEMICAL FERTILISERS

Organic sources according to this scheme will provide nearly 4 million tons of nitrogen out of the total requirements of 9 million tons. With 2 million tons as the constant supply from invisible sources, this leaves a balance of a minimum of 3 million tons which will have to be met from inorganic sources. In case of any shortfall in respect of the organic sources as given above, the deficiency will have to be made up from chemical fertilisers. The Fourth Plan target of 2·4 million tonnes of Nitrogen from Chemical Fertilisers is an admission of the virtual defeat in utilising the organic sources. Since no positive action has so far been taken to develop organic sources, we may put a target of 4·0 million tons of Nitrogen from chemical fertilisers. This additional quantity of Nitrogen would also come quite handy to meet any losses or wastages etc. in the soil or even shortfall in any programme. There is, all the same, no reason why every possible effort should not be made to utilise these organic resources fully.





As stated earlier in this study, provision will have to be made for Phosphatic as well as Potassic fertilisers from inorganic sources as well. In the absence of properly analysed and reliable data, it might not be possible for us to come to a definite decision about the exact ratio for N, P and K. Small quantities of P_2O_5 and K_2O are already being used in the country. It will be extremely necessary to conduct regular experiments on the field of the cultivator. During the Third Plan period, the Ministry of Food and Agriculture has been trying to introduce fertiliser mixtures for different crops in various States. The Plan itself fixed a consumption target of 1·0 million tons of N, 0·4 million tons of P_2O_5 and 0·2 million tons of K_2O by the end of 1965. Table 13·12 shows the consumption of various fertilisers for the past few years. Distribution of some important fertiliser materials is shown on page 290. The accompanying map would give an idea of the use of fertilisers in the various parts of the country.

The present consumption ratio of NPK is roughly 8 : 2 : 1 against the corresponding Third Plan targets of 5 : 2 : 1. Because of the different agro-climatic conditions prevailing in the other parts of the world, it is not possible to base our recommendations on the basis of experience elsewhere. Potassic fertilisers have in any case to be imported. The exact quantity required can be determined on the basis of experience gained during the Fourth Plan period.

In any case, since the country has to depend upon foreign imports for potassic fertilisers, their requirements should be calculated with great care. Their use should be recommended only when we have before us some positive data about their usefulness. Even then every effort should be made to tap the organic sources for K_2O. We have a potential of 10·0 million tons of K_2O from livestock urine also. In the discussion under organic manures, we have assumed a very moderate target of only 10 per cent of this potential. If it is found necessary to have more of potassic fertilisers, an effort should first be made to conserve as much of animal urine as possible.

According to the report of the Central Salt and Marine Chemicals Research Institute, Bhavnagar, a new process has been evolved for the manufacture of potassium chloride and potassium schoenite (a double sulphate of potassium and magnesium) from mixed salt which is produced by solar evaporation of bitterns from salt works. A small unit is already operating to produce potassium chloride nd a bigger pilot plant is already in hand.

Under the present conditions of India, this will supply a very valuable source of potash, practically the whole of which is being imported today. It would be in the interest of the country to examine the possibilities of exploring such possibilities further.

For so long as possibilities of increasing local production of Potassic fertilisers seem to be limited, we would prefer to be a little conservative in this regard and fix a target of 400 thousand

TABLE 13·12

PRODUCTION, IMPORTS AND DISTRIBUTION OF FERTILISERS—1952-53 TO 1965-66

(Metric tonnes)

Year	*Nitrogen* (N)[a]			*Phosphoric acid*[ab] (P_2O_5)			*Potash* (K_2O)	
	Produced	*Imported*[c]	*Distributed*[d]	*Produced*	*Imported*	*Distributed*[e]	*Imported*	*Distributed*[f]
1952-53	53,067	44,294	57,822*	7,445	—	4,552	3,311	—
1953-54	52,905	19,346	89,287*	13,831	—	80,261	7,490	—
1954-55	68,478	19,984	94,810*	14,345	—	15,027	11,097	—
1955-56	76,859	53,370	107,494*	12,365	—	13,018	10,265	—
1956-57	78,788	56,768	123,054*	17,585	—	15,874	14,791	—
1957-58	81,144	110,100	149,019*	25,785	—	21,922	12,786	—
1958-59	80,766	97,540	171,988*	30,987	—	29,490	22,366	—
1959-60	83,694	142,335	229,326†	51,407	3,819	53,930	33,103	21,342
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	229,462	360,033†	88,300	7,959	81,385	44,276	36,503
1963-64	219,072	197,691	(406,976)†	107,836	12,267	(116,674)	64,060	(50,570)
			425,895			121,047	—	51,860
1964-65	243,230	256,517	(434,473)†			(147,652)		(70,440)
			492,249†	130,464	12,293	147,269	57,176	71,640
1965-66	237,889	376.270	(547,363)†	118,779	21,766[g]	(132,178)	93,641[h]	(77,746)
			583,017†			134,316		89,631[h]

[a] Includes complex fertilisers which contain both N and P_2O_5.

[b] Excludes bonemeal and ground rockphosphate for which data are not available.

[c] Figures from 1952-53 to 1957-58 are on financial year (April-March) basis.

[d] Figures from 1952-53 to 1956-57 relate to calendar years ending in the first half of the period stated while from 1957-58 to 1962-63 they are on financial year (April-March) basis. In respect of 1963-64, 1964-65 and 1965-66 figures are furnished both on financial year as well as agricultural year (July-June) basis, the former being in brackets.

[e] Figures from 1952-53 to 1957-58 refer to calendar year ending in the first half of the period stated while from 1958-59 to 1962-63 they are on financial year (April-March) basis. In respect of 1963-64, 1964-65 and 1965-66 the figures are furnished both for financial year and agricultural year (July-June), the former being in brackets.

[f] In case of sulphate of potash, quantity imported is taken as distributed. Figures relate to financial year (April-March). In respect of 1963-64, 1964-65 and 1965-66 figures are furnished both for financial year and agricultural year, the former being in brackets.

[g] Includes basic slag.

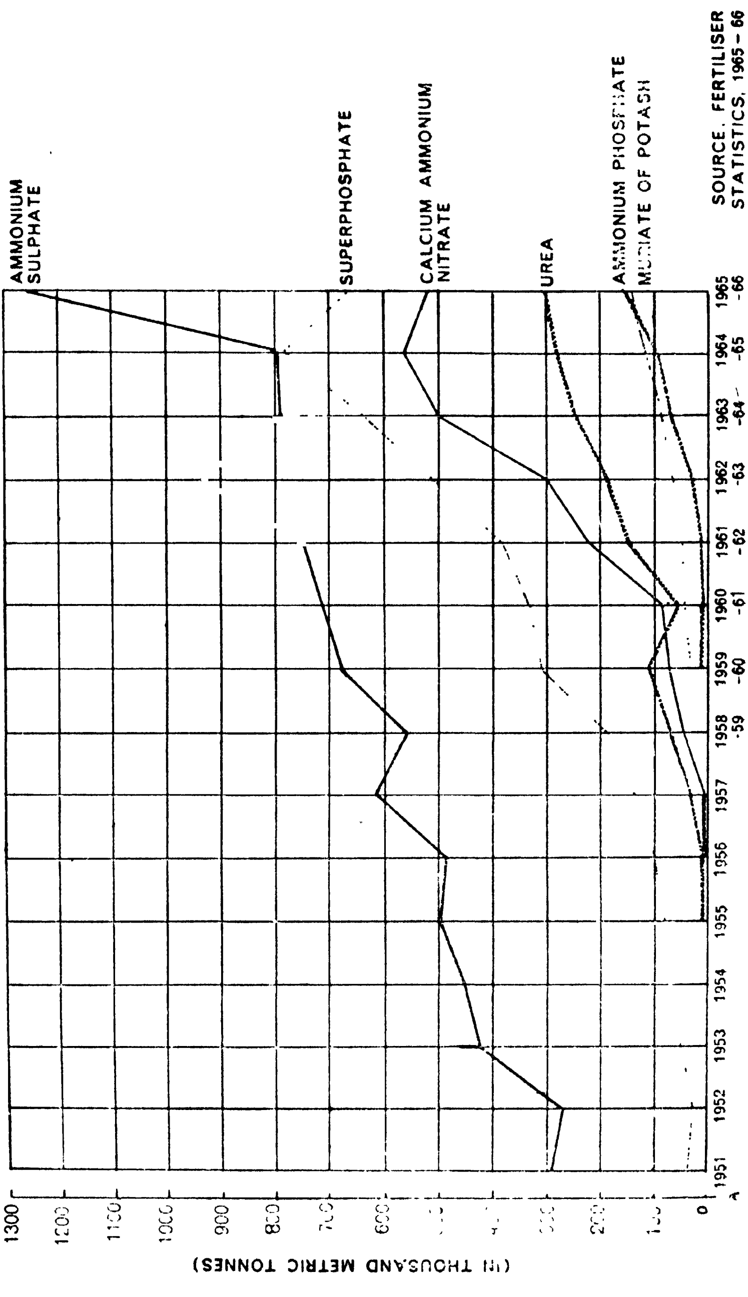
[h] Includes Kamex (38-42 % K_2O).

* Allotments of fertilisers under the "Central Fertiliser Pool."

† Actual dispatches of fertilisers under the "Central Fertiliser Pool."

Source : *Fertiliser Statistics*, 1965-66, pp. 99-100.

DISTRIBUTION OF SOME IMPORTANT FERTILISER MATERIALS 1951 to 1965-66



of potash for 1980-85. As for Phosphoric acid, we consumed nearly the total of 54 thousand tons of P_2O_5 in 1960-61. Consumption increased to 134 thousand tons in 1965-66. Assuming roughly a NPK ratio of 8 : 3 : 1 for chemical fertilisers, P_2O_5 targets will have to be put at 1·5 million tons.

All these targets will, however, have to be considered as preliminary which might need modification in the light of experience we gain during the coming plans. Discussion on manures/fertilisers in the preceding pages can then be summarised as in Table 13·13. When the total consumption of plant nutrients both from organic and inorganic sources is taken into consideration, we get a NPK ratio of roughly 2 : 1 : 1.

TABLE 13·13

MANURIAL AND FERTILISER RESOURCES FOR 1980-85 IN TERMS OF N, P, K

('000 tons)

	N	P_2O_5	K_2O
Organic sources			
Miscellaneous from invisible sources*	2000	1000	1000
Dung from stabled livestock	2000	1000	1300
Urine of livestock	600	—	1000
Sewage and sullage compost	160	160	100
Other waste products†	80	50	70
Green manure	1000	1000	1000
Fertilisers	4000	1500	400
Total	10000	4710	4870

* This includes:

(*a*) Urine and excreta of cattle, while in the field.

(*b*) Human urine and excreta from rural area where open field latrine system exists.

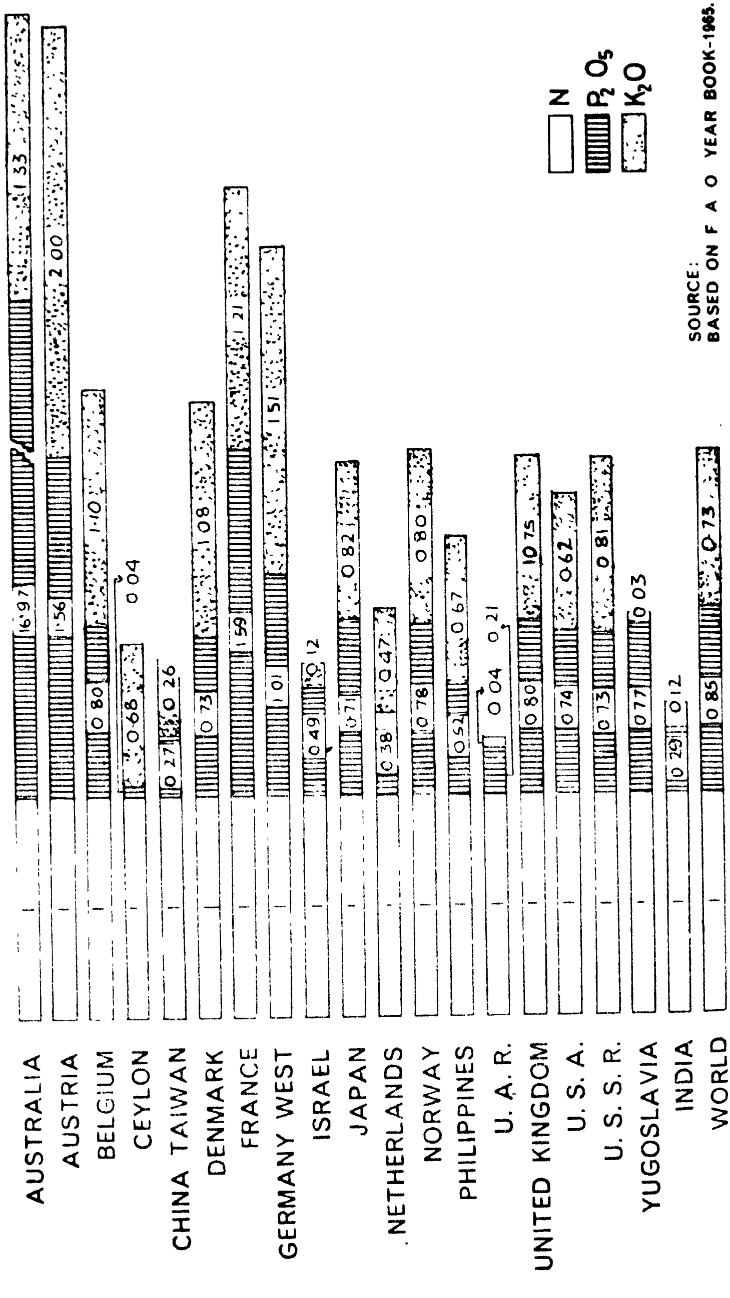
(*c*) Plant roots and other vegetable matter left in the field.

(*d*) Atmospheric fixture of nitrogen from the air and rain.

(*e*) Miscellaneous sources like oil cakes, 'rab' system, bone meal etc.

† Reference to materials like sugarcane trash, water hyacinth, dried blood meal of sheep and goats slaughtered, groundnut husk, tea and coffee wastes, tobacco wastes etc.

RATIO OF N : P_2O_5 : K_2O CONSUMPTION (1964-65)



It is not the object of this study to go into the controversy on manures *versus* fertilisers. On the other hand, it is maintained that there is no competition between the two and both are complementary to each other. None of them singly can meet all the requirements of a rapidly developing agriculture. As is well known. China has been maintaining for a long period a very high level of agricultural production as compared to India primarily on organic sources. She has now before her a very ambitious programme for the production of chemical fertilisers. This has been necessitated for the attainment of still higher levels of production.

For stepping up the use of organic sources, we have not to spend much of money, but a tremendous organisational effort is called for. On the other hand, chemical fertilisers involve not only heavy financial commitments, but also a well established and competent extension service.

A Sindri type of factory producing approximately 70 thousand tons of 'N' needs an investment of about Rs. 21 crores. A production programme of 4 million tons of 'N' would mean the setting up of some 56 factories. Assuming that, the Third Plan target of 500-600 thousand tons of nitrogen is achieved, we will still need more than 48 factories, costing over Rs. 1000 crores. Besides this, a huge expansion will be called for in the existing credit organisations. The cultivator left to himself will not be in a position to invest from his own resources for the purchase of fertilisers.[34]

In this comparison, there will be nothing like having as much manures as possible because they can be applied to practically every type of soil in any quantity, without much cost. But if we cannot utilise manures, the balance whether it is two million tons or more of nitrogen has to be supplied by chemical fertilisers and there is no alternative before the country but to make all the necessary investments.

This is in no way the end of the story. Every day increasing population and rising standards of living are going to put a greater and greater demand on agriculture. The answer to all this is higher and higher inputs of manures and fertilisers. A stage may ultimately come when we may be required to marshal all our organic as well as inorganic resources.

[34] There is the interesting case of Ceylon cultivator who gets a 50 per cent subsidy on fertilisers and even then per acre consumption of Nitrogen on paddy fields is only 15 lbs.

It would thus be in the fitness of things to make a start right now for the proper utilisation of organic resources for which as already stated, a huge organisational effort is needed. Once the programme indicates some success, it will create its own momentum. Maybe, extra yields provided by higher levels of production, are themselves capable of supplying the necessary finance both to the nation and the individual cultivators for the production as well as utilisation of chemical fertilisers.

In a tight budget economy, all programmes of self-financing type should get precedence over others. This principle would be applicable more to agriculture than to other sectors of the economy.

14

IRRIGATION

THE scriptures describe the nutritional cycle as:

> Water is the essence of earth, plants are the essence of water and creature—man is the essence of plants.

Water in this cycle thus occupies the pivotal place. Even otherwise, crops may be grown without soil, as in hydroponics but not without water. Yields in irrigated areas are said to be 60 to 100[1] per cent

TABLE 14·1

YIELDS OF CROPS IN INDIA FROM IRRIGATED AND UNIRRIGATED AREAS

(In maunds)

	Canal irrigated	*Dry farmed*
Sugarcane	70	—
Jowar grain	8	3½
Wheat	7½	3
Groundnu	20	8
Gram	5	3
Bajri grain	6	2½
Cotton	3	1

NOTE: One maund=82·3 lbs.

Source: Dr. D. R. Gadgil, *Economic Effects of Irrigation*, pp. 100-105.

[1] Sir William Stamp, "Irrigation from the Groundwater for Stimulating Food Production in Desert Areas," *Empire Journal of Experimental Agriculture*, Jan. 1948, p. 46.

TABLE 14·2
IRRIGATED AND DRY CROP YIELDS IN ISRAEL

	Yield in tons per hectare		*No. of working days required per hectare*	
	Irrigated crops	*Dry farmed crops*	*Irrigated crops*	*Dry farmed crops*
Tomatoes	30-40	7-12	250-350	100
Potatoes	20-300	8-105	100-150	
Carrots	30-40		150-250	
Egg plant	30-50		150-250	
Cucumbers	20-30	5-10	150-200	100
Cauliflower	10-20			
Onions	30-50	10-15	210-250	150
Groundnuts (seeds)	3-4		90-120	
Fodder crops:				
Beets (fodder)	120-200	30-40	230-250	40-50
Clover	60-90	30-40		
Vetches (winter)	20-30			
Corn	3-4	1-5		
Barley	3	1		

Source: Karl Manubelm, *Studies in Economic Development*, p. 141.

higher than in the dry areas. Tables 14·1 and 14·2 give an idea of the possible increases as a result of water alone in India and Israel.

This shows a vast difference in yields in the two cases. It would, however, be wrong to say that all these differences are due merely to the presence or absence of water. It was rightly observed by Chakravarty at the West Bengal Power and Water Resources Development Symposium that many amongst the educated people try to assess the benefits of irrigation by comparing yields in irrigated and non-irrigated areas. The real benefit from irrigation is in its ability to present the manure in a suitable form for being taken in by the plant. For optimum growth, addition of manure is essential and irrigation being a sort of catalytic agent, it enables the plant to take the food in.[2]

Present Irrigated Area

There is at present a good deal of confusion about irrigation

[2] *Journal of Power and River Valley Development*, Vol. VIII, No. 9, p. 71.

statistics. No clear-cut demarcation is made between major and medium irrigation projects on the one hand and between this group of projects and minor irrigation schemes on the other. Again, source-wise distribution of irrigated area is available only for the net area irrigated and not for the gross area.[3]

According to the Working Group on Major Irrigation,[4] of the net irrigated area of 51·5 million acres on the eve of the First Plan, the share of major and medium irrigation projects was 22 million acres. The contribution of major and medium projects is put at 25·8 million acres (gross) out of the total gross irrigated area of 55·8 million acres.

The Working Group on Minor Irrigation on the other hand puts the estimated net irrigated area from major and medium irrigation at 17·9 million acres and the gross irrigated area at 19·7 million acres. Thus, whereas according to the Report of the Working Group on Major Irrigation, the net area under minor irrigation was of the order of 29·5 million acres, according to the Working Group on Minor Irrigation, this was 33·6 million acres. Corresponding estimates of the two Working Group Reports in respect of gross irrigated area under minor irrigation were 22 million acres and 36·1 million acres, respectively. One reason for this discrepancy was that the area under private canals was accounted for under minor irrigation schemes by the Working Group on Minor Irrigation and shown under major and medium irrigation works by the Working Group on Major and Medium Irrigation. On the assumption that all irrigation through private canals falls under major irrigation, we might assume that on the eve of the First Plan, of the total net irrigated area of 51·5 million acres, 20·7 million acres (40·2 per cent) were accounted for by major and medium projects and 30·8 million acres (59·8 per cent) under minor irrigation.

In the absence of any other basis for classifying the gross irrigated area between the two categories, we have allocated the gross area as reported by the land utilisation statistics for the different

[3] The Working Group on Minor Irrigation which went into the question of effecting improvements in irrigation statistics contained in the progress Reports, has also recommended that source-wise break-up of the gross irrigated area should also be given along with that of the net irrigated area.

[4] Report of the Working Group for Fourth Plan on Irrigation, Flood Control, Soil Conservation and Power, p. 1.

TABLE 14·3

SOURCE-WISE DISTRIBUTION OF THE IRRIGATED AREA, 1950-51 TO 1964-65

(Thousand acres)

Year	Net Area Irrigated								Gross Area		
	Canals				Wells						
	Government	*Private*	*Total*	*Tanks*	*Tube wells*	*Wells*	*Other sources*	*Total*	*Major & Medium*	*Minor*	*Total*
1	2	3	4	5	6	7	8	9	10	11	12
1950-51	17,898	2,814	20,712	8,776	—	14,712	7,329	51,500	22,342	33,314	55,755
1955-56	19,832	3,561	23,193	10,929	—	16,651	5,464	56,257	25,472	37,892	63,364
1960-61	22,803	3,021	25,924	11,096	—	17,995	5,983	60,896	27,701	41,208	68,909
1963-64	24,339	2,824	27,163	11,362	2,540	16,698	6,131	63,892	29,476	43,348	73,324
1964-65	24,595	2,807	27,402	11,762	19,546		6,197	64,908	30,213	44,943	75,156
1965-66	24,283	2,800	27,083	10,974	4,843	16,025	6,412	65,338	30,787	45,797	76,584

periods on a pro-rata basis as calculated for 1950-51. This would give a gross irrigated area of 45·8 million acres under minor irrigation for the end of the Third Plan when the total irrigated area is estimated at 76·6 million acres. Information regarding source-wise irrigated area in the country thus calculated is given in Table 14·3

Table 14·4 provides information about the targets, potential created and area said to be actually utilised under major as well

TABLE 14·4

IRRIGATION TARGETS, POTENTIAL AND UTILISATION ACCORDING TO STATE PROGRESS REPORTS

(Million acres)

	First Plan	*Second Plan*	*Third Plan*	*Total Three Plans*
1	2	3	4	5
Major and Medium				
Target	8·3	10·4	12·8	31·7
Potential	6·5	5·2	6·3	18·0
Utilisation	3·1	5·2	5·5	13·8
Minor				
Target	11·2	9·0	12·8	33·0
Potential	9·5	9·0	12·8	31·3
Utilisation	9·5	9·0	12·8	31·3

as minor irrigation projects separately as given by the Progress Reports. According to these reports there should have been an addition of 45·1 million acres to the gross irrigated area of the country during the first three plan periods. This shows a gap of 24·3 million acres in the irrigat d area actually being put to use according to the land utilisation statistics and the one said to have been utilised according to the State Progress Reports.

The general question regarding discrepancies between the two sets of figures of irrigation statistics has been examined in detail in the Report of the Working Group for the formulation of Fourth Five Year Plan Proposals on Agricultural Statistics.[5] A type study carried out in Punjab by the Directorate of Economics & Statistics, Ministry of Food, Agriculture, C. D. and Co-operation re-

[5] See Report of the Working Group on Agricultural Statistics, p. 33-34.

vealed that the statistics of area benefited by minor irrigation reported in the Progress Reports did not represent truly the additions to irrigated area, for they also included (*a*) old irrigated area over which irrigation has been made more certain, (*b*) area benefited by water conservation-cum-ground water recharging schemes, and (*c*) area benefited by drainage, flood-control, etc. Further, while the irrigation statistics given in Land Utilisation Statistics make allowance for the losses due to depreciation of existing works as they relate to areas actually receiving irrigation, Progress Reports often refer to irrigation facilities created.

There are other factors which vitiate the comparison between the two sets of figures. The minor irrigation schemes are often not properly classified with the result that the figures are reported against wrong categories. The difference between gross and net irrigated areas is also not fully appreciated. The figures in the Progress Reports relate to gross irrigation potential in some cases, and to net irrigation potential in others. Further, while in some cases, the additional area benefited during the period is reported, in other cases a cumulative total from the very inception of the scheme is given. There is often some time-lag between the completion of a work and actual utilisation of irrigation potential. In the Progress Reports an area may be reported as irrigated as soon as a work is completed. In the case of private works, such as wells, pump-sets, etc., the irrigation benefits are calculated on the basis of yardsticks, the accuracy of which is yet to be tested.

According to the calculation made by us in Table 14·3 there may be still some discrepancy in the allocation of the total area under irrigation as between the two categories. This, as the figures stand, would not be of much significance when it is accepted that the total addition to the gross irrigated area in the country during the first three plan periods is not more than 20·8 million acres from all sources.

Ultimate Irrigation Potential

The annual rainfall over the entire country represents something more than 3 thousand million acre feet of water. Of this amount, about one thousand million acre feet are lost immediately due to evaporation and roughly 650 million acre feet seep into the soil, leaving 1350 million acre feet to flow into the river systems. It has been investigated by the experts that the entire surface flow cannot be utilised because topography, flow characteristics, climate and soil conditions impose limits on their usability. According to available estimates not more than 450 million acre feet can be harnessed for purposes of irrigation. Progress in actual utilisation has so far been as follows:

TABLE 14·5

SURFACE WATER UTILISATION FOR IRRIGATION

	Million Acre Feet	*Per cent of Usable Flow*	*Per cent of Total Flow*
Up to 1951	76	17	6
Up to 1960-61	120	27	9
Up to 1965-66*	150	33	11

Estimated.

The Central Water Power Commission initiated in 1954 a study of different river basins in the country to assess the ultimate potential of major and medium irrigation projects. The country was divided into five principal zones covering groups of river basins and for each river basin the topography, rainfall, intensity of cultivation, possible storage sites, irrigable areas, reservoir

TABLE 14·6

IRRIGATION POTENTIAL OF MAJOR AND MEDIUM PROJECTS

(Million acres)

Zone 1 :	West-flowing rivers (covering river basins in Kerala, Mysore and Maharashtra States and the basins of Tapti, Narmada and others)	10
Zone 2 :	East-flowing rivers (covering the basins of Tambraparani, Vaigai, Cauveri, Mahanadi, Godavari, Krishna, Pennar and others)	33
Zone 3 :	Indus Basin	13
Zone 4 :	Ganga basin (covering Chambal, Jamuna, Ramganga, Tons, Gomti, Sone, Ganga and its tributaries)	41
Zone 5 :	Brahmaputra basin	3
	Total	100

capacity and other relevant factors were examined. Studies in respect of four zones are almost complete, while the fifth has still to be taken up. A preliminary assessment put the irrigation potential of major and medium projects at 100 million acres[6] (gross) distributed as shown in Table 14·6.

As regards underground water, of the 650 million acre feet of water that seep down annually into the soil, about 350 million acre feet get absorbed in the top layers, thereby contributing to soil moisture which is essential for the growth of vegetation. The remaining 300 million acre feet percolate into porous strata and represents the annual enrichment of underground water. The total storage underground at any particular time may be several times this amount, but it can be assessed only if a country-wide investigation is undertaken. The actual utilisation of underground water at present is less than 20 per cent of the annual enrichment. Over the past 8 years efforts have been made through a series of ground water exploration projects to establish areas favourable to the sinking of tube wells. For the Third Plan a project including 500 exploratory borings was included. Geophysical investigations have also been proposed.

While all these investigations are still in hand, the first comprehensive attempt towards assessment of underground water potential in the form of minor irrigation was made in 1955 by the Minor Irrigation Committee set up by the Ministry of Food and Agriculture. Similar studies were later initiated by the Minor Irrigation Team of the Committee on Plan Projects. A tentative appraisal of the data from these surveys indicates that a total ultimate irrigation potential of minor irrigation projects may be about 75 million acres (gross).

These studies which in no way can be considered as a final word in so far as the irrigation potential of the country is concerned, give an indication that it should ultimately be possible for the country to have an irrigated area of 175 million acres (gross). This, when achieved, would raise the amount of water utilised to 350-400 million acre feet, or 60 per cent of the annual supply from both surface and underground sources and will leave adequate quantities of water for meeting public supply and industrial needs etc. After making an assessment of the position as it stands today we

[6] This is now being put at 112 million acres (gross).

will try to find out in the subsequent pages how far it would be possible to exploit this potential during the coming 20 years.

Major Irrigation

Precise information about coverage or ultimate potential of the major irrigation projects undertaken during the various plan periods is not available. The available information is summarised in Table 14·7.

On completion, the First and Second Plan schemes are expected to irrigate about 38 million acres[7] and the tentative ultimate potential of all the schemes accepted in the First, Second and Third Plans has been put at 44 million acres.[8]

In the First Five Year Plan, nearly 250 irrigation schemes (20 major and 230 medium) were included, of which 237 (18 major and 219 medium) schemes were taken up for actual execution during the First Five Year Plan. In the Second Five Year Plan, 188 new schemes (30 major and 158 medium) were included, of which 154 irrigation schemes (20 major and 134 medium) were taken up for execution. In addition, 13 irrigation schemes which were not taken up in the First Five Year Plan were also started in this period bringing the total number of major and medium irrigation works taken up in the Second Plan to 167. In the Third Plan, 103 irrigation schemes (16 major and 87 medium) were included.

While formulating projections of gross area under irrigation that might be available from major irrigation projects, we have to take due note of the achievements during the past 15 years. Total addition to the area under major and medium projects during the period 1950-51 to 1965-66 comes to only 8·5 million acres with a total investment of about Rs. 1252 crores against a target of 31·7 million acres, potential created of 18 million acres and assumed utilisation of 13·8 million acres. If the total potential of all the three plan projects is 44·0 million acres, we are left with a balance of 35·5 million acres which has either not yet been created or if created has not yet been fully utilised.

[7] Fourth Plan Working Group Report on Irrigation, Flood Control, Soil Conservation and Powers.

[8] *Ibid.*, p. 10.

TABLE 14·7

DEVELOPMENT OF IRRIGATION FROM MAJOR AND MEDIUM SCHEMES IN DIFFERENT STATES AND SCOPE OF NEW SCHEMES IN FUTURE PLANS

Thousand acres

Name of State	*Approximate ultimate potential*	*Irrigation from Pre-Plan Schemes (gross)*	*Ultimate Potential of Schemes accepted in I, II and III Five Year Plans*	*Balance potential for new Schemes*
Andhra Pradesh	16000	4139	3836	8025
Assam	2400	162	179	2059
Bihar	10600	1454	7480	1666
Gujarat	5300	80	3283	1937
Jammu & Kashmir	241	105	136	—
Kerala	1543	391	1152	—
Madhya Pradesh	13900	1261	2629	10010
Madras	3858	2818	1040	—
Maharashtra	5800	689	1509	3602
Mysore	4400	760	2560	1080
Orissa	6000	1124	1912	1964
Punjab	10229	4092	6137	—
Rajasthan	7800	800	3687	3313
Uttar Pradesh	18800	4918	4802	9080
West Bengal	5700	1086	2721	1893
Total	11257	23879	44063	44629

Source : Working Group Report on Irrigation, Flood Control, Soil Conservation and Power for the Fourth Five Year Plan, p. 10.

The irrigation potential created during the first three plan periods constitutes 76, 50 and 53 per cent respectively of the targets set under the First, Second and Third Plan periods. The assumed utilisation was of the order of 36 per cent of the target for the First Five Year Plan, 50 per cent for the Second Plan period and 43 per cent for the Third Five Year Plan. The percentage of actual utilisation of the potential created in the three plan periods successively has been 57, 60 and 49 respectively (Table 14·8). This would indicate that the efficiency in the utilisation of the potential created has actually fallen over the Plans.

It would be apparent from the foregoing paragraphs that our performance in the field of irrigation has been very much below the targets envisaged in the various plan periods. Nevertheless it would be safe to assume that it would be possible to complete all

TABLE 14·8

TARGETS AND UTILISATION OF IRRIGATION THROUGH MAJOR AND MEDIUM IRRIGATION WORKS

(Million acres)

Period	*Target*	*Potential created (addl.)*	*Utilisation*		*Col. 3 as % of Col. 2*	*Col. 4 as % of Col. 2*	*Col. 4 as % of Col. 3*	*Col. 5 as % of Col. 3*	*Col. 5 as % of Col. 2*
			State Progress Reportts	*Land Utilisation*					
1	2	3	4	5	6	7	8	9	10
First Plan	8·53	6·5	3·1	3·13	76	36	48	57	44
Second Plan	10·40	5·2	5·2	2·23	50	50	100	60	30
Third Plan	12.80	6·3	5·5	3·09	53	43	87	49	24
Total Three Plans	31·73	18·0	13·8	8·45	53	43	77	47	27

the major and medium projects started during the first three plans and to utilise their potential fully by 1980-85. If in the perspective period in view, assumption that the remaining area of 35·61 million acres will be fully utilised and would become available for cultivation comes true, it would mean a more than four-fold increase of the performance under the past three plan periods. A total area of 66·4 million acres would benefit from major and medium projects as a result of the full utilisation of the projects initiated during the first three plan periods.

Data for making realistic calculations of actual cost incurred per acre during the plan periods are lacking. Calculations on the basis of area actually utilised and total investment made would indicate (Table 14·9) that the cost per acre of irrigation in the country works out to Rs. 958 in the First Plan, Rs. 1704 during the Second Plan and Rs. 1850 during the Third Plan.

TABLE 14·9

TOTAL OUTLAY AND UTILISATION OF MAJOR IRRIGATION PROJECTS

Period	*Area covered (million acres)*	*Total Expenditure (Rs. crores)*	*Expenditure per acre of irrigation facilities utilised (Rs.)*
First Plan	3·13	300	958
Second Plan	2·23	380	1704
Third plan	3·09	572	1850
Total	8·45	1252	1482

It is quite possible that the benefits of a major portion of the investment made during the first two plan periods would have accrued during the Third Plan period. If so, cost per acre would seem to have gone up over the successive plan periods and there is every reason to believe that the projects in the future plans would cost much more. This is because the general price level is rising and along with that the cheaper and the easier projects have already been handled and harnessed. At an average investment of about Rs. 2000 per acre, achievement of a target of 66·4 million acres total or 35·6 million acres (additional) from major irrigation projects would involve an investment of the order of Rs. 7120 crores, roughly six times the investment made in the past 15 years.

Minor Irrigation

It is normally believed that minor irrigation projects do not take so long a period to develop. Recent experience, however, shows that this assumption is wrong. The Team for the Study of 'Utilisation of Irrigation facilities etc.' points out that in one district of Orissa, Dhenkanal, area irrigated during 1957 was 16,640 acres as against the original anticipation of 25,461 acres. Area that could be further irrigated if field channels were dug was not computed. Full report for the whole of the country is not available. From this and many other stray investigations it would be clear that the gestation period for minor irrigation also may be at least a few years.

The State Minister's Conference at Srinagar, in 1957, made the following recommendations for a fuller utilisation of water from minor irrigation sources.

(*i*) It is observed that the cultivators in several States are unable or unwilling to construct water courses for the conveyance of water to all portions of the commanded area. It was, therefore, recommended that the State Governments should in such cases construct water courses and recover the cost separately from the beneficiaries.

(*ii*) On all public minor irrigation works where water rate is not being recovered cess on the entire irrigable area should be levied. This would ensure funds for maintenance and would also serve as an inducement for using the water available.

(*iii*) In order to encourage full use of water in new irrigation schemes, water may be supplied at concessional rates during the first few years.

(*iv*) Electricity rates for irrigation shold be lower than those for industrial purposes. Efforts should be made to ensure that more electric power is made available in rural areas for agricultural purposes.

(*v*) Irrigation rates charged on old and new works should be pooled together.

(*vi*) An irrigation Extension Service should be provided to ensure proper use of water.

(*vii*) There should be proper maintenance of completed minor irrigation works and funds required for this purpose should be allocated regularly from year to year.

There is another problem connected with minor irrigation projects. The GMF Enquiry Committee very aptly pointed out that:

> While new wells or tanks, etc. are being constructed as a part of GMF campaign, a number of existing works are going out of use every year.

Again, the Srinagar Conference took the following decisions on the subject:

(*a*) Efforts should be made to ensure proper maintenance of completed minor irrigation works and that the funds required should be allocated regularly from year to year.

(*b*) On all State owned irrigation works where a water rate is not being recovered from irrigation, cost on the entire irrigable area should be levied. This would ensure funds for maintenance and would also serve as an inducement for using the water available.

(*c*) The need for a proper record of completed works and for a regular watch of irrigation performance was recognised.

The present study has been projected with the assumption that all these recommendations are fully implemented.

Against targets of 11·2 million acres in the First Plan, 9 million acres in the Second Plan and 12·8 million acres in the Third Plan, the actual achievement of minor irrigation has been only 12·5 million acres during the three plan periods As percentage of the targets, achievement constituted 41 per cent during the First Plan, 37 per cent during the Second Plan and 61 per cent during the Third Plan. (Table 14·10).

TABLE 14·10

TARGETS AND UTILISATION OF IRRIGATION THROUGH MINOR IRRIGATION WORKS

(Million acres)

Period	Target	Utilisation: State Progress Reports	Utilisation: Land Utilisation statistics	Col. 3 as % of Col. 2	Col. 4 as % of Col. 2
1	2	3	4	5	6
First Plan	11·2	9·5	4·58	85	40·6
Second Plan	9·0	9·0	3·32	100	36·9
Third Plan	12·8	12·8	4·59	100	36·0
Total	33·0	31·3	12·49	94·8	37·8

Gross area irrigated under minor irrigation projects on the eve of the First Plan was 33·3 million acres. For the first three plans, against the target of 33 million acres and proclaimed achievement of 31·3 million acres, additional area covered under minor irrigation on the basis of Land Utilisation Statistics was only 12·49 million acres, just 36 per cent of the reported achievement for the three plan periods. This would indicate that we have not been able to add even a million acres per annum to the gross irrigated area of the country from minor projects. With regard to the future possibilities of extending the area under minor irrigation we have to take into consideration the fact[9] that

1. increasing attention will have to be paid to proper maintenance and utilisation of new minor irrigation works;
2. construction would gradually extend through more difficult and problematic areas; and
3. as more irrigation potential is created, the area lost due to depreciation would increase.

In the light of this, one would wonder how it would be possible for us to move faster in the coming 15-20 years. If our annual addition from minor irrigation projects was of the order of 0·8 million acres during the past three plan periods we can at best assume that we will be able to improve our efficiency by say 50 per cent, so as to add another 22 million acres in the coming 15-20 years. This would give a gross irrigated area of about 68 million acres from minor irrigation by the stipulated period.

Actual investment outlay on minor irrigation during the First Plan period is not available. Central assistance for minor projects was, however, Rs.45·83 crores.[10] Assuming a minimum of 50 per cent as the contribution of States, total investment would come to Rs. 91.66 crores or Rs. 202 per acre. (Table 14·11).

These calculations do not take into consideration the matching contribution of the private sector which may in certain cases be of the order of 50 per cent. While calculating the real cost to the nation, this investment has also to be included.

[9] Report of the Working Group on Minor Irrigation for the Fourth Five Year Plan, p.127.

[10] *Ibid.*

TABLE 14·11

TOTAL OUTLAY AND UTILISATION OF MINOR IRRIGATION PROJECTS

Period	*Area covered (million acres)*	*Total expenditure (Rs. crores)*	*Expenditure per acre of irrigation facilities utilised (Rs.)*
First Plan	4·58	92	202
Second Plan	3·32	95	286
Third Plan	4·59	269	588
Total Three Plans	12·49	463	371

The above calculations do not take account of the fact that minor irrigation schemes go out of use from year to year. This has tended to vitiate our calculations relating to cost per acre. It is normally believed that minor irrigation projects once created remain in use over a longer period. We cannot, however, escape from the conclusion that some of the minor irrigation projects will certainly go out of use. This has been acknowledged by the Working Group on Minor Irrigation. According to the Report of Minor Irrigation Committee, 1957 (p.48), the estimated percentage of wells getting into disuse in Rajasthan has varied from 10 to 20. We can at best assume that efforts would be made to reduce losses to the minimum by a better care of old works. Even then it might not be possible to cut these losses below 2 per cent per annum.[11]

Gross addition of 22·2 million acres under minor projects would then cost proportionally more on a unit basis as compared to the investment made during the Third Plan period because (*i*) areas going out of use will increase every year (in so far as the absolute figure is concerned), and (*ii*) cost per acre would go on increasing.

Calculating at about Rs. 600 per acre as the share of the public sector investment under Minor Irrigation, total investment would amount to Rs. 1332 crores—nearly three times the amount spent in the past 15 years.

[11] The Fourth Plan Working Group on Minor Irrigation assumed a figure of 1 per cent.

Gross Irrigation

Total irrigated area from minor as well as major projects may then work out to about 135 million acres as shown in Table 14·12.

TABLE 14·12
GROSS IRRIGATED AREA BY 1980-85

(Million acres)

Year	*Major and medium*	*Minor*	*Total*
1950-51	24	32	56
Net addition 1950-51 to 1980-85	43	36*	79
Total	67	68	135

* Minor irrigation projects going out of use during the 30 years period have been taken as 18 million acres.

Areas of Assured Rainfall

Besides this, there are certain areas in the country which can be said to have an assured supply of water and considered more or less at par with irrigated areas. The definition of the phrase assured rainfall area is rather vague. What is most important in this connection is not only the total quantity of water falling on the fields but also its distribution. Normally, all areas falling in an average annual rainfall zone of 50 inches or even a little less may be considered to make available sufficient quantities of water for crops. But this is not true for all practical matters.

In West Bengal, where average annual rainfall is nearly 69 inches, broadcast varieties of true 'Aman' paddy maturing in August or the 'Boro' paddy grown in winter under irrigation, have been rarely in evidence. It is a paradox that though this rice is grown during the season of maximum rainfall, it still needs irrigation. The reason is that the rainfall itself is variable both in quantity and distribution. But water requirements for paddy follow more or less a set pattern. While excess rainfall at any time serves no useful purpose, it is actually harmful if sufficient water is not available at the proper time. Deficiencies must be made up if proper cultivation has to be ensured. The object of irrigation is to ensure supplies of water as and when required not only to protect the crops but also to augment the yield that irrigation, particularly from silt-laden river supplies, can give.

As against a normal rainfall of 53 inches during the year in one area, the normal monsoon precipitation during different months may be as shown below.[12]

(Rainfall in inches)

July	*August*	*September*	*October*	*Total*
12	11·75	8·50	3·5	35·75

The minimum in any month, however, may be as low as 30 to 50 per cent in deficit.

Given proper distribution, a total supply of about 25 inches may be sufficient for raising a successful harvest. The optimum requirement would be of the order of 40 inches. In any case quantity and distribution must both be taken together. This will go to show the necessity for ensuring supplementary irrigation.

The need for extra irrigation arises because the rainfall is not well distributed. Appendices 33 and 34 give this distribution district-wise for West Bengal as well as Bihar. They show that nearly 75 per cent of the rainfall is recorded during the monsoon months. Naturally crops growing in the other parts of the year would need some extra water.

(Rainfall in inches)

	1st 10 days	*2nd 10 days*	*Rest of the month*	*Total*
May	—	—	2	2
June	2½	2½	2½	7½
July	4	4	4½	12½
August	4	2	2	8
September	3½	2½	1½	7½
October	1½	1½	1½	4½

Source : A. Das, "Problem of West Bengal Rivers with particular reference to rainfall," *Indian Journal of Power and River Valley Development, op. cit.*, p. 15.

[12] *Indian Journal of Power and River Valley Development*, Vol. VII.

Sometimes it so happens that even those crops which grow during the rains require some extra water for optimum production levels. 'Aman' paddy for example, in West Bengal, which grows during rains requires about 42 inches of rainfall in the rainy season as shown on page 312.

A comparison of water requirements as given above and the actual rainfall as shown in Appendix 33 would indicate that June-September rainfall is sufficient to meet the requirements of the crop. But the difficulty arises because the actual distribution of rainfall during the months (though likely to be 42 inches or more) may not be the same as detailed above. Consequently, during any 10 days period, when actual rainfall is short of what is required, arrangements will have to be made for some additional supply of water by some irrigation channels of, at least, protective type.

What is applicable to Bengal will be equally applicable to other areas. The Minor Irrigation Committee, for example, says that

TABLE 14·13

DISTRIBUTION OF ASSURED RAINFALL AREA—1953-54

(Thousand acres)

Crops	*Gross cultivated area*	*Gross irrigated area*	*Area under assured rainfall (without irrigation)*
1. Rice	48,770	11,732	37,038
2. Wheat	2,722	205	2,517
3. Pulses	12,061	307	11,754
4. Coarse grains	7,965	214	7,751
5. Total food grains	71,518	12,458	52,060
6. Sugarcane	550	188	362
7. Cotton	161	—	161
8. Fibres other than cotton	1,379	—	1,379
9. Oil seeds	4,969	—	4,969
10. Other miscellaneous crops	6,852	1,098	5,754
All India (gross)	85,429	13,744	71,885
All India (net)	72,849	12,892	59,957
Double cropped	12,580	852	11,728

Orissa has fairly good rainfall ranging between 50 to 60 inches. The demand on irrigation is, however, more in areas where a high percentage of the annual rainfall is observed during monsoon.[13] Under the circumstances, it becomes rather difficult to estimate correctly the extent of areas with an assured supply of water. Appendix 35, all the same, gives the break-up of cropped area and irrigated area in the different rainfall zones. Table 14·13 summarises the position regarding assured rainfall area.

Crops may require water at critical periods of growth when rain water may not be available in a major portion of the so-called assured rainfall regions. It would then be wrong to assume that crop yields from this area spreading over 71·9 million acres (Table 14·13) would be the same as from irrigated areas. Of this, not more than 25 million acres in Kerala, Assam, Mysore, West Bengal and Bombay (Konkan) where total rainfall is heavy and well spread can be considered as equal to irrigated areas. Existing cropping pattern in this area is given in Appendix 36. Since every acre of extra irrigation provided in this region enables the second crop to grow on another acre, gross cultivated area would increase in proportion to the increase in irrigation facilities.

At present about 4 million acres out of this 25 million acres is irrigated. From a study of the distribution of 135 million acres of irrigated area by 1980-85, it can be computed that in this assured rainfall area, irrigated area would be roughly 16 million acres. This additional irrigation facility of 12 million acres is likely to increase the gross cultivated area in the assured rainfall region to 35 million acres (a net addition of 10 million acres).

Net Position

We can conclude from what has been stated above that India will have about 135 million acres of irrigated area[14] and another 35 million acres in the assured rainfall region where intensive cultivation may be possible. We can then say that intensive cultivation of the type we envisage may be possible on not more than 170 million acres of gross cultivated area by the year 1980-85.

[13] Report: *op. cit.*, p. 99.

[14] It would be interesting to know that this would be more or less equal to the present irrigated area in the world, outside India and Mainland China as shown in Appendix 37. But it would be hardly 1/3 of the gross cultivated area of India.

Cropping Pattern

As regards the distribution of irrigated area between different crops from State to State, it seems to be rather a hard job. We have got a complete picture of irrigation distribution for the year 1962-63. One assumption could be that all the additional irrigation facilities would be distributed between various crops in the same ratio as it existed in 1962-63. But this will be far from actuality. Irrigation at present is primarily restricted to food crops only. But in the future agricultural development, non-food crops are bound to come to prominence. Percentage increase fixed for the production of such crops in our targets are pretty high. This being the case, it can possibly be assumed that no more new areas may be allocated to food crops.

Irrigation will also have to be provided for some other crops like oil seeds. Since in any scheme of intensive cultivation, unirrigated cotton and sugarcane, may not have a significant place, major portion of the area under these crops may be irrigated. Vegetables and fruit gardens where our deficiency is the maximum at the moment will also have to be paid some special attention. In fact a sort of a new land utilisation pattern will have to be drawn so as to provide the basic minimum necessities of an average citizen.

Irrigated Production Potential

Next question that comes up for consideration is the contribution that this much irrigation will make towards the achievement of our agricultural targets. On the basis of existing yardsticks, we can assume that food crops will give an additional yield of 1/5th of a ton per acre as a result of irrigation. But this suffers from a number of defects. First this yardstick is not applicable for different parts of the country. Secondly, it is not based on a very scientific principle. Thirdly, no such yardsticks are available for crops other than food grains. This approach to the problem has, therefore, to be discarded.

An attempt was then made to find out the irrigated and unirrigated yields. Such classification is not at present being made by the Ministry of Food and Agriculture in their production statistics. Recently, the Crop Survey Wing of the Cabinet Secretariat has calculated irrigated and unirrigated yields for some of the food crops in certain States. Some information on irrigated/unirrigated yields is also available for U.P.[15]

On the basis of available data from these and other sources Table 14·14 has been drawn up which shows the all-India average irrigated and unirrigated yields for these major food crops. In order to make these yield figures comparable with the total production, some minor adjustments were made (both for irrigated and unirrigated yields).

TABLE 14·14
IRRIGATED AND UNIRRIGATED YIELDS PER ACRE AND TOTAL PRODUCTION FOR SOME FOOD CROPS 1953-54

Crops	*Irrigated area* Average yield (lbs. per acre)	Area ('000 acres)	Total production ('000 tons)	*Unirrigated area* Average yield (lbs. per acre)	Area ('000 acres)	Production ('000 tons)	Total production (mn. tons)
Rice	1,034	25,647	11,835	692	51,671	15,965	27·8
Wheat	945	9,576	4,038	514	11,818	3,862	7·9
Barley	901	4,063	4,038	609	4,656	1,266	2·9
Jowar	952	1,348	573	391	42,534	7,427	8·0
Bajra	780	968	337	320	29,177	4,163	4·5
Maize	1,056	1,090	5,514	657	8,471	2,486	3·0
Gram	671	2,809	841	525	16,880	3,959	4·8

Irrigation Planning

In this long term study, it would be useful to emphasise the importance of proper irrigation planning. Voelcar pointed out in 1893 that the requirements of each district in the matter of irrigation may be ascertained and also the best means by which improvement may be effected.

Many of the original irrigation schemes have been executed 'rather too hurriedly' without a detailed consideration of their future effects on the agrarian economy of the area concerned. As a result of the construction of the anicut at Naraj in Orissa,

15 *Census of India*, 1951, Vol. II, Uttar Pradesh, Part IA Report, p. 260.

for example, the average annual discharge in the Kathjari river decreased and consequently its carrying capacity diminished considerably. This resulted in the rise of the level of the Kuakhal head at the point of bifurcation from Kathjari. No doubt, the floods are thus becoming rare in low and medium flow levels in the Daya-Kusabhadra sector than before. But it has led to the development of moribund conditions and consequently due to water-logging malaria has become a common disease in these areas. The result is that agriculturists are becoming increasingly inefficient as they are mostly confined to bed for a greater part of the rainy season. This would explain the falling paddy yields in the region in spite of all the natural facilities.

Similarly irrigation practices now in vogue in West Bengal do not fit in at all with the real aim of maximising production and raising the economic level of the country which is so wistfully visualised. It was pointed out at the Symposium held on West Bengal Power and Water Resources Development that it is likely that the productive potentialities of the State will further deteriorate under the present system of irrigation and agriculture and essentially we will be producing only 'aman' rice and nothing else.

The state of affairs in other parts of the country may not be far different. East Punjab, for example, is threatened with the imminent danger of water-logging. The whole question calls for an immediate and thorough investigation.

It would be necessary that no new project is undertaken until a proper soil survey of the whole of the region has been made and all the long and short term problems involved have been properly studied. This was pointed out long back by Sir John Russel but the progress made in the direction seems to be quite negligible. The country can be divided for the purpose into three parts as follows:

(*a*) Areas like Assam and Western Ghat where rainfall is abundant.

(*b*) Areas of uncertain rainfall like Deccan and Madras. There is always a fear of famine in such places and proper irrigation facilities are extremely necessary.

(*c*) The desert parts of India like the Punjab and Rajasthan where irrigation is absolutely necessary.

Requirements of the smallest unit and the best possible method of providing irrigation facilities should then be decided. It would also be necessary to have a scientific record of hydrometrological data.

This having been done, it has to be realised that in a developing economy, irrigation alone cannot play the trick. Very few cultivators have the scientific mind to obtain optimum yields from their fields. Along with irrigation, demonstration of wet cultivation is essential if optimum results are desired. The present unhappy situation of under-utilised or unutilised irrigation potential is invariably due to the hesitation on the part of the cultivators to invest money on manuring properly even when irrigation water is assured. It takes them a long time (after irrigation is made available) to get into the habit of using even a moderate quantity of manure and to acclimatise themselves to wet cultivation.

Future irrigation planning will have to pay proper attention to the existing lags in the irrigation data. We have at present, as already discussed, what may be called the 'potential created' and 'actual utilised' areas for irrigation. There has been a lot of confusion upto the end of the Third Plan in the sense that the irrigated area in the country was taken to be equivalent to the 'potential created.'

This lacuna has now been removed in the Fourth Plan under which separate computation is given for 'potential created' and the actual area irrigated. According to the available data even this refinement does not meet the requirement of the situation. Area actually irrigated on the basis of this calculation comes to 83·1 million acres in 1960-61. But according to the Land Utilisation Statistics, gross area irrigated during that year was only 68·9 million acres. It was 76 million acres in 1963-64.

This discrepancy possibly lies in the fact that irrigation under minor schemes is taken to be as fully utilised. This, however, does not represent a correct position. Firstly because even minor irrigation projects take some time before they are fully put into use and secondly because minor irrigation projects going out of use are not taken into consideration. It would be very necessary that gaps of this type in irrigation statistics are carefully examined and removed. The Fourth Plan Working Group on Minor Irrigation has made some revised calculations. But even this fails to explain the discrepancies fully.

Major and Minor Projects as Partners

Minor irrigation projects which comprise of small projects have no doubt a clear advantage[16] over the major ones in the sense that :

1. They can be conceived and handled to a large extent by the cultivators themselves.
2. Works can be completed quickly with lesser delay and they also yield quicker results.
3. The works being owned by the cultivators themselves bring about major satisfaction of the psychological as well as physical needs of the cultivators.
4. Since the cultivator knows fully the capability of these works, water supply from these projects can be assumed to be more dependable. This gives the cultivator more freedom to plan his cropping pattern according to his needs.
5. As the utilisation of water in those cases is usually confined to the area very near to the source, loss of water in conveyance and distribution is very much reduced.

It may then be pointed out that these minor works having a sphere of feasibility and utility of their own which call for a little care and initial planning, should not clash with those of major and medium irrigation. With the introduction of intensive cultivation as envisaged, it is being recognised that major, medium and minor irrigation projects are the inevitable partners in any programme of development of water resources of a region. There are certain tracts where major and medium schemes may be considered more feasible. But there are other areas as well where only minor irrigation schemes can possibly be taken up. Yet there is another category of areas where major, medium and minor irrigation schemes may have a complementary role to perform and only through integrated development of these resources may it be feasible to obtain maximum utilisation of the available resources. This programme of having minor irrigation works as supplementary to major works in the areas under intensive cultivation has already been accepted and is being implemented.

[16] See Report of the Working Group for Formulation of Fourth Five Year Plan on Minor Irrigation, pp. 6-10.

15

SOIL CONSERVATION

Soil Erosion

STRICTLY speaking the term "Soil Conservation" means the *status quo ante*, that is the prevention of deterioration or protection from destruction rather than a positive change for the better.[1] It is, in fact, an integrated applied science having to do with the use and care of the land. By controlling and preventing erosion and improvement of the soil by making economical use of available water it is possible to use these resources to the greatest advantage. Almost invariably such work results in increased production of all crops. Soil Conservation is thus not merely terracing, contouring, strip cropping, filling gullies, or planting excessively steep or erodible land with grass and trees: it is that and whatever else needs to be done to keep the soil permanently productive or make it more productive. It means drainage if the land is too wet and irrigation if it is too dry; and it means addition of fertiliser and organic matter if the soil is deficient in these constituents.[2]

Early Ideas

Soil erosion is all the same, one of the serious ills of soil deterioration the world over. Although vaguely aware of it, it used to be

[1] S. Thirumalai, *Post-war Agricultural Problems and Policies in India*, p. 61.

[2] H. H. Bennet, Chief Conservation Service, U.S. Department of Agriculture, Foreword to *A Soil Conservation and Utilisation Programme for India*, D. C. Kaith *et al.*, Washington, 1948.

dismissed by most as a natural event, unfortunate no doubt, but a geological process. Plato in his early works, however, gives an amazingly accurate technical account of deforestation and erosion in the mountains of Attice, which destroyed the farms of plains and drove the Greeks to become seafarers and traders.[3] Primitive people well understood that our relation with the earth is an ethical one. They had a deep religious reverence for the earth and its fruits and a profound, if not "scientific" insight into the need for harmony between man and nature.[4]

Visible Results

Various forms of soil erosion are already well known in the country.[5] The process has been going on for centuries. Classic examples are those of the now buried mighty civilisation of Babylonia and Syria. If a testimony is required nearer home one need see only the ruins of Taxila and Harappa (Pakistan). There was a time when Bijapur was the capital of a flourishing kingdom. Now it presents a picture of devastation and famines are its recurring feature.[6]

There is evidence that as early as the time of Alexander the Great, there were thick forests and well populated cities in the north of Kutch and the south of Punjab which now form part of the Rajasthan desert. All this happened due to wind erosion as a result of misuse and abuse of land. Malarial Tarai area in U.P. has been mentioned as the most fertile region in ancient India. Surat was, just in our living memory, a large commercial city. Its population during the last 50 years has reduced from 8 lakhs to 8 thousand. This is because the Tapti river has been rendered unnavigable as a result of sedimentation caused by erosion in the uplands.

Rajasthan desert which already covers an area of about 80,000 square miles is advancing towards the Gangetic Plains at a rate of

[3] Ward Shepard, *Food or Famine—The Challenge of Erosion*, New York, 1946, p. 8.

[4] *Ibid*, p. 32.

[5] For details refer to Sir Harold Glover, *Soil Erosion*, Oxford Pamphlet No. 23, p. 4.

[6] D. C. Kaith *et al.*, *A Soil Conservation and Land Utilization Programme for India*, p. 3.

about half a mile a year over a front of about 100 miles. The beautiful Nilgiris are bare; the hillsides of the Himalayas in Kumaon and Shiwaliks from the Punjab to Assam are also being fast eroded for want of afforestation.

Today, according to available estimates, no less than 123 million acres of land in India are in the process of either soil erosion or exhaustion caused by primitive methods of farming.[7] A random soil survey also reveals that 71 per cent of the area in the scarcity tract has been severely eroded of which 26 per cent of the land has been rendered useless for agricultural purposes.[8]

If nothing is done to arrest this recurring loss, reclamation of new areas will have no significance, because much more will be lost by erosion. Land is like an important document which lends testimony to man's achievements. A nation actually writes its record on the land. The edict 'civilisation is rooted in the soil' is true for all times to come.

Man's Negligence

What is after all the cause of this scourge which has been described as a 'creeping death'? It lies in the actions of man himself. When vegetation is destroyed by man or his animals, top soil is left bare. For worst effects of erosion of this type, a reference may be made to the conditions in Palestine, where centuries of uncontrolled grazing have destroyed the forests and arable cultivation in the hills has reduced the quantity and quality of the soil.[9] Soil bereft of vegetation is unable to withstand the impact of storm-water or strong winds.

The responsibility for all this thus lies in our reckless destruction of forests,[10] shifting cultivation, deterioration of village pastures, and faulty methods of cultivation.

[7] Mayadas, *Between Us and Hunger*, p. 14.

[8] *Proposals for the Second Five-Year Plan*, Agricultural Sector, Planning Commission, p. 117.

[9] Doreen Warner, *Land and Poverty in the Middle East*, Royal Institute of International Affairs, 1938, p. 52.

[10] According to Mr. K.M. Munshi (Broadcast talk on the A.I.R., New Delhi, *Indian Express*, Dec. 9, 1954) India requires 2,000 crores of more trees to rehabilitate our agricultural economy.

What happens is that in most parts of the country after the harvest is over, fields are used as common pastures till the next crop is sown. This practice coincides with hot and dry summer preceding the monsoon rains. By the end of June most of the vegetative cover is eaten up and the ground trampled and pulverised by large number of cattle roaming in search of food. With the advent of torrential monsoons, the loose powdery soil is washed off the sloping ground in large quantities. This explains how bad agricultural practices lead to the loss of top fertile soil.

The carrying capacity of running water or its eroding capacity increases considerably with velocity which depends upon the slope characteristics of the land. Doubling the velocity increases the carrying capacity of the run-off for an average size of particles by 64 times, and if the velocity is trebled its capacity goes up to an alarming figure of 729 times. Water moving at a velocity of 2 feet per second can carry average sized pebbles in its course.

The power of vegetation to control run-off and erosion is not merely an abstract theory. It is supported by overwhelming experimental proof. In New York, during a period of precipitation totalling 9·47 inches extending over 19 days in March, 88 per cent of rainfall was lost by surface run-off from a sloping potato field and over 1,000 pounds of top soil per acre were washed away. In a neighbouring forest, on a much steeper slope, there was no soil wash whatever and 99½ per cent of the rain water was absorbed by the forest litter and soil.[11]

Government Responsibility

These causes as well as their remedies are already well known. It is commonly believed that much of the work is required to be done by the cultivator himself. But the Royal Commission on Agriculture had emphasised that "the question is not one in regard to which it should be left to the cultivator to seek advice."[12] Active Government help was recommended.

But for some little work in the Punjab and Bombay nothing tangible could, however, be achieved. Although '*Chos*' Act of 1900 in

[11] *Op. cit.*, p. 147.

[12] Royal Commission on Agriculture in India, 1928, p. 280. Russell Report (p. 59) also reminded the State of its responsibility in this respect.

the Punjab was passed more than half a century back, the area affected by these seasonal torrents in the Hoshiarpur District of the Punjab increased from 75 square miles in 1852 to 147 in 1896 and 700 square miles in 1939. This shows the extent of the work[13] that is required to be done. Some work was also done in Dr. Sausman's school at Bijapur.

First and Second Five-Year Plans

Magnitude of the problem was for the first time fully appreciated by the First Five Year Plan. Central Soil Conservation Board was set up by December 1953. Land Utilisation and Soil Conservation Boards have also been constituted practically in all the States by now.

Generally speaking, schemes under soil conservation plan. the pioneer national plan, fall under three heads. In the first category are schemes aiming at immobilizing deserts. Secondly, there are measures for bunding and terracing on agricultural lands. The third task to be tackled is to afforest ravines and badly gullied lands. Importance of sound but at the same time simple soil conservation measures such as contour ploughing—ploughing the fields across instead of up and down the slopes, strip cropping, sowing of some cover crops like gram, cowpea or groundnut in strips to prevent the soil being washed, raising of shelter belts by growing trees to check encroachment of the desert, mulch farming; bunding, terracing, gully-ploughing, and check damming, are being well appreciated.

Notable progress has since been made in the initiation, organization and co-ordination of soil conservation research training and action programmes on a national level.The Central Board has given technical and financial assistance to the several State Governments in order to develop a sound programme in the States. It has set up a working concept of soil conservation which includes all soil and water management practices that are needed to attain sustained production of cultivated crops, grasses and trees at the highest practical level.

Tangible results of the first plan were, however,-restricted to research, demonstration training and extension. Progress during the second plan has also suffered in many States because,

[13] *Op. cit.*, p. 4.

1. there is no suitable organisation for carrying out soil conservation work,
2. no soil conservation acts have been passed, and
3. there have been delays for administrative sanctions for schemes.

The Third Five Year Plan

Such obstacles can be visualised in any new programme. Against an actual expenditure of Rs. 16 million in the First Five Year Plan and Rs. 200 million in the Second Plan, an outlay of Rs. 720 million was provided in the Third Plan. Actual expenditure expected is Rs. 780 million and the Fourth Plan target has been put at Rs. 2180 million. Definite targets have also been fixed separately for agricultural lands, desert areas, hilly regions, and river valley projects, etc. It can be expected that initial hurdles having been crossed, twenty years from the beginning of the Third Plan will be devoted to solid work and a good deal of the affected area will be saved from deterioration. A rough target of say 100 million acres of agricultural lands for 1980-85 should be considered as feasible and in any case the minimum to be attempted.

One of the best indicators of India's soil conservation progress is the emergence of an aggressive approach to complete soil conservation planning which is based on soil treatment, fertility, bunding rotations, modern cultural practices, the use of high-quality seed, control of erosion by agronomic measures, supported by mechanical measures such as contour farming and bunding, providing adequate drainage, and most important of all, the recognition that the cultivator is the key man in the soil conservation programme.[14]

An important sphere of soil conservation relates to control of ravines. It is estimated that more than 6 million acres of land have been badly eroded and transformed into ravines in the States of Madhya Pradesh, Uttar Pradesh, Rajasthan, Gujarat, Punjab and Maharashtra. The expansion of these ravines is continuing unabated resulting in loss of productive lands. The research work at experimental farms indicates vast scope for the reclamation of ravine lands through afforestation, controlled grazing terracing and

[14] B. F. Muirheid, *Soil and Water Conservation Project Report*, U. S. Technical Co-operation Mission 1959, p. 21.

other soil conservation measures. Surveys to determine the severity of the problem in various States have been undertaken. In the Third Plan, 2·12 lakh acres are likely to be covered by ground surveys. A sub-committee was constituted by the Standing Committee of the Central Board of Forestry to examine, *inter alia*, the question of reclamation of ravines for increasing the production of timber and fuel wood. This sub-committee has suggested the formulation of comprehensive perspective plans by the concerned States for a 15-year period.

Control of desert is another sphere where a lot of work is called for. A Desert Afforestation Station was established in 1952 at Jodhpur. It has since been converted into a Research Institute for the Arid Zone, with the assistance of UNESCO. During the last 13 years this station has evolved techniques of stabilising, shifting of sand dunes on about 1800 acres at the cost of about Rs. 125 per acre and techniques of plantation of problem sites. Shelter belt plantings have been carried out over 220 kms. Some of the exotic species from other arid regions of the world, tried at the station, have been found to be promising. Besides afforestation, pasture development is also receiving attention, and 50 paddocks of 200 acres each have been established. Improved pastures have been found to yield 4 to 5 times the forage as compared to the existing deteriorated grazing areas. The Rajasthan Government is also taking measures for pasture development. Both in the control of ravines and control of desert, closest co-ordination would have to be ensured between soil conservation and forest departments.

In view of the various objectives mentioned above, the programmes of research on suitable soil conservation techniques, training of personnel in various scientific disciplines, e.g., soil science, agronomy, engineering, hydrology, extension arrangements, and evaluation, will have to be tackled on a much larger scale in the coming years.

16

IMPROVED SEEDS

It is believed that the use of improved varieties of seeds increases yields of crops by 10-15 per cent (Table 16·1).

TABLE 16·1
CONTRIBUTION OF IMPROVED SEED TOWARDS INCREASED AGRICULTURAL PRODUCTION

(Percentage increase)

Crops	*Irrigated*	*Unirrigated*
Rice	10	—
Wheat	10	10
Maize	10	5
Jowar	20	10
Barley	10	10
Other coarse grains	10	10
Pulses	10	10
Cotton	10	10
Jute and Mesta	—	15
Groundnut	20	20
Other oil seeds	—	—
Potato	6	—
Sugarcane (*gur*)	2	—

Improved varieties also help to increase production indirectly by way of checking pests and diseases. By virtue of their superior constitution, such varieties resist the attack of diseases and withstand the rigors of frost and drought to a greater extent. Some experiments conducted on cultivators' fields under the auspices of the Crops Survey Wing of the National Sample Survey support the above contention (Table 16·2).[1]

TABLE 16·2
EFFECT OF IMPROVED SEEDS ON WHEAT
(Results of National Sample Survey)

		Average yield control plot (lbs.)	*Average additional yield (lbs.)*	*Percentage increase*
Bombay	1951-52	624	75	12
Madhya Pradesh	1951-52	476	43	9
Madhya Pradesh	1952-53	622	49	8
Madhya Bharat	1952-53	673	33	5
Punjab	1952-53	962	156	16
Average increase	—	—	—	10

Source : P. C. Bansil, *India's Food Resources*, p. 135.

Earlier Position

Cultivators are well aware of the importance of using good seed and progressive ones are known to preserve their own seed. Agriculture Departments in some of the States also used to make arrangements for the supply of improved seeds to the cultivators, but the number of such cultivators was limited. On the whole no organised effort has till recently been made by the Government to provide improved seed to the cultivators.

The Foodgrains Policy Committee, 1943, and the Foodgrains Enquiry Committee, 1957, were rather critical of the then existing state of affairs. According to these Committees, complaints made by the peasants about the seed supplied to them being not of improved varieties were genuine. Truly speaking, in cases where improved seed was not supplied according to specification, it sometimes resulted in lower yields than those available from local varieties. This led to the losing of confidence in the Government programme.

Not only that, existing data about the area under improved seeds under various crops are all the more inadequate and in many

[1] Appendices 38·1 and 38·2 give in a summary form the effect of improved seed in raising yield of various crops.

cases defective. Table 16·3 supplies the available information for the years 1951-56.

TABLE 16·3

AREA UNDER IMPROVED SEEDS IN INDIA

(Million acres)

	1951-52		1955-56	
Crops	*Area under improved varieties*	*Percentage to total*	*Area under improved varieties*	*Percentage to total*
Paddy	6·74	9·14	8·03	10·53
Wheat	5·36	22·92	5·93	20·29
Millets	6·01[a]	9·55	3·75	5·37
Others	3·99[b]	23·66	16·00	17·60

Source : Adapted from *Review of the First Five Year Plan*, May 1957, pp. 94-95.

[a] Jowar and Bajra only.

[b] Gram only.

The above figures are subject to certain limitations. It would be better to quote the relevant observations made by the Planning Commission in this respect.

> The two sets of data given above are not comparable and in each there are large elements of error and possible guess work. It would, however, be correct to say that the progress made during the period of the First Plan in evolving improved strains for different crops, in producing quantities of nucleus seed and in multiplying them for local distribution was on the whole poor and work which should have been accomplished in the first phase of planning was left over for the period of the Second Five Year Plan. It should also be observed that accurate data regarding the seed multiplication and distribution programmes are not available and this makes it difficult to offer a precise statistical assessment of the work actually done in this field.[2]

It would look strange that after five years of planned development, the position should have deteriorated. In the Grow More

[2] *Review of the First Five Year Plan*, Planning Commission, May 1957.

Food Enquiry Report, the entire area under paddy, wheat, jowar and gram was reported to be under improved varieties. The figures made available for 1956 show that it had gone down. The Third Plan target in this respect was 203 million acres under food grains. The estimated coverage for 1964-65 comes to only 101·5 million acres. Reasons for this situation are not far to seek. Sources of proven high yielding varieties of certain field crops in India are quite few. Fairly extensive work is being done on some crops, notably rice, sugarcane, wheat and tobacco. But farmers are not protected by rigid standards of seed purity or certification as to source or strain and, therefore, cannot depend on the quality, purity, or source of seed offered for sale. Hence, there is little incentive for the production and use of high quality seed.

Although breeding work is under way at the Indian Agricultural Research Institute and in some of the States, facilities for increasing seed stocks of improved strains on a large scale and getting them into the hands of cultivators are very limited. There is no agency either at the State or national level to inspect fields and certify as to the purity, quality or identity of improved seeds. For this reason new strains rapidly become contaminated and lose their identity. This leaves the breeders and other experimental workers with a feeling of futility which is not conducive to their exerting every effort toward improving the conditions.[3]

The Second Five Year Plan

Question of extending improved varieties over the entire cultivated area in the country was examined at the beginning of the Second Five Year Plan by an Expert Committee on the subject appointed by the Indian Council of Agricultural Research. It recommended the setting up of seed farms in the country at the rate of one farm of 25 acres per block. Taking into consideration the yield of each crop and the multiplication factor thereof (20 for wheat, sugarcane and cotton, 25 for gram and pulses, 50 for broadcast paddy and jowar, 100 for transplanted paddy and bajra) it was calculated that foundation seed farms of 25 acres set up in each Block would bring a complete saturation of the total cropped

[3] *Inadequate and Inefficient Production and Distribution of Agricultural Commodities*, Technical Co-operation Mission to India, 1959.

area with pure seed of most of the crops grown therein within a period of 3 to 4 years. This was on the assumption that the 'founda tion' seed produced on the farm will be multiplied further in one or two stages through the registered growers.

It was accordingly tentatively claimed that one 'Foundation' seed farm of 25 acres would suffice for each Development Block and a total of 5000 such seed farms will be required. Once such a 'Foundation' seed farm is set up it would not take more than 4 to 5 years to saturate the whole of the cropped area with improved seed.

This original calculation of one seed farm of 25 acres per block came in for criticism. The Report of the Commltteeon Agricultural Production, Madras, for example, pointed out (pp. 70-71) that against the fixed target of 360 such farms, 210 will be sufficient. Similar is the case with Mysore and West Bengal. Working on the multiplication formula given by the Ministry, Appendix 39 shows that for a cent per cent saturation of the whole country, we need in all 3,400 farms. About 480 farms were already in existence by the end of the First Plan. Some of these farms may be for research, etc. If an allowance is also made for States like Kerala where because of the small size of holdings, 'A' class growers might not be able to part with the whole of the grain and new nurseries may be needed for other crops like coconut, arecanut and other plantations, the maximum number of farms needed should not exceed 3,500. A large number of such farms were set up during the Second Plan period and there were already 4,000 of them in terms of 25 acre unit.

The quality concept in seed was also taken up and for enforcing quality standards, four seed testing laboratories were organised at New Delhi (IARI), Ludhiana, Patna and Hyderabad. The general approach adopted is to send the nucleus seeds from the research stations to the block level seed farm to produce foundation seeds which are further distributed to registered seed growers for multiplication and subsequent distribution to cultivators.

Even so the programme seems to suffer from a number of deficiencies in relation to seed multiplication and seed distribution. In 1960, the Committee on Plan Projects, Planning Commission, set up a Team to make an appraisal of the Seed Multiplication Schemes with particular reference to the sufficiency of the programme, comparative economics of various types of seed schemes and effectiveness of distribution arrangements. The Team stressed the need for a full-scale distribution programme in all the States. It also suggested that comprehensive State-wise trials of different varieties of seeds might be undertaken to reduce the number of varieties recommended to farmers, and to help in maintaining purity of crops. The Team also recommended that seed multiplication and seed distribution work might be entrusted to Village Panchayats.

The Programme Evaluation Organisation of the Planning Commission also carried out a study in 1960-61 to assess the progress achieved in the multiplication, distribution and extension of improved varieties of seeds during the Second Five Year Plan, to analyse the problems faced and to make suggestions for the improvement of the programme. This study suggested *inter alia* greater attention to operation and management of seed farms, strengthening of seed distribution arrangements, and increased attention to extension.

The Third Five Year Plan

The Third Five Year Plan proposed (*i*) the setting up of new seed farms preferably in larger sizes than 25 acres, (*ii*) trying to make villages self-sufficient in regard to supplies of improved seeds, and (*iii*) taking up cultivation of hybrid maize on a country-wide scale starting with a target of 25 per cent coverage during the Third Plan. It was also laid down that the State Governments should review their programmes in view of the weaknesses pointed out by the P.E.O. study in the existing situation and the working of the seed farms.

Based on these observations and suggestions, the Ministry of Food and Agriculture drew up an Action Programme laying down various steps starting from the production of nucleus and foundation seeds, seed multiplication arrangements followed by seed testing, seed treatment, handling, packing, storage, provision of credit for seed and marketing arrangements at various levels. This was sent to the States for implementation. In order to encourage the production and distribution of improved seeds, a premium of Rs. 2 per maund of improved seed of food grains other than hybrid maize is also given which is shared equally between the Central and State Governments. For hybrid maize, cotton, groundnut and jute also subsidies on improved seeds were permitted.

A National Seeds Corporation was set up. Currently, it is producing and distributing seeds of hybrid maize and jowar. The work is proposed to be extended to hybrid bajra also. The Corporation is handling the seeds of jute and vegetables and proposes to take up the seeds of fodder crops.

A Seed Bill has been passed by the Rajya and Lok Sabhas. Under the provisions of this legislation, a seed certification programme envisaging the enforcement of certain minimum standards of quality of seed is proposed to be implemented. Accepted international nomenclature and standards of various categories of seed, e.g., breeders' seed, foundation seed, registered seed and certified seed are proposed to be introduced and enforced. Measures are envisaged for supply to the Seed Multiplication Farms, equipment for cleaning, moisture testing, seed drying and seed testing.

At present nucleus seeds are produced under controlled conditions and are reliable. In the reproduction of this seed at State Seed Farms certain impurities can creep in. When the foundation seed is multiplied in the private farms the deficiencies are likely to get multiplied. This calls for improvement in the system. One of the measures being adopted to remove deficiencies has been a shift from 25-acre farms to bigger farms, so that technicians of high calibre could be employed economically to supervise this seed production programme.

One of the approaches being considered for multiplication of seeds is that instead of spreading the registered seed farms, Seed Villages might be selected in compact areas preferably near the State Seed Farms, where supervision by technically qualified personnel can be ensured. Proper incentives might also be necessary for inducing suitable farmers to undertake multiplication of seed under the supervision of qualified specialists. Another suggestion under consideration is about the formation of Seed Corporations on commodity-wise or region-wise basis. Suitable standards for quality seed would be laid down. Provision will have to be made for adequate seed testing arrangements and certification of improved seeds according to prescribed criteria. These Corporations will ensure whether the agency of registered seed growers for multiplication of foundation seed could continue to serve the purposes in view usefully or certain modifications would be necessary in this arrangement.

Another suggestion which needs consideration relates to the establishment of Corporations which might combine three or four functions including supply of improved seeds, fertilisers pesticides and other requisites and provision of technical guidance and help as extension agency. These could be public or private organisations or even federations of co-operative societies. The main point here is whether certain agencies possessing adequate technical competence, can be organised in such a way that by propagating the use of new inputs they are able to earn profits to be self-sustaining as also to carry the work of increased application of science and technology in agriculture farther and farther. Such agencies are successfully functioning in a number of western countries and it is considered that it might be possible to have such arrangements in our country also.

On the distribution side, at present, co-operative societies, registered seed growers, and certain Government sponsored agencies are functioning in various States. There is no streamlined apparatus which ensures that the purity and germination capacity of seeds supplied are of the superior level, that there are no admixtures and no defects in handling and storage of such seeds. The number of sale points are also not adequate and the importance of improved seeds is not as well impressed on farmers as it should be. Thus the arrangements for distribution of improved seeds have to be completely re-organised.

High Yielding Varieties Programme

Until recently there has been a widespread feeling that the production potential of soils of India was very low. This assessment was not without reason since studies on response to fertiliser application conducted prior to 1962 had revealed that an economic response was seldom obtained in crops like wheat and rice when the dose applied exceeded 20 kgs. of nitrogen per hectare. An analysis of factors responsible for low yields even in irrigated areas conducted about 10 years ago revealed that the primary defect lay in the varieties then cultivated having an architecture more suited to growth and survival under poor conditions of soil fertility and water management than for performance under good agronomy.

When wheat varieties having the Japanese "Norin" dwarfing genes were introduced from Mexico in 1963 and rice varieties with the Chinese "Dee-Gee-Woo-Gen" dwarfing gene were introduced from Taiwan and the Philippines in 1964, the first requisite for breaking the yield barrier was fulfilled, namely a morphological frame permitting the cultivation of the crop under well-fed conditions. Such dwarf varieties were found to give an economic response to fertiliser dosages even exceeding 100 kgs. of nitrogen per hectare in all parts of India. The old myth that Indian soils have a low production potential was thus proved incorrect and it has since become clear that what is needed to increase production is alleviation of the hunger of the soils and better water management.

Certain new high yielding varieties and hybrids of wheat, rice, sorghum, maize and pearl millet have been released in rapid succession during the years 1961 to 1965. They are likely to act as a catalyst in transforming the outlook of the farming community and provide a physiological base as well as political and administrative support necessary for the production and supply of the necessary inputs. The Fourth Five Year Plan has before it a target of 32·5 million acres to be brought under the high yielding varieties. In the experimental plots, yields as high as 4 to 5 thousand pounds per acre have been obtained for rice and wheat. It might not be possible for us at this stage to visualise the potentialities of these new varieties. One will not, however, be surprised if they succeed in bringing about a biological revolution. The time horizon before us is quite long and one can expect many more results of research being made available to the cultivator. For purposes of multiplication and distribution of various quality seeds one can also visualise the role which various agricultural universities, now coming up, are likely to play in the future agricultural development of the country. In the present study we have not, however, taken into consideration the full contribution of such high yielding varieties when adopted by the cultivator in his field, in the coming years.

Future Problems

There is also the need to divert research to qualitative aspects. Investigations at the International Rice Research Institute, Manila, have revealed that there are a number of rice varieties with a high protein content (about 12 per cent), more or less equal to whole wheat. If so, an effort should in future be made to introduce such varieties in the country where there is a marked protein deficiency in the diets of rice eating population of South and East India.

Then in the case of cotton, there are a number of fundamental problems of research which remain to be tackled as yet. According to Harland,[4] it is difficult, rather impossible, to combine length with equally necessary economic characters in the case of cotton. But future cottons of India need to have length, strength, fineness and maturity which none of the existing cottons possess. Future cotton breeders will thus have to carry out a good deal of basic research in this direction. Different varieties will also have to be evolved for different areas where no suitable varieties are at present available.

A word of caution may be added about a crop like paddy. Different kinds of paddy grown in the country are legion. Several hundred distinct botanical varieties have been found in Madras.[5] Orissa accounts for another 1,000 varieties,[6] while in Bengal they number about 4,000.[7] Traditional varieties change from place to place. Soil and climatic conditions of different localities suit one variety better than the other. To break the prejudices of cultivators and convince them about the superiority of improved varieties would not be an easy task. An ideal plan under which full saturation of the total cropped area may be possible, will have to pay due attention to three basic changes.[8]

These are: firstly, making available to the farmers greatly increased supplies of pure high quality seed of improved varieties of field crops through: (*a*) greater efforts of the Indian Agricultural Research Institute and State plant breeders in the development of improved strains, (*b*) introduction of adapted high yielding varieties from other countries, and (*c*) provision of adequate facilities for storage and handling. Secondly, establishment of a national seed certification and inspection agency and similar agencies in every State whose duties it shall be to prescribe and

[1] S. C. Harland, *Report on a Visit to India to Study Schemes of Cotton Research*, Indian Central Cotton Committee, 1955, p. 4.

[5] M. S. Sivaraman, *Farmers of India*, Madras, I.C.A.R., Chapter IV.

[6] Dr. H. K. Nandi, *Proceedings of the Seventh Meeting of the Crops and Soils Wing of the Board of Agriculture and Animal Husbandry*, p. 293.

[7] John Kenny, *Intensive Farming in India*, p. 246.

[8] T. C. M. Report, *Inadequate and Inefficient Production and Distribution of Agricultural Commodities, op. cit.*, p. 13.

enforce standards of purity, quality and genetic identity of the seed offered for sale. This must involve careful field inspection and laboratory investigation of all seed offered for sale, and thirdly, commercial seed companies to take newly introduced varieties and increase seed stocks on a large scale under the supervision of the inspection agency and to serve as retail outlets. In order to improve the situation it is essential that private capital be attracted to this enterprise.

A Continuous Process

Seed improvement is a sort of a chain and an ever continuing process. After certain improved varieties have been evolved, work in the experimental stations does not come to an end. Some outstanding plants and seed from among the improved ones are picked up and multiplied further. The method is the utilisation of hybrid vigour. Seed farms, under the circumstances, will continue to be of permanent utility in the programme for agricultural production.

17

PLANT PESTS AND DISEASES

CROP pests in India, numbering over 250, range from wild animals like elephants, jackals, monkeys, flying foxes, porcupines, stray cattle, birds, snails and crabs to rats and small insects of many types. India's rat population is estimated at over 2,400 millions.[1] Of about 5,000 species of insect pests known to be injurious to crops in various parts of the world, more than 200 are found in this country.

Indian crops also suffer from about 150 diseases, 30-40 weeds and four kinds of parasitic flowering plants. Diseases are caused by fungi bacteria and viruses, as well as by deficiencies of such trace elements in the soil as boron, zinc and manganese.

Weeds compete with the cultivated plants for space and sunshine above ground and for moisture, soil nutrient and root growth under ground. The four parasitic plants, namely, *Striga*, *Loranthus*, *Orobanche* and *Cuscuta*, act as parasites on such cultivated plants as jowar, sugarcane, tobacco and mango and reduce their vitality and sometimes even kill them.

Paradoxically, as agricultural methods have improved so have the number of pests. Since new methods enrich the plants, pests find the contents of leaves more succulent.

There are instances when some diseases or pests appeared in a very serious form and took a toll of a major part of the crop resulting

[1] Six rats are believed to eat as much as one man. Some put 25 per cent of the food production in India as being eaten by rats.

in enormous losses and widespread famine conditions. Blast disease outbreak of rice in the Thanjavur Delta in 1919 destroyed 66 per cent of the crop. The same disease in 1956 wiped out the entire early paddy crop in Kashmir and caused a loss of nearly 30 per cent in the later maturing crops. Blast and Helminthosporium diseases caused extensive damages in the deltaic tracts of the Godavari and Krishna in 1918-19 and in Bengal in 1942. Gundhi bug epidemic in 1952 caused enormous loss infesting 7-8 million acres of rice in Uttar Pradesh, Madhya Pradesh, Bihar and Orissa. Similar examples of losses in other crops, wheat, potato, etc., can be cited.

In spite of the fact that a heavy loss to standing crops in the field as well as agricultural commodities in storage is being caused from year to year, adequate data in regard to the extent of loss caused at different times and different places for various crops are not available. In the absence of any survey or assessment of loss caused by various pests and diseases, some of the conventional figures are being used.

The International Conference organised by the Food and Agriculture Organisation in London in 1947 considered that in tropical and sub-tropical countries where climatic conditions are conducive to a rapid multiplication of pests, losses in storage might be estimated at about 10 per cent. In addition to it, 10 per cent of the loss can be accounted for by diseases, weeds, parasites and flowering plants and to the extent of 5 per cent in storage. Considering the above factors the total annual loss on account of pests and diseases may be taken to be of the order of about Rs. 600 crores.

Losses to crops caused by insects have been estimated by Burmah Shell[2] at 5 per cent in the case of pulses including gram, potatoes, tobacco, oil seeds, jute, tea and coconut, 10 per cent in paddy, 7 per cent in other cereals, 8 per cent in coffee, 16 per cent in sugarcane and 18 per cent in cotton. Estimated reduction in losses as a result of application of various plant protection measures varies from 10 to 50 per cent. In the case of food grains, it is 10 per cent except for paddy where it has been taken as 20 per cent. Appendices 40 and 41 supply similar information from other sources.

Since none of these figures is based on any regular survey, no sanctity can be attached to them. Nobody would, all the same, deny

[2] Agricultural production in India and estimated losses due to pest damage.

the immediate need for the protection of our crops. But before any effective programme can be worked out, it would be extremely necessary to know the position as it exists today.

All the crops are not infested by all the pests each year. We must know first of all the maximum area infested at various given points in a year over a period of last five or ten years. The organisational set up of the machinery to be evolved during the coming plans will depend on the type of the problem that will emerge if accurate information on the above lines is collected.

Remedial Measures

Methods of controlling pests and diseases fall into the following main categories.

Mechanical methods include measures for the physical removal of pests and disease-affected plants or parts thereof by such means as collecting insects and other pests in nets and traps, pruning of diseased branches of fruit and other trees and weeding with suitable implements. The method is usually laborious, though sometimes it can be practised with great effect and advantage.

Cultural methods aim at modifying agricultural practices in such a way as to put the pest or the disease organism at a disadvantage so as to prevent its growth and multiplication. Alterations in the times of sowing and harvesting, avoidance of ratooning, judicious use of manures, fertilisers and irrigation water and the growing of crop varieties which may resist pest or disease attacks are among the cultural measures adopted. Spotted boll-worm, which bores into the bunds and young bolls of cotton plants, can be effectively controlled. After the harvest, the cotton stumps are removed from the ground with their roots before a specified date, leaving some six weeks or ten months in which there is no cotton on the ground. This prevents the insect from being carried over from one 'season' to another by living on shoots coming up from the old roots in the ground.

Biological method implies the liberation of parasites and predators in large numbers, which may prey upon the pests, mostly insects, so as to reduce their population to the point of harmlessness. Some insects have also been employed to eradicate weeds or other unwanted plants, whose mechanical removal was expensive and impracticable.

Control of pests and diseases by means of chemicals and other poisons, collectively called pesticides, though known for a long time, has been intensively developed in many countries, including India, since World War II. It is also the most popular method because it quickly removes pest and disease infestations at economic costs and the results are apparent within a matter of weeks, if not days. In most cases, special machines are required to spray or dust pesticides over crops and to fumigate rat and other burrows and various agricultural commodities. Considerable developments have taken place in the designs and use of such machines. In the case of those diseases which are carried through the seed, it is important to see that the seed is free from infestation.

Stem-rot, a soil fungus of jute, for example, can be checked by treating the seed with Ceresan (an organic preparation of mercury).

Control can be preventive or curative and in plant protection, as in public health, prevention is always better than cure. Preventive measures include the use of resistant plant varieties, the pre-sowing treatment of seeds of wheat, barley, jowar, some millets, paddy and cotton to prevent the appearance of certain seed-borne diseases on the crop and various prophylactic treatments in storage godowns to prevent the multiplication of pests. Resistant varieties have not always been easy to evolve and have generally not maintained their quality of resistance over large periods or areas. During the past few years, seed treatment has been increasingly popular in India.

Prophylactic measures such as destruction of old staples and plant residues which harbour diseases and pests, when carried out with thoroughness, also pay rich dividends. Based on the knowledge of existing pests and diseases in the country, plant quarantine measures can be taken to prevent the entry of diseases and pests through inter-State movement of plant materials.

Progress During the Plans

The cropped area covered by plant protection measures has marked a gradual increase, and in 1963-64 the coverage was about 30 million acres as against the Third Plan target of 50 million acres. The quantity of pesticides used is correspondingly increasing. At the beginning of the Second Five Year Plan in 1956-57, 9·5 thousand tonnes of pesticidal formulations valued at Rs. 1·36 crores were used. At the beginning of the Third Plan, the quantity used increased to 37 thousand tonnes valued at Rs. 4·6 crores. In 1962 the quantity produced was 46·6 thousand tonnes worth Rs. 7·5 crores. In the matter of weed control and biological control only small beginnings have been made.

The three essential requirements for the extension of plant protection practices are technical personnel, plant protection equipment and pesticides. The increasing number of agricultural graduates are being employed for plant protection work. Eight regional training programmes have been conducted by the Central Directorate of Plant Protection for imparting refresher courses for plant protection personnel. However, these courses have been very brief and efforts are being made for organising greater specialised training in plant protection.

In the matter of plant protection equipment, manually operated equipment has been sought to be popularised through its distribution on a subsidised basis. The indigenous industry is equipped to produce about two lakh units of such equipment working on single shift basis. In the matter of power sprayers, the country has been largely dependent on imports. One indigenous firm was licensed to produce power sprayers with a capacity of 924 sprayers per year with imported engines. The quantity manufactured has been, however, limited by the allocation of foreign exchange for the import of engines. The State Governments have been helped with foreign exchange for importing about 2,600 engines. It is now proposed to promote the manufacture of engines for power sprayers within the country and a suitable type of engine has been selected for this purpose. Lately, knap-sack type of sprayers-cum-dusters have gained popularity and their demand is rising. About 645 of these sprayers were imported in 1963-64 and another 8,200 in 1964-65 under the Dutch credit available to the country. At the same time, in view of the rising demand for such sprayers, steps have been taken to encourage the indigenous manufacture of such equipment.

An aerial unit of three aeroplanes for dusting and spraying started functioning in May, 1957, and by the end of 1958 had sprayed and dusted a total area of about 4,000 acres in several States.

Now a small unit of 8 aircraft is available in the country. This was originally established to deal with the locust menace in the desert areas. Government contemplates expanding this unit substantially and the possibility of supply of a large number of aircraft from the United States under the Aid programme is being explored. The problem of training a large number of pilots for such aircraft has also to be taken up in a systematic manner.

The pesticides industry has established itself in the country and about 2/3rds of the current requirements of pesticides are met from indigenous production. For meeting the growing needs, the industry will have to be expanded substantially. In addition to the present industrial units which can produce 16 thousand tonnes of technical grade materials and about 50 thousand tonnes of formulations in respect of 13 pesticides, new units for the manufacture of 8 new types of insecticides have been licensed. Some of the pesticide materials are being procured under Special Aid Programmes and credit arrangements. One of the problems faced in the popularisation of pesticides is their high prices. Steps have been taken to reduce certain levies which affect the prices of pesticides, notably, import duty on many items of technical grade materials. The Central Government also gives 25 per cent subsidy in respect of pesticides to be supplied to the farmers. The State Governments have been advised to add to this subsidy where necessary. Special stress is also being laid for making available pesticides and plant protection equipment to all the cultivators through co-operatives, departmental supply stores and other agencies. Since 1963, the Central Government is advancing short-term loans to States for the distribution of pesticides. By the end of the Third Plan about 43 million acres of area are expected to be covered with plant protection measures.

At a meeting of the State Plant Protection Officers held in New Delhi, the following proposals were made for the development of plant protection during the Fourth Plan period.

(*i*) Facilities should be provided all over the country, for treating improved seeds against seed-borne diseases, free of cost.

(*ii*) In areas with particular crops which give poor monetary return and where plant protection measures would contribute substantially to larger outputs, complete prophylactic treatment should be provided free with a certain amount of Central assistance.

(*iii*) Extensive local campaigns should be organised for protection particularly against rodents.

(*iv*) There should be Plant Protection Service Organisations all over the country.

(*v*) In each development block one of the Extension Officers should be given special training in plant protection. At the district level, specialists in plant protection should be appointed to advise the Extension Officers. Arrangements should also be made for special training of the field staff.

Consideration is also presently being given to these recommendations as also to the amendment of legislation which would enable Government to take plant protection measures promptly and compulsorily. The possibilities of making arrangements for giving advance warning against epidemics and diseases are being explored.

Apart from these detailed aspects, it is being considered whether the entire approach to plant protection might be revised. As is well known, many of the farmers do not know when plant protection is necessary and what action should be taken. Even when some persons undertake plant protection measures while others do not resort to them, the plant diseases spread from the untreated fields. Therefore, plant protection arrangements might have to be organised on a national basis. This is also essential since significant increase in fertiliser consumption which is being envisaged will give results only if proper plant protection measures are also taken side by side. The alternative approaches to the problem are under consideration.

Recent Researches in Pesticides

Some new weed killers developed by the Imperial Chemical Industries in the U. K. promise to revolutionise agricultural practices the world over. The ICI claims that experience has shown that by using the chemical weed killer, known as Paraquat, a seed treated with this weed killer can be planted directly on unploughed land. Such planting of seeds is said to give better yields than seed grown in the traditional way.

Salts of Paraquat kill all green plant tissue on which they are sprayed and are rendered ineffective virtually as soon as they touch the soil.

Other weed killers also have a significant effect on the current agricultural technology. For instance, hormone weed killers, such as MCPA, have simplified the growing of cereals to a point where alternative crops need not be grown through intensive mechanical cultivation.

The ICI's scientists hold that Paraquat, either alone or with its sister-product Diquat, is now beginning to be used on a wider scale throughout the world to control weeds in such diverse crops as cotton, rubber, potato, sugar-beet and tea. It can very well be safely used even for jute.

There are cultivable lands in India which though potentially productive, cannot be ploughed because either they are too steep (hill-side cultivation), or too shallow or there might be other reasons why mechanical cultivation fails on them. Thus, reducing dependence on mechanical cultivation as a means of controlling weeds in growing crops in such areas could but be a step from abandoning or drastically reducing mechanical inputs to establish the crop. As far as cereals, potato and cotton are concerned, the results have shown that over a three-year period, lands sown without ploughing and through these weed killers, gave better yields than the mechanically cultivated ones.

With the use of seeds treated with this chemical, the flexibility and shortening of inter-crop cultivation periods can also be of considerable benefit, where climatic conditions furnish technical possibilities of growing two or three crops in a year.

Once the utility of such chemicals is proved under Indian conditions, it would not only save the present loss as a result of pests and diseases but would also help to increase the total cropped area as well as production directly.

18

CONCLUSION

We have discussed in the previous chapter the requirements as well as potentialities of various agricultural commodities. Some of the basic assumptions made are :

1. All the major and medium projects started during the first three plans will be fully utilised during the period under study. In case of any shortfall in the utilisation of the benefits from these projects, deficiencies will be made up by the irrigation facilities provided from the projects started during the subsequent plans.
2. Fertilisers will be available for all the crops in quantities required by the cultivator according to the optimum doses recommended, and organic resources developed to the targeted levels.
3. The cultivator will be able to make use of pest control measures and pesticides will be available to him in required quantities.
4. Power and machinery will be available to the cultivator so that the average cultivator is not handicapped for want of labour etc. to resort to intensive cropping as envisaged in this study.
5. Credit facilities will be available to all those who will need them for their genuine productive purposes so as to increase agricultural productivity.
6. Necessary protection will be provided to the landless cultivators by way of security of tenures and fixed rents.

7. An average cultivator in the country will be posted with complete information regarding the use of new varieties and extension services will be available to him so as to give him full guidance with regard to all the technical problems involved.

From what has been done during the past 15 years, it can be expected that the future plans will be able to devote much more attention to the problems discussed in this study. If so, the conclusion that emerges is that it should be quite within the reach of the country not only to have narrow self-sufficiency at a reasonable standard of living but also some exportable surplus from the agricultural sector, within the next 15-20 years.

This may sound odd when judged against our past performance. Over the 15 years, 1949-50 to 1964-65, agricultural production increased at a little over 3 per cent per annum. Allowing for an increase in areas under crops, agricultural productivity went up by a little over 1·5 per cent only. Between different States, rates of growth in agricultural production ranged from 1 to 5 per cent per annum and increase in agricultural productivity varied from less than 1 per cent to around 2·5 per cent. Imports of food grains (Table 18·1) and cotton have increased from year to year. With not much of success during the first three Plans, one wonders how far India would be able to achieve the targets suggested by us.

TABLE 18·1

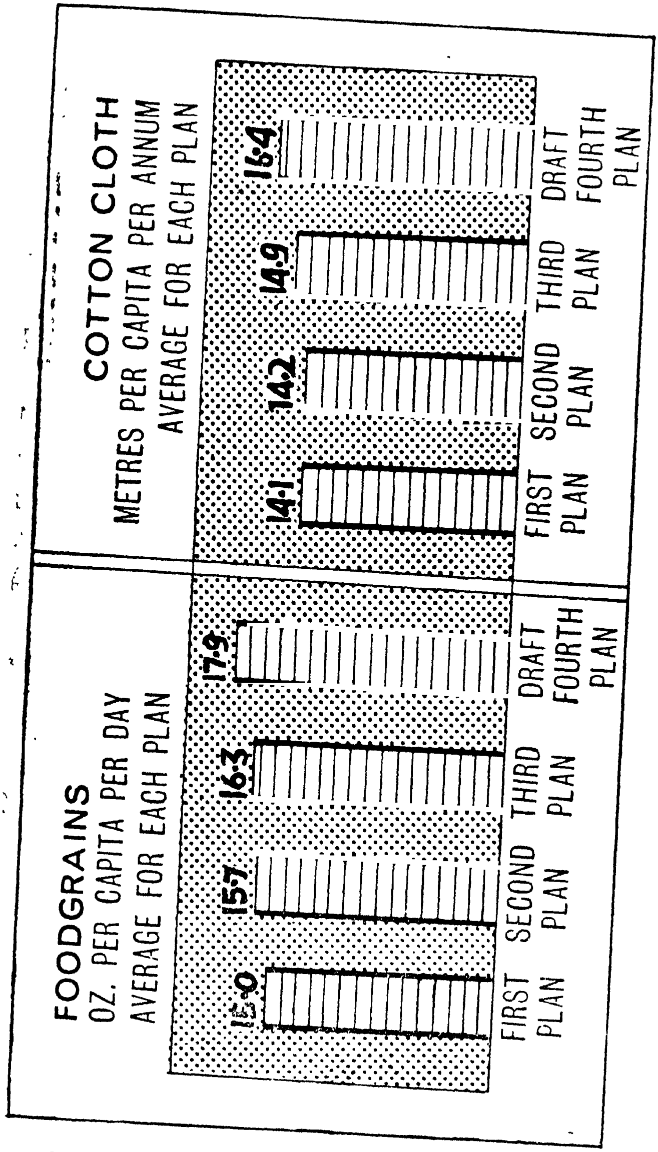
IMPORTS OF CEREALS INTO INDIA 1960-1966

(Thousand tonnes)

Year	*Rice*	*Wheat*	*Others*	*Total Cereals*
1960	698·8	4,385·9	52·4	5,137·1
1961	384·2	3,092·2	19·1	3,495·5
1962	389·6	3,250·4	—	3,640·0
1963	483·4	4,072·7	—	4,556·1
1964	644·5	5,621·4	—	6,265·9
1965	783·2	6,583·3	95·5	7,462·0
1966*	392·9	4,795·2	991·6†	6,179·7

* Upto July 1966. Total for the year is over 10 million tonnes.

† Includes 48·6 thousand tonnes of Wheat Flour imported upto July 1966.



PER CAPITA PER DAY CONSUMPTION OF FOODGRAINS AND COTTON CLOTH DURING THE PLAN PERIODS

How differently will the next 15-20 years behave from the past 15 years or so? These are some of the urgent questions which come to the mind of any research worker. But we have to learn from the mistakes of the past and attempt to correct them. There were some peculiar disadvantages during the Third Plan period—(*i*) the Chinese attack in 1962, which necessitated the diversion of resources from development to defence, (*ii*) the conflict with Pakistan and the consequent pause in aid, and (*iii*) the most recent blow—the unprecedented drought which has affected a very wide area of the country.

There is no reason to be pessimistic because of our past experience. Growth of agriculture in India during the past 10-12 years has been quite comparable with a number of other countries in South East Asia as shown in Table 18·2. Even otherwise it has to be borne in mind that production at the end of the targeted period will depend not on the technology of 1950 or even 1965, but the one being evolved during the coming two decades.

TABLE 18·2

LINEAR GROWTH RATE OF AGRICULTURE IN INDIA AS COMPARED TO OTHER SOUTH EAST ASIAN COUNTRIES DURING 1952-53 TO 1963-64

(Average: 1952-53 to 1954-55—100)

Countries	*Agricultural Production (Per cent)*	*Food Production (Per cent)*
India	3·19	2·55
Burma	2·34	2·55
Federation of Malaya	4·63	7·57
Indonesia	1·41	1·91
Japan	3·49	3·74
Pakistan	1·85	1·84
Philippines	3·93	3·54
Thailand	6·01	5·44

Source : Growth Rates in Agriculture, 1949-50 to 1964-65, Directorate of Economics and Statistics, Ministry of Food and Agriculture, 1966.

What is needed is that cultivators should adopt effectively improved practices (most of them already known and others being evolved), that they work harder and use their time more effectively. With the Indian cultivator as shrewd and pragmatic in his approach to the soil as his counterpart elsewhere and the soil equally fertile, the problem is to convey the idea of improved practices to him in meaningful terms to facilitate his access to better practices and to give him the incentive to produce more. These are primarily organisational and motivational problems.

Administrative machinery will have to be streamlined. There are evidences of black marketing in the supply and distribution of items like fertilisers. Certainly, arrangements will have to be made not only to increase the supply of various inputs but also to remove the existing obstacles in the distribution line.

As for motivations, pure and simple 'self-interest' should normally be a sufficient incentive for the Indian cultivator. But the trouble so far has been that his environment has not made the expansion of output a sufficiently clearly attractive and attainable objective. The difficulty in agriculture could well be summarised as a failure to harness fully the farmers' self interest to the task of supplying the food and fibre requirements of the country. This is a pure and simple organisational issue which we have already discussed at length.

Future development of agriculture, if at all, is thus not going to be foundered on the rock of technological improvements or even the lack of economic incentives, but on eliminating the organisational bottlenecks. Since the development of agriculture is 'a must,' there is no way out but to streamline our administrative machinery. A tremendous effort will be needed to gear the operative organisation in the village to the needs of the developing economy. It would, perhaps, be useful to mention in this connection that local initiative and local co-operation[1] will be necessary to surmount organisational difficulties.

Human Investment

The list of technical and technological innovations in agriculture may be quite impressive and economic development in the country, in the physical sense, i.e., irrigation, transport, industrialisation, urbanisation, etc. may be quite significant. In order that full benefits are derived from these changes, the farmers' own apprehension will have to be made through education interpreted in a wider sense. Any programme can become the farming community's own programme only when the farmer himself decides in favour of it.

[1] P. C. Bansil, "Approach to Third Plan, Organisational Aspects," Paper read at the 1959 Conference of Indian Economic Association, for an elaboration of the point.

This demands improving his capacity in decision-making. It is then alone that the programme will take root and will not be looked at as an imposition by officials. In spite of the recognition of the benefits which would accrue from community development, a serious view has not been taken to either expand or improve this organisation.

Another aspect of the human problem is the long-term objective of changing the very character of the people. An average person today has no enthusiasm for work. He is prepared to sacrifice a national cause for his paltry selfish interest. No nation in the world has progressed with unwilling workers. A UNO report on 'Measures for the Economic Development of Underdeveloped Countries' rightly pointed out, "There cannot be rapid economic progress unless the leaders of a country at all levels—politicians, teachers, engineers, business leaders, trade unionists, priests and journalists—desire economic progress for the country and are willing to pay its price, which is the creation of a society from which economic, political and social privileges have been eliminated. On the other hand, given leadership and the public will to advance, all problems of economic development are soluble. We wish to emphasise that the masses of the people take their cue from those who are in authority. If the leaders are reactionary, selfish and corrupt, the masses in turn are dispirited, and seem to lack initiative. But if the leaders win the confidence of the country, and prove themselves to be vigorous in eradicating privilege and gross inequalities, they can inspire the masses with an enthusiasm for progress which carries all before it."

Besides enthusing the masses by setting an example, they have to be encouraged to take the initiative. A movement like that of the 'Stakhnovites' in Russia[2] may be able to deliver the goods in such a case.

A programme of the sort has necessarily to be a slow one. The national character of our country cannot be changed overnight. But a beginning has got to be made and the sooner we do it the better.

How this is to be done is perhaps beyond the scope of this study. But a perspective plan of the type under study has to face this problem and reorientate its educational programmes in this light.

[2] Cf. Maurice Dobb, *Soviet Economic Development*, pp. 428-37.

Technical Approach

Input factors like water, manure, seed, pesticides, machinery, etc., are no doubt most important in the programme of agricultural development. But that alone is not sufficient. The cultivator has at his disposal limited resources in the form of land, labour, capital and management. Resource allocation is a big problem in itself and will depend upon the goals set before the cultivator. He must be made capable of utilising these resources most efficiently. We have to look to the farm economy as a whole. This emphasises the management aspects of farming in respect of most efficient use of the resources, taking fully into account the developments around the farm.

A manifestation of this approach to the development of agriculture is to be seen in the intensive development programme popularly known as the 'Package Programme.' This was started on a pilot basis in 1961. By the end of 1964-65, the Programme had covered 280 blocks in 16 districts. In terms of cultivated area, it amounted to 2·9 million hectares. The programme which was originally restricted to food grains is being extended to cash crops as well.

There is visible today a high degree of unevenness in growth between different regions and areas, between different crops and between different cultivators even within the same local environment. We have to cash on this experience. The whole country has been divided into 15 resource regions for the purpose so that suitable development strategy can be adopted for each of them.

Price Policy

A stable price level will always create a most congenial situation for the growth of an economy. Wide fluctuations in agricultural prices over time and space have thus got to be checked. But a more important problem will be the stability of the price structure as between various agricultural commodities. Wherever technological possibilities exist, there is already a severe competition between cash and food crops—jute and rice is one glaring example. If price parity moves in favour of one or the other group, a balanced growth of agriculture as envisaged in this study may become a difficult task.

Future price policy will have to be formulated on a comprehensive and continuing basis. *Ad hoc* measures to meet the exigencies of the situation, as in the past, would always suffer from the element of time lag and will fail in the timely redress of the situation. Fixation of a minimum and maximum price for a few commodities without establishing a price parity among competing crops may only result in unbalanced production of each of them. Such a state of affairs ill fits a planned programme of agricultural development envisaged under the plans.

With due consideration to the targets fixed and tentative allocations made for area needed for different crops, if we find that a diversion of the area is called for from one to another, our price policy will have to be orientated in a way that the desired shift takes place.

A different price policy, for example, in favour of jute and cotton will have to be worked out for an achievement of the targets. Similar decisions will have to be taken for sugar and wheat in U.P., and cotton and groundnut growing areas. Areas under these competing cash crops have invariably responded to the price parity of substitutable crops in all those States where such a substitution was possible.

The operative part of this programme has to be launched with care. Before taking any steps in the direction, it would be necessary to undertake detailed studies about the cost structure, determination of minimum fair prices and consequently the relative parity prices. Along with this, a definite assurance will have to be given to the cultivators of various crops for the purchase of their produce at the predetermined prices, announced much in advance of the sowing period. As for the commodities entering the export market, some sort of minimum export quotas can be declared for a long period on the basis of our past experience and the trend of the world market. This would do away with adverse fluctuations in the market which at present are significantly related to variations in the export policy of the nation. Additional releases can then be made on suitable occasions as dictated by the situation of each commodity in the internal and external markets.

A fillip to agricultural production in general can be given only if our price policy aims at increasing the efficiency of the cultivator. A doubling of labour productivity in Japan during 1885-1915, for instance, was possible because the cultivator was enabled to make use of improved techniques which consisted primarily of a liberal use of fertilisers and the improvement of rice strains. In the context of Indian agriculture it would mean the provision of fertilisers/manures, improved seeds, cement for the construction of irrigation wells, iron for implements, diesel oil for pumps, etc., at prices which maintain a reasonable parity between the prices paid and prices received by the cultivator.

The emphasis so far has been on the production of food grains. In a long term development of agriculture, as discussed here, the production in adequate quantities of non-food crops for industrial use and for earning foreign exchange is equally important. Surely, in the interest of national health, national diet has to be more varied and balanced. This means increasing emphasis on the production of protective foods drawn mainly from fish and livestock, e.g. milk, eggs and meat and also from fruits and vegetables. This group of farm products being perishable, presents special problems and more than fixation of statutory prices, measures such as marketing facilities, bulk handling and arrangement for sale on a fixed price basis through co-operative or State organisations, etc. are likely to prove successful in increasing production.

Prices of these products are much higher in the cities and towns. If the present policy of establishing dairy schemes like those of Bombay, Calcutta and Delhi is extended to practically all the important towns and cities, and milk as well as milk products are made available to the consumer at fixed prices along with a guarantee of quality, prices of such products are bound to remain within the desired limits. Consequently, prices will be stabilised at the producing centres as well. With an assured demand, production will also get sufficient incentive.

As for meat, slaughter and sale houses will have to be licensed so as to ensure quality and stabilise prices. Egg Boards like those of the United Kingdom and proper marketing as well as warehousing facilities for fish may serve as an answer to all those other items which are likely to be in great demand.

Once we succeed in keeping the prices of all these major items of consumption within desired limits, it may not be necessary to regulate the prices of the remaining crops like fruits and vegetables. Incentives for their increased production and the provision of necessary marketing facilities alone may be more than sufficient.

It should not, however, be forgotten that though a sound price policy is one of the essentials in a planned development of agriculture, to meet the food requirements of the people, to ensure a balanced diet, to produce raw materials for industries and earn foreign exchange, price alone cannot tackle all the farm problems. This has to be one of the links in the whole chain, other links being technical knowledge, intensive cultivation, irrigation, effective extension of education, agrarian reforms, credit, co-operation, etc.

In the present context, the problem is not one of increasing the production of one commodity at the cost of another, but that of increasing the production of all the commodities simultaneously. On the one hand a stable and remunerative price level with maintenance of parity between competing crops will play its role in providing the necessary incentive by reducing unhealthy fluctuation and balancing production in the desired direction. On the other, increased production over the present level has to be achieved by commanding and using all the factors of production in the best possible way. The problem of production can best be tackled by a judicious combination of economic as well as technical policies and measures. The Agricultural Prices Commission, recently set up, will thus have to shoulder a huge responsibility in shaping the future agricultural development of the country.

Marketable Surplus

Production is "one end" of the food problem in India, the other being distribution, making it available at the places and at the time it is needed.

Along with production, distribution of food grains may thus be an equally important problem to be faced. This has got two facets—distribution machinery and creation of marketable surplus.

The existing distribution machinery which is primarily in the hands of private traders is already being substituted by marketing co-operatives so as to narrow the farmer's mark-ups to the point that they no longer sap the producer's incentive. Substantial increase in the average level of Government stocks is contemplated today. Once the market has been appropriately conditioned in these ways by allowing free play as a pricing and allocating device, long term outlook for food distribution would possibly brighten up.

But then the basic question, that of collecting enough food from farmers to meet the demands of an ever rising non-farm population will still remain. The process of economic development which leads to increased requirements of urban supplies of food grains, at the same time generates forces which result in larger retention on farm and restricted flow to the market.

Bigger crops do not thus necessarily mean larger market arrivals, and thus larger sales by the farmers. This will be substantiated by what is known as the 'scissors crisis' in U.S.S.R. and the experience of India. During 1958-59 in spite of a record crop of 73·5 million tons (12 million tons more than the previous year), larger marketable surplus did not flow out of the agriculture sector. Marketed surplus does not, therefore, depend on production alone but also on farmers' behaviour regarding retention on farms.

A mere physical increase in the production of agriculture will have no meaning if the non-producers fail to get the required share of their demand through the normal functioning of the market. With more fundamental forces, released by economic development, inhibiting the flow of marketed surplus, a positive approach to increase its size will be of paramount importance.

Since agricultural prices or for that matter general price level is determined by the volume of marketable surplus, i.e. surplus of the agriculture sector which is exchanged with non-agriculture commodities, if we fail to mobilise this agricultural surplus, the resultant distorted price structure will shatter the planned growth and development of not only agriculture, but of the whole economy.

The long term solution of the problem will lie in stimulating the farmers' desire for the things they can buy with cash. Japan did it by imposing high land taxes and U.S.S.R. by collectivising agriculture in 1929.

On the other hand, the proper flow of marketable surplus in India is threatened, both in deficit and surplus areas by a considerable increase in the incomes and monetary resources of the cultivating classes. Their resources have increased as a result of several factors such as increase in the production of commercial crops (besides food grains), higher prices of both commercial and food crops, a large increase in Government developmental expenditure in rural areas including loans and grants to cultivators, a rapid increase in co-operative credit facilities to the growers, etc. On the other hand, fiscal measures and savings campaigns have not been successful in siphoning off a considerable part of these increased resources.

Additional surplus resources will have to be mopped up by more taxes, rural savings, direct investment outlays and inducement to farmers to make cash consumption purchases away from the farm. Whatever additional taxes can be levied and collected under the existing political situation would be most welcome to all those who are up against the task of finding resources for the implementation of plans. But in a voluntary development effort, taxation beyond a certain limit may not be possible. Compulsory procurement of food grains may also not fit and may be rather difficult in the context of democratic planning as well as free economy.

The only alternative left would then be the inducement to the cultivator for making purchases of non-farm goods and services. Opening up of rural areas and efforts to make him invest in human capital will obviously be healthier trends in this direction. Favourable terms of trade for agricultural produce will be another positive step for the purpose. Once the existing vicious circle is broken, further monetisation of the rural market may be quite easy. The matter is, however, quite serious and some vigorous measures will need to be taken.

Still Longer Perspectives

This study has taken into consideration the effect of only those research findings which have already been adopted by quite a large number of progressive cultivators in the field. The High Yielding Varieties Programme recently introduced might usher in a biological revolution. If experimental results are any guide in this respect, nothing will prevent India from shifting the base of the production curve much above the existing levels. The present study does not take account of the potentialities as a result of this programme. Further, some of the successful experiments with regard to the use of atomic energy in the field of agriculture and artificial rain etc. have also been ignored in this study.

This would then mean that there is nothing for us to be pessimistic about the period beyond 1980-85 in so far as the role of agriculture in the economic development of the country is concerned. There is nothing static in the scientific world of today and in a dynamic situation many new researches, not even expected today, are likely to be made. Certainly, they will help the Indian cultivator to raise the level of agricultural productivity still higher. With the achievement of the targets envisaged in this study, we will still be far behind some of the progressive countries in the world. The targeted yield levels have actually been already obtained by enterprising cultivators on their individual fields in the various parts of the country. We will, under the circumstances, be justified in assuming that this is not the end of the story and that it would be possible for India to raise the level of agricultural production still higher in the coming years.

With these few general remarks it is hoped that this study will be able to provoke thought and interest so that our short term plans not only take a more concrete shape, but are at the same time also directed towards the achievement of long term goals set before us.

Besides the various technological and economic issues involved for the future development of agriculture as discussed in this study, it would be useful to point out that no information is available at present on many vital aspects of agriculture. It will not be possible to draw out any worth-while plan in the absence of such data. Now that the country has embarked upon a scheme of comprehensive planning, she can ill afford to ignore such studies. A tentative list of some of the short and long term studies which are necessary in this context is given below.

Suggested List of Short and Long Term Studies

Food Grains

1. Existing food consumption pattern among different income groups in different parts showing quantity as well as value of each grain consumed.
2. Estimates of private stocks at the end of each crop year with the trade and individuals.
3. Existing utilisation pattern of the gross production of food grains; quantities (along with type of grain) being fed to animals, used for seed and being wasted.
4. Estimates about the growth of urbanisation in the coming 15-20 years on the basis of our development programmes.
5. Survey of the maximum demand for food grains (broken up into types of grain) for the existing population in the different regions of the country.

6. Studies about wastages under different conditions of storage and transportation.

7. Quantities of food grains being annually moved by the different systems of transportation—rail, road and river, etc.

8. Existing seed rates and those that can be recommended for the maximum exploitation of the land resources in different parts of the country.

9. Studies pertaining to changes in food habits—from the standpoint of nutrition and the needs of the country.

Milk

1. The present population of livestock and its distribution breed-wise and region-wise. (25 cattle and 8 buffalo breeds).

2. A study of breeds suitable for different regions for the production of milk as well as draught wherever needed.

3. Availability of existing pedigree bulls for the breeds proposed to be spread in the country.

4. On the basis of the existing stock and other physical limitations (which should be explained in detail) what can possibly be the maximum number of good quality animals in the different regions at intervals of 5 years.

5. Detailed programme for the removal of all the physical imitations and the minimum time necessary to remove them. This includes marketing, refrigeration, etc.

6. A survey of the existing grass resources of the country and a programme for the full utilisation of the same.

7. A comprehensive study of the feed requirements: for a full exploitation of the improved stock at different periods in the different regions of the country.

8. Drawing up a balance sheet—region-wise for the requirements and availability of feed stuff. Feed requirements should be worked out at different levels of milk and meat production.

9. Scientific method to find out the existing milk yields in the country and total production of milk region-wise at regular intervals of say 5 years.

10. Utilisation of milk in the country.

11. Measures for reducing the ratio between dry and wet animals.

Meat

1. Existing production and consumption of meat in the country, type-wise and region-wise.
2. Meat eating population and also those who have no objection to taking it if made available to them within reach of their purchasing power.
3. What type of animals and poultry would be needed for meat in each region.
4. How far the meat stock can be linked with dairy and poultry development programmes.
5. Feed requirements for the meat stock in each region which is needed in addition to dairy and poultry industries.
6. Regular forecasts about the production and consumption of meat in the country for each region.
7. A programme for the development of meat stock. Hindrances in that programme and how to remove the same.

Poultry

1. Census of the existing poultry population in each district, type-wise.
2. Egg laying capacity of different types of birds in the different parts of the country.
3. Census of the persons who are eating eggs or have no objection to eat—demand pattern, season-wise.
4. Progress of the poultry industry in the past 10 years. Reasons for its slow progress. How can this be improved ?
5. How fast the industry can be developed and the needed minimum programme for the achievement of the same.
6. Marketing and other problems connected with the industry.

Fisheries

1. Existing production and consumption of fish in different parts of the country among various income groups.
2. Census of the population who have no objection to taking fish and those who are eating at present.
3. A survey of the inland resources of fish. How far they have been developed already and how far they can be developed to meet the requirements in each part and region of the country.

4. What has so far stood in our way for the development of inland and marine fisheries. How and to what extent those difficulties can be removed.

5. A phased programme of fish development in each region, both inland and marine—under the best conditions.

6. A thorough understanding of the problem of fishermen who are at present a neglected class.

Manures/Fertilisers

1. A comprehensive survey of the existing utilisation of organic manures in the country.

2. Quantity of manures being put into the soil and their crop responses in the various parts in different types of soil.

3. Ways and means to improve the quantity and quality of organic resources—studies should also be conducted to explore the utilisation of sources like river mud, etc.

4. Regional studies to be taken up to work out the potentialities of green manuring with due consideration to all limitations. Suitable cropping patterns for different areas so as to fit in a green manure crop.

5. Most suitable types of chemical fertilisers from the long range point of view for different soil types for the different crops.

6. Methods of application of the same so as to get the maximum benefit from the fertiliser.

7. Losses of crop nutrients at various stages and replenishment from natural sources.

8. Consumption of various types of fertilisers at the district level for different crops under irrigated and unirrigated conditions.

9. Total requirements of crop nutrients for given levels of production.

10. Studies in selected areas with regard to the spread of the use of fertilisers. If the progress is slow, analysis of the reasons responsible for the same.

11. Organisational and other steps necessary for popularisation of the use of fertilisers.

Irrigation

1. Potentialities of major and minor irrigation for each State at the district level: maximum that can be developed—phasing

of the programme in the light of technical difficulties—financial resources needed for each.

2. Double cropped areas at present, crop-wise: contribution of irrigation in this. Relation of irrigation to double cropping in different parts of the country.

3. Studies pertaining to the best utilisation of the irrigation resources existing and potential—a programme of the best land utilisation system for the irrigated areas in the various regions.

4. Complementary programmes necessary for a maximum exploitation of irrigation facilities.

5. Problems of water logging and drainage in various localities.

6. Devices like those of contour bunding, and other water and soil conservation practices. Areas facing such problems—their extent, nature etc.

7. In respect of minor irrigation, comprehensive studies of different types of wells, feeding channels and hydraulic equipment etc. which are suitable for different areas.

8. Irrigated and unirrigated yields for all the major crops at least at the district level on a regular basis.

APPENDICES

APPENDIX 1

NATIONAL AND PER CAPITA INCOME IN INDIA

Year	*Net National output* (*Rs.* 100 *crores*)		*Per capita net output* (*Rs.*)	
	At current prices	*At* 1948-49 *prices*	*At current prices*	*At* 1948-49 *prices*
1950-51	95·3	88·5	266·5	247·5
1955-56	99·8	104·8	255·0	267·8
1960-61	141·4	127·3	325·7	293·2
1961-62	148·0	130·6	333·6	294·3
1962-63	154·0	133·1	339·4	393·4
1963-64	172·1	139·7	370·9	301·1
1964-65*	200·1	150·5	421·5	317·0

* Provisional.

APPENDIX 2·1

NET FOOD SUPPLY PER PERSON — CALORIES PER HEAD PER DAY

Country	*Period*	*Cereals*	*Potatoes and other Starchy Roots*	*Sugar and Syrup*	*Pulses and Nuts*	*Fruits and Vege-tables*	*Meat*	*Eggs*	*Fish*	*Milk*	*Fats & oils*	*Total*
1	2	3	4	5	6	7	8	9	10	11	12	13
India	Pre-war	1345	19	136	185	59	12	2	3	148	59	1970
	1963-64	1374	29	180	176	28	7	1	4	111	82	1990
Ceylon	Pre-war											
	1964	1293	97	226	326	48	9	8	39	43	88	2180
Pakistan	Pre-war											
	1963-64	1614	18	154	60	58	18	2	5	153	138	2220
Japan	Pre-war	1480	124	150	148	71	9	10	30	5	23	2050
	1964	1356	142	182	140	115	50	37	73	60	164	2320
Egypt(UAR)	Pre-war	1752	11	136	218	71	29	7	5	92	129	2450
	1963-64	2082	30	177	105	174	54	6	19	109	177	2930
Netherlands	Pre-war	1014	223	339	56	95	191	37	26	362	499	2840
	1964-65	708	183	469	56	143	350	50	24	397	705	3080
United Kingdom	Pre-war	925	158	471	54	119	504	51	35	275	515	3110
	1964-65	795	198	547	62	121	518	65	30	378	589	3300

APPENDIX 2·1—(*Cont.*)

1	2	3	4	5	6	7	8	9	10	11	12	13
United States	Pre-war	899	130	506	80	177	459	64	22	370	540	3210
	1964	654	92	502	96	171	610	71	21	403	525	3140
West Germany	Pre-war	1083	356	280	36	97	329	29	24	299	510	3040
	1964-65	734	234	345	48	154	400	54	23	299	629	2920
Denmark	Pre-war	912	231	535	11	108	523	30	35	363	648	3420
	1964-65	720	196	514	81	173	456	49	61	386	696	3330
Argentina	Pre-war	1057	154	288	24	80	596	28	8	269	227	2730
	1962	757	146	392	25	125	614	27	7	170	395	2660
Cuba	Pre-war	1005	273	624	123	270	135	17	7	149	206	2610
Australia	Pre-war	1010	98	575	31	183	695	48	30	276	389	3300
	1963-64	841	92	565	51	140	687	47	20	357	359	3160

Source : Production Year Book, *F.A.O.*, 1958 and 1965.

APPENDIX 2·2

NET FOOD SUPPLY PER PERSON — KILOGRAMS PER YEAR

Country	*Period*	*Cereals*	*Potatoes and other starchy foods*	*Sugar*	*Pulses, Nuts and Seeds*	*Vege-tables*	*Meat*	*Eggs*	*Fish*	*Milk*		*Fats and oils (fat content)*
										Proteins	*Fat*	
1	2	3	4	5	6	7	8	9	10	11	12	13
India	1963-64	142·0	10·9	17·4	18·9	2·7	1·5	0·2	1·2	1·8	2·7	3·4
Ceylon	1964	131·3	35·1	21·4	30·6	39·6	2·0	1·9	6·9	0·8	0·7	3·6
Pakistan	1963-64	165·3	8·1	14·8	6·4	12·6	3·5	0·4	1·6	2·7	3·4	5·7
Japan	1964	147·4	67·4	17·2	15·1	101·2	10·4	8·6	24·8	1·1	1·1	6·8
U. A. R.	1963-64	213·8	14·5	13·8	10·6	102·7	13·0	1·3	5·0	1·7	2·7	7·3
Netherlands	1964-65	74·0	95·7	40·6	4·5	74·1	54·1	12·9	6·3	8·4	8·2	29·1
United Kingdom	1964-65	79·0	102·8	48·2	5·8	59·2	74·0	16·5	10·2	7·6	7·8	24·0
United States	1964	65·6	47·1	39·8	8·0	96·4	102·6	18·1	4·8	8·6	8·1	21·6
West Germany	1964-65	74·1	122·0	30·1	3·7	50·7	65·8	13·6	6·3	7·0	5·6	25·7
Denmark	1964-65	75·1	105·5	47·9	7·7	63·3	62·9	12·4	16·9	9·1	8·9	28·7
Argentina	1962	75·7	68·7	36·9	2·2	47·2	101·3	7·0	2·0	3·5	3·6	16·2
Australia	1963-64	85·2	46·8	49·4	4·1	63·9	110·7	12·1	5·4	7·2	7·5	14·5

Source : Production Year Book, *FAO*, 1965.

APPENDIX 3·1

RECOMMENDED DAILY BALANCED DIET PER HEAD PER DAY BY AGE GROUPS

(Ounces)

Foodstuffs	*Below 2 years*		*2 to 5 years*		*6 to 12 years*		*Above 12 years Medium workers*		*Hard Workers*	
	Veg.	*Non Veg.*	*Veg.*	*Non Veg.*	*Veg.*	*Non Veg.*	*Veg.*	*Non Veg.*	*Veg.*	*Non Veg.*
1	2	3	4	5	6	7	8	9	10	11
Cereals	1·50	2·00	4·00	4·00	8·00	8·00	12·00	12·00	16·00	16·00
Pulses	1·50	—	1·00	1·00	2·00	2·00	3·00	3·00	4·00	4·00
Green Leafy Veg.	1·50	1·50	2·00	2·00	2·00	2·00	4·00	4·00	3·00	3·00
Roots & Tubers	1·00	1·00	1·50	1·50	1·50	1·50	3·00	3·00	4·00	4·00
Green Non-Leafy Veg.	—	—	1·50	1·50	1·50	1·50	3·00	3·00	3·00	3·00
Fruits	1·00	1·00	1·50	1·50	1·50	1·50	1·50	1·50	—	—
Sugar & Jaggery	0·25	0·25	1·50	1·50	1·50	1·50	1·50	1·50	2·00	2·00
Oils and Fats	0·25	0·25	0·50	0·50	1·00	1·00	1·50	1·50	2·00	2·00
Milk & Curds	2·50	2·00	20·00	16·00	16·00	12·00	16·00	12·00	10·00	10·00
Meat & fish	—	0·50[2]	—	1·00[2]	—	2·00[2]	—	2·00	—	3·00
Eggs[1]	—	0·25	—	1[3]	—	1	—	1[3]	—	—
Nuts	—	—	—	—	0·50	—	0·50	—	1·00	—

[1] In numbers.

[2] Three times a week.

[3] Four times a week.

APPENDIX 3·2

RECOMMENDED DAILY BALANCED DIET AND THEIR FOOD VALUES PER ADULT ACCORDING TO NUTRITION ADVISORY COMMITTEE

(Ounces)

Commodity	Vegetarian						Non-vegetarian					
			Protein content						Protein content			
	Quantity	Carbohydrate	Animal origin	Plant origin	Fat content	Calories	Quantity	Carbohydrate	Animal origin	Plant origin	Fat content	Calories
1	2	3	4	5	6	7	8	9	10	11	12	13
Cereals	14	10·220		1·330	0·2100	1386	14	10·220		1·330	0·2100	1386
Pulses	3	1·800		0·600	0·0390	297	3	1·800		0·600	0·0390	297
Root vegetables	3	0·600		0·030	0·0045	69	3	0·600		0·030	0·0045	69
Fresh vegetables	4	0·200		0·080	0·0200	60·4	4	0·200		0·080	0·0200	60·4
Other vegetables	3	0·273		0·018	0·0060	30	3	0·273		0·018	0·0060	30
Fruits	3	0·510		0·030	0·0060	45	3	0·510		0·030	0·0060	45
Milk	20	1·000	0·80	—	1·2000	400	10	0·500	0·400	—	0·6000	200
Sugar	2	1·900		0·008	0·0020	220	2	1·900		0·008	0·0020	220
Vegetable oil & Ghee	2				2·0000	464	2				2·0000	464
Meat & fish							3		0·600		0·1500	96
Egg*							1·3		0·169		0·1690	63·7
Total		16·503	0·80	2·096	3·4875	2971·4		16·003	1·169	2·096	3·2065	2931·1

* One egg weighs about 1·3 ounces.

APPENDIX 3·3

CONSTITUENTS OF DAILY BALANCED DIET FOR VARIOUS AGE GROUPS

(Ounces)

Age	Vegetarian					Non-Vegetarian				
		Protein Content					*Protein Content*			
	Carbo-hydrate	*Animal origin*	*Plant origin*	*Fat content*	*Calories*	*Carbo-hydrate*	*Animal origin*	*Plant origin*	*Fat content*	*Calories*
1	2	3	4	5	6	7	8	9	10	11
1 and below	2·82	0·10	0·49	0·45	495	2·25	0·15	0·24	0·45	404·0
2-5 years	6·74	0·80	0·69	1·79	1278·2	6·54	0·80	0·66	1·65	1239·9
6-12 years	10·16	0·64	1·38	2·33	1893·2	9·86	0·78	1·24	2·06	1805·6
above 12 years	14·21	0·64	2·02	2·91	2583·9	13·91	0·95	1·89	2·65	2511·9
for a hard adult	17·90	0·40	2·71	3·32	3199·3	17·70	1·00	2·45	3·07	3127·3
worker	16·50	0·80	2·10	3·49	2971·4	16·00	1·17	2·10	3·21	2931·1

APPENDIX 4

FEED, SEED AND WASTAGE RATES IN INDIA
(Percentage of Production)

Sl. No.	Commodity	Feed	Seed	Wastage	Total
1	Rice (paddy)	2*	6·4	1·1	6·7
2	Wheat	neg.	82·7**	3·0	15·6
3	Barley	1·2	72·0**	2·0	22·7
4	Jowar	2·6	3·0	5·0	10·6
5	Bajra	4·1	2·7	5·0	11·8
6	Maize	1·0	3·3	5·0	9·3
7	Ragi	1·2	2·3	5·0	8·5
8	Small millets	2·1	2·3	2·5	6·9
9	Gram	12·0	50·0**	2·0	18·7
10	Other pulses	5·0	5·0	2·5	12·5
11	Potatoes	—	70·8**	17·0	—
12	Groundnut (in shell)	—	12·0	—	12·0
13	Sesamum seed	—	2·3	—	2·3
14	Fruits	—	—	25·0	25·0
15	Sugarcane (Gur)	3·0	6·6	—	10·5

* Absolute figure in thousand tons. neg. = negligible.

** Lbs. per acre.

Source : *Agriculture in Brief*, third edition, 1957, p. 62, Dte. of Economics and Statistics, Ministry of Food & Agriculture.

APPENDIX 5·1

LIVESTOCK UNITS IN SOME OF THE COUNTRIES

(Thousand)

Country	Livestock					Units					Total Units
	Horses	*Cattle*	*Pigs*	*Goats*	*Poultry*	*Horses*	*Cattle*	*Pigs*	*Goats*	*Poultry*	
1	2	3	4	5	6	7	8	9	10	11	12
Argentina	7255*a*	43596*c*	3512*c*	4459	44500	7265	34877	702	446	445	43735
Australia	803	15836	1297	85	16509	803	12669	259	9	165	13905
Brazil	7286	61442	35555	9481	134255*c*	7286	49154	7111	948	1343	65842
Canada	904	9481	5427	18*e*	66353	904	7585	1085	2	664	10240
Ceylon	3*c*	1433	43	491	1793*c*	3	1146	9	49	18	1225
Denmark	309	3180	4598	5	3834*c*	309	2544	920	1	238	4012
Egypt	42	1362	19	745	63518	42	1090	4	74	635	1845
France	2215	17322	7570	1251	85000	2215	13858**	1514	125	850	18562
India	1482*d*	203566*b*	4932*d*	55405*d*	94683*d*	1482	171836	986	5541	947	180792
Japan	897	2919	745	495	37938	897	2335	149	50	379	3810
Sweden	312	2575	1568	16*a*	11697	312	2060	314	2	117	2805
Switzerland	120	1583	1038	120	6310	120	1266	208	12	63	1669
U.K.	310	10688	5843	37*c*	86858	310	8550	1169	4	86	10902
U.S.A.	2973	96592	50474	2983	395625	2973	77274	10095	298	3956	94596
China	7385*d*	66611*	97800*d*	46065*d*	323811	7385	53289	48900	4607	3238	117419

a 1947/48-1951/52.
b 1952-53.
c 1953-54.
d 1956.
e 1950-51.

* Includes buffaloes.
** Includes 44916 thousand buffaloes of unit one.

APPENDIX 5·2

CEREAL CONSUMPTION PER CATTLE UNIT PER DAY IN SOME COUNTRIES

Countries	*Total animal food (000 metric tons)*	*Total animal units*	*Food grains consumed per animal per day (oz)*
Argentina	1474	43735	3
Australia	1181	13905	8
Brazil	3700	65842	5
Canada	9348	10240	88
Ceylon	—	1225	—
China	16479	117419	14
Denmark	3408	4012	82
Egypt	84	1845	4
France	6063	18562	32
India	760	180792	—
Japan	737	3810	19
Sweden	1489	2805	51
Switzerland	515	1669	30
U. K.	7468	10902	66
U. S. A.	85172	94596	87

APPENDIX 6·1

FOOD REQUIREMENTS OF LIVESTOCK

(Lbs. per head per day)

Description	*Quantity*	*Dry matter*	*D.C.P.*	*T.D.N.*
(a) *Cows and buffaloes*				
Maintenance				
Straw or kaddabi	6·5	5·9	—	2·60
Greeenfodder (Maize silage)	22·0	6·6	0·22	4·00
Grazing (as green grass) guina	11·0	3·3	0·14	1·65
Total	39·50	15·80	0·36	8·25
For milk production				
Oil cake (rape cake)	0·57	0·51	0·16	0·46
Maize	0·50	0·50	0·04	0·43
Barley	0·50	0·45	0·03	0·39
Gram	0·50	0·45	0·05	0·38
Cotton seed	0·50	0·45	0·06	0·40
Bran	0·28	0·22	0·02	0·18
Total	2·85	2·58	0·36	2·24
Grand Total:	42·35	18·38	0·72	10·49
(b) *Breeding Stock (bulls)*				
Straw or kaddabi	12·0	10·8	—	4·80
Green fodder	20·0	6·0	0·56	2·56
Concentrates				
Oil cake (rape cake)	0·8	0·72	0·22	0·63
Maize	0·4	0·40	0·03	0·34
Barley	0·4	0·36	0·03	0·31
Bran	0·4	0·32	0·03	0·25
Total	34·0	18·68	0·87	8·89
(c) *Young stock*				
Maintenance				
Straw or kaddabi	2·00	1·80		0·80
Green fodder	10·00	3·00	0·28	1·28
Total	12·00	4·80	0·28	2·08

For Growth				
oil cake (rape cake)	0·30	0·27	0·08	0·24
maize	0·20	0·20	0·01	0·17
barley	0·20	0·18	0·01	0·16
gram	0·15	0·14	0·02	0·11
cotton seed	0·15	0·14	0·02	0·12
Total	1·00	0·93	0·14	0·80
Grand Total :	13·00	5·73	0·42	2·88
(d) *Bullocks doing hard work*				
straw and kaddabı	11·0	9·90	—	4·40
Concentrates				
oil cakes (rape cake)	0·70	0·63	0·19	0·55
maize	0·87	0·87	0·07	0·70
barley	0·88	0·79	0·06	0·68
gram	0·35	0·32	0·04	0·25
cotton seed	0·35	0·32	0·04	0·28
bran	0·35	0·28	0·03	0·22
Total	14·50	13·11	0·43	7·08
(e) *Bullocks doing medium work*				
straw and kaddabi	12·00	10·80	—	4·80
Concentrates				
oil cake (rape cake)	0·50	0·45	0·14	0·39
maize	0·62	0·62	0·05	0·52
barley	0·63	0·57	0·04	0·49
gram	0·25	0·23	0·03	0·19
cotton seed	0·25	0·23	0·03	0·20
bran	0·25	0·20	0·02	0·16
Total	14·50	13·10	0·31	6·75
(f) *Bullocks doing light work*				
straw and kaddabı	6·00	5·40	—	2·40
Concentrates				
oil cake	0·30	0·27	0·08	0·24
maize	0·37	0·37	0·03	0·31
barley	0·37	0·33	0·02	0·29
gram	0·15	0·14	0·02	0·11
cotton seed	0·15	0·14	0·02	0·12
bran	0·15	0·12	0·01	0·10
Total	7·49	6·77	0·18	3·57

(g) *Bullocks doing no work*				
Straw and kaddabi	4·00	3·60	—	1·60
Total	4·00	3·60	—	1·60
(h) *Sheep over one year (weighing* 80 *lbs.)*				
berseem hay	2·0	1·8	0·19	1·00
Maize green	2·0	0·5	0·02	0·33
concentrates	1·0	0·8	0·06	0·78
Total	5·0	3·1	0·27	2·11
(i) *Lambs upto one year* (40 *lbs. live weight)*				
berseem hay	1·5	1·3	0·14	0·75
Maize green	1·0	0·3	0·01	0·16
Concentrates (crushed gram hussed cake)	0·5	0·4	0·03	0·36
Total	3·0	2·0	0·18	1·26
(j) *Goat weighing* 60 *lbs. per day (over one year)*				
Lucerne (Green)	7·0	1·7	0·21	1·03
Concentrates	1·0	0·8	0·06	0·84
Total	8·0	2·5	0·27	1·87
(k) *Lamb weighing* 30 *lbs. (upto one year)*				
Lucerne (green)	5·0	1·25	0·15	0·73
Concentrates	0·5	0·40	0·03	0·42
Total	5·5	1·65	0·18	1·15
(l) green jowar	12	3·0	0·12	2·16
bhusa	4	3·7	0·04	2·24
lucerne hay	4	3·5	0·44	2·40
pasture	12	2·4	0·30	1·68
gram	2	1·8	0·34	1·38
maize grain	2	1·8	0·12	1·68
Total	36	16·2	1·36	11·54
(m) *Colt, age below* 3 *years, weighing about* 500 *lbs.*				
sat hay	4	3·72	0·088	1·92
lucerne hay	2	1·74	0·220	1·20
lucerne green	20	5·01	0·613	2·94
grain mixture	2	1·83	0·184	1·51
Total	28	12·30	1·105	7·5

(n) *Camels doing hard work*				
dry fodder (gram straw)	20·0	18·0	0·43	6·68
gram	3·0	2·7	0·32	2·26
mote	3·0	2·7	0·56	2·17
Total	26·0	23·4	1·31	11·11
(o) *Camel doing medium work*				
dry fodder (gram straw)	24·0	21·6	0·52	8·02
gram	2·0	1·8	0·21	1·57
mote	2·0	1·8	0·37	1·44
Total	28·0	25·2	1·10	10·97
(p) *Camel doing light or no work*				
dry fodder (gram straw)	48·0	43·2	1·04	16·03
Total	48·0	43·2	1·04	16·03
(q) *Mule*				
dry fodder (oat hay)	20·0	18·60	0·44	9·60
gram	2·5	2·25	0·26	1·88
barley	3·0	2·70	0·18	2·16
Total	25·5	23·55	0·88	13·64
(r) *Pig weighing* 150 *lbs.*				
lucerne (green)	12	2·4	0·39	1·44
skimmed milk	5	0·4		
concentrates	2	1·8	0·26	1·54
grazing		available		
Total		5·5	0·70	5·00

Grazing is extra in the case of all bullocks (a to g).

Source: 1. (a) to (g) adapted from Human Nutrition vis-a-vis Animal Nutrition in India, ICAR and Livestock Feeding, K. C. Sen, ICAR.

2. (h) to (i) Adapted from L. R. Lender, *Scientific Feeding of Livestock.*

3. (m) to (r) Morison standards.

APPENDIX 6·2

FEED REQUIREMENTS FOR CATTLE AND BUFFALOES FOR MAXIMUM PRODUCTION

Class of cattle	*Number (million) in 1956*	*Dry fodder*		*Green fodder*		*Grazing (as green grass)*	
		per head per day (lbs.)	*total annual (million tons)*	*per head per day (lbs.)*	*total annual (million tons)*	*per head per day (lbs.)*	*total annual (million tons)*
1	2	3	4	5	6	7	8
cows & buffaloes							
maintenance	72	6·5	76·27	33	387·22[4]	11	129·07
milk	32	—	—	—	—	—	—
Work cattle	71						
60 days of hard work	,,	11	20·90	—	132·00[2]	—	—
60 days of medium work	,,	12	22·82	—	—	—	—
150 days of light work	,,	6	28·52	—	—	—	—
95 days (no work)	,,	4	12·04	—	—	—	—
Breeding stock (bulls)	0·8	12	0·96	20	2·61	—	—
Young stock maintenance	60	2	19·55	10	97·76	—	—
for growth[1]	10	—	—	—	—	—	—
Total	203·8	—	181·06	—	619·59	—	261·07

Oil cakes		*Maize or barley*		*Gram or cotton seed*		*Bran*	
per head per day (lbs.)	*total annual (million tons)*	*per head per day (lbs.)*	*total annual (million tons)*	*per head per day (lbs.)*	*total annual (million tons)*	*per head per day (lbs.)*	*total annual (million tons)*
9	10	11	12	13	14	15	16
—	—	—	—	—	—	—	—
0·57	2·97	1·00	4·21	1·00	4·21	0·28	1·46
0·7	1·33	1·75	3·33	0·7	1·33	0·35	0·65
0·5	0·95	1·25	2·38	0·5	0·95	0·25	0·47
0·3	1·43	0·75	3·57	0·3	1·43	0·15	0·71
—	—	—	—	—	—	—	—
0·8	0·10	0·80	0·10	—	—	0·40	0·05
—	—	—	—	—	—	—	—
0·3	0·37	0·40	0·51	0·3	0·37	—	—
—	7·15	—	15·10	—	9·29[3]	—	3·34

[1] The Figures are 25 per cent less than actual calculation as it is assumed that these are having their feed from milk.

[2] Estimated in Memorandum (p. 21) by taking the number of hours for grazing.

[3] Five million tons out of this may be gram.

[4] It includes 129·07 million tons which will be from grazing, calculated at 11 lbs. per head per day.

Source : Appendix 6·1.

APPENDIX 6·3

FEED REQUIREMENTS FOR LIVESTOCK OTHER THAN CATTLE AND BUFFALOES FOR MAXIMUM PRODUCTION

Class of livestock	*number in thousands in* 1956	*dry fodder*		*green fodder*		*oil cake*	
		per head per day (lbs.)	*total annual (thousand tons)*	*per head per day (lbs.)*	*total annual (million tons)*	*per head per day (lbs.)*	*total annual (thousand tons)*
1	2	3	4	5	6	7	8
Sheep	39246	1·89	12115	1·79	11·4	0·10	667
(i) Upto one year	8296	1·5	2028	1·0	1·4	0·12	162
(ii) Over one year	30951	2·0	10087	2·0	10·1	0·10	505
ats	55405	—	—	6·4	58·2	0·22	1960
(i) Upto one year	15305	—	—	5·0	12·5	—	—
(ii) Over one year	40100	—	—	7·0	45·7	0·30	1960
Horses & Ponies	1483	7·4	1784	22·8	5·5	—	—
(i) Upto three years	460	6·0	450	20·0	1·5	—	—
(ii) Over three years	1023	8·0	1334	24·0	4·0	—	—
Camels	776	39·4	1913	—	—	—	—
60 days of hard work	,,	20·0	416	—	—	—	—
60 days of medium work	,,	24·0	499	—	—	—	—
245 days of light or no work	,,	48·0	998	—	—	—	—
Mules	40	20·0	130	—	—	—	—
Pigs	4932	—	—	12·0	9·6	—	—
Total	101882	—	15942	—	159·9	—	2627

Food grains		Bran		Oats		Skimmed milk	
per head per day	total annual (thousand tons)	per head per day (lbs.)	total annual (thousand tons)	per head per day (lbs.)	total annual (thousand tons)	per head per day (lbs.)	total annual (thousand tons)
9	10	11	12	13	14	15	16
0·45	2849	0·16	1036	0·18	1171	—	—
0·24	324	0·02	27	0·12	162	—	—
0·50	2525	0·20	1009	0·20	1009	—	—
0·35	3143	0·25	2253	0·05	424	—	—
0·16	399	0·17	424	0·17	424	—	—
0·42	2744	0·28	1829	—	—	—	—
3·4	816	—	—	—	—	—	—
2·0	150	—	—	—	—	—	—
4·0	666	—	—	—	—	—	—
1·6	208	—	—	—	—	—	—
6·0	125	—	—	—	—	—	—
4·0	83	—	—	—	—	—	—
—	—	—	—	—	—	—	—
5·5	36	—	—	—	—	—	—
2·0	1607	—	—	—	—	5·0	4018
—	8659	—	289	—	1595	—	4018

APPENDIX 7

PER CAPITA AVAILABILITY OF CLOTH IN INDIA

Year	*Estimated mid-year population (millions)*	*Availability for home consumption (million metres)*		*Per capita availability (metres)*	
		cotton cloth	*man made fibres*	*cotton cloth*	*man made fibres*
1951	363·30	3992	—	10·99	—
1952	369·49	4972	—	13·46	—
1953	375·94	5273	—	14·03	—
1954	382·78	5293	—	13·83	—
1955	390·00	5595	—	14·35	—
1956	397·62	5847	—	14·71	—
1957	405·67	5882	—	14·50	—
1958	414·16	5913	382·16	14·28	0·92
1959	423·12	5806	485·38	13·72	1·15
1960	432·56	5971	520·52	13·80	1·20
1961	442·57	6527	508·93	14·75	1·15
1962	453·24	6482	526·71	14·30	1·16
1963	464·16	6780	573·59	14·61	1·24
1964	475·35	7179	766·88	15·10	1·61
1965	486·81	7097	833·47	14·58	1·71

Source : *Indian Textile Industry*, October 1966, p. 32.

APPENDIX 8

PRODUCTION OF COTTON AND NON-COTTON FABRICS IN INDIA

(Million metres)

Year	Cotton Fabrics			Non-Cotton Fabrics		
	Mill sector	*Decentralised*	*Total*	*Woollen Worsted Fabrics*	*Staple Fibre Fabrics*	*Man made Fabrics (Power looms & Handlooms)*
1951	4,076	1,108	5,184	12·14	14·19	313·33
1952	4,599	1,436	6,035	11·38	16·03	192·67
1953	4,878	1,542	6,420	13·16	8·94	259·36
1954	4,998	6,653	6,651	13·75	6·26	336·78
1955	5,094	1,771	6,865	13·58	5·70	361·59
1956	5,307	1,819	7,126	16·31	6·78	470·24
1957	5,317	1,981	7,298	16·14	4·62	459·41
1958	4,927	2,151	7,078	18·37	4·70	433·63
1959	4,924	2,270	7,194	14·83	3·60	538·08
1960	5,048	2,202	7,250	14·61	3·02	598·00
1961	5,141	2,595	7,736	13·13	2·26	623·45
1962	4,987	2,638	7,625	16·21	2·76	655·65
1963	4,837	3,146	7,983	19·75	2·45	708·58
1964	5,089	3,353	8,442	12·81	2·95	910·39
1965	5,017	3,342	8,359	10·79	4·17	947·57

Source : Indian Textile Bulletin—Cotton, 1966.

APPENDIX 9·1

AREA UNDER RAW JUTE IN THE CHIEF PRODUCING COUNTRIES

(Thousand acres)

	1954	1955	1956	1957	1958	1959	1960	1961	1963
Raw Jute									
Pakistan	1,243	1,634	1,230	1,563	1,528	1,375	1,518	2,061	1,700
India	1,243	1,739	1,908	1,741	1,811	1,685	1,512	2,280	2,130
China[a]	178	287	350	360	370	(370)	(365)	(340)	(380)
Brazil	55	53	64	67	64	59	69	88	89
Burma	—	—	8	22	34	34	22	24	(55)
Formosa (Taiwan)	28	37	33	17	31	44	39	27	17
Soviet Union	43	18	13	(13)	(13)	(13)	(13)	(13)	—
Thailand	3	4	6	5	5	7	10	25	13
Vietnam	1	1	1	2	4	3	5	4	(1)
Japan	2	1	2	1	1	1	1	1	1
Total raw jute	2,796	3,774	3,615	3,791	3,861	3,591	3,554	4,863	4,386
Allied fibres									
India (Mesta)	438	571	734	766	825	704	689	960	952
Thailand (Kenaf)	15	21	43	31	50	109	346	664	375
Soviet Union (Kenaf)[b]	161	116	83	(83)	(83)	(83)	(83)	(83)	—
Congo	23	23	21	23	24	24	24	24	24
Spain (Kenaf)	—	—	3	4	5	6	5	4	1
Total allied fibres	637	733	884	907	987	926	1141	1735	1352

NOTE : Jute is sown in February-March and harvested from July onwards.
[a] Including mesta. [b] Including small area under Kanatnik.

Source : Industrial Fibres—A Review, the Commonwealth Economic Committee, 1965, p. 169.

APPENDIX 9·2

PRODUCTION OF JUTE IN THE CHIEF PRODUCING COUNTRIES

(Thousand tons)

July-June	Average 1946-47 1950-51	Average 1951-52 1955-56[a]	1956-57	1957-58	1958-59	1959 60	1960-61	1963-64
(i) Raw jute								
Pakistan[b]	1,327	965	985	1,018	1,072	992	796	1,071
India[b]		694	766	711	921	822	711	1,055
China[c]	12	59d	84	99	103	107	106	(116)
Brazil	10	21	31	32	31	32	38	43
Formosa (Taiwan)	7	14	17	9	17	24	22	10
Burma	—	—	1	2	3	6	6	(12)
Nepal	6	7	7	7	7	7	7	7
Thailand	3	2	2	3	3	4	6	1
Japan	1	1	1	1	1	1	1	1
Total raw jute	1,366	1,763	1,894	1,882	2,158	1,993	1,693	2,316
(ii) Allied fibres								
China(Kenaf)[c]	24	118	170	197	207	218	214	(134)
India (Mesta)	(122)	51	263	233	66	204	202	322
Thailand (Kenaf)	12	13	17	21	29	50		178
Congo	19	9	9	12	13	12	12	(8)
Iran (Kenaf)	4	4	5	5	4	4	6	(4)
Spain (Kenaf)	—	—	2	3	4	4	4	1

Vietnam (Kenaf)	—	—	—	1	1	2	2	(2)
Brazil	(10)	(10)	—	—	—	17	18	5
Total allied fibres	181	295	466	472	524	511	636	804
Total jute and allied fibres (excl. Soviet Union)	1,547	2,058	2,360	2,354	2,682	2,504	2,329	3,120

NOTE : Raw jute in India and Pakistan is harvested between July and September; output in 1960-61 relates to the crop harvested in July-September 1960. Figures for the remaining countries refer to calendar years, first of two shown.

[a] Average of years available.

[b] Figures in the table are official estimates. Trade estimates based on exports, consumption and changes in stocks are as follows (thousand tons):

July-June	*Average* 1946-47 1950-51	*Average* 1951-52 1955-56	1956-57	1957-58	1958-59	1959-60	1960-61	1963-64
Pakistan	1,450	1,034	1,093	1,110	1,073	1,012	821	1,054
India		753	765	770	983	818	727	1,053
Total	1,450	1,787	1,858	1,880	2,056	1,830	1,548	2,107

[c] Published figures showed only combined output of jute and kenaf. It is estimated that one-third of the crop is jute and the remainder kenaf.

Source : Industrial Fibres, *ibid.*, 1965.

APPENDIX 10·1

EXPORTS OF RAW JUTE AND ALLIED FIBRES FROM THE CHIEF PRODUCING COUNTRIES

(Thousand tons)

July-June	*Average* 1946-47 1950-51	*Average* 1951-52 1955-56	1956-57	1957-58	1958-59	1961	1962	1963
1	2	3	4	5	6	7	8	9
Pakistan	953[c]	931	725	871	730	599	686	726
India		—	—	—	8	—	7	19
Nepal[a]	6	4	6	3	3	(7)	(7)	(7)
Thailand[d,f]	—	—	6	14	27	126	213	110
China[e,d]		(20)[b]	(20)	(7)	(6)	(1)	(1)	1
Congo	11	9	3	4	6	5	2	2
Total	970	964	760	899	780	738	916	865

NOTE : Pakistan returns include land-borne and sea-borne exports.

[a] Imports into India from Nepal—fiscal years beginning 1st April.

[b] Average 1954-55 and 1955-56.

[c] Excludes trade between Pakistan and India in 1946-47.

[d] Calendar years (first of the two shown); the figures include waste.

[e] Calculated from the import returns of the chief importing countries.

[f] Mostly kenaf.

Source : Industrial Fibres, *ibid.*, 1965.

APPENDIX 10·2

EXPORTS OF JUTE MANUFACTURES FROM THE CHIEF EXPORTING COUNTRIES

(Thousand tons)

	Average 1934-38	*Average* 1947-50*	*Average* 1951-55	1956	1957	1958	1959	1960	1961	1963
1	2	3	4	5	6	7	8	9	10	11
Commonwealth										
India†	877	823	796	870	867	778	860	848	719	890
Pakistan	—	—	13	75	71	86	190	188	202	231
United Kingdom	53	17	18	19	18	14	15	16	16	18
Belgium	30	26	44	41	37	44	44	48	43	57
France	11	8	27	27	26	28	27	29	18	19
Western Germany	11	4	18	14	14	9	12	13	12	9
Netherlands	—	1	4	3	3	4	5	7	4	6
Italy	9	9	4	1	1	1	1	1	1	—
Japan	—	—	6	8	4	7	4	3	3	4
United States	2	4	2	5	5	5	4	4	5	4
Austria	3	1	2	1	—	—	1	1	—	1
World Total	989	938	930	1,064	1,064	976	1,163	1,161	1,023	1,239

NOTE : This table excludes, as far as possible, trade in used sacks.

* Or years available.

† Sea-borne and land-borne trade.

APPENDIX 11

EDIBLE AND INDUSTRIAL FATS : PREWAR CONSUMPTION STANDARDS IN SPECIFIED COUNTRIES

Country		*Total food and edible fats*						*Industrial fat usage*[a]	*Total visible fat*
		Total dietary	*Total fats (Visible and invisible)*			*visible fat*[a]			
		Cal	Cal	Gm.	Km.	Cal	Kg.	Kg.	Kg.
High fat consumption countries									
Denmark		3,400	1,400	150	54	650	26	11	37
Netherlands		3,000	1,075	113	42	550	22	11	33
United Kingdom		3,100	1,150	123	44	525	21	9	30
U.S.A.		3,200	1,175	127	45	500	20	10	30
Germany		2,950	1,040	112	40	600	24	5	29
Australia		3,300	1,200	130	49	475	19	8	27
Medium level countries									
France		2,900	775	84	31	375	15	7	21
Argentina		2,750	850	93	34	426	17	3	20
Italy		2,650	575	61	22	275	11	4	15
Cuba		2,600	450	48	17	275	11	3	14
U.S.S.R.		2,800	—	—	—	250	10	2	12
Low fat consumption countries									
Egypt		2,450	400	42	15	188	7·5	b	8·5
Fr. N. Africa	2,300	2,400	—	—	—	175	7·0	b	7·8
Balkans	2,000	2,900	650	70	25	163	6·5	b	7·6
U. of S. Africa		2,250	400	43	15	163	6·5	b	7·4
China		2,250	375	40	14	150	6·0	b	6·5
India-Pakistan		1,950	250	27	10	113	4·5	b	5·0
Japan		2,200	175	20	7	100	4·0	b	4·7

One kilogram : 2·2 lbs. [a] Excluding synthetic fats or detergents. [b] Technical ~~use small~~; estimated to be 1 kg. per caput.

Source : *Fats and Oils, F. A. O.*, August 1949.

APPENDIX 12

AREA, PRODUCTION AND YIELD OF OILSEEDS IN INDIA

(Area: '000 hectares;
Production: '000 tonnes;
Yields: Kgs. per hectare)

Oil seeds	1950-51	1955-56	1960-61	1965-66
1	2	3	4	5
Groundnut				
Area	4,494	5,133	6,463	7,428
Production	3,481	3,862	4,812	4,230
Yield	775	752	745	570
Castor Seed				
Area	555	574	466	409
Production	103	125	107	80
Yield	186	218	230	195
Sesamum				
Area	2,204	2,293	2,169	2,480
Production	445	467	318	425
Yield	202	204	147	171
Rape & Mustard				
Area	2,071	2,556	2,883	2,884
Production	762	860	1,347	1,276
Yield	368	336	467	442
Linseed				
Area	1,403	1,529	1,789	1,727
Production	367	420	398	335
Yield	262	275	222	194
Total Five Major Oil Seeds				
Area	10,727	12,085	13,770	14,928
Production	5,158	5,734	6,982	6,346
Yield	481	474	507	425

APPENDIX 13

UTILISATION OF OIL SEEDS IN INDIA

(Thousand tons)

Utilisation	*Groundnut* average during 1933-34 1937-38	*Groundnut* average during 1943-44 1947-48	*Utilisation*	*Rape and mustard* average 1934-35 to 1938-39	*Rape and mustard* average 1939-40 to 1941-42	*Utilisation*	*Castor seed* average 1939-40 to 1941-42	*Utilisation*	*Linseed* average 1934-35 to 1936-37	*Linseed* average 1950-51 to 1952-53
Exports	1112	328	Exports	30	33	Used as seed sowing	8·5	Exports	233	25
Seeds	322	464								
Edible use	173	28	Seed	16	17	as clarifying agent in preparation of gur	1·0	Seed	26	25
			Oil extraction	925	1000			domestic consumption	27	13·2
			edible use	36	44	medicinal uses	0·5	oil extraction	200	309
Oil extraction: *India*	1198	2620	Toilet and other miscellaneous uses	5	5					
						crushing	160·00	wastage etc.	3·0	1·8
Total	2822	3692		1022	1109		170·00		489	374·00

Source : Agricultural Marketing in India, *Reports on the marketing of groundnuts, rape and mustard, castor seed and linseed.*

APPENDIX 13A

AVAILABILITY OF COPRA, COCONUT OIL AND IMPORTS OF PALM OIL IN INDIA

('000 tons)

Year	COPRA			COCONUT OIL PRODUCED FROM					
	Domestic production of coconut in terms of copra*	*Imports*	*Total*	*Domestic copra*	*Imported copra*	*Total*	*Imports of coconut oil*	*Total availability of coconut oil*	*Imports of Palm oil*
1	2	3	4	5	6	7	8	9	10
1952-53	664	19	683	153	12	165	20	185	n.a.
1953-54	686	30	716	159	19	178	23	201	n.a.
1954-55	681	66	747	158	41	199	23	222	n.a.
1955-56	634	62	696	147	51	198	22	220	n.a.
1956-57	622	99	721	144	61	205	21	226	n.a.
1957-58	664	124	788	154	77	231	14	245	19
1958-59	681	94	775	158	58	216	5	221	20
1959-60	682	86	768	158	53	211	4	215	28
Average	664	72	736	154	46	200	16	216	22

*Represents total production of coconuts in the country.

APPENDIX 14·1

OILS AND FATS USED IN THE MANUFACTURE OF SOAP IN THE UNITED KINGDOM

(Thousand tons)

	1954	1955	1956	1957	1958	1959	1960
Vegetable oils							
Coconut	8	4	8	8	13	6	11
Palm	56	32	44	33	29	25	20
Palm kernel	38	45	45	50	37	35	30
Acid oils and miscellaneous*	84	83	70	63	61	66	44
Total	186	184	167	154	140	132	105
Animal fats							
Tallow and grease	75	87	100	127	120	130	134
Marine	1	1	1	1	2	3	4
Total oils and fats	262	272	268	282	262	265	243

*Includes acid oils and residues, fatty acids and soapstocks.

Appendix 14.2

OILS, FATS AND RESIN USED IN THE MANUFACTURE OF SOAP IN FRANCE

(Thousand tons)

	1955	1956	1957	1958
Vegetable Oils				
Coconut } Palm kernel }	41	40	38	26
Palm	7	8	5	2
Other liquid oils	27	22	14	17
Other hard oils*	14	9	7	7
Others	—	6	6	2
Total *	89	85	70	54
Animal fats				
Tallow and grease	76	83	84	73
Resin	4	4	3	2
Total	169	172	157	129

May include some animal or marine oils.

APPENDIX 14·3

OIL, FATS, RESIN AND TALL OIL USED IN THE MANUFACTURE OF SOAP IN THE UNITED STATES

(Thousand tons)

	1954	1955	1956	1957	1958	1959	1960
Vegetable oils							
Coconut	78	77	79	77	72	64	64
Palm	4	5	2	1	—	2	3
Palm kernel	3	2	—	—	—	5	7
Other	3	5	1	1	1	1	—
Total	88	89	82	79	73	72	74
Animal fats							
Tallow and grease	405	386	363	352	325	326	331
Other [b]	—	2	1	1	—	—	—
Total [a]	405	388	364	353	325	326	331
Secondary oils and fats [c]	60	52	46	44	38	11	8
Total oils and fats	553	529	492	476	436	409	413
Resin	8	8	7	4	3	1	—
Tall oil	5	5	8	5	5	10	6
Total	566	542	507	485	444	420	419

[a] Excluding secondary fats and oils, the aggregate totals of which are given separately.

[b] Mainly lard, including rendered pork fat.

[c] Includes foots and other soapstock, as well as fatty acids.

APPENDIX 14A

ESTIMATE OF INTERNAL CONSUMPTION OF TEA IN INDIA

(Thousand kgs.)

Year	*Opening stock as on 1st April*	*Production during the year*	*Export during the year*	*Closing stock at the end of financial year*	*Estimated consumption cols.* (2+3) — *cols.* (4+5)	*3 year moving average*
1	2	3	4	5	6	7
1953-54	49,115	278,777	213,500	31,727	82,665	—
1954-55	32,084	295,519	208,462	39,922	79.219	87,368
1955-56	39,652	307,704	182,769	63.367	100.220	88,954
1956-57	63,367	308,719	233,088	51,554	87,444	100,047
1957-58	51,554	310,802	191,755	58,104	112,497	102,939
1958-59	58,104	325,225	217,322	57.132	108.875	112,433
1959-60	63,933	328,011	215,459	60.559	115.926	117,202
1960-61	60,559	322,429	196,473	59.709	126,806	127,458
1961-62	59,709	355,493	205,329	70,231	139.642	134,054
1962-63	70.231	344,551	220,800	58,268	135,714	138,674
1963-64	58,268	344,705	209,328	52.978	140,667	141,796
1964-65	52,978	372,984	212,255	64,701	149,006	—

N. B. : Production for the years 1953-54 to 1958-59 relates to calendar year while that of 1959-60 to 1964-65 relates to financial year.

NOTE : Estimates of internal consumption do not take into consideration variations in stocks held in retail channels. In other words, the estimates are based on the tacit assumption that stocks in retail channel remain more or less the same in any two consecutive years. In case there is any large variation in retail stocks as between two consecutive years, the accuracy of the estimate of consumption will be vitiated to that extent. However, such unusual variations are likely to smooth out over a period of about 3 years. A 3-year moving average of the original estimates arrived at will, therefore, afford more reliable estimates of consumption of tea in India.

Source : Tea Statistics, 1965.

APPENDIX 15

QUANTITY AND VALUE OF TEA EXPORTED FROM INDIA TO DIFFERENT COUNTRIES DURING THE YEARS 1956 TO 1965

Countries of destination	Quantity (in thousand kgs.) 1956	1957	1958	1959	1960	1961	1962	1963	1964
1	2	3	4	5	6	7	8	9	10
U. K.	165,743	136 859	150,104	127,596	120,803	123,215	119,862	135,590	119,658
West Germany	2,849	1,872	1,940	2,546	1,697	1,583	1,713	1,419	2,045
Irish Republic	7,594	8,824	7,191	7,430	6,204	6,499	7,243	7,287	5,021
Netherlands	2,210	859	1,288	1,523	1,429	1,601	2,937	3,084	3,112
U. S. S. R.	6,189	7,234	11,466	2,405	10,212	11,874	12,414	16,583	21,130
Afghanistan	1,095	864	1,283	2,597	3,361	3,313	4,546	4,192	4,821
Bahrein Island	840	755	1,072	590	490	425	420	260	299
Iraq	70	22	52	1,660	2,119	2,116	2,767	2,705	1,968
Iran	2,973	4,511	5,451	3,463	3,547	3,853	4,506	3,290	2,264
Kuwait	1,302	1,453	1,241	1,049	932	938	882	772	623
Arabia	194	164	416	435	202	121	102	60	64
Turkey	2,641	3,228	3,725	4,802	2,367	4,229	1,807	1,177	43
U. A. R.	10,484	7,630	11,576	11,706	14,100	15,612	18,541	17,083	15,944
Sudan	3,039	1,980	6,333	10,701	3,875	6,709	5,316	3,644	3,666
Canada	10,246	7,658	8,638	7,239	6,968	6,374	6,321	5,342	5,703
U. S. A.	12,862	10,587	11,564	10,679	8,560	10,767	11,458	10,087	9,380
Chile	64	441	566	517	518	589	463	134	97
Australia	4,262	3,582	3,306	2,877	2,429	1,876	5,254	3,623	5,362
New Zealand	659	736	534	742	663	527	553	409	378
Other Countries	2,168	1,707	1,757	3,123	2,587	4,071	4,721	6,801	8,945
Total	237,484	200,786	229,503	213,680	193,063	206,292	211,826	223,542	210,523
(Lbs.)*	(523,564)	(442,659)	(505,969)	(471,085)	(425,632)	(454,798)	(466,998)	(492,827)	(464,125)

* Figures in brackets are in pounds.

Source: Tea Statistics 1963 and 1965-1966; Tea Board of India.

APPENDIX 15—Contd.

	Value (in thousand Rupees)									
1965	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965
11	12	13	14	15	16	17	18	19	20	21
104,197	9888,58	8235,95	8947,58	7536,15	7475,92	7509,47	7060,80	8126,21	7206,40	5881,04
1,883	210,93	140,22	144,45	190,99	131,47	120,96	138,25	114,27	163,68	146,30
6,359	441,88	550,55	423,37	468,64	396,94	359,37	444,35	461,21	313,87	395,85
2.887	128,57	54,30	75,03	88,45	86,14	95,83	163,59	180,66	191,16	180,97
26,175	416,21	538,47	829,88	911,07	752,02	860,23	959,51	1105,26	1369,44	1731,48
3,694	45,87	28,78	63,85	128,10	182,93	176,07	210,46	199,95	245,68	185,10
410	40,79	41,95	56,51	32,91	28,72	25,43	17,88	15,26	17,33	23,72
1,536	4,20	1,60	3,38	89,00	120,00	121,85	133,08	134,24	101,78	73,99
2,945	288,37	484,33	442,96	267,71	273,60	282,45	348,35	267,48	199,98	270,37
537	64,62	78,63	65,60	54,12	53,35	52,03	45,73	42,33	34,14	30,28
72	12,23	9,89	23.72	25,76	13,80	8,79	7,58	5,45	6,25	6,63
12	157,54	214,31	236,67	286,86	153,26	253,33	104,70	66,60	2,37	3,15
17,977	634,35	414,35	538,10	594,34	786,67	802,78	911,80	866,80	802,32	807,29
3,597	117,90	88,51	276,89	483,29	202,27	333,78	224,48	171,22	168,72	159,32
4,779	651,96	468,60	532,41	439,63	457,05	387,68	365,32	317,53	340,52	381,45
7,787	784,07	640,50	657,80	609,97	524,57	627,79	653,39	580,14	527,10	441,05
66	3,89	25,94	31,41	28,69	32,29	38,54	24,86	7,88	5,10	3,43
4,321	231,49	176,13	164,88	143,97	124,06	93,11	243,03	178,03	274,11	218,59
635	40,13	42,57	30,32	42,34	38,96	30,52	29,83	23,08	21,05	34,41
9,495	118,91	103,00	108,96	179,36	164,73	245,12	266,40	373,50	499,12	524,08
199,365	14282,49	12338,58	13653,77	12601,35	11998,83	12425,13	12353,39	13237,10	12490,12	11497,47
(439,526)										

APPENDIX 16

AREA, PRODUCTION AND AVERAGE YIELD PER ACRE OF INDIAN TEA DURING 1885 TO 1965

Year	*Area (acres)*	*Production (thousand lbs.)*	*Avg. yield (per acre in lbs.)*
1885-1889	310,519	90,600	292
1890-1894	374,980	124,870	333
1895-1899	466,058	158,307	340
1900-1904	523,234	201,326	385
1905-1909	538,681	242,280	450
1910-1914	590,691	289,953	491
1915	634,940	372,203	586
1916	649,030	370,314	571
1917	667,088	371,296	557
1918	678,533	380,459	561
1919	691,768	377,056	545
1920	704,059	345,340	490
1921	709,006	274,264	387
1922	708,199	311,639	440
1923	711,209	375,356	528
1924	714,710	375,256	525
1925	727,663	363,507	499
1926	739,423	392,933	531
1927	755,994	390,920	517
1928	775,898	404,153	521
1929	788,001	432,842	549
1930	803,532	391,081	487
1931	806,829	394,084	488
1932	809,455	433,669	636
1933	817,921	383,674	469
1934	826,337	399,251	483
1935	831,688	394,429	474
1936	834,113	395,180	474
1937	834,304	430,250	516
1938	833,771	451,861	542
1939	832,501	452,596	544
1940	832,832	463,881	557
1941	839,745	500,102	596
1942	766,969	514,779	671
1943	765,827	524,330	685
1944	762,367	471,468	618
1945	763,364	504,938	661
1946	764,190	542,482	710
1947	765,993	561,740	733
1948	768,000	577,807	752

1949	771,953	585,030	758
1950	779,998	613,354	786
1951	782,998	629,197	804
1952	785,584	614,365	782
1953	787,378	614,598	781
1954	789,442	651,508	825
1955	791,322	678,372	857
1956	792,185	680,609	859
1957	798,850	685,203	858
1958	803,969	717,001	892
1959	806,786	718,609	891
1960	817,272	707,854	866
1961	818,486	781,312	955
1962	821,685	764,420	930
1963	825,422	763,702	925
1964	834,906	821,181	983
1965*	844,197	804 417	953

NOTE : Figures upto 1941 include Pakistan.

* Provisional.

Source: Tea Statistics, The Tea Board of India, 1965.

APPENDIX 17

QUANTITIES OF COFFEE AVAILABLE IN INDIA FOR HOME CONSUMPTION DURING THE PERIOD 1938-39 TO 1962-63

('000 tonnes)

Season	*Total production*	*Available for home consumption including propaganda Dept.*	*Percentage of col. 3 to 2*
1	2	3	4
1938-39	18	8	45
1939-40	16	7	44
1940-41	14	11	80
1941-42	18	11	62
1942-43	16	11	70
1943-44	17	14	82
1944-45	17	13	73
1945-46	26	19	76
1946-47	15	13	83
1947-48	16	15	96
1948-49	22	19	84
1949-50	20	16	79
1950-51	19	18	97
1951-52	21	19	88
1952-53	24	20	86
1953-54	29	20	66
1954-55	25	21	85
1955-56	34	27	77
1956-57	42	27	63
1957-58	44	30	68
1958-59	46	37	82
1959-60	49	NA	—
1960-61	68	NA	
1961-62	48	NA	—
1962-63	55	NA	—

Source : Report of the Plantation Enquiry Commission Part II—Coffee, and Commonwealth Economic Committee Review, Plantation Crops.

APPENDIX 18·1

PER CAPITA NATIONAL INCOME AND ESTIMATED PER CAPITA CONSUMPTION OF COFFEE AND TEA IN SELECTED COUNTRIES IN 1956

Country	National income (Rs.) [1]	Consumption of Coffee (lbs.) [2]	Consumption of Tea (lbs.) [3]	Consumption of Total	Index with Ceylon as 100 National income	Index with Ceylon as 100 Tea & Coffee consumption
1	2	3	4	5	6	7
India	284	0·12	0·50	0·62	50	35
Ceylon*	567	0·14	1·63	1·77	100	100
Japan	1031	0·08	1·50	1·58	182	89
New Zealand	5428	0·60	6·50	7·10	957	401
Australia	4918	1·39	5·67	7·06	867	399
U. K.	4287	1·63	9·54	11·17	756	631
U.S.A.	9731	14·04	0·60	14·64	1716	827
Canada	6742	5·80	2·83	8·63	1189	488
France	4046	8·32	0·08	8·40	714	475
West Germany	3279	5·00	0·25	5·25	578	297
Italy	1821	2·92	0·06	2·98	321	168
Norway	4358	11·88	0·26	12·14	769	686
Sweden	5653	14·73	0·40	15·13	997	855
Netherlands	2977	7·08	1·94	9·02	525	510
Denmark	3789	13·08	0·68	13·76	668	777
Switzerland	5428	8·35	0·53	8·88	957	502

* Figures relate to the year 1955.

Source : [1] International Financial Statistics, Nov. 1957.

[2] Statistical Volume of 17th Annual Report, App. XIII (b), Coffee Board.

[3] International Tea Committee's Bulletin of Statistics, June 1958.

Appendix 18·2

ESTIMATED PER CAPITA CONSUMPTION OF COFFEE (ROASTED) IN SELECTED COUNTRIES

(Lbs. per annum)

	Average 1951–55	1960	1961	1962
U. K.	1·4	2·1	2·1	2·7
Canada	6·9	9·0	9·0	8·8
Australia	6·9	1·7	1·7	2·6
U. S. A.	16·1	15·8	15·9	15·8
West Germany	7·7	7·6	8·3	8·6
Netherlands	5·0	9·9	10·6	11·5
Belgium	12·0	14·8	13·8	12·7
France	8·4	9·5	9·5	9·8
Italy	3·0	4·0	4·2	4·6
Sweden	14·8	20·5	21·5	
Switzerland	8·1	11·2	11·9	10·6

Source : Commonwealth Economic Committee, Plantation Crops, 1964.

APPENDIX 19

AREA PLANTED AND PRODUCTION OF COFFEE IN INDIA
(1941-42 TO 1960-61)

Season	*Area (thousand acres)*			*Per cent of col. 3 to 2*	*Production (thousand tons)*			*Per cent of col. 7 to 6*
	Arabica	*Robusta*	*Total*		*Arabica*	*Robusta*	*Total*	
1	2	3	4	5	6	7	8	9
1941-42	152	29	181	19	15	3	18	20
1942-43	161	33	194	20	13	3	16	23
1943-44	162	36	198	22	12	5	17	42
1944-45	162	42	204	26	13	4	17	31
1945-46	165	46	211	28	19	6	25	32
1946-47	167	50	217	30	12	3	15	25
1947-48	167	52	219	31	7	9	16	128
1948-49	167	54	221	32	19	3	22	16
1949-50	164	61	225	37	13	8	21	62
1950-51	167	62	229	37	15	4	19	27
1951-52	168	67	235	40	14	7	21	50
1952-53	168	72	240	43	13	11	24	84
1953-54	169	77	246	46	23	7	30	30
1954-55	167	86	253	53	16	9	25	56
1955-56	162	92	254	56	22	12	34	55
1956-57	—	—	232	—	—	—	35	
1957-58	—	—	244	—	—	—	39	
1958-59	—	—	267	—	—	—	41	
1959-60	—	—	274	—	—	—	49	
1960-61	—	—	281	—	—	—	43	

Source : Report of the Plantation Inquiry Commission, Part II—Coffee.

Appendix 20

STATEMENT SHOWING AGES OF COFFEE PLANTS (REGION-WISE)

(Acres)

Name of Region	*Reported Acreage*	*Acreage Planted*				
		Before the year 1900	*Between* 1900 *and* 1910	*Between* 1910 *and* 1920	*Between* 1920 *and* 1930	*After* 1930
1	2	3	4	5	6	7
Madras	10010	2808 (28)	1319 (13)	1171 (12)	987 (10)	3725 (37)
Mysore	4637	2036 (44)	356 (8)	712 (15)	638 (14)	895 (19)
Coorg	4985	1044 (21)	181 (4)	526 (11)	995 (20)	2239 (45)
Travancore-Cochin	188	—	—	—	—	188
Total	19820	5888 (30)	1856 (9)	2409 (12)	2620 (13)	7047 (36)

Note : Figures in brackets indicate percentage of reported acreage.

Source : Report of the Plantation Inquiry Commission, Part II—Coffee.

APPENDIX 21

PER CAPITA CONSUMPTION OF NATURAL AND SYNTHETIC RUBBER IN MAIN CONSUMING COUNTRIES

Country	1954 Kg.	Lb.	1964 Kg.	Lb.
1	2	3	4	5
U. S. A.	7·71	17·0	10·28	22·66
Canada	4·76	10·5	7·15	15·77
Australia	5·17	11·4	6·65	14·65
U. K.	5·01	11·2	6·18	13·63
F. R. Germany	3·04	6·7	5·94	13·09
France	3·36	7·4	5·65	12·46
Japan	1·09	2·4	3·80	8·38
Italy	1·41	3·1	3·47	7·65
Netherlands	2·00	4·4	3·36	7·40
Brazil	0·68	1·5	0·92	2·02
India	0·07	0·15	0·16	0·35

Source : Indian Rubber Statistics.

APPENDIX 22

WORLD PRICE OF NATURAL RUBBER

(R. S. S. 1/per lb.)

Year	*London* *Shillings*	*London* *Pence*	*New York* *U.S. cents*	*Singapore* *Straits Cents*	*Colombo* *Rupee Cents*
1	2		3	4	5
1955	2	$9\frac{6}{16}$	39·14	114·16	128·2
1956	2	$4\frac{19}{32}$	34·17	96·76	144·7
1957	2	$2\frac{3}{32}$	31·15	88·75	115·7
1958	1	$11\frac{1}{2}$	28·07	80·25	93·5
1959	2	$6\frac{3}{32}$	36·55	101·56	126·2
1960	2	$8\frac{5}{32}$	38·16	108·08	123·7
1961	2	$0\frac{3}{4}$	29·50	83·54	100·4
1962	1	$11\frac{5}{16}$	28·56	78·20	97·8
1963	1	$9\frac{3}{4}$	26·26	72·42	92·7
1964	1	$8\frac{19}{32}$	25·24	68·14	89·5
1965	1	$9\frac{7}{16}$	25·69	70·02	91·4
1966	1	$7\frac{27}{32}$	23·62	65·36	89·1

Source : Rubber Statistical Bulletin of the International Rubber Study Group.

APPENDIX 23

LAND UTILISATION STATISTICS — ALL INDIA 1950-51 TO 1980 85

	1950-51	1955-56	1960-61	1961-62	1962-63	1963-64	1964-65	1980-85	1964-65	1980-85
				(*Million hectares*)					(*Million acres*)	
1. Geographical Area	326·8	326·8	326·8	326·8	326·8	326·8	326·8	326·3	806·3	806·3
2. Reporting Area	284·3	291·9	298·5	299·2	305·0	305·2	305·3	314·0	754·4	776·0
3. Forests	40·5	51·3	54·1	54·2	60·5	60·7	60·4	70·0	149·3	173·0
4. Not available for cultivation	47·5	48·4	50·8	50·7	50·3	50·1	50·2	46·5	124·0	115·0
5. Other uncultivated land excluding fallow lands										
(*a*) Culturable waste	22·9	21·5	19·2	18·6	17·9	17·7	17·4	16·2	43·0	40·0
(*b*) Permanent Pastures and other grazing lands	6·7	11·5	14·0	14·1	14·1	14·6	14·7	16·2	43·7	40·0
(*c*) Land under miscellaneous tree crops & Groves (not included in net area sown)	19·8	5·9	4·5	4·5	4·6	4·4	4·1	8·1	10·1	20·0
Total	49·4	38·9	37·6	37·2	36·6	36·6	36·2	40·5	89·5	100·0
6. Fallow lands										
(*a*) Fallow lands other than current fallows	17·4	12·1						6·1		15·0
			22·8	21·6	21·3	21·3	20·4		50·4	
(*b*) Current fallows	10·7	11·7						6·5		16·0
7. Net area sown	118·7	129·2	133·2	135·4	136·3	136·5	138·1	139·6	341·3	345·0
8. Gross sown area	131·9	147·3	152·8	156·2	156·8	157·0	159·2	176·0	393·4	435·0
9. Area sown more than once	13·2	18·1	19·6	20·8	20·5	20·5	21·1	36·4	52·1	90·0
10. Gross Irrigated Area	22·6	25·6	28·0	28·5	29·5	29·7	30·7	54·6	75·9	135·0
11. Net Irrigated Area	20·9	22·8	24·7	24·9	25·7	25·9	26·6	42·9	65·7	106·0
12. Area irrigated more than once	1·7	2·8	3·3	3·6	3·8	3·8	4·1	11·7	10·2	29·0

APPENDIX 24

LAND UTILISATION IN SELECTED COUNTRIES

(in '000 acres)

Country	Period	Total area	Cereals	Pulses	Fruits & vegetables	Oil seeds	Fibre	Sugar beats for sugar cane	Miscellaneous	Total	P. c. of col. (11) to col. (3)	Permanent meadows & pastures	P.c. of col. (13) to col. (3)	Area under forest	P.c. of col. (14) to col. (3)	Unused but potentially productive	Built on area waste land and others
			Agricultural area and area under tree crops														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Czechoslovakia	1957	31595	6581	67	1631	227	151	561	37	9255	29	4004	15	10744	44	n.a.	2723
Denmark	,,	10636	2735	22	217	7	12	213	—	3206	30	917	9	1082	39	n.a.	1806
Finland	,,	83278	2056	22	285	25	—	30	—	2368	3	699	1	53549	4	n.a.	22615
France	,,	136248	21896	516	6126	381	114	766	79	29878	22	32722	24	28482	46	10695	11654
E. Germany	,,	26685	5674	119	2001	69	79	541	12	8495	32	3091	12	7076	44	314	3141
W. Germany	,,	61266	11043	57	2941	82	10	640	40	14813	24	14046	23	17547	47	n. a.	8177
Netherlands	,,	8019	1208	99	345	72	57	161	—	1942	24	3096	39	642	63	n. a.	1677
Poland	,,	77031	22450	227	6917	588	383	835	82	31482	41	10329	13	18439	54	n. a.	8174
U. K.	,,	60299	7107	178	818		2	427	22	8554	14	30330	50	4062	64	n. a.	8382
U. S. S. R.	1956	5535316	317041	3178	24914	17114	11478	4967	—	378692	7	913535	16	217348	23	n. a.	1899423
Canada	,,	2464759	43934	156	398	3667	2	79	128	48364	2	54058	2	845021	4	17900	1285654
U. S. A.	1954	1934364	197366	1809	2459	42199	16927	1085	1601	263446	14	632419	33	640909	47	15074	180634
China (Mainland)	,,	2412033	138164	19492		49199	14547	788	460	222650	9	439044	18	198972	27	n. a.	1502994
India	1955	812712	213090	36980	2162	48423	22845	4564	1646	330710	40	27565	3	123774	43	56519	213576
Israel	1957	5115	348	15	59	32	...	7	27	488	10	1889	3	153	49	n. a.	1994
Japan	1956	91373	12580	677	1646	1735	52	69	291	17050	19	3351	4	55710	23	n. a.	19838
Pakistan	1957	233901	39058	4238	126	5459	5128	1233	259	55501	24	—	—	5170	24	n. a.	167661
Egypt	1957	247109	4772	131	171	1982	1900	144	17	9087	4	—	—	2	4	1275	239381

Source: *Production Year Book*, FAO, Rome.

APPENDIX 25

DOUBLE CROPPING SYSTEM IN INDIA

Some of the important double cropping systems followed in different parts of India are mentioned below:

Rice after rice

This is practised in Assam, West Bengal, Orissa, coastal Andhra Pradesh, Tamilnad, Mysore, southern Hyderabad (Deccan), Konkan and Malabar-cum-South Kanara tract. The second crop sometimes requires protective irrigation but must be manured to obtain good yield.

Ragi after ragi

This sequence of double cropping is followed in Mysore and some parts of Tamilnad.

Rice-pulses

In Bengal, parts of Bihar and Orissa, Lathyrus is raised after rice. In drier parts of Uttar Pradesh and eastern Madhya Pradesh, peas or gram follow rice. In Orissa, most parts of Madras State, Mysore and southern Deccan, Dolichos bifloru or Doliches lab-lab and black gram follow rice. In Gujarat, coastal alluvial tract of Bombay State and parts of Khandesh and North Hyderabad (Deccan) gram usually is the crop taken after paddy. In northern India berseem under irrigation is rotated with paddy and it enriches the land for subsequent crops when it is given dressing of phosphate.

Bajri after bajri

Winter bajri is only taken in southern India under irrigation or where winter rains are sufficient to raise the crop. On black clay soils of Deccan plateau in Bombay and Hyderabad states, it is common to raise two crops of bajri. Both crops require manuring.

Bajri-pulses

In northern India gram is the common pulse after bajri. In Madhya Bharat Vindhya Pradesh, Saurashtra and Kutch, gram usually follows bajri. In southern India dal and red gram follow bajri. In some parts bajri linseed is the sequence but it is not so common.

Bajri-wheat

In Gujarat, Khardesh and Deccan plateau where irrigation facilities are available wheat is raised after irrigation. With one or two irrigations the crop matures. It is not a common practice in northern India except in eastern Rajasthan and some parts of Madhya Bharat and Vindhya Pradesh. In Saurashtra and Kutch bajri is followed by wheat to a limited extent wherever late rains are received and can be conserved for the rabi crops.

Sorghum-pulses

This is a very common system of double cropping all over India. In northern India sorghum is usually raised for fodder and is followed by gram. In southern India it is sown after grain sorghum. Besides gram, other pulses sown in rabi are Dolichos biflorus, Dolichos lab-lab, red gram and black gram.

Millets-sorghum

Millets usually follow sorghum or vice versa in Tamilnad and coastal Andhra Pradesh, Mysore and southern Hyderabad. Usually this rotation is followed when sufficient manuring for application is available with the cultivator otherwise he resorts to green manuring in the interval between two crops. This practice is, therefore, not common.

Wheat-maize

In sub-mountainous tracts in northern India where rains start early in June double cropping is practised. Under irrigation it is usual to raise clover crop such as senji (*melilotus parviflora*), berseem (*T. alexandrium*) or methra (*Trigonelia sp.*)

Ground-wheat or barley

In northern India in localised tracts, in northern Hyderabad, Deccan plateau, Berar and Khandesh, it is common to have this double cropping. In Rayalaseema, Tamilnad and Mysore it is practised to a limited extent.

Ground-ragi and other millets

It is a very profitable practice followed in Rayalaseema, Tamilnad, southern Hyderabad and Mysore state where both south-west and north-east monsoons bring rain.

Gingelly-ragi or sorghum

In wetter areas of Madras State along the coast and in Tamilnad it is common to have such double cropping.

Cholam-Linseed

This is usually followed on garden lands in Tamilnad and some parts of Madhya Pradesh.

Appendix 26A

COMPOSITION OF AVERAGE CROPS PER ACRE EXPRESSED AS LBS. PER ACRE (U.K.)

	Dry matter	*Nitrogen*	*Phosphoric Acid*	*Potash*
Wheat, Grain, 30 bushels	1,530	34	14	9
Wheat, Straw, 1½ tons	2,650	16	7	20
Total	4,180	50	21	29
Barley, Grain, 40 bushels	1,750	35	16	10
Barley, Straw, 1 ton	2,080	14	5	26
Total	3,830	49	21	36
Oat, Grain, 45 bushels	1,630	34	13	9
Oat, Straw, 2¼ tons	2,350	18	6	37
Total	3,980	52	19	46
Maize, Corn, 50 bushels	2,500	46	17	11
Maize, Forage, 3 tons	3,000	25	14	50
Total	5500	71	31	61
Meadow Hay, 1½ tons	2,800	49	12	51
Red Clover Hay, 2 tons	3,760	100	25	83
Swedes, Roots, 20 tons	4,700	100	23	90
Mangolds, Roots, 30 tons	7,900	131	48	290
Potatoes, 8 tons	4,480	61	28	100

Source : Hall and Ogg, *The Feeding of Crops and Stocks*, London.

APPENDIX 26B

AMOUNTS OF PLANT NUTRIENTS IN GRAIN CROPS* (U.K.)

Crop	*Yield*	*Nitrogen* (N)	*Phos-phorous* (P_2O_5)	*Potash* (K_2O)	*Calcium* (CaO)	*Mag-nesium* (MgO)
Barley, grain	35bu	29·4	12·6	8·4	0·7	2·0
Straw	1,600 lb.	13·4	4·5	24·6	3·7	1·1
Total		42·8	17·1	33·0	4·4	3·1
Buckwheat,						
Grain	20 bu	15·0	6·0	3·0		
Straw	5,000 lb.	62·5	7·5	57·5	34·5	6·0
Total		77·5	13·5	60·5	34·5	6·0
Corn, grain	50 bu	46·4	18·2	11·0	0·4	3·0
Stover	3,000 lb.	30·0	9·0	42·0	14·2	2·5
Cobs	500 lb.	2·0	0·4	2·2	0·1	0·1
Total		78·4	27·6	55·2	14·7	5·6
Flax, grain	15 bu	30·5	12·5	8·2	2·8	—
Straw	1,800 lb.	20·5	3·4	18·8	13·2	—
Total		51·0	15·9	27·0	16·0	—
Oats, grain	50 bu	32·00	13·00	9·6	1·6	1·9
Straw	2,500 lb.	16·00	5·0	31·2	7·5	3·5
Total		48·0	18·0	40·8	9·1	5·4
Rye, grain	20 bu	19·1	9·8	6·7	0·5	1·3
Straw	2,000 lb.	10·1	6·0	17·0	4·4	1·4
Total		29·2	15·8	23·7	4·9	2·7
Wheat, grain	25 bu	30·0	12·8	6·0	0·6	2·0
Straw	2,500 lb.	12·5	3·8	15·0	5·2	1·5
Total		42·5	16·6	21·0	5·8	3·5

* Adapted from C. E. Millar and L. M. Turk, *Fundamentals of Soil Science*, New York, 1943.

Source : H. K. Wilson, *Grain Crops*.

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A.P 27

APPENDIX 26C

AVERAGE AMOUNTS OF NUTRIENTS REMOVED BY CROPS (U.S.A.)

Crop	*Yield*	*Part of crop*	N(lb)	P_2O_5 (lb)	K_2O	*Total*
Cotton	500 lb.	Lint	38	18	14	70
	1,000 lb.	seed				
	1,500 lb.	Burs, leaves, stalks	27	7	36	70
		Total	65	25	50	140
Tobacco	1,500 lb.	Leaves	55	10	80	145
		Stalks	25	10	35	70
		Total	80	20	115	215
Maize	60 bu	Grain	57	23	15	95
	2 tons	Stover	38	12	55	105
		Total	95	35	70	200
Wheat	30 bu	Grain	35	16	9	60
	1·25 tons	Straw	15	4	21	40
		Total	50	20	30	100
Oats	50 bu	Grain	35	15	10	60
	1·25 tons	Straw	15	5	36	55
		Total	50	20	40	115
Barley	40 bu	Grain	35	15	10	60
	1 ton	Straw	15	5	30	50
		Total	50	20	40	110
Potatoes	300 bu	Tubers	65	25	115	205
		Tops	60	10	55	125
		Total	125	35	170	330
Sweet potatoes	300 bu	Roots	45	15	75	135
		Vines	30	5	40	75
		Total	75	20	115	210
Sugar beets	15 tons	Roots	55	22	53	130
		Tops	60	23	92	175
		Total	115	45	145	305

Tomatoes	10 tons	Fruits	60	20	80	160
		Vines	40	15	95	150
		Total	100	35	175	310
Cabbage	15 tons	All	100	25	100	225
Celery	350 crates	All	80	65	235	380
Spinach	9 tons or 1,000 bu	All	90	30	45	165
Apples	400 bu	Fruit	20	7	30	57
		Leaves, wood	10	3	5	18
		Total	30	10	35	75
Peaches	500 bu	Fruit	30	15	55	100
		Leaves, wood	55	10	45	110
		Total	85	25	100	210
Grapes	4 tons	Fruit	10	6	20	36
		Leaves, canes	15	4	15	34
		Total	25	10	35	70
Orange	600 boxes	Fruit	65	23	105	193
		Leaves, wood	25	7	25	57
		Total	90	30	130	250
Soyabeans	25 bu	Grain	110	35	40	185
	1·25 tons	Straw	15	5	20	40
		Total	125	40	60	225
Peanuts	1 ton	Nuts	60	10	10	80
	3 tons	Vines	25	5	40	70
		Total	85	15	50	150
Pea beans	30 bu	Grain	73	23	24	120
			22	7	31	60
		Total	95	30	55	180
Alfalfa	3 tons	All	140	35	135	310
Sweet clover	5 tons	All	185	45	165	395
Red clover	2 tons	All	80	20	70	170
Lespedeza	3 tons	All	130	30	70	230
Cow peas	2 tons	All	125	25	90	240
Timothy	1·5 tons	All	40	15	45	100

Source : Fred C. Blank, *Handbook of Food and Agriculture.*

APPENDIX 26D

PLANT NUTRIENTS REMOVED BY CROPS (INDIA)

(Pounds)

Crops		*Area yield*	*Nitrogen* N	*Phosphoric acid* P_2O_5	*Potash* K_2O	*Remarks*
Bajra	(grain)	1000	15	6	9	
Bajra	(straw)	3000	14	4	81	
Barley	(grain)	1500	27	12	7	
Barley	(straw)	2500	18	6	36	
Jowar	(grain)	1000	14	9	7	
Jowar	(stalks)	3000	12	7	65	
Maize	(grain)	1800	32	17	10	
Maize	(stalks)	3600	39	12	58	
Paddy	(grain)	2000	26	14	8	
Paddy	(straw)	4000	28	8	75	
Wheat	(grain)	1400	22	12	7	
Wheat	(straw)	2800	13	4	35	
Cotton	(seed cotton)	1500	40	16	16	
Cotton	(stalks)	2800	35	10	38	
Groundnut	(nuts)	1500	45	8	8	
Groundnut	(vines)	4500	20	4	30	
Soyabeans	(grain)	1500	110	35	40	
Soyabeans	(stalks)	3000	18	6	24	
Sugarcane		67200	105	315	65	
Cholam[a]		—	72	25	45	
Ragi[a]		—	49	30	202	
Tobacco[a]		—	67	9	85	1000 lbs. of tobacco per acre.
Coconut[a]	(nuts only)	—	1·5	0·2	1·0	800 trees per acre.
Tea[a]		—	20	3	10[b]	
Coffee[a]		—	42	7·4	47[c]	

Source: *Plants Need Food*, Indo-American Technical Cooperation Programme, Agriculture Section.

[a] *Source*: *AICC Economic Review*, Nov. 1, 1958, p. 25.

[b] 400 lbs. made tea and assuming prunings are returned to the soil.

[c] 7 cwts. of parchment and assuming prunings are returned to the soil.

APPENDIX 27

PLANNED CULTURE OF LEGUMES

Legumes are known to liberate fixed phosphates and potash, besides satisfying the nitrogen hunger of soils. They improve physical condition of the soil by their extensive root system, which rapidly decomposes owing to high C-N ratio and aids in accelerating azotobacter and other nitrogen fixing bacterial activity for indirect fixation of elemental nitrogen. Every crop of gram, peas, lytharus, sunnhemp, green gram, red gram, horse gram, pigeon pea and clovers etc., leaves more than 20 lbs. of nitrogen (equivalent to two tons of farm yard manure or 100 lbs. of ammonium sulphate). Some of the American estimates show that from 40 to 50 lbs. of nitrogen may be fixed by bean and clover crops.[1]

In Egypt, U.S.A. and China, production has been kept at a high level by rotating legumes with cereals and other cash crops. Table 1 shows the results of long term experiments at Pusa.[2]

TABLE 1

YIELD OF CROPS IN DIFFERENT ROTATION WITH AND WITHOUT LEGUMES (22 YEARS' AVERAGE)

Rotation	Series	*Average yield in lbs. per acre*		
		Maize	*Barley*	*Oats*
1. purely cereal rotation	A	464·3	317·1	413·4
(maize-barley-oats)	B	481·6	354·9	444·3
		maize	pigeon pea	oats
2. pulse in rotation	A	579·0	758·4	473·9
(maize-pigeon pea-oats)	B	508·3	685·2	439·2
3. rotation as (2) but 20 lb. nitrogen adds as F.Y.M.		943·0	1107·0	861·0
4. rotation as (2) but 30 lb. nitrogen added as F. Y. M.		1066·0	1025·0	962·0

Replacement of barley by pigeon pea alone increased the yield of both maize and oats in the series A and B. Further increases were witnessed by the addition of 'N' in the form of F. Y. M. In Uttar Pradesh, a campaign has been started to cultivate Moong type 1, which is a short duration pulse crop on summer fallow

[1] P. C. Raheja, "Pulses in the National Economics," *Rural India*, Nov. 1952,

[2] Raheja, *op. cit.*

lands. The crop is able to fix about 40 lbs. of nitrogen. Yield of wheat was higher after moong type 1 than wheat sown after fallow and equal to that of sunnhemp or cow peas green manured. Triple advantage of this practice is that besides 560 to 800 lbs. of moong, higher yield of wheat by 320 lbs. is realised and the soil is protected against rain and erosion. Nitrifying process in the soil is accelerated in addition to all this.

In dry farmed areas of low rainfall legumes fit in admirably. As the requirements of moisture for the soil are low, several of them, after germination can subsist on conserved soil moisture in the sub-soil. They have the capacity to make available phosphate and potash and fix elemental nitrogen from the atmosphere. Often they are short duration crops and fit in well as catch crops both on dry farmed areas and irrigated tracts. In areas where rainfall seldom occurs in the winter season, pigeon pea crop after the harvest of bajra continues to flourish on the unused moisture in the sub-soil. In sandy soils, where the top soil moisture escapes readily, gram quickly picks up its growth once it has germinated. In paddy fields gram, peas and lytharus flourish on residual moisture.

The yield particularly of peas can be augmented by phosphate fertilisation. It not only increases the yield of peas but also builds up nitrogen and phosphate reserve for the succeeding crop of paddy to yield higher production without any special expenditure on manuring.

APPENDIX 28

RELATIVE WEIGHTS OF PLANT NUTRIENTS REMOVED BY PRINCIPAL CROPS

Commodity	*Yield per acre in lbs.*	*Plant nutrients removed (lbs.)*			*Relative Ratio in terms of paddy removals*			*Relative weights*		
		N	P_2O	K_2O	N	P_2O	K_2O	N	P_2O	K_2O
Paddy	1040	28·1	11·4	43·2	1·0	1·0	1·0	5·0	2·0	9·1
Wheat	632	15·8	7·2	19·0	0·9	1·0	0·7	4·6	2·0	6·5
Jowar	346	9·0	5·5	24·9						
Barley	735	22·1	8·8	21·1	1·1	1·2	1·5	5·2	2·3	13·8
Bajra	27	7·8	2·7	24·3						
Cotton	78	3·9	1·4	2·8	1·8		0·8	8·7	2·9	6·8
Jute	966	40·6	—	—	1·6	—	—	7·8	—	—
Sugarcane	29341	45·8	137·5	28·4	5·8	43·1	2·4	29·1	84·7	21·3
Groundnut	671	29·1	5·4	17·0	1·6	0·7	0·6	8·0	1·0	5·4
Tobacco	1000	67·0	9·0	85·0	2·5	0·8	2·0	12·4	1·6	16·6
Tea	400	20·0	3·0	10·0	1·8	0·7	0·6	9·3	1·4	5·5
Coffee	784	42·0	7·4	47·0	2·0	0·8	1·4	9·9	1·7	13·0

Source: *Fertiliser News*, November 1960, The Fertiliser Association of India, 85 Sunder Nagar, New Delhi.

APPENDIX 29

LOSSES OF CROP NUTRIENTS

It would not be out of place to form an idea of the losses of these crop nutrients on various accounts. During studies on the nitrification in soils[1] it was found that from 30 to 60 per cent of the applied 'N' was lost during a period of two or three months. The factors which governed those losses appeared to be the kind of soil, its reaction, colloid contents, rate of moisture losses and temperature conditions. Again, it was noted that 25-40 per cent of 'N' added to the water logged soils in the form of oil-cake, Sodium Nitrate and water hyacinth was lost as gas in Bengal.[2] Various losses are discussed below in brief.

Leaching : The water-soluble fractions of plant food elements are subject to loss by leaching in rain water or irrigation water. Some losses of this type undoubtedly do occur under the heavy rainfall of the monsoon type climate which prevails in India, but as we have seen earlier, the amount of water-soluble nutrients in the soil is never very large, and this fact tends to minimise the loss by leaching. Sandy soils are more subject to leaching than heavier or bare ones than those covered by plants. On an average, one might estimate that loss of nitrogen by leaching is less than one-tenth of that caused by crop harvest, loss of potassium is appreciably less than that of nitrogen, and that of phosphorous negligible.

Erosion: Erosion is the physical removal of soil by water or wind. When severe, it may cause the loss of much or all of the top soil. If the soil itself is lost, the nutrients it contains are also lost. Actually the nutrient loss is greater than might be expected at first glance. If for example, one-tenth of the top soil is washed away, more than one-tenth of the nutrients of the top soil are lost since these nutrients are mainly found in the finer soil particles which erode most easily and are the first to be washed away. Since an actual physical loss of the soil is involved, losses of nitrogen, phosphorus and potassium are proportionately the same.

Loss of nutrients by erosion can be large or small, important or negligible, according to the amount of erosion which occurs. The extent of erosion is governed by many factors, including slope of the land, intensity and duration of rainfall or velocity of the wind, the crop on the land and the characteristics of the soil itself. Because of these factors and because erosion varies so much

[1] Summary of investigations carried out in the Agricultural Chemistry Section, Bombay State, 1953-54.

[2] The brief report of the work done in the sector of Microbiology, West Bengal (Co-ordination of Research) 1953-54.

from year to year, no correct estimates of the average nutrient losses from erosion alone is possible, although it is clear that such losses can be quite appreciable under certain conditions.

Gaseous form: This mode of nutrient loss affects only nitrogen. It results from a chemical transformation in which nitrate, one of the soluble forms of soil nitrogen is changed to elemental nitrogen, which is lost from the soil as a gas. Under Indian conditions, the loss is usually negligible.

APPENDIX 30

ESTIMATED AVAILABILITY OF PLANT NUTRIENTS FROM FERTILISERS AND MANURE DURING 1949-50 IN SOME OF THE SELECTED COUNTRIES

Country	*Livestock Units per Hectare*	*Plant Nutrients* (kg/ha[1])	*Plant Nutrients from ferti-lisers* (kg/ha[1])	*Total Plant Nutrients* (kg/ha)	*Approxi-mate per cent from manure*
Benelux	1·21	110	163	273	40
Germany	0·88	86	91	177	49
Denmark	1·20	111	71	182	61
United Kingdom	0·94	90	75	165	55
Austria	0·79	83	26	109	76
Ireland	0·89	84	13	97	87
Sweden	0·67	63	45	108	58
France	0·71	60	35	95	63
Greece	0·60	59	11	70	84
Italy	0·71	47	19	66	71
Portugal	0·54	43	18	61	70
All countries	0·87	70	40	110	64

NOTE: No separate figures have been included for Switzerland, Norway, and Turkey, as the large area of rough grazings in these countries includes a calculation on a per hectare basis, which is unreliable. The figures shown above for some other countries, notably France, the United Kingdom and Ireland are similarly affected. In the total, however, all countries are included.

[1] Agricultural area omitting rough grazings.

Source: Fertilisers in Agricultural Recovery Programmes, O.E.E.C., p.18.

APPENDIX 31

COST OF A COW DUNG GAS PLANT

			(Rs.)
1.	Drum 5 ft. in diameter, 4 ft. in height made of 16 G M S open at one end with 3 handles fixed at equal distance near the closed end of the drum and an iron rod $\frac{1}{2}''$ in diameter welded all round the open end		150·00
2.	Angle iron $1\frac{1}{2}''$ wide on each side, 12 ft. long, bent at right angles at a place $15''$ from the one end with shafts screwed on two sides	3	50·00
	(Alternative: Wooden hallies about $4''$ in diameter and 10 ft. long with a $2''$ broad and $10''$ long slit sawed out in the centre at one end......3 Rs. 20·00)		
3.	Hose pipe $\frac{3}{4}''$ in diameter	8 ft.	6·00
4.	Iron pulleys $7''$ in diameter	3	4·00
5.	G I twisted 6 ply wire $\frac{3}{8}''$ in diameter	45 ft.	5·00
6.	Wooden boxes $15'' \times 10'' \times 12''$	3	5·00
7.	Feeding pipe $10'$ long and $4''$ square of 22 G I sheet	1	10·00
8.	G I pipe $\frac{1}{2}''$ in diameter	30 ft.	20·00
9.	G I pipe $\frac{1}{4}''$ in diameter	1 ft.	1·00
10.	G I elbow $\frac{1}{2}''$	4 pieces	2·00
11.	G I socket $\frac{1}{2}''$	$4''$	2·00
12.	G I socket $\frac{1}{2}''$ reduced to $\frac{1}{4}''$	1	1·00
13.	G I Tee $\frac{1}{2} \times \frac{1}{2} \times \frac{1}{2}$	1	1·00
14.	Bolts and nuts $1/2''$ in diameter and $6''$ long for pulleys	3	2·00
15.	Wheel cock $\frac{1}{2}''$	1	3·00
16.	Water tap for $\frac{1}{2}''$ pipe	1	2·00
17.	Rubber tube $\frac{3}{8}''$ in diameter	8 ft.	2·00
18.	G I bend $\frac{1}{2}''$	1	1·00
19.	Iron sheet 2 ft. square	1	1·00
20.	Burner		
	For the fermentation well	1	5·00
21.	Bricks (second quality)	1600	35·00
22.	Cement	1 cwt.	7·00
23.	Sand (10 c ft.) and Rori (broken stones)	5 c ft.	5·00
			320·00
	Labour charges		30·00
		Total	350·00

Source : I. C. A. R,

APPENDIX 32

AMOUNT OF NITROGEN TURNED UNDER BY SOME OF THE GREEN MANURING CROPS[a]

(Per acre)

Sl. No.	*Common name*	*Yield of green matter (mds. per acre)*	*Percentage constituents*		*Total nitrogen (lbs.)*
			moisture	'N'	
1.	Sunnhemp	212·2	75	0·43	75·0
2.	Sesbania	200	78·2	0·42	68·9
3.	Pulses, urad	120	83·2	0·41	38·3
	pillipesara	183	75	1·10	49·7
	mung	80	75	0·53	34·5
4.	Cluster beans	200	75	0·34	55·7
5.	Cow pea	150	86·4	0·49	50·3
6.	Horse gram	100	71·5	0·33	27·1
7.	Indigo	100	44·7	0·78	64
	Rabi				
8.	Lentil	56	65	0·7	32·8
9.	Peas	201	83	0·36	59·4
10.	Mellilotus sp.	286	80	0·51	120·1
11.	Egyptian clover	155	87	0·43	54·2
12.	Lathyrus sp.	123	79	0·54	54·9

"Green Manuring," I. C. A. R. Review series No. 6, pp. 11-12.

APPENDIX 33

NORMAL AVERAGE RAINFALL IN VARIOUS DISTRICTS OF WEST BENGAL

	June	*July*	*August*	*September*	*Total*	*Annual Average*
24-Parganas	11·04	13·23	12·51	8·92	45·70	61·59
Nadia	9·13	9·85	10·11	7·21	36·30	50·88
Murshidabad	9·37	10·84	10·92	8·62	39·75	50·87
West Dinajpur	11·79	13·93	13·30	11·56	50·58	63·86
Jalpaiguri	32·99	36·09	29·37	23·43	121·88	154·25
Darjeeling	23·56	31·53	26·26	18·11	99·46	122·67
Malda	10·44	13·14	12·37	11·51	47·46	59·63
Cooch Bihar	(n)	(n)	(n)	(n)	106·40	(n)
Burdwan	9·94	11·43	11·40	7·78	40·55	53·56
Birbhum	8·92	11·30	11·03	7·75	39·00	49·13
Midnapur	10·40	13·09	12·72	8·32	44·53	59·61
Hooghly	9·88	11·57	12·36	8·53	42·34	57·11
Howrah	11·71	13·28	21·63	8·56	46·18	62·05
Bankura	8·80	12·23	12·20	6·95	40·18	50·95

Source : *Indian Journal of Power and River Valley Development*, West Bengal Power & Water Resources Development, Symposium number, p. 18.

Appendix 34

NORMAL AVERAGE RAINFALL IN THE DISTRICTS OF BIHAR

	June	*July*	*August*	*Sep-tember*	*Total*	*Annual normal average*
Patna	4·98	10·61	11·24	7·47	34·30	39·46
Gaya	5·46	12·48	13·50	7·58	39·02	34·96
Shabad	5·19	12·59	13·03	7·87	38·68	44·19
Saran	6·59	12·41	11·78	8·59	39·28	44·91
Champaran	9·17	15·66	13·30	10·41	48·54	56·18
Mazaffarpur	7·27	12·21	11·71	8·75	39·94	46·44
Darbhanga	7·77	12·65	12·01	9·41	41·84	49·66
Monghyr	7·16	12·11	12·24	9·00	40·51	48·15
Bhagalpur	6·99	11·76	10·80	8·09	37·64	45·98
Saharsa	9·25	13·39	11·86	9·99	44·49	54·05
Sub District						
Purnea	11·12	15·34	13·36	11·53	51·35	62·64
Santhal Pargana	9·05	12·77	12·16	9·74	43·72	54·20
Hazaribagh	6·94	13·05	13·01	8·25	41·25	49·55
Ranchi	7·88	15·68	14·99	8·52	47·17	57·61
Palamau	6·55	14·69	15·10	7·87	44·21	51·62
Manbhum	8·25	13·04	12·84	8·02	42·15	52·90
Singhbhum	9·51	13·69	13·84	7·97	45·01	56·43

Source : *Indian Journal of Power and River Valley Development*, West Bengal Power and Water Resources Development, Symposium number, p. 18.

APPENDIX 35

RAINFALL DIVISIONS OF INDIA—SEASONAL BREAK UP AND CULTIVATED AREA

(Area in thousand acres)

				Normal seasonal break up			Cultivated area	
Serial No.	***Rainfall division***	*Total rainfall (inches) per year*	*1st June to 30th Sept.*	*1st Oct. to 31st Dec.*	*1st Jan. to 28th Feb.*	*1st March to 31st May*	*Net*	*Gross*
(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	A. *Heavy Rainfall (above 75 inches)*							
1	Malabar & South Kanara	125·5	100·3	14·1	0·4	10·7	2,338	2,867
2	Bay Islands	123·3	70·9	30·9	2·9	18·6	12	12
3	Sub-Himalayan West Bengal	106·8	83·8	6·1	1·1	15·8	1,468	1,626
4	Assam (Manipur & Tripura)	94·1	60·6	6·4	2·3	24·8	5,676	6,696
5	Travancore & Cochin	91·0	51·8	20·9	1·6	16·7	2,820	3,462
6	Konkan	86·0	77·6	5·6	0·1	2·7	2.339	2,431
	Total—A	...	...	...	...	...	14,653	17,094

	B. *Assured Rainfall* (45-75 *inches*)							
7	Orissa	60·1	44·9	8·2	1·4	5·6	14,116	15,079
8	Gangetic—West Bengal	57·5	43·1	5·6	1·5	7·3	11,049	11,235
9	Madhya Pradesh—East	56·0	47·3	4·1	1·5	3·1	12,911	15,615
10	Bihar	52·0	43·7	3·2	1·3	3·8	13,632	18,864
11	Chhota Nagpur (Bihar)	52·0	42·5	3·5	2·3	3·7	6,488	7,542
	Total—B	...	...	...	...	...	58,196	68,335
	C. *Medium Rainfall* (30-45 *inches*)							
12	Madhya Pradesh—West	44·3	39·2	2·8	1·0	1·3	17,709	18,275
13	Vindhya Pradesh	43·7	39·0	2·3	1·4	1·0	4,430	5,092
14	Uttar Pradesh—East	42·4	37·0	2·5	1·4	1·5	11,758	15,250
15	Uttar Pradesh—West	41·8	36·3	1·7	2·2	1·6	29,200	35,382

APPENDIX 35—*Contd.*

(Area in thousand acres)

Sl. No.	*Rainfall division*	*Normal seasonal break up*					*Cultivated area*	
		Total rainfall (inches) per year	*1st June to 30th Sept.*	*1st Oct. to 31st Dec.*	*1st Jan. to 28th Feb.*	*1st March to 31st May*	*Net*	*Gross*
(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
16	Coastal Andhra Pradesh	40·5	20·4	16·4	1·0	2·7	9,425	11,282
17	Tamilnad	39·9	11·3	22·2	2·1	4·3	13,974	16,679
18	Madhya Bharat & Bhopal	39·7	36·5	1·8	0·5	0·9	13,639	14,109
19	Gujarat	35·9	33·7	1·7	0·2	0·3	13,284	13,943
20	Hyderabad—North	33·7	28·3	3·2	0·7	1·3	12,331	12,711
21	Hyderabad—South	30·3	23·3	4·0	0·6	2·4	16,742	16,985
22	Mysore	30·2	15·0	8·6	0·4	6·2	6,962	7,290
23	Jammu & Kashmir (Plus H. P.)	...	...	...	...	...	2,348	2,837
	Total—C	...	...	...	...	...	1,51,802	1,69,835

	D. Dry *Rainfall—(a) (20-30 inches)—*							
24	Deccan Desh	27·6	19·9	4·9	0·2	2·6	25,774	27,503
25	Delhi & Punjab	27·4	22·2	1·1	1·4	1·7	18,144	20,395
26	Rajasthan East	27·0	24·6	1·0	0·5	0·9	10,695	12,005
27	Royalseema	24·9	15·3	6·6	0·5	2·5	8,146	8.647
	Sub-Total (D) (*a*)	...	...	...	...	...	62,759	68.550
	(*b*) *Less than* 20 *inches—*							
28	Saurashtra & Kutch	18·9	17·5	0·8	0·2	0·4	9,219	9,323
29	Rajasthan West	12·5	10·8	0·4	0·5	0·8	15,009	15,529
	Sub-Total (D) (*b*)	...	..	...	...	...	24,228	24,852
	Total—D	...	...	...	...	...	86,987	93,402
	All India Grand Total	...	...	...	...	...	3,11,638	3,48,666

APPENDIX 35—*Contd.*

(Area in thousand acres)

Sl. No.	Rainfall Division	Irrigated area Net	Irrigated area Gross	Rice Irrig.	Rice Total	Wheat Irrig.	Wheat Total	Pulses Irrig.	Pulses Total
(0)	(1)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
	A. *Heavy Rainfall* (*above 75 inches*)								
1	Malabar & South Kanara	12	12	11	1,429	...	1	...	70
2	Bay Islands	...	...	...	6	...	...	1	...
3	Sub-Himalayan West Bengal	238	238	194	1,015	...	12	1	48
4	Assam (Manipur & Tripura)	1,375	1,375	1,302	4,763	...	5	20	203
5	Travancore & Cochin	920	1,229	807	1,042	...	...	23	82
6	Konkan	105	107	51	1,200	...	...	...	120
	Total—A	2,650	2,961	2,365	9,455	...	18	44	523

	B. *Assured Rainfall* (45-75 *inches*)								
7	Orissa	1,739	2,165	1,929	9,310	7	12	71	989
8	Gangetic—West Bengal	2,418	2,533	2,222	9,532	38	120	88	1,643
9	Madhya Pradesh—East	1,683	1,685	1,614	7,602	2	971	...	3,427
10	Bihar	3,481	3,481	2,745	7,924	154	1,519	101	4,473
11	Chhota Nagpur (Bihar)	919	919	857	4,947	4	82	3	1,006
	Total—B	10,242	10,783	9,367	39,215	205	2,704	263	11,538
	C. *Medium Rainfall* (30 45 *inches*)								
12	Madhya Pradesh—West	315	320	99	1,516	92	1,822	17	2,982
13	Vindhya Pradesh	189	198	3	1,169	65	746	30	2,004
14	Uttar Pradesh—East	3,543	4,038	176	4.503	1,004	2,135	1,040	2,391
15	Uttar Pradesh—West	8,688	9,384	694	4,549	3,617	7,094	1,781	8,911
16	Coastal Andhra Pradesh	4,410	4,807	3,949	4,249	...	1	26	901

APPENDIX 35—*Contd.*

(Area in thousand acres)

Sl. No.	*Rainfall Division*	*Irrigated area*		*Rice*		*Wheat*		*Pulses*	
		Net	*Gross*	*Irrig.*	*Total*	*Irrig.*	*Total*	*Irrig.*	*Total*
(0)	(1)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
17	Tamilnad	5,190	6,674	4,606	4,996	1	2	65	1,163
18	Madhya Bharat & Bhopal	501	504	62	242	187	2,354	59	2,831
19	Gujarat	843	971	135	1,121	270	814	12	1,046
20	Hyderabad—North	270	339	24	146	61	447	25	2,810
21	Hyderabad—South	1,679	1,871	1,653	1,796	5	137	...	2,563
22	Mysore	1,089	1,231	836	946	...	1	22	1,096
23	Jammu & Kashmir (plus H. P.)	741	844	482	579	120	636	30	207
	Total—C	27,464	31,181	12,719	25,812	5,422	16,189	3,107	28,905

	D. *Dry Rainfall* (*a*) (20-30 *inches*)								
24	Deccan Desh	1,438	1,709	211	964	211	1,159	87	3,183
25	Delhi & Punjab	7,066	8,980	476	660	2,531	4,475	1,328	4,975
26	Rajasthan—East	1,565	1,851	11	25	458	1,228	86	2,609
27	Royalseema	617	851	414	438	4	11	6	588
	Sub-Total—D (*a*)	10,686	13,391	1,112	2,087	3,204	6,873	1,507	11,355
	(*b*) *Less than* 20 *inches*								
28	Saurashtra & Kutch	501	526	72	79	192	285	9	474
29	Rajasthan West	1,304	1,454	13	149	551	794	193	2,582
	Sub-Total (D) (*b*)	1,805	1,980	85	228	743	1,079	202	3,056
	Total—D	12,491	15,371	1,197	2,315	3,947	7,952	1,709	14,406
	All India Grand Total	52,848	60,296	25,648	76,897	9,574	26,863	5,123	55,372

APPENDIX 35—*Contd.*

(Area in thousand acres)

Sl. No.	*Rainfall division*	*Total food grains*		*Sugarcane*		*Fibre cotton*		*Other fibres*	*Oil seeds*
		Irrig.	*Total*	*Irrig.*	*Total*	*Irrig.*	*Total*	*Total*	
(0)	(1)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
	A. *Heavy Rainfall (above 75 inches)*								
1	Malabar & South Kanara	11	1,530	...	18	...	3	...	473
2	Bay Islands	...	6	...	...	...	...	...	4
3	Sub-Himalayan—West Bengal	203	1,185	...	...	...	...	108	56
4	Assam (Manipur & Tripura)	1,327	5,006	4	64	...	53	327	339
5	Travancore & Cochin	832	1,165	10	27	...	15	...	778
6	Konkan	54	1,745	3	3	...	...	4	56
	Total—A	2,427	10,637	17	112	...	71	439	1,706

	B. *Assured Rainfall* (45-75 *inches*)								
7	Orissa	2,034	11,290	46	68	...	23	83	849
8	Gangetic—West Bengal	2,358	11,474	25	52	...	1	469	234
9	Madhya Pradesh—East	1,617	14,171	16	19	...	55	23	1,327
10	Bihar	3,156	16,930	76	286	...	4	345	481
11	Chhota Nagpur (Bihar)	866	7,016	8	13	...	7	20	372
	Total—B	10,031	60,881	171	438	...	90	940	3,263
	C. *Medium Rainfall* (30-45 *inches*)								
12	Madhya Pradesh—West	211	10,664	9	11	1	3,765	89	1,444
13	Vindhya Pradesh	177	4,431	3	3	...	2	9	620
14	Uttar Pradesh—East	3,559	13,917	351	533	...	1	85	172
15	Uttar Pradesh—West	7,814	30,685	972	1,439	90	138	159	831

APPENDIX 35—*Concld.*

(Area in thousand acres)

Sl. No.	*Rainfall division*	*Total food grains*		*Sugarcane*		*Fibre cotton*		*Other fibres*	
		Irrig.	*Total*	*Irrig.*	*Total*	*Irrig.*	*Total*	*Total*	*Oil seeds*
(0)	(1)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
16	Coastal Andhra Pradesh	4,425	8,810	89	102	2	77	173	1,019
17	Tamilnad	5,874	12,757	81	131	185	855	164	1,892
18	Madhya Bharat & Bhopal	346	10,754	36	36	7	927	63	1,115
19	Gujarat	509	8,992	8	8	36	1,923	29	1,043
20	Hyderabad North	222	8,356	29	29	1	2,130	214	1,698
21	Hyderabad South	1,734	11,987	41	41	...	1,177	120	3,253
22	Mysore	967	5,234	47	47	2	140	10	672
23	Jammu & Kashmir (plus H. P.)	774	2,498	1	5	1	7	4	100
	Total—C	26,612	1,29,085	1,667	2,386	325	11,142	1,119	13,859

	D. *Dry Rainfall* (*a*) (20-30 *inches*)								
24	Deccan Desh	1,089	20,945	187	191	15	2,077	49	2,651
25	Delhi & Punjab	5,790	15,075	333	422	943	760	32	766
26	Rajasthan East	1,402	9.915	20	21	136	298	25	1,002
27	Royalseema	722	5,987	17	22	2	981	5	1345
	Sub-Total—D (*a*)	9,003	51,922	557	656	1,096	4,116	111	5,764
	(*b*) *Less than* 20 *inches*								
28	Saurashtra & Kutch	413	6,054	15	15	16	1,115	...	1,677
29	Rajasthan West	1,114	11,897	21	22	112	132	14	714
	Sub-Total—D (*b*)	1,527	17,951	36	37	128	1,247	14	2,391
	Total—D	10,530	69,873	593	693	1,224	5,363	125	8,155
	All India Grand Total	49,600	2,70,476	2,449	3,629	1,549	16,666	2,623	26,983

Source: (1) Col. 2 to 6—Indian Crop Calendar, 1956, p. 10.

(2) Col. 7 to 24—Indian Agricultural Statistics, 1952-53, 1953-54, Vol. II, Directorate of Eco. and Statistics, Ministry of Food and Agriculture.

APPENDIX 36

CROPPING PATTERN—ASSURED RAINFALL, 1953-54

(Area in thousand acres)

			Food grains									*Plantation crops*			
			Cereals												
Sl. No.	*State*	*Assured rainfall area*	*Rice*	*Wheat*	*Coarse grains*	*Pulses*	*Total food grains*	*Sugarcane*	*Cotton*	*Oil seed*	*Jute & mesta*	*Tea*	*Coffee*	*Rubber*	*Other crops*
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Assam	4,426	2,846	5	49	171	3,071	55	34	303	372	384	...	...	207
2	Bihar	407	...	...	...	...	...	...	...	...	403	4	...	...	...
3	Bombay	2,097	1,001	...	420	110	1,531	...	...	44	114	...	...	...	408
4	Kerala	4,325	1,088	...	13	85	1,186	7	19	87	...	87	27	149	2,763
5	Madras	240	8	1	8	1	18	...	...	...	1	73	44	16	88
6	Mysore	1,083	705	...	8	54	767	8	...	71	63	9	161	4	...
7	Punjab	10	...	...	...	...	...	...	...	...	1	9	...	...	...
8	Uttar Pradesh	6	...	...	...	...	...	...	...	...	...	6	...	...	...
9	West Bengal	11,652	8,131	94	275	1,602	10,102	27	1	291	1,021	191	...	...	19
	Union Territories	754	570	1	4	2	577	5	20	25	20	13	...	...	94
	All India	25,000	14,339	101	777	2,025	17,252	102	74	821	1,995	776	232	169	3,579

APPENDIX 37

IRRIGATED AREA IN THE WORLD

(In '000 hectares)

Years/Countries	1963	1964	1965
Bulgaria	888	941	941
Greece	541	562	576
Spain	1988	2006	2055
U. S. S. R.	9129	9129	9270
Mexico	3515	3515	3515
Argentina	1500	1500	1500
Chile	1103	1103	1103
Paraguay	1106	1106	1106
Burma	758	786	753
Ceylon	378	381	341
China (Taiwan)	97	100	101
India*	29453	29707	30704
Indonesia	3688	3668	3668
Iran	4651	4651	4651
Iraq	3675	3675	3675
Japan	3133	3126	3123
Republic of Korea	690	690	702
Laos	750	750	750
Nepal	1071	1071	1071
Philippines	937	930	958
Syria	671	489	522
Thailand	1764	2063	2275
Turkey	1310	1310	1310
Republic of Vietnam	613	613	613
Madagascar	680	680	680
Morocco	265	265	265
South Africa	808	808	808
Sudan	790	790	790
United Arab Republic	2514	2673	2730
Australia	1052	1076	1170
Pakistan	12043	12043	12043
Others	18186	18294	18210
Total	109747	110501	111979

* From Indian sources.

Source : F. A. O. Production Year Book.

APPENDIX 38·1

PERCENTAGE INCREASE IN YIELDS OF CROPS DUE TO THE USE OF IMPROVED SEEDS

(Per cent)

Crop	*Punjab experiments*	*S. J. Souvenir I.C.A.R.*	*Technological possibilities of agricultural development (W. Burns)*	*Miscellaneous*
Rice			10—25	10—15[a]
Wheat	18·8	10	15—40	13—52[b]
Jowar				57—74[c]
Bajra			25	50[c]
Maize	17·82	100	66·7	—
Ragi				15·30[c]
Barley	—	—	—	—
Sugarcane (Gur)	2·0	—	—	2·5[g]
Pulses	26·7	1,227	—	5·26[d]
Gram	20·0	5—7	—	10—30[d]
Groundnut	8·0—15·5	170[e]	50·0	1,230[e]
Linseed	100·0	50—125[e]	—	85·0[h]
Castor seed	—	147	—	20[f]
Sesamum	—	—	—	20—30[h]
Rape and mustard	—	—	—	50·0[f]
Cotton	—	—	—	—
Jute	—	20—30	—	—

Source :

a Ramiah, *Improved Rice Varieties.*

b I. C. A. R.

c Millets in India by Pannikar (conference of workers of millets).

d Kumar and Chavan, *Improvement of Pulse Crops in Bombay State.*

e The Indian Central Oilseeds Committee.

f *Better Seeds*, The Publication Division.

g Second-Five-Year-Plan Proposals.

h C. M. John, *Report on Research on Oilseed Crops in India*, p. 17.

APPENDIX 38·2

CONTRIBUTION OF IMPROVED SEED TOWARDS INCREASED AGRICULTURAL PRODUCTION

(Per cent increase)

Crops	*Irrigated*	*Unirrigated*
1	2	3
Rice	10	—
Wheat	10	10
Maize	10	5
Jowar	20	10
Barley	10	10
Other coarse grains	10	10
Pulses	10	10
Cotton	10	10
Jute and Mesta	—	15
Groundnut	20	20
Other oil seeds	—	—
Potato	6	—
Sugarcane (gur)	2	—

APPENDIX 39

SEED FARMS REQUIRED FOR A CENT PER CENT SATURATION OF THE TOTAL CROPPED AREA

Sl. No.	*State*	*Number of blocks*	*Culti-vated area per block*	*Size of farms needed on the basis of*		*Area needed for*		*Gross size per block*	*Number of 25 acre seed farms needed*	*Farms already in exist-ence*[1]	*Addi-tional needed*	*Number of farms to be set up by II F.Y.P. end*
				Single crop-ping	*Double crop-ping*	*Fruits and vege-tables*	*Build-ings, roads, drain-age, fences, etc.*					
1	2	3	4	5	6	7	8	9	10	11	12	13
1	Andhra Pradesh	447	62,531	24·18	18·0	2·0	2·0	22·0	393	33	360	447
2	Assam	224	22,562	5·94	3·5	0·1	0·5	4·1	37	15	22	150
3	Bihar	575	38,250	12·29	9·0	1·0	1·0	11·0	253	22	231	574
4	Bombay	649	93,298	32·22	26·0	0·8	2·7	29·5	766	66	700	323
5	Jammu and Kashmir	52	22,727	9·14	7·0	3·0	1·0	11·0	23	18	5	47
6	Kerala	142	14,238	2·48	1·5	1·0	0·3	2·8	16	15	1	24

7	Madhya Pradesh	416	93,045	37·95	25·0	2·2	2·7	29·9	498	52	466	284
8	Madras	358	43,466	16·32	11·0	0·6	1·2	12·8	183	27	156	360
9	Mysore	268	82,450	17·32	11·5	1·3	1·3	14·1	151	40	111	56
10	Orissa	307	37,305	5·57	3·0	0·6	0·4	4·0	49	46	...	140
11	Punjab	228	86,991	26·35	20·0	5·0	2·5	27·5	251	46	205	228
12	Rajasthan	232	21,258	21·59	16·0	1·5	1·7	19·2	178	10	168	164
13	Uttar Pradesh	899	58,633	14·17	12·0	1·6	1·4	15·0	539	41	498	876
14	West Bengal	341	39,404	4·13	2·5	0·4	0·3	3·2	44	24	20	100
15	Delhi	5	49,400	13·90	12·5	6·0	1·8	20·3	4	...	4	4
16	Himachal Pradesh	34	28,087	9·06	8·0	4·4	1·2	13·6	19	21	2	10
17	Tripura	15	28,404	4·74	3·0	2·0	0·5	5·5	3	...	3	10
18	Manipur	16	24,375	3·60	2·0	1·0	0·3	3·3	2	7	5	9
19	Andamans, Nicobar and Pondicherry	8	1,500	0·23	0·2	0·9	0·3	3·2	1	...	1	6
	All India	5,216	62,250	...	...	..	...	.	3,410	483	2,927	3,831

(1) Data from "Agri Research in Indian Institutes and Organisation" *by* Dr. M. S. Randhawa, 1958—I.C.A.R., p. 281.