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INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

INTERNATIONAL DEVELOPMENT ASSOCIATION

INDIAN ECONOMIC POLICY

AND THE

FOURTH FIVE YEAR PLAN

(in four volumes)

VOLUME II

AGRICULTURAL POLICY IN INDIA

May 23, 1967

Asia Department

EQUIVALENTS

1 Indian Rupee	=	U.S. $0.13
1 U.S. Dollar	=	Rs. 7.5
1 lakh	=	100 thousand
1 crore	=	10 million

Metric tons are referred to as tonnes.

NOTE

This Volume of the Report was prepared by Sir John G. Crawford assisted by W. David Hopper, Lorne Sonley and A. Van Nimmen.

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AGRICULTURAL POLICY IN INDIA

PREFACE

i. This report is principally designed to draw attention to important developments in agricultural policy announced in 1965/66 and now being implemented by the Government of India in collaboration with the several States of the Indian Federation. These policy developments are important and call for a re-appraisal of the programs to improve Indian agriculture. This re-appraisal has led us to a more hopeful view of the outlook for the expansion of agricultural production in the Fourth Plan period. Some acceleration of the growth rate above the recent trend rate of 2½ to 3 percent per annum now seems possible and, indeed, given a vigorous policy, seems likely by the end of the Fourth Plan. Given the availability of high yielding seed varieties, other needed physical inputs, credit supply and continued price incentives as contemplated in the revised policies, we now foresee a more substantial achievement of the food grain production and other agricultural production targets than was previously thought possible. This view is made more particular at a later stage in this report.

ii. The principal documentary source material for statements of policy reviewed in this report are:

(a) "Draft Outline of the Fourth Five-Year Plan", planning Commission, G.O.I., August 1966;

(b) "The Annual Plan, 1966-67", Planning Commission, G.O.I., March 1966;

(c) "Agricultural Development, Problems and Perspective", Dept. of Agriculture, G.O.I., April 1965;

(d) "Agricultural Production in the Fourth Five-Year Plan, Strategy and Programme", Dept. of Agriculture, G.O.I., August 1965;

(e) "Re-orientation of Programmes of Agricultural Production", Dept. of Agriculture, G.O.I., November 1965.

To these should be added the major speeches of the former Minister of Food and Agriculture, Shri C. Subramaniam, official notes made available to us in New Delhi and a number of other official publications referred to in the text which follows. Of great value to us have been the cordial and frank discussions we have had with members and official of The Planning Commission, Finance Ministry and the Ministry of Food and Agriculture. They have not been supplemented with extensive field visits; but those we have been able to make give strong support to the conclusions we have now reached.

iii. Our present purpose is simply to appraise the recently developed policies designed to ensure an adequate acceleration of growth in agriculture in the Fourth Plan period. Matters which do not call for major reconsideration in the light of these new policies are not further discussed. One such item

is agrarian reform. This is not to minimize the importance of agrarian reform, especially in such respects as security of tenure for the operating landholder. Nevertheless, in a short report - as this is intended to be - the subject does not call for review although the new policies with which we are concerned will undoubtedly affect the future shape of land reform policies. We will make occasional reference to this.

iv. Again, too, this report fails to deal in any adequate fashion with two major areas of food and agricultural policy namely, the production of protein and vitamin yielding foodstuffs and the needed expansion of commercial agricultural exports or import substituting crops other than foodgrains. These are regrettable omissions; the Bank would be well advised to support a major study of these two areas. Both subject matters were within our terms of reference but were quite beyond our resources of time. While we have commented on the credit problem (Part V) we consider there is room for a special study which, however, could be based on an "All-India" enquiry now underway under Reserve Bank of India direction.

v. We are concerned, then, to re-examine the prospects for agricultural expansion in the Fourth Plan period. To do this we rely on the analytical approach through "critical factors" which we apply to the new policies and programmes principally announced and developed since April 1965. Our discussion will group into sections as follows:

I New Policies and New Programmes

II The Fourth Plan Targets Restated

III Price and Buffer Stock Policy

IV The Critical Input Factors:

(1) The Supply of Seeds of High Yielding Varieties

(2) Fertilisers

(3) Water

(4) Plant Protection Materials; and Other Physical Inputs

V Credit Supply

VI Research and Extension

VII The Critical Matter of Foreign Exchange

VIII Conclusion

vi. Responsibility for the writing of this report has been assumed by the leader of the agricultural group. The work of his colleagues has been fully utilised. Some appendices are included; these have been prepared by individual members.

BACKGROUND FACTS

Contribution of agriculture to national income	45% approx.
Share of total work force dependent on agriculture*	70%

Total Area Under 28 Specified Crops 1/
1965-66 (anticipated)

Net area	330 m. acres
Area harvested more than once	65 m. acres
Gross area	395 m. acres

Area under Irrigation

Net area	73 m. acres
Area harvested more than once	14 m. acres
Gross area	87 m. acres

Unirrigated Crop Area

Net area	259 m. acres
Area harvested more than once	49 m. acres 2/
Gross area	308 m. acres

1/ Ministry of Food and Agriculture sources.
2/ This figure and the 14 m. acres under irrigation do not add to the 65 m total shown. We are not able to explain the discrepancy.

* Total population at the end of 1966 has exceeded the 500 million mark.

PART I: NEW POLICIES AND PROGRAMMES

1. There are several statements which cover the "new strategy" for agriculture. We may cite just one from "Agricultural Production in the Fourth Five Year Plan - Strategy and Programme", August 1965: 1/

> "2.2 The new policies could be described as follows:
>
> (a) to apply scientific techniques and knowledge of agricultural production at all stages, particularly in the fields;
>
> (b) to select a few areas with assured rainfall and irrigation for concentrated application of package of practices based on improved varieties of seeds responsive to heavy doses of fertilisers and availability of inputs and to fix special targets of production of foodgrains for such areas, the area proposed being 32.5 million acres and the additional yield expected in 1970-71 being 25.5 million tonnes;
>
> (c) to achieve higher production of subsidiary foods both through intensive production programmes and overall development; and
>
> (d) to base the implementation of important projects under the Plan, on "Schedules of Operation" specifying the responsibilities and roles of the Central and State Governments and other agencies so that programmes may be operated in the light of a clearly defined understanding between the Centre and the States."

2. Scientific agriculture has been emphasized not only in the "Memorandum on the Fourth Plan", but also in Mr. Subramaniam's many speeches on agricultural policies. The new feature, however, is the more confident note behind the term "new strategy". This strategy is essentially the application of a new technology capable of producing a major expansion in output despite the traditional constraints (such as illiteracy and economically inefficient systems of land tenure and farm structure) so long thought to hamper expansion in Indian agriculture. The new technology is based on the planned availability of high-yielding varieties of the various foodgrains for use especially in areas of assured water supply supported by a large increase in the supply and use of fertilisers,

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1/ Pages 3-4. See also the other references in the Preface of which probably the most useful is "Reorientation of Programmes of Agricultural Production, November 1965." The treatment in the "Draft Outline of the Fourth Five-Year Plan" (p.175) is very brief and clearly assumes some familiarity with the general detail available in the publications of the Ministry of Food and Agriculture. A greater note of urgency is to be found in "The Annual Plan, 1966-67", p.32: "In the Annual Plan, top priority has been given to agricultural production particularly to schemes which are quick-yielding in nature and help to augment production in the shortest possible time."

plant protection materials and farm equipment. Appropriate price incentives and adequate supplies of credit complete the ingredients of a policy to be applied vigorously by the Centre and States in collaboration. 2/

3. The programmes for assuring supplies of seed and inputs, together with research, price policy and credit policies will be discussed in Parts III to VI below. The target (output) objectives will be further examined in Part II. In the remainder of this Part we wish to discuss the broad administrative and economic assumptions made in the "new strategy" as outlined in the material available to us. We will note difficulties mainly arising from a situation in which inputs, more especially fertilisers, will remain in short supply relatively to the demand for them. These difficulties will throw doubt on the wisdom of expressing the new strategy in terms of precise arithmetic of acreage to be brought under new high-yielding varieties of rice, wheat and the hybrids, maize, sorghums and millets grown under conditions of assured water supply and recommended dosages of fertiliser. The acreages may be larger and the average dosage of fertiliser less than planned.

4. Before elaborating on the problems of administering the "new strategy" it is well to note two other aspects. The first is that the programme naturally highlights the production of foodgrains: but it is not confined to this. Cash crops important for export earnings or for import saving are to be subject to somewhat similar package (intensive area) programmes. 3/ This is significant not merely for the implied recognition that the agricultural sector is expected to increase its direct contribution to an improvement in the Indian balance of payments situation but also because expansion of these crops will necessarily aggravate the competition for inputs (again especially fertiliser) likely to be in short supply.

5. The second aspect - one of great importance - is that the gains from the new technology are not limited to the increased output directly associated with higher-yielding varieties of rice, wheat, maize and so on. It is worth quoting the "Draft Outline" on this particular matter. 4/

> "There is another facet to the new approach which has far-reaching implications for Indian agriculture, namely, the introduction of short duration crops which enable the same land to produce larger yields. The importance of cropping

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2/ All these elements have been emphasised in the past; the critical differences are the greater assurance now that high-yielding varieties are available and the recognized need for large applications of fertilisers. The two factors are important both in emphasising the new priority for agriculture and in understanding the difficulties which "priority" impose in India's recent economic circumstances.

3/ See documents previously listed, especially page 6 of that quoted in para. 1 above. The "Draft Outline" is somewhat skimpy on these matters and ought not to be relied on alone for detailed understanding of the new programme.

4/ "Draft Outline", op.cit., para. 9, pages 175-176.

patterns has often been emphasised in the past; but it was not possible to make it a central theme of the agricultural production programme, partly for want of suitable short duration varieties and partly because the irrigation system and the procedures under it were not attuned to dynamic and flexible cropping patterns. Suitable short duration varieties have now been evolved. Also, the spread of minor irrigation schemes in recent years and their use in reducing and making more effective the command area of the major irrigation projects has facilitated the introduction of short duration crops over large areas."

6. There is here a clear recognition that policy must be directed to maximising the yields per acre over a whole year of crop cycles. The new technology (in which we must include improved water management) holds considerable promise here - a promise likely to yield higher dividends as experience is gained by research and extension workers and, of course, by farmers themselves. Initial gains in the Fourth Plan may be significant: they will be even more significant in the Fifth Plan period.

7. As we have noted, the "new strategy" calls for intensive production of areas selected for their favorable productive qualities but more particularly their location in areas of assured rainfall or irrigation water supplies, or both. The areas selected (i.e. nominated by the States) amount to 32.5 million acres or some 11 per cent of the normal acreage under the crops concerned. The planned cropping on this acreage for 1970-71 is as follows:

TABLE I: HIGH-YIELDING VARIETIES PROGRAMME: FOODGRAINS

	Target 1970-71	Approx. % of normal acreage	Additional Production Expected 1/
Rice (Paddy)	12.5 m. acres	15	12.5 m. tonnes
Wheat	8.0 " "	24	8.0 " "
Maize	4.0 " "	9	2.0 " "
Jowar	4.0 " "	15	2.0 " "
Bajra	4.0 " "	36	1.0 " "
Total	32.5 " "	11	25.5 " "

1/ The total of 25.5 m. tonnes is freely stated in documents listed in para. 1 above. The breakdown for particular crops was given informally in discussion and may not be available for publication.

8. It is not completely clear that this target acreage is a true physical area total containing no overlapping. 5/ The point is not unimportant for the use of short duration paddy in the kharif (monsoonal) season in areas suitable for wheat could lead to high-yielding wheat varieties being used in the following rabi (winter) season. 6/ In terms of area under crop the programme is significant. As to the reality of the 25.5 m. tonnes figure more will be said later.

9. The special areas are selected by the States and the role of the Centre through its appropriate instruments is that of "facilitator" of the programme. This includes operation of the Central Fertiliser Pool, acting as a major source of credit supplies, allocating to State supplies of plant protection materials, acting where foreign exchange is needed for equipment or supplies of fertilisers and materials, and generally acting as major stimulator and co-ordinator of needed research and extension and of the programme as a whole. What we might call the field programme, however, rests with the States. This is sensible but calls for comment on the false air of precision of the programme.

10. A study of the selected areas makes it apparent that many other areas of reasonably assured water supply could qualify for the proposed special treatment. This is important for it will be impossible in practice so to ration supplies that there can be a neat marriage of the selected areas with the requisite supply of high-yielding seeds and that allocation of fertiliser which exactly matches the recommended dosages. 7/ It may be

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5/ See, for example, "Re-orientation of Programmes of Agricultural Programmes", op. cit., page 3, where it is stated that 30 blocks have been chosen for the new paddy varieties and 53 blocks for the wheat. Some overlapping of blocks is possible.

6/ To the extent this occurs the programme has a more limited application (i.e. to fewer growers), a factor which would aggravate some of the social objections raised against the preference being shown to the favoured growers.

7/ See "Re-orientation of Programmes", op. cit., page 5 for details which imply an allocation of 1.29 million tonnes of N and 0.47 million tones of P_2O_5. It has now been realized that the dosages there recommended (100 lbs. N per acre for paddy and the same for wheat) are too high and are not likely to be applied by the average progressive farmer. We understand that "expected" dosages are now 60 lbs. N for paddy and 80 lbs. for wheat. A great deal of guessing is involved. Reduced applications would, of course, enable a given quantity of fertiliser to be used on a larger acreage under high-yielding varieties. The level of yields obtained per acre would, however, be lower. As suggested in the text, this is the likely outcome, since the supplies of fertiliser may prove a greater limiting factor in the special programme than the supply of high-yielding seeds, even if the quality of seeds proves to be less than satisfactory, for lack of a properly organised seed industry (See Part IV (1)).

easy enough to give effective preference for other items in the package such as tubewell equipment, plant protection materials and credit. The simplest policy would be to saturate all demand with supplies of critical inputs so enabling all those wishing to intensify their production to do so. However, this, for reasons made clear in the fertiliser section, is probably impractical at least for fertiliser supplies. As we suggest later, seed supply may prove to be more than adequate for the nominal acreage. This fact plus the already marked and widespread response to, and eager interest in, the new technology make it certain that the demand for the right to farm at a higher level of technology can not and will not be limited to the target of 32.5 m. acres. The likely shortage of fertiliser will either result in supplies being swallowed up in "favoured" areas (i.e. areas suitable for intensive use of water) or in attempts to ration in more or less crude form in an effort to retain a share of fertilisers for less favoured areas. While rationing cannot be precise it will, no doubt, be possible (e.g. by suitable location of stocks) to channel some supplies to less intensive rainfall areas. Administration will vary in quality from State to State. One thing is clear; the high-yielding varieties programme cannot be confined to selected areas and there will be keen competition - either open or black market for limited supplies of needed inputs.

11. While we would- as would the Government of India - greatly prefer a position of abundant supplies, so offering a package of inputs to all potential users, we are not too greatly concerned about the fact that the final areas and arithmetic will be different from the announced plan. The area under high-yielding varieties may be larger and the average dosage of fertiliser somewhat lower. The final impact on production is unpredictable but we would not think 15 to 20 million tonnes from the high-yielding varieties alone too optimistic if the planned levels of fertilisers are available.

12. Nor are we too concerned with another criticism which has relevance in a situation in which inadequate fertiliser supplies act as a constraint on possible total output. We have a situation in which a great mass of farmers in India use little or no fertiliser. If a large proportion of these could be persuaded to use a little fertiliser on old varieties, the total response might be greater than that from using on a small proportion of farms, high-yielding varieties which must have relatively heavy applications of fertiliser to yield their best physical and economic returns. Even with a technology based on old varieties, farmers would respond to incentives and productivity in agriculture could be accelerated, although only moderately in total. 8/

13. However, the contrast of a great many farmers increasing output by say 10 to 15% per acre with a small number (say 1 for every 10 of the farmers) in selected areas increasing yields by 70 to 100% is not real. In truth, "progressive" farmers are now clamouring for the new technologies especially,

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8/ Except for rice, yields per acre have not been rising significantly - an unsatisfactory position in view of the apparent decline in the amount of new area coming under crop in each year.

Third Plan, of "high priority" for agriculture. In the light of actual experience we had not been confident that similar assurances in the "Memorandum on the Fourth Plan" could be accepted at face value. 11/ We doubted the existence of an "organized will" to give the allocation of resources to agriculture that "high priority" demands. However, the assurances of "highest priority" have been repeated in all our discussions and in the 1966 documents available to us. 12/ Fortunately, we are now far more confident on this matter for reasons we think worth stating.

16. Several factors account for what we believe to be a more convincing attitude towards, and performance in respect of, agriculture on the part of the planning and executive authorities in India. First, the droughts of 1965-66 and 1966-67 are having a salutary effect. Second, there is a realisation, reinforced by the droughts, that an expanding agriculture is vital to general economic growth or, in negative terms, a stagnant agriculture is a serious drag on economic growth elsewhere. Third, there is a conviction shared by political leaders, civil service, scientists, and farmers alike that a new technology is available which can give quick results even within traditional constraints which dog the agricultural sector. All these factors have produced a determination to try to give agriculture the resources it needs even if this squeezes other strong claimants for the same resource, especially in the foreign exchange sector.

17. These points need but little elaboration. The droughts have made it clear that India neither has domestic foodgrain stocks adequate to carry it through adverse seasons nor the foreign exchange resources which would enable it to import on commercial terms. Moreover, it has become no less clea that the population increase is an inexorable source of rising pressure on foo supplies, a situation for which a revitalised family planning programme, now becoming evident, can offer no immediate solution. It has become apparent that unless agricultural productivity is greatly stepped up, the annual increase of food supplies, even in normal years, would be inadequate to sustain the rising demand for food carbohydrates, let alone, the more nutritive foodstuffs increasingly required in the Indian diet. Again, this pressure has undoubtedly contributed to rising social and political unrest which has begun to challenge the effective operation of democratic institutions.

18. The droughts have played their part in producing new attitudes and determination; but droughts do not account for the higher morale now evident in respect of the future. There are two positive factors at work: the first is the gain from exploiting the mutual interests of industry and agriculture. For too long there has been evident in India, a feeling that industrialisation and agricultural expansion were antithetical forces or worse, that agricultural expansion could "take care of itself". It is now clear, that if agriculture stagnates food price inflation occurs to the damage of sound economic growth

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11/ A view shared by most experts familiar with the Indian Agricultural scene.

12/ See especially the "Draft Outline", pages 16 and 46 and the "Annual Plan, 1966-67", page 2.

policies in the industrial and commercial sectors. 13/ On the other hand, if agriculture is encouraged to expand and succeeds, higher agricultural income will provide a rising market for industrial products. Agriculture in a normal year accounts for roughly 45% of total income - a fact of clear importance to other sectors. If fertilisers, plant protection materials, tubewell equipment are produced in India, an expanding agriculture will absorb them as well as an increasing amount of consumer goods. A mutually beneficial relation is possible and important to all sectors. This is now realised and the "Fourth Plan" rightly gives emphasis to agriculturally-oriented industrial development. As we will see, nowhere is this more important than in respect of fertiliser production. For, to ignore agricultural needs in domestic industrialisation plans would be to throw an insupportable strain on the foreign exchange section if priority for agriculture is to be a reality. Such priority can only be real if industrial expansion is geared to the needs of agricultural expansion.

19. All this is now realised; but this alone would not be enough. What makes the reshaping of industry to fit agriculture's needs worthwhile is the prospect that the "new technology" can and will do the job in reasonable time. There is no need to argue this point here for, indeed, the whole of this Report is concerned with it. It is sufficient to reaffirm that it is this awareness that has brought Chief Ministers of the States far more actively into the national agricultural plan as willing participants. It is this that has given the scientists a new approach to their tasks and an exciting conviction that they are contributing significantly to national advancement. There is ample evidence (as there has been for some time) that enough farmers are willing and able to use a more advanced technology to ensure substantial progress as long as the means - seeds, fertilisers, credit, etc. - are made available to them. Again, it is this (and good ministerial leadership) that is giving a more confident tone and morale to civil service activities in the Centre and in key States. Finally and not least, it means that the Planning Commission, Finance Ministry and the Ministry of Food and Agriculture are significantly united in an understanding that priority for agriculture is needed and gives promise of an effective result.

20. In all our discussions assurances to this end were given with a conviction that was not communicated in the past. We are satisfied that the translation of "high priority" in terms of resources is already and

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13/ As witness the setback experienced in 1965-66.

will continue to be a meaningful one. 14/ Whether it can, in view of the very great difficulties which operate in the Indian economy, be a fully effective one within the Fourth Plan period requires further examination. We begin this by looking again at the agricultural output targets set in the Plan and at the expected and likely allocation of resources of inputs required to achieve those targets.

14/ The actual allocations of foreign exchange in 1966-67 to support agriculture's needs have been higher than, in our view, would have been likely before the new policies were adopted. Similarly, the investment pattern for this and later Plan years of the new agriculture sectors is better directed to the support of agriculture. (In this respect it is not enough, in reading the "Draft Outline", to note the direct investments in agriculture; it is important also to study that part of industrial investment, both public and private, directed to agriculture's needs.) The device of the Annual Plan may well provide the additional flexibility needed to meet ad hoc special problems, although we realise that it could also be used against agricultural interest.

PART II: THE FOURTH PLAN TARGETS

21. Tables II and III set out the principal agricultural targets in the Fourth Plan as revealed in the "Draft Outline". Table II gives the major information we need for output targets for foodgrains and certain commercial crops. 15/ Table III gives the physical targets and input supply objectives which are the basis for the expected output of the final farm products. There have been some recent changes here mainly by way of building up domestic production of equipment needed for minor irrigation and other farm operations. These changes are consistent with the greater emphasis to the use of irrigation water from ground water sources now given in the "new strategy".

22. The major point to notice immediately is that the crop targets have not been raised. At first sight this may be a little surprising in view of the general tone of expectancy generated by the "new strategy". Few were confident that the targets could be realised under the old technology, even with substantial increases in input supplies, for some of the yardsticks seemed overstated. There is more confidence in the higher yardsticks 16/ (ratio of additional yield to additional units of inputs, especially fertiliser) of the new technology and more belief that the needed supplies of inputs will be forthcoming. However, the new technology based on high-yielding varieties is but at its beginnings and even in the full period of the Plan cannot blanket much more than some 10-15% of total cultivated acreage under the five foodgrains covered in Table 1. 17/ Whether even yet the targets for foodgrain output are too high is open to question. It is, however, a question which cannot yet be answered with certainty - the new technology and the "new strategy" are still subject to uncertainties of one kind or another. It is, however, our belief that the targets are far more realistic, given the projected inputs, than they were. Our further comments in this Part are designed to lend support to this view.

23. The Foodgrain Target: This remains at 120 m. tonnes for 1970-71. It has two facets: (a) its relation to "needs" (including that increase in demand associated with rising incomes), and (b) its reality in terms of inputs presumed to be available. We deal first with "need" of which many estimates have been made. 18/ We need not stay on detail except to note

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15/ It has not been considered necessary to repeat all the detail given in the "Draft Outline" in Chapters XI and XII and elsewhere. It should be stressed, however, that our statement and Tables in this Report do not cover the livestock and fisheries objective on which see the "Draft Outline", Ch. XI.

16/ See Appendix II prepared by Dr. Hopper which gives a good deal of technical information on the new high-yielding varieties.

17/ See para. 7 above.

18/ See Appendix I prepared by Mr. Van Nimmen. See also "Draft Outline", op. cit., pp. 182-183 for the explanation of the official target given by the Ministry of Food and Agriculture.

that the official target takes into account population growth, planned income growth and its accompanying income elasticity of demand, an allowance for seed, animal feed and wastage (12½% of gross production) and a desire to reduce dependence on imports to nil by 1970-71. 19/ There is room for doubt whether the wastage and seed allowance is enough, whether the wheat component will be enough 20/ and whether it is necessary to contemplate the ending of imports. We would agree that self-sufficiency is desirable to save foreign exchange as long as this does not call for greater foreign exchange usage for other foodstuffs.

24. If we were disposed to challenge the target, it would be on the grounds that it will yield a per capita availability of some 18.0 oz. which, if other elements in a balanced diet were adequately available, could be too high. 21/ If productive capacity does expand to the level which would yield 120 m. tonnes, foodgrain prices ought not to exceed floor prices by very much. It may well be that prices of livestock products, fruits and vegetables would then so rise relatively as to encourage some diversion of resources to milk, eggs, fruit and meat. This would not be an undesirable outcome. Nor would it necessarily be bad if export crops and cotton were to gain a relative boost before the full foodgrain target were realised. There seems little point in arguing the arithmetic for, as each year goes by, actual prices and the year-to-year review of policy envisaged in Annual Plans will determine the final mix. 22/ It is sufficient to say that 120 m. tonnes is designed to give a comfortable foodgrain supply to the population but it may be possible to reduce this target if doing so would give other needed foodstuffs or assist the balance of payments even more significantly.23/

25. When we turn to the question whether the planned additional inputs of water, fertiliser, plant protection materials, better farm practices and so on will yield the crop targets, we embark on rather more treacherous grounds. We give first the official view as we understand it from our discussions and then some comment which, although far from precise or complete, is far less discouraging than we felt constrained to be in April 1965.

19/ It is assumed that a buffer stock of some 6 million tonnes will be built up from imports during the Plan period - a perhaps optimistic assumption on which comment is offered in Part III.

20/ The exact component is not known to us, but it is not unthinkable to contemplate some rice exports which would facilitate wheat imports or internal price adjustments which could lead to more wheat being produced.

21/ See Table of per capita availability in Appendix I and note that in the best year (1964-65) the assessed figure was 16.7 oz. In 1965-66 and the current year the figure will be much lower. It is useful to also note the comment along the lines of this paragraph in "Draft Outline", para. 123, page 211.

22/ Discussed below - Appendix I.

23/ In our view market prices, as said above, would themselves contribute to this result once foodgrain production began to approach target levels. Although we are unable (see Preface) to deal with these other products they are of great importance. A precis of the Fourth Plan targets relating to them is included in Appendix I.

TABLE II: AGRICULTURAL OUTPUT TARGETS

Commodity	Unit	Third Plan Target	Base Level 1965-66 /1	Additional Production Fourth Plan	Estimated Production at end of Fourth Plan	Percentage Increase over Base Level
Foodgrains	Million tonnes	101.6 /3	90.0	30.0	120.0	33%
Cotton	Million bales /2	7.0	6.3	2.3	8.6	37%
Jute	Million bales /2	6.2	6.2	2.8	9.0	45%
Oilseeds	Million tonnes	10.0	7.5	3.2	10.7	43%
Sugarcane(gur)	Million tonnes	10.2	11.0	2.5	13.5	23%

/1 Due to the 1965-66 drought actual output figures for most products were considerably below the normally expected trend value. Actual figures were as follows: foodgrains 72.3 m. tonnes, cotton 4.7 m. bales, jute 4.5 m. bales, oilseeds 6.1 m. tonnes, sugarcane 11.8 m. tonnes. For explanation of the base, see para. 26 of the text.

/2 Bales of 180 kg each.

/3 This target was subsequently revised to 92 m. tonnes.

Sources: Third Five- Year Plan - Summary

Fourth Five-Year Plan - A Draft Outline

Ministry of Food and Agriculture

TABLE III: AGRICULTURAL DEVELOPMENT AND INPUT TARGETS 1/

Item		Unit	Third Plan Target	Achievement 1965-66	Fourth Plan Target	% Increase over Base Level or over Third Plan Achievement
I.	Irrigation					
	(a) Major & Medium additional utilisation (gross)	Million acres	12.8	5.5	9.0	64%
	(b) Minor additional (gross)	Million acres	12.8	13.1	17.0	30%
II.	Land Reclamation Additional	Million acres	3.6	4.2	2.5	-40%
III.	Soil Conservation Additional	Million acres	11.0	9.8	20.0	104%
IV.	Double Cropping Area	Million acres	n.a.	65.0	91.0	40%
V.	Area Under Improved Seeds	Million acres	203	120	274	128%
VI.	Plant Protection	Million acres	50	41	137	234%
VII.	Fertilisers					
	(a) Nitrogenous consumption of N	Million tonnes	1.0	0.6	2.0	233%
	Domestic prod. of N	Million tonnes	0.8	0.2	2.0	900%
	(b) Phosphatic consumption of P_2O_5	Million tonnes	0.40	0.15	1.0	567%
	(c) Potasic consumption of K_2O	Million tonnes	0.20	0.09	0.35	289%
VIII.	Organic and Green Manures					
	(a) Urban compost	Million tonnes	5.0	3.4	5.4	59%
	(b) Green manure	Million tonnes	41.0	21.5	64.0	198%
IX.	Other Inputs (domestic prod.)					
	(a) Tractors	Thousands	10.0	6.2	35.0	465%
	(b) Power driven pumps	Thousands	150	150	400	167%
	(c) Diesel engines	Thousands	66	85	200	135%

1/ Targets and achievements are expressed as total additions during a five year period for items I, II and III, as total cumulative achievements measured at five-year intervals for items IV and V and as yearly figures for the remaining items.

Sources: Third Five-Year Plan - Summary; Fourth Five-Year Plan - A Draft Outline

26. Since the official analysis is in terms of additionality, we need to have a base from which to start. This was the 92 m. tonnes anticipated production for 1965-66 (See Table II). This has been adjusted to 90 m. tonnes because fertiliser availability was some 200,000 tons N less than anticipated when the revised target of 92 m. tonnes was fixed. 24/ Starting with this base we can approach the official version of "feasibility" of the target in two ways: (a) entirely in terms of the "old" input:output yardsticks (see Table IV); and (b) that which is based on a combination of the yardsticks implicit in the "new strategy" and old yardsticks where this is still relevant.

27. The "old" yardsticks show the then-official view of potential gains from increased supplies of fertiliser, further water supplies from irrigation works, "improved" seeds (not the new technology) and "improved practices", the last being assessed at 15% of the total of the farmer. These estimates also required a judgment as to the share of inputs applied to foodgrains. For some of the items we felt the yardsticks were overstated although for irrigation we felt they were understated - a view we certainly hold more strongly now in relation to the new technology.

28. The official view would, we believe from our discussions, now be put in somewhat different terms. 25/ There are two parts to the presentation - the intensive acreage under the "new technology" and the "balance" under the old technology (i.e. old varieties plus a share of the increased supplies of inputs).

24/ Informal advice from Ministry of Food and Agriculture. This represents a direct gross application to foodgrain production of the old standard yardstick of 10 tonnes of foodgrain gained for every additional tonne of nitrogen. In view of the fact that, in our opinion trends had fallen below 3.0% per annum in the sixties (mainly because yields per acre were not rising fast enough to offset the declining rate of growth in new areas under production), we consider the true "potential" for 1965-66 to have somewhat less than 90 m. tonnes. However, we are not attempting an argument of great precision and are content to make it clear that the "base" assumed is of some importance.

25/ An official study is under way and we do not wish to commit the G.O.I. to acceptance of this statement - except, of course, the first item of 25.5 m. tonnes which has been officially publicised.

TABLE IV: AGRICULTURAL (FOODGRAINS) OUTPUT IN THE FOURTH PLAN (1970-71 ONLY)

1.	Additional from Intensive High-Yielding Varieties Programme in already assured areas (See Table I)		25.5 m. tonnes
2.	Outside the H.Y.V. Programme 1/		
	(a) Additional irrigation area of 26 m. acres		4.0 " "
	(b) "Soil conservation" on 20 m. acres		1.0 " "
	(c) Say 500,000 tonnes N. additional under old technology on irrigated and non-irrigated. 2/		5.0 " "
	(d) For double cropping "improved practice"		no allowance
	Conservative (?) total	=	35.5 m. tonnes
3.	Base for 1965-66	=	90.0 " "
4.	Total production		125.5 m. tonnes

1/ The estimates here apply the general yardsticks used prior to the enunciation of the new strategy for agriculture.

2/ This assumes application of 1.3 m. tonnes N to the H.Y.V. Programme (See para. 16 above) and a total availability of 2.4 N in 1970-71 from which the 0.6 m. tonnes used in 1965-66 must be deducted for this exercise in additional response. No reference is made to P_2O_5 and, no doubt, some increase will come on this score, too, provided extra supplies reach farmers outside the High Yielding Varieties Programme.

29. This would appear to render the official target of 120 m. tonnes too low or to suggest an excessive allocation of inputs to foodgrain production. It rather supports the Ministry's known wish to state the target higher at 125 m. tonnes and also to have an allocation of resources to cover 2.4 m. tonnes of N. in 1970-71. 26/ We have, however, queried the word conservative in the Table for two good reasons. First, it would be unwise

26/ The target for 1970-71 for supplies (and production) is still placed at 2.0 m. tonnes N.; the question of raising this to 2.4 m. tonnes is still more or less open to be decided at an appropriate time.

yet to assume the availability of 2.4 m. tonnes of N., much as we stress its desirability. A reduction of 0.4 m. tonnes would certainly produce great strains on administration if an effort is made to preserve 1.3 m. tonnes out of a total availability of 2.0 m. tonnes for the H.Y.V. Programme in a narrowly defined area of 32.5 m. acres. Secondly, we have given reasons for thinking that farmers in the High-Yielding Varieties Programme will not be applying the high dosages originally recommended, 27/ and output per acre assumed will not be reached. However, the special programme will spill over into other potentially "good" areas and some non-irrigated areas so off-setting some and possibly a good deal of this "loss" of yield per acre. At the same time this "spill-over" will replace some of the efforts by progressive farmers now counted in Section 2 of Table IV. In our view, the net effect is that some reduction of expectations in respect of final output would be wise at this very early stage of introducing the new technology. Altogether, even if we note the fact that some items (double cropping and "improved practice"), important in Table X of our early Report, 28/ are not given any credit in this present table, the best we ought safely to conclude is that a conservatively stated case is made out for a very substantial achievement (i.e. 110 to 115 m. tonnes) of the official target. This allows for the "base" in 1965-66 being lower than 90 m. tonnes. The case rests very significantly on securing 15 to 20 m. tonnes additional output from the High-Yielding Varieties Programme and only 5 to 10 m. tonnes elsewhere. On this we should offer further comment which, while not quantitatively precise (precision would be false), does lend weight to this possibility. 29/

30. The High-Yielding Varieties: Elsewhere 30/ we give some reasons for thinking that the supply of seed of high-yielding varieties may not be as limiting on production as the supply of other fertilisers. Given no limits on fertiliser availability, we would feel less need for the caution expressed in the last paragraph. This view is supported merely by listing some of the known features of the high-yielding varieties. This is done here by drawing on data assembled by Dr. Hopper in Appendix II to this Report. We are content merely to make a series of points quite briefly which add up to an obvious conclusion that there is great potential in the new technology. It must, however, never be overlooked that the new technology is, for the

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27/ See footnote to para. 10 above.

28/ Double cropping and "improved" practice accounted for 7 m. tonnes of the 28 m. tonnes of additional foodgrain there projected as "officially" feasible.

29/ It is worth noting from Table II that the target of 120 m. tonnes represents an increase of 33-1/3% over the base of 90 m. tonnes which is the assumed yield for 1965-66 given the inputs then available and had rainfall in that year been normal. This is an annual growth rate of 5.9% compound. The year 1966-67 is, of course, below base and trend, but the high rate of growth is not iself a reason for objection provided a new technology is effectively introduced over a significant area. At every turn, unfortunately, we are confronted by shortages, especially of fertilisers which limit its full application.

30/ See especially Part IV, Sections (1) Seed Supply and (2) Fertilisers.

most part, 31/ an "intensive" package of water, fertiliser, plant protection materials, equipment and, not least, good practices, not to mention short- and long-term capital and incentive prices.

31. Absolute yields per hectare are higher for the new varieties 32/ of wheat, rice, maize, jowar (sorghum) and bajra (millet) at given levels of fertiliser applications and the maximum yield possible by increasing applications of fertiliser are considerably greater in every case. It is difficult to quote "average" or "typical" results for the whole operation is too young to warrant the use of "average" results, yet the data - experimental, demonstrations and actual farm experience - given in Appendix II suggest that, at less than maximum yield applications of fertiliser, it would not be unsafe to talk in terms of the following possibilities:

Wheat: dwarf varieties: 40 to 60% increase in yields over standard local non-dwarf varieties.

Rice: probably 80 to 100% in favour of new varieties under similar con ditions of water control.

Maize: probably 40 to 50% better

(In all three cases the assumed application by farmers of fertiliser to the new varieties would be higher than would in practice be used for old varieties but would be well below maximum yield levels.)

Jowar: possibly 100% or more better, at any likely level of fertiliser application and some 40% better even at nil application.

Bajra: possibly 60 to 80% better at any likely level of fertiliser application, and again significantly better (perhaps 25 to 30%) at nil application.

32. It is important to note that much of the favourable result is due, not only to the high up-take of fertilisers by the new plants, but also, and even mainly, to the "genetic" ability of the varieties to yield under conditions of extreme crowding. That is, to produce in circumstances of a high-plant population: "the yield increases are in a most important measure due to the higher populations per hectare". 33/

31/ See point made below concerning jowar and bajra crops.

32/ The term 'new varieties' is meant to contrast with old traditional varieties. Several of the new varieties are, of course, the result of Indian breeding for high-yielding qualities of both indigenous and exotic stocks.

33/ See Appendix II.

33. It is particularly important to note also that while assured water conditions are vital to the most effective results for rice, wheat and maize, the new jowar and bajra varieties hold promise for significant increases in yields over old varieties without fertiliser and under non-irrigated conditions. It is suggested that there are some 14 m. acres with reliable 20" monsoon rainfall suitable for jowar and a similar area suitable for bajra with a monsoonal rainfall in the growing season of at least 10". Maize also lends itself to development in 20" to 25" monsoon rainfall areas. This point is stressed since it conveys important hope to farmers outside irrigation areas.

34. We do not have the data to present costs and returns in any systematic way. One illustration will be indicative. 34/ In the major wheat growing areas of Punjab, northern Rajasthan and western U.P., dwarf wheats in 1965-66 average 5340 kg./ha against locals at 3330 kg./ha, a 60% difference. The gross return per hectare would be respectively about Rs. 3500 and Rs. 2200. Costs of fertiliser in the former case would be (for 100 kg. N and 50 kg. P_2O_5 per hectare) about Rs. 300 and for the local variety about Rs. 130 (40 kg. N and 30 kg. P_2O_5). - thus giving an increase of 54% in net returns in favour of the new variety. This difference is the more striking, it is true, at the present high grain nitrogen price ratio. Without this improved ratio of the last two to three years, however, the incentive to invest in old (local) varieties would be low indeed. Even if prices were to fall to the declared floor prices, the incentive will remain strongly in favour of the new high-yielding varieties.

35. There are problems, some of which we discuss in later sections. These include: a) the need for good water and soil management to get the best results at any level of fertiliser applications; b) the prospect that some new varieties will bring with them both known and as yet unknown disease problems - a fact which requires constant vigilance in research; c) the limitation of seed supply of good quality and the even greater problem of assuring adequate supplies of fertilisers and other inputs; and, perhaps not least, d) the social impact of a programme which appears heavily weighted in favour of these already enjoying comparatively favourable conditions of assured irrigation water or reliable rainfall. The last point merely stresses the importance of research into the varietal problems of less favoured areas, exploiting ground water where available and not yet used, and of allocating fertilisers to these areas too for use especially in years of better rainfall experience.

36. With all the apparent problems it is impossible to escape the conclusion given in Appendix II even with the incomplete research and practical experience so far available, "That there is so wide a difference between the new and old genetic base on which India's crops might rest, that a development strategy for agriculture that is based on the new genetic

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34/ We do have data on the 1965-66 Kharif season national demonstrations. While many of the demonstrations are apparently open to some criticism there is no doubt the tenor of the results.

potential offers a substantial promise of revolutionizing the nation's agriculture". That strategy has now been adopted, has started modestly and is capable of fairly rapid expansion - provided its critical input, credit and research requirements are met. Given these we believe that, despite almost certain difficulties likely to be experienced, with attendant frustration, an output of 110-115 m. tonnes foodgrain is a conservative expectation. But these requirements are indeed critical and to them we now turn.

PART III: INCENTIVES - PRICE POLICY

37. In this Report, we are primarily concerned with new developments in policy and their reflection in the Fourth Plan. In the matter of price incentives offered to farmers to produce more, there have been no recent changes in policy since early 1965. 35/ The policy remains one of assuring minimum or floor prices to the farmer for his output which, while not unreasonable to consumers, will give him the incentive to invest for expansion of production. Important adjuncts of this policy are the Agricultural Prices Commission and the National Food Corporation, the former to advise on proper floor price levels and the latter to operate a buffer system which would equalise food supplies year by year and thereby stabilise prices. The Corporation would, as necessary, buy in "surplus" years to reinforce the floor price guarantees or to build up depleted stocks, and sell in "deficit" years to protect consumer interests as well as contribute to price stability in the economy as a whole.

38. The policies have not changed since early 1965, but the underlying conditions have. Moreover, the changes have been so severe as to threaten the usefulness of the floor price guarantees as an assurance to farmers, the feasibility of the economy as a whole. The underlying conditions are, of course, food shortage and general price inflation in which food shortage is a major contributing factor. A considerable amount of detail accompanied by charts is given in Appendix I. This shows the course of food production and imports in recent years, the trends in prices and gives some detail on floor prices and food procurement operations. 36/

39. We reproduce here two tables, showing the marked development of general inflation and the clearly contributory inflation in foodgrain prices. Table V(a) is taken from Appendix I.

35/ But events have overtaken price policy, as described below.

36/ The Appendix is necessarily brief. Other Reports by the Mission will contain data on general price inflation. On food procurement problems a most valuable document is the "Report of the Foodgrain Policy Committee - September 1966" issued by the Ministry of Food and Agriculture. This and other Reports of 1965 and 1966 prompt a grateful comment on the excellent series of frank reports on critical subjects issued by the G.O.I. in the last two or three years.

TABLE V: YEARLY PRICE INDICES

Foodgrains and Food Articles

According to Economic Times Index 1/
(As Adjusted to a Base of January 1963 = 100.0) 2/

	All Commodities	Wheat	Rice	Food Articles
January 1963	100.0	100.0	100.0	100.0
January 1964	110.1	135.2	121.0	114.7
January 1965	126.5	193.1	140.0	142.2
January 1966	134.1	182.7	159.9	147.5
October 1966 *	158.4	246.6	219.1	177.9

1/ The Economic Times Index of Wholesale Prices is based entirely on open market prices. It does not include a weight for sales at governmentally fixed prices through the "Fair Price Shops."

2/ All indices were taken on the last Friday of the month.

* Nine months.

40. We are not entirely familiar with the details of construction of the Economic Times Index. Comparable data based on the index numbers of wholesale prices prepared in the office of the Economic Adviser, Ministry of Industry, Government of India, are given in Table V(a). 37/ Although the movement shown in the official series is somewhat less dramatic 38/ the inflationary pressures are all too evident.

41. The general problem of inflation is discussed in other reports. It is not suggested that the shortage of foodgrains is the only factor in the general inflation but it is certainly a highly significant one. While sound monetary and fiscal policies can contribute to maintenance of general price stability, it is rather too much to expect these policies to absorb, "in

37/ See also Table 13 of Vol. III, Statistical Appendix to Mission Report.
38/ We are not able to offer technical explanation which are no doubt associated with differences in weighting and the market centres used. Since the trend is unmistakeably similar we have not felt that technical analyses was called for.

their stride", as it were, the inflationary pressure of food shortages. In the "Report of the Foodgrain Policy Committee", 39/ the committee envisages a shortage of foodgrains over the next five years 40/ and particularly notes that this:

> "implies the continuance of an upward pressure on foodgrain prices. At the same time, the demand for foodgrains is price inelastic, so that even a marginal shortage tends to result in a big rise in foodgrain prices. Such a rise, if excessive, 41/ can generate conditions leading to a wage-cost spiral. Hence, one of the important objectives of food policy is to ensure that the shortage of foodgrains does not cause an excessive and unbridled rise in their prices. But it is necessary to emphasize that food policy can achieve this objective only if it is supported by appropriate monetary and fiscal policies. If, in the absence of such policies, an attempt is made to keep foodgrains prices alone at a low level, two things will happen, both of them harmful to food production. There will be diversion from food crops to other crops and there will be discouragement of investment in agriculture."

TABLE V(a): INDEX NUMBERS OF WHOLESALE PRICES

(Base shifted to last week of Jan. 1963 = 100)

Last week of	All Commodities	Wheat	Rice	Food Articles
January 1964	108.2	127.5	110.4	111.5
January 1965	123.8	166.5	117.8	131.8
January 1966	133.9	159.1	139.5	137.4
October 1966	150.6	174.6	155.8	161.6
As on 11.2.67	160.0	212.1	166.6	173.9

42. The "Draft Outline" notes the same problems and early in that Report stress is laid on the only adequate solution, namely, achievement of the production targets for agriculture. Until the production targets are

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39/ Op. cit., page 5, para. 2.5.

40/ See para. 2.3, page 4: "...the problem of shortage is one which will be with us for a number of years. We are not increasing our food supply or decreasing our population growth fast enough for it to be otherwise. A couple of good seasons do not provide the answer, for the problem is deeper than just a bad season, however bad." It is to be observed that the "new strategy" is designed to give the needed break through this vicious circle.

41/ As it surely has been.

sufficiently achieved, with or without the help of imports, to exercise a brake on foodgrain price inflation there is the danger that the guaranteed floor prices may lag so far behind prevailing market prices as to become meaningless. 42/ Lack of meaning can arise in two ways. In the first place, the support prices may not influence investment decisions, the market prices being far more attractive. 43/ In the second place - and this is the worst danger - cost inflation may engulf the floor prices, making them unreal unless revised when selling prices flatten out or fall. We certainly feel some upward revision will be necessary.

43. We will return to the policy implication of inflation shortly. It is important, first, to note another policy victim of the droughts, in particular, but also of any continuing lag in the trend of production in relation to demand. We refer to buffer stock policy. We cite a somewhat sad paragraph from the "Draft Outline" (p. 211).

> "Buffer Stocks - Though the average annual production of foodgrains during the Third Plan (80 million tonnes) was higher by 6 million tonnes (8 percent) than during the Second Plan and imports, too, were at higher levels as indicated, it was not possible to build up buffer stocks as contemplated owing to fluctuations in output and the operation of factors impinging on the demand for and availability of foodgrains. Establishment of adequate buffer stocks continues, however, to be an important plank of food policy during the Fourth Plan. It is proposed to build up buffer stocks of six million tonnes by the end of the Fourth Plan."

In short, food supplies, even including large quantities of imported grain, have not been sufficient to build up a buffer stock. 44/ And yet, the very fluctuations in output, likely to continue albeit perhaps somewhat reduced as the "new strategy" gathers effective momentum, demand a buffer stock policy. On this we comment further below.

42/ As shown in Appendix I, the concept is perhaps kept alive by the fact that emergency food procurement is mostly at less than market prices but above the official floor price levels.

43/ The incentive for production may not be destroyed at this stage, since the farmer is an immediate beneficiary of the inflation: this is the stage of improved "terms of trade" for the farmer. This is still the stage in India for, as can be seen in Appendix I, farm costs have not yet caught up with farm prices. The harm to the economy in general and the urban consumer in particular has, however, begun at this point: the price rises are excessive by any test.

44/ Procurement has mostly been for immediate consumption under the emergency conditions prevailing but were it not so, there would undoubtedly be more resistance to procurement at prices below those ruling in the market.

44. It is not our intention to discuss the detail of the current shortage 45/ which is so severe as to demand all possible procurement locally and imports to meet it. It is necessary, however, to stress again the correctness of the view expressed by the Foodgrains Committee that a constant upward pressure on prices will prevail, so long as upward production trend remains less than say 4 to 4.5%, for, as noted in Part II dealing with targets, rising money incomes add heavily to the pressure exerted in any case by the population growth rate, currently at 2.6%. In our view, even allowing for drought, the production trend rate has recently been well below the 3.0% and even less than the population growth rate. (More than 4.5% is desirable if buffer stocks are to be built up in part from local production and if independence of imports is finally to be achieved.

45. We are not able to say what level of crop will bring foodgrain price inflation to an end. One "good" crop of say, 95 m. or even 90 m. tonnes in 1967-68 would slow the rate of further inflation, but probably not eliminate it. 47/ For private stocks need replenishment, Government procurement would continue for reasons of prudence and imports might not be readily available or if they were, would, we hope, go into buffer stocks. A second "good" crop would produce results and could reinstate the significance of floor price policy. But the only permanent solution to the fear of renewed inflation is, we repeat without apology, to get the trend rate up and to have sufficient stocks to weather fluctuations about the trend. 48/ In the meantime, maximum foodgrain procurement, such imports as can be arranged, and a degree of food price subsidy through fair price shops are inevitable ingredients of policy. 49/ In this period, too, the threat of inflation for the stability of the rest of the economy remains, unless imports available for consumption are large enough to take the place of shortfalls in production.

46. In respect of the content of price and buffer stocks policy, a few comments will make it clear that we believe those policies to be essential still to the future course of agricultural policy:

45/ The major setback in Bihar, Eastern U.P., Gujarat, Rajasthan and Madhya Pradesh seemed likely to be as much as 10 to 12 m. tonnes in say a possible total of 90 m. for 1966-67 - that is, that the current year's crops could have fallen well below 80 m. tonnes. The outlook has been improved, perhaps to the extent of some 3 to 4 million tonnes by timely rains which could help rabi crop plantings in much of these areas.

46/ See Part II, para. 23 above.

47/ Clearly the level of imports which can be fed into consumption is a relevant factor.

48/ We endorse para. 43, page 17 of the "Draft Outline".

49/ For a useful discussion of all these matters, we refer to Report of the Foodgrains Policy Committee, op. cit.

(a) If the "new strategy" succeeds and the crop trend begins to rise, price and buffer stock policies will become highly relevant. It could be counted a positive contribution to general economic growth if better crops bring an end to the inflation associated with food shortages. It would, however, be unfortunate if the price pendulum so swung as to destroy incentives.

(b) It follows that we think the task of the Agricultural Prices Commission important. Points made earlier remain valid. The Commission will need to take into account rising costs of inputs and other changes, including productivity changes and desirable changes in the crop patter. 50/ It will need, as will the Food Corporation, a much improved market and crop intelligence service. 51/

(c) It is the hope of the Government of India that a buffer stock of six million tonnes will even yet be established. It appears that imports are to be used for this purpose. 52/ To this hope, the recent droughts have offered a harsh check while in the background is the likely rising in foreign exchange cost of even "non-commercial" aid. It appears to us that it may be easier to achieve the objective, provided somewhat nearer "normal" seasonal conditions return for the rest of the Plan period, if an effort is made to build stocks both by internal procurement and from imports, even if consumption standards remain squeezed. The choice will indeed be a hard one, not only in terms of human wants but in terms of economic policy. 53/ Nevertheless a programme of imports on "aid" terms would perhaps be less difficult to arrange, if it were clearly and definitely going to establish a buffer stock operation. 54/

47. We do not feel the need to comment further. We share the present concern of all interested parties in the general threat to the Fourth Plan objective represented by the present inflationary condition. We can see no satisfactory ending to inflationary pressure represented by the failure of foodgrain production except in terms of raising the production levels. The

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50/ Ibid.
51/ Ibid.
52/ See "Draft Outline", para. 122, page 211, quoted in para. 43 above.
53/ As the Foodgrains Policy Committee observe in their Report, given the underlying situation, "there are no soft options: there are only hard choices." (Para. 2.8, page 6). The committee has useful comment on the buffer stock problem and has probably sensibly lowered its sights from the official 6 m. tonnes objective to 4 m. tonnes.
54/ The importance of storage needs no further amplification; we are pleased to find that storage construction has an important place in the Fourth Plan. (See "Draft Outline", para. 208.9).

"new strategy" for agriculture is vital to this objective. As it begins to succeed, it will need the economic underpinning implicit in an incentive policy expressed in terms of assured floor prices. These clearly will remain particularly important to the small-scale producers and although the new technology offers bigger returns to producers able to use the new varieties, their investment costs are larger and they also require the underpinning of assured floor prices. We shall regard a buffer stock operation as contributing to this end, as well as to other objectives such as stabilising food supplies and prices for urban consumers. Our judgment, in short, is that price policy has not lost its relevance to long-term agricultural policy. However, since, in the short term, an expansion of output is vital if general cost inflation is to be curbed, consumers and farmers alike have an interest in assuring the latter the inputs with which to do their job. This is a highly critical area of policy and to this we now turn.

PART IV: THE CRITICAL INPUT FACTORS

(1) The Supply of Quality Seed for the High-Yielding Varieties Programme.

48. The crops primarily affected at present by the High-Yielding Varieties Programme are rice, wheat, maize, jowar and bajra. These crops account for some 85% of the normal output of foodgrains and 70% of the acreage. As we have seen, the Programme proposes to utilise 32.5 m. acres with assured water supply for intensive production under the new seeds. 55/ The seeds in use for the Programme so far are fully described in Appendix II, while the annex to Appendix II reviews the problems of the seed industry in more detail than is appropriate here.

49. It is important immediately to notice three major points:

(a) The Programme is based on a mixture of exotic seeds imported on the basis of known performance under research and commercial production conditions abroad and locally developed varieties: rice varieties from Taiwan e.g. Taichung (Native) 1, the Philippines (IR 8-288-3), and ADT 27 (a localised Madras variety); wheat varieties from Mexico (Sonora 64 and Lerma Rojo) with important Indian adaptations and selections (PV-18 and S-227); and the hybrids for maize, jowar and bajra developed in India principally under a co-ordinated Rockefeller Foundation-programme.

(b) Undoubtedly the programme for rice and wheat had been given a great boost by the determined and large scale import from abroad but momentum is being assured by (i) the nationally co-ordinated programme in wheat which has been operating now since 1963 with promising results and (ii) ensuring that the major programme for rice involving both international collaboration and national co-ordination now in its beginning stages be given the necessary resources. In the rice programme especially, large scale effort is necessary to ensure the steady development and availability of high-yielding, disease-resistant, high-protein strains embodying the desired qualities of rice from the Indian consumers' point of view. Already there is promise that by breeding and by chemical-control disease problems can be handled without loss of desired high-yielding, short-growing-period qualities of Taichung N-1 and ADT 27, the latter quality being important to hopes for double and triple cropping in assured water supply areas.

55/ See Table I, para. 7 above and discussion in Part I.

(c) We have already noted something of the yield experience and promise 56/ of the varieties now in use. This has resulted in a widespread demand for seed and a somewhat indiscriminately flourishing seed production industry. In the short term this may be of no great matter; yet the future of Indian agriculture is highly dependent on a seed industry which will guarantee for the user the high-quality seed produced by the research workers. We are confident that the research worker will be given support, both from international and Indian Government sources. At the present time, we are less confident about quality seed production. 57/

50. A programme of 32.5 m. acres distributed as suggested by the Ministry of Food and Agriculture in Table I (para. 7 above) appears to require the following tonnage and acreage of quality commercial seed (which does not include foundation stock).

TABLE VI: HIGH-YIELDING VARIETIES PROGRAMME

Seed Requirements 1/

	Target Acreage to be grown in 1970-71 (M. acres)	Seed Rate (Kg per acre)	Tonnage Commercial Seed Required	Yield of Commercial Seeds (Kg per acre)	Acreage Seed Production Required for Target Plantings
Paddy	12.5	10	125,000	1,000	125,000
Wheat	8.0	40	325,000	1,000	325,000
Maize	4.0	6	24,000	500	48,000
Jowar	4.0	5	20,000	400	50,000
Bajra	4.0	2	8,000	400	20,000
Total	32.5				568,000

1/ See "Agro-Seeds Diary" published by the National Seeds Corporation of India which gives recommended seed rates for the high-yielding varieties. This table is based on these rates. See also "Re-orientation of Programmes of Agriculture Production", op, cit., para. 17, et. seq.

51. For several reasons including inevitable changes in the composition of varieties as the result of research and over-optimistic assumptions about the efficiency of the growers (State and private) at this stage of the new seed industry, it would be foolish to take these acreage figures too literally.

56/ Paragraph 31 above.
57/ See Annex to Appendix II.

Nor, on the other hand, should we assume that a full five years will be needed to achieve the seed output required, particularly if advantage can be taken of the possibility of arranging more than one multiplication in a year. 58/

52. The principal conclusions that seem possible at this stage are:

(a) There will be a considerable change in the All-India mix of varieties in any one crop and therefore a growing complexity in the seed programmes.

(b) It is likely that the seed supply for dwarf wheat and rice will, by 1970-71, be more than sufficient to meet the acreage target, 59/ although quality may not be all that could be desired. Moreover, there is room for considerable concern about the maintenance of the initial lines (or breeder seed) with a high-genetic purity. (We observe later that the National Seeds Corporation (NSC) has a vital role to play here).

(c) The outlook for the hybrids is much more uncertain. This is largely due to the difficulties of the seed-producing processes which require higher levels of skill in preparation of land, timing and supervision of the crop-growing operations. The development of so-called synthetics (open pollinated varieties) designed to reduce the frequency with which the farmer must seek new seed will help. Despite the difficulties we believe it will be possible to exceed the required acreage of commercial seed production; we are less optimistic about maintenance of first class foundation stock and hence also about the derivative quality of commercial seed production.

53. We have observed elsewhere that the acreage represented by the farmers' demands for high-yielding seeds would almost certainly exceed the target of 32.5 m. It is, therefore, fortunate that the prospects of exceeding the related seed acreage and output targets are reasonably good. 60/ However, the real note of concern is the quality of the seed outturn and this raises sharply the institutional arrangements to this end. Central to these arrangements is, or ought to be, the National Seeds Corporation.

58/ The yields of seed output per acre (column 4 of Table VI) are conservatively stated. However, they are high in relation to actual performance as yet in State seed farms although many private commercial seed producers are already doing better.

59/ See Appendix V.

60/ This apparent gain, unfortunately, only aggravates the constraint already apparent in the inadequate fertiliser supply position. The acreage under high-yielding seeds (of some quality) will be larger than planned but output will be less than would likely if fertiliser supplies were more plentiful than is likely.

54. The history of efforts to raise standards of seed production is a rather sorry one and this judgment is amply contained in Government of India Reports. 61/ There must be improvement, quickly achieved, for production of high-standard seed is crucial to the success of the High-Yielding Varieties Programme. Fortunately, in the Charter 62/ of the National Seeds Corporation, in certain developments in some of the agricultural universities, and in the clear indication that trained and experienced farmers can make highly efficient seed producers, there is an ample basis for building an effective seed industry.

Hybrid Seeds

55. The structure of the seed industry is a complex one, especially in respect of hybrid-seed production. Here we are satisfied to note the main steps and problems. However, it is useful to distinguish between the hybrid seeds and the open-pollinated varieties used in the rice and wheat industry. 63/ We begin with the hybrid seeds the farmers use.

(a) Production of quality seed begins with the "breeder" seed from the research stations. Responsibility for supplying the seed is centered in the Indian Council for Agricultural Research (ICAR) which conveys the "breeder" seed to an appropriate authority for multiplication as foundation seed. 64/

(b) At the national level the logical authority for the second step is the National Seeds Corporation (NSC) which ought to convert the breeder seed into foundation stock for whose quality it ought also to accept full responsibility. In practice, it does some conversion on its own farms but also makes breeder seed available under contract to others (including Puntnagar University) for conversion to foundation seed. Our impression is that the Corporation has not yet effectively managed its role as prime promoter of high-quality foundation stock, whether in respect of growing (by itself or others) or storing.

61/ See, for example, "Report of the Programme Evaluation Organization of the Planning Commission, 1960."

62/ In view of the importance of the Charter, we have reproduced its terms in Appendix V.

63/ The maize, jowar and bajra crops account for about 30% of total foodgrain acreage but their relative importance is likely to increase for reasons already noted, namely, their suitability in large areas of nonirrigated lands. (See para. 33 above.).

64/ This authority must also accept responsibility for reproducing and holding the quality of breeders lines. It may do this by arrangement with the research stations if need be.

(c) The third step is conversion of foundation stock into quality commercial seed for use by the ordinary farmer. Here the story becomes complicated indeed as may be seen from reading annex to Appendix II. So far the results are not good enough in quality terms and, although only a part of the responsibility rests with the National Seeds Corporation, we believe it must play a more active role of co-ordination and assistance to other members of the total structure-- State Government, universities and private producers of seed. Some 80% of the foundation seed is sold by the NSC to the States who process part themselves but in turn release some 80% of their share to private producers under varying conditions of contract. The remaining 20% of NSC stocks are sold to private producers who can be required to sell up to 30% of their output stock to the NSC.

56. These three steps appear clear cut enough but even cursory examination reveals a still far from satisfactory state of affairs in respect of guaranteeing quality either of foundation stock or commercial seed, of training of growers, (whether State or private) in the skills necessary, or of promoting specialised equipment needed for land preparation and processing seed or credit for these operations. While of no great moment in the very short run, there is badly needed, too, a more permanent and co-ordinated system of seed certification and, no less, a systematic approach to marketing. It is likely the supervised formation of associations of seed growers would assist in developing sound processing certifications 65/ and marketing systems. It seems to us that a National Seeds Corporation suitably strengthened in staff, finance and in its cooperative links with States, universities and producer associations could assume a major role as National leader and co-ordinator. While its own competence must be put beyond doubt for this purpose, not to make use of its Charter in this way would be to condone a rather chaotic state of affairs in which neither public nor private initiative is properly harnessed.

Rice and Wheat

57. The problem is somewhat less complicated in respect of the open-pollinated varieties used in rice and wheat production. The same responsibility for promoting "breeder seed" rests with the research station. However, although the NSC acted as general agent for distribution of the imported dwarf wheats and rice, it is not really clear whether it will be the active link with the research stations (through the ICAR) in respect of locally-developed "breeder" stock. It may, and could usefully, undertake a role of a prime (but not sole) multiplier of some of this stock to provide

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65/ A general Seed Act is badly needed but in its absence the standards developed by the NSC ought to be followed as widely as possible.

a reserve of high-quality pure seed in case of need. Otherwise multiplication follows a simpler course than in respect of the hybrids. Nevertheless, there is no escape from the necessity to maintain purity of the line and to enforce standards for certification of commercial seed. We think again of the NSC as the apex of a collaborative, co-ordinated arrangement between the Centre, States, universities and producer associations. 66/

58. If we have given an impression of an industry badly in need of leadership, skills and investment resources it is because this is our impression. We believe that a good deal in fact has been achieved and more will be achieved even under present conditions in which co-ordination of Centre, State and private activities is nevertheless too weak for comfort. The whole industry needs underpinning and priority should be accorded to securing additional financial backing: (including overseas support), for the technical assistance as needed, and the firm establishment of a framework of co-ordinated responsibility at National, State and private level to ensure both adequate quality and quantity of output for the High-Yielding Varieties Programme.

66/ Such associations can certainly include seed production cooperatives such as that at Jounti, Delhi State.

PART IV: THE CRITICAL INPUT FACTORS

(2) Fertilisers

59. This is not a long Part but it deals with almost certainly the most critical aspect of the Fourth Plan for agricultural growth. 67/ What needs to be said can be said briefly but in not very comforting terms. It was already anticipated, even before the "new strategy" or the High-Yielding Varieties Programme was promulgated, that the Fourth Plan for agriculture would require a marked expansion in the usage of chemical fertilisers. 68/ The level of projected usages during the Fourth Plan and especially that proposed for 1970-71 has not yet been officially increased but it can be said that if these projected usages were reasonable in terms of the strategy available in November 1964 (as we think they were), the "new strategy" will require more. 69/ This strategy rests heavily on increased applications of fertiliser required by the high-yielding varieties. 70/ The strategy could collapse if starved of fertilisers or, as is likely to prove the case, it will not be fully effective since it will be impossible (as well as unwise) to give absolute priority in supplies to the farmers belonging to the favoured group in the new strategy if this means a widespread denial of supplies to the great bulk of farmers who must rely on a less favourable technology. As we have stressed in Part I, many of these latter will wish to use more fertilisers and will press their demands.

67/ The most critical bottleneck in the whole Plan is lack of foreign exchange: to agriculture's share of this problem fertiliser contributes most heavily - See Part VII below.

68/ See Table VII below.

69/ See notes to Table VII and such references as "Report of the Committee on Fertilisers" (Ministry of Food and Agriculture, 1965) and "Agricultural Production in the Fourth Five-Year Plan", cited in Table VII.

70/ The original "allocation" for the Programme in 1970-71 was 1.29 m. tonnes N. or 70% of the 2.00 m. tonnes projected by the Planning Commission for 1970-71. (See para. 10 above).

60. TABLE VII: PROJECTED USE OF NITROGEN IN FOURTH PLAN

(all tonnages in million tonnes)

Year	Ministry of Food and Agriculture[a] (Aug. 1965)			Planning Commission[b]		
	Supplies	Domestic Production	Imports Required	Supplies	Domestic Production	Imports Required
1965-66	0.60	0.30	0.30	0.60	0.30	0.30
1966-67	1.00	0.40	0.60	1.00	0.40	0.60
1967-68	1.35	0.525	0.725	1.25[c]	0.55	0.70
1968-69	1.70	1.10	0.60	1.50	0.763	0.737
1969-70	2.00	1.40	0.60	1.75[d]	1.25	0.50
1970-71	2.40[d]	1.70	0.70	2.00	2.00	0.0
Annual compound rate of growth	35%[e]			27%[f]		

(a) See pages 7-8 "Agricultural Production in the Fourth Five-Year Plan", for these figures to which an estimate for supplies in 1965-66 has been added.

(b) For 1966-67 to 1970-71 two sources have been used: the "Draft Outline", Ch. XI and the "Report of the Working Group on Imports During the Fourth Plan", Sept. 1966, p.32.

(c) At a meeting of Planning Commission officials and some members of the Bank Mission it was indicated that this figure had been raised to 1.45 with a consequential addition to the import requirements. For these latter the additional foreign exchange is now being negotiated.

(d) The target for the final year is not firmly settled by the G.O.I. However, it apparently has been firmly agreed to aim at 2.00 m. tonnes for 1969-70, thus raising the Planning Commission figure for that year. The target for 1970-71 (and 1971-72, 1972-73) is to be determined later in the light of developments.

(e) For four years only, 1965-66 to 1969-70. Applying the same rate to 1970-71 would require 2.7 m. in that year.

(f) For five years; if this rate were applied evenly through the period, the annual requirements would be at lower levels than shown, except, of course, in the last year. This is due to the simple arithmetical steps or straight-line phasing used.

61. It is well-nigh impossible to overstress the importance of fertilisers to agricultural expansion in the next few years. The authors of the "Draft Outline" have this to say:

> "The necessity for concentrated and integrated efforts on specific programmes in areas where the assured availability of water can facilitate the use of large quantities of fertilisers needed for high-yielding varieties of seeds, has not arisen suddenly. It is the culmination of certain trends hastened by the breakthrough in the matter of seed and the change in the attitude of the Indian cultivator towards chemical fertilisers." 71/

Whatever the social factors which may have inhibited usage of fertilisers by the Indian cultivators we make no apology for holding the view that regardless of these factors a large response from a significant number of farmers was nevertheless to be expected to effective demonstration of the favourable physical and economic results of using fertilisers. The new technology certainly does this for those who can meet the required conditions and, as we have already argued, the demand is not likely to be confined to a neat selection of blocks adding up to 32.5 m. acres.

62. Moreover, we go further. What is happening is that a number of new developments are converging in a way to make the fertiliser bottleneck appear more relatively constrictive than ever. Research is throwing up more high-yielding varieties including some which can be used in non-irrigated areas and which respond to fertiliser usage. 72/ Large-scale and minor irrigation development are likely (fortunately) to provide a substantial addition to acreage under irrigation. 73/ Additional water can be used to add to production of crops even without additional supplies of fertilisers, but it is only natural that farmers would wish to maximise the new asset by using new seeds and fertiliser with it. Demonstrations of the effectiveness of plant-protection materials and the opportunities presented for second crops (including cotton in some areas) by the use of short duration (i.e. short growing period) paddy crops are simply two other developments likely to add to the pressure for larger supplies of fertiliser.

63. The apparently fantastic compound rates implicit in the targets (see Table VII) are, of course, partly explained by the low absolute levels of fertiliser usage hitherto prevailing in India. However, the rate of usage planned is stepping up. The lower rate at 27% implicit in the 2.0 m. tonnes N. for 1970-71 compares with 18% over the 1952-53 to 1964-65 period and 20 to 22% in the last few years. Already it seems that both the Planning Commission and the Ministry of Food and Agriculture understated the need in

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71/ "Draft Outline", para. 8, p. 175 (Italics ours).
72/ See para. 33 above, dealing with jowar and bajra hybrids.
73/ See next section.

1967-68 which is now placed by agreement at 1.45 m. tonnes N. This is likely to be the experience throughout the Plan and it is fortunate that the device of Annual Planning within the total Plan will enable adjustments, and it is even more fortunate that "priority for agriculture" has been officially interpreted to mean a willingness to obtain imported supplies to make up short-falls in domestic production. Unfortunately, it is precisely here that an extremely severe test of willingness to sustain "priority" is inevitable.

64. The last point needs to be taken further, as it is in some detail in Part VII (Foreign Exchange) below, in Appendix IV and in that part of the Mission's Report dealing with industrialisation. We merely summarise the main points here. 74/

(a) Table VII gives an indication of the problem of imports of nitrogenous fertilisers. Similar information, given in Part VII and Appendix IV in respect of P_2O_5 and K_2O merely adds to the problem.

(b) Table VII, however, understates the problem. On the one hand, we suggest the demand may well exceed 2.0 m. tonnes N. and even 2.4 m. tonnes in 1970-71. On the other hand, the figures for domestic production are overstated for reasons adequately explained elsewhere in the total Report on the Fourth Plan. Domestic production, for reasons not necessarily wholly attributable to Indian Government policy, may not exceed 1.3 million tonnes. Accordingly, imports needed in 1970-71 could be as high as 0.7 m. tonnes or 1.10 m. tonnes according to which target for supplies (2.0 m. or 2.4 m. tonnes) for 1970-71 is used.

(c) The foreign exchange implications are examined in Part VII below but it is clear that the present import estimates for fertilisers by the Government of India are understated. If, for what would have to be imperative reasons, the short-fall in domestic output could not be made up by imports, the blow to the "new strategy" could be serious and the social problems created by the task of allocating the inadequate supplies 75/ perhaps even more serious.

74/ We have not engaged here in further discussion of technical problems of plant usage of fertiliser, of distribution of supplies whether produced or imported or of pricing policy. These are not unimportant and the problem of availability overshadows most others right now and is likely to do so as the ingredients in the new strategy become more widely available.

75/ We have already in early parts of this Report given reasons for thinking that the "new strategy" is not likely to operate at the levels of fertiliser application per acre calculated to give most physical returns; it is likely also that the average applications will be less than participating farmers would wish to apply on economic grounds.

65. We stand on the view that not only the High-Yielding Varieties Programme but a number of concurrently developing forces in Indian agriculture are throwing great pressure on fertiliser supplies; that these pressures are likely to force upward revisions in the Plan for fertiliser supplies; and that if the supplies are not forthcoming, the likelihood of reaching the agricultural production targets as a whole will be significantly lessened.

Addendum

66. Since this report was written we have received advice of an important decision which calls for amendment to Table VII and several of the comments made. The difference of view within the Government of India apparent in Table VII, has now been resolved and a firm decision taken on the target for supplies in 1970-71. Indicative of the growing recognition of the demand by farmers and need for fertilisers in support of the new policies, the target of 2.4 m. tonnes of nitrogen has now been adopted. We believe this to be the right decision which, if made effective, will offer a considerable added support to the new agricultural programme. Moreover there has been no change in the assurance that priority will be given to imports to make up the shortfall of domestic production against the annual target for supplies. It will be noted from Table VII(a), which sets out the new decision and thinking of the Government of India that the estimates of imports required have been increased above those given in Table VII: this follows from the revision downwards of estimates of domestic production during the Fourth Plan period. 76/ The good faith of the Government of India is shown in the fact that import procurement for 1966-67 and for 1967-68 has proceeded in accordance with the projection of needs shown in Table VII(a).

76/ Whether this revision continues to be somewhat optimistic or the Mission's estimates (see para. 64b) and Annex 4 to this Volume and para. 45 of Volume I) are too pessimistic, or both, is under further consideration at the time of writing.

TABLE VII(a): PROJECTED USE OF NITROGEN IN FOURTH PLAN

Revised Estimates of Government of India

(million tonnes)

Year	Target Supplies	Estimated Domestic Production	Estimated Imports Required
1965-66 (a)	0.60	0.30	0.30
1966-67	1.00	0.308	0.692 (b)
1967-68	1.35	0.525	0.825 (b)
1968-69	1.70	0.760	0.940
1969-70	2.00	1.00	1.00
1970-71	2.40	1.70	0.70

(a) Actual

(b) Import procurement proceeding on basis of these estimates.

PART IV: THE CRITICAL INPUT FACTORS

(3) Water

67. Because of the nature of priorities established in the Fourth Plan, irrigation development promises some worthwhile returns during the currency of the Plan as well as a useful trial of better integrated policies for irrigation development.

TABLE VIII: IRRIGATION TARGETS

Item	Third Plan Target	Third Plan Achievement	Fourth Plan Target
Irrigation: (a)			
Major : m. acres	12.8	5.50 (b)	9.0 (c)
Minor : m. acres	12.8	13.10	17.0
Nos. Wells: (d)			
Dug Wells ,000	-	450	800
Boring of Dug Wells ,000	-	130	300
Deepening of Dug Wells ,000	-	100	250
Construction of shallow tube-wells ,000	-	15	80
Construction of deep tubewells	-	-	5
Pumpsets: installation (f)			
- Electric ,000	-	240	700 (750) (g)
- Diesel ,000	-	80	250 (350)

Footnotes to Table VIII

(a) Source: "Draft Outline", Table 2, page 185.

(b) Includes 9.16 m. acres newly-irrigated area, besides area under drainage, flood control, etc. Similar breakup for Third Plan Target not available.

(c) Includes 12.0 m. acres newly-irrigated area, besides area under drainage, flood control, etc.

(d) Source: Typescript memorandum by Ministry of Food and Agriculture given to Mission in course of discussions. Status of these targets is not clear in the "Draft Outline".

(e) Dug wells are the ordinary percolation wells. There are many varieties of tubewells, but all have some form of pipe to draw the water for which purpose a pump and power are required. A great many of the simple dug wells will be bored deeper to tap additional aquifers and, accordingly, will call for a pump and power.

(f) These figures at first sight are difficult to reconcile with data on diesel engines and power-driven pumps given in Table III above which specifies 400,000 power-driven pumps and 200,000 diesel engines. We have satisfied ourselves that they can be reconciled by noting that figures in Table III are annual production figures.

(g) The bracketed figures are given in one place in the text of the typescript memorandum mentioned in Note (d) above, the others in Annex III to the same document.

68. The major points to be noted which are supported by the data in Table VIII include:

(a) The completion of major schemes carried forward from the Third Plan, "right up to the cultivators' fields (i.e. including field channels)"; 77/

(b) Starting of "a few new major and medium schemes" if economic circumstances permit. (That is, these are not yet included in the Plan and can only come in if, in one of the Annual Plans, resources can be found. Their relevance to carrying some continuing momentum into the Fifth Plan is obvious);

(c) A relative upgrading of minor irrigation development, including (i) expansion of private well development, and (ii) better integration of minor irrigation development with both existing and new canal systems (see reference to Ayacut programme below);

(d) Special attention to integration of engineering, agronomic and administrative services in all irrigation development. 78/

69. We consider the policy approach a sound one and welcome the strong evidence in our discussions in New Delhi of the move towards the development of water as an intensive input for maximising output in suitable areas. The decisions to stress minor irrigation a little more, to encourage private well development, to plan to construct village field channels and to begin, albeit on a pilot scale, the task of land shaping in the Ayacut programme are all capable of yielding early results as well as increasing returns in the period of the Fifth Plan. We welcome, too, the intention on the part of both Executive Ministries concerned - Irrigation and Power, and Food and Agriculture (and the Planning Commission) - to develop joint studies and implementation of water programmes. We welcome, too, the approach illustrated in the Kosi area (Bihar) with the appointment of a water development officer with Divisional Commissioner rank to co-ordinate the work of the Federal and State Ministries and agencies responsible for water programmes so that the development work is carried out as a unified whole throughout the entire watershed. The principle of focusing authority at a single point is important, particularly to developments of ground water usage in which problems of credit, equipment supply and advice on crop patterns and water management must be co-ordinated to facilitate smooth advance in the areas concerned. There appears also to be a marked advance in the understanding between States and Centre where more than one state is involved as in river basin schemes.

77/ "Draft Outline", page 218.

78/ See "Draft Outline", para. 6, page 217 and other references (such as "Reorientation of Programmes") on new agricultural policies cited elsewhere in this Report.

70. All these new planning and administrative concepts will take time and good will to work out in practice. For this reason the Ayacut programme is particularly important. This programme is a welcome initiative from the Centre which is briefly described in the "Draft Outline" as follows: 79/

> "In order to ensure speedy and full agricultural benefits from irrigation projects, a programme of ayacut development is proposed as Centrally sponsored programme. This programme envisages an integrated approach, use of improved agricultural practices in relation to irrigated farming, cooperation and development of rural industries. It is intended to cover about 2 million acres of unutilised irrigation potential. The programme will, as far as possible, be implemented in compact blocks, each covering about 5000 acres. Although the programme would vary in detail from region to region and project to project, its essential ingredients would be crop planning, regulation of irrigation supplies, proper distribution and application of irrigation water, land shaping and consolidation of holdings, soil survey, arrangements for supply of inputs, extension and demonstration, credit, cooperatives, storage and marketing, communications and agro-industrial development. To start with, 20 blocks would be taken up for development. In the selection of blocks, priority is being given to 8 projects, namely, Kosi, Nagarjunasagar, Chambal Valley, Rajasthan Canal, Tungabhadra, Chataprabha, Sone Valley and Bhakra Nangal. Apart from these programmes, State Governments are also undertaking similar programmes for fuller utilisation of irrigation potential in other areas. In regard to credit, the Agricultural Refinance Corporation will have an important part to play in the programme of ayacut development."

71. This programme is especially cited not because of the volume of increased output it promises immediately, but for the new concepts embodied in it. We like the comment in another document: 80/

> "Minor irrigation is not to be a rival to major and medium irrigation; it is to be a part of the system wherein works like wells, tubewells and renovated tanks supplement the availability of water from canals and thus complete the gap in the cycle of water supply as well as meet the requirements of areas not otherwise served and remove water logging and facilitate drainage."

It is clear that research programmes urgently necessary (see below) could usefully be integrated with the Ayacut programme. Moreover, since this programme, research needs and the wider programmes of major, medium and

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79/ Para. 40, p. 187.
80/ "Recrientation of Programmes of Agricultural Production", op. cit., para. 33.

minor works will make heavy calls on experienced personnel, it is hoped that the Government of India and other governments can work out useful technical assistance programmes in which suitable overseas personnel could be made available to supplement Indian resources.

72. Our primary concern in this report is the prospect for building up agricultural output rapidly. On this a few specific comments are offered:

(a) The use of ground water, especially under private development, is being encouraged. This requires co-ordination of supplies of credit, supplies of pumpsets and power and agronomic advice. This we know is recognised but we take the liberty of stressing it again in view of past experience in which much discouragement came to those private farmers willing to invest in wells but unable to secure promised electric power or forced to use less satisfactory diesel equipment. Again this point is well taken by the Department concerned. We were assured that the number of wells without power (energy) to operate them was falling rapidly and that local manufacturers were responding to increased demands for pumpsets. For obvious reasons a particularly energetic programme is currently being mounted for emergency work in Bihar and eastern Uttar Pradesh.

(b) It would be worth examining the possibility of supplementing dug and tubewell subsidies or even replacing them by incentives (e.g. tax rebates) to manufacturers of well equipment. They could be encouraged to develop their sales and service organisation in a way designed to help farmers install and efficiently maintain irrigation equipment. 81/ A harnessing of private initiative in both farming and manufacturing could give further impetus to the achievement of the minor irrigation programme ahead of time.

(c) We feel bound to observe, yet again, that enlargement of utilised irrigation area will undoubtedly yield results in increased output (e.g. through higher yields and double cropping) even if no additional supplies of fertiliser are available. 82/ It must be expected, nevertheless, that there will, at the same time, be a further stimulus to demand for new seeds, fertiliser and plant protection materials. Shortage of these items is not an argument for slowing down the pace of irrigation development: it is simply a reminder that the shortage of these and other inputs will be increasingly felt by cultivators.

81/ We have in mind encouraging, on the domestic front, the type of activity which has developed a fine international reputation (e.g. in the Philippines) for Indian (Kirloska) pumps.

82/ On the old yardsticks used by the Ministry of Food and Agriculture, the additional irrigation area expected in the Fourth Plan period would yield 4.0 m. tonnes of foodgrains without taking into account double-cropping possibilities. (See para. 28 and Table IV above). Much depends on the "quality" of the irrigation facility resulting (e.g. quantity and period of availability of water to farmers); but we can agree that 26.0 m. acres brought under irrigation would be highly significant.

73. A general view which can be expressed without pretence of precision is that irrigation policy is now better conceived and that the short-term relative emphasis on small-scale public and private sector effort is the right one. We are unable very usefully to judge the adequacy or feasibility of the targets for supplying pumpsets at the level suggested in Table VIII. If the intended "upgrading" of minor irrigation is real in terms of capacity of domestic industry to supply equipment then what may happen is a "higher" (i.e., more effective) utilisation of existing irrigation facilities as well as the planned addition of new irrigable area. Both would be significant for potential output, that significance being increased further when and to the extent, that high-yielding seed programmes can be applied to all irrigable areas.

74. As already noted, one strong implication of the improved philosophy of irrigation now evident is the need for a continuing research programme. A few specific examples (and a few only) are indicative of the need which should engage the attention of the new "water cells" in the two Ministries concerned, the ICAR (including the associated Universities and Foundations capable of supporting research programmes) and those authorities responsible for geological surveys.

(a) The plant/water relationship needs much experimental study, not only as to amounts of water required but as to the timing or irrigation. Studies already made of wheat growing under irrigation at the Indian Agricultural Research Institute, Delhi, and the U.P. Agricultural University, Puntnagar, reveal highly significant response to correct timing of water applications. Obviously there is room on the one hand for fundamental studies of plant evaporation/transpiration ratios and, on the other, for studies of the economics of improved water management.

(b) There is hardly less scope for research in the agricultural engineering appropriate to irrigation. This includes tubewell technology; the engineering and economic aspects of various methods of water distribution from canals and wells; and the timing of water releases from reservoirs into main canals. There appears to be a scope for reconciling agricultural needs and engineering requirements or practices.

(c) Another field includes a study of soil reaction to water, including the often related problem of salinity and drainage.

(d) Not least of the needs, especially in view of the likely acceleration of ground water exploitation, is the mounting of a larger effort to survey ground water resources. This should be continuous with some preference for areas in which exploitation is likely now to proceed most rapidly.

75. The Government of India is well aware of these problems and needs. We stress them for two reasons. One is to indicate once again that while concern with the immediate gain from supplying additional water is fully understandable it does not dispose of the need for a continuing programme

of research which may not yield its dividends before the Fifth, Sixth and later Plan periods. The second is to say again that the research and survey field particularly lends itself to joint programmes of the Indian authorities and overseas agencies able to supply scarce personnel and equipment. We know several proposals are under consideration and simply commend the approach. We also refer to the scope for collaborative effort - already happily demonstrated in the Rockefeller and Ford programmes - in our notes in Part VI on Research and Extension.

76. In summary we note:

(a) Promising developments in concepts of irrigation policy and experimental application of the new thinking;

(b) The plan for a considerable expansion of area under irrigation in the Fourth Plan and the greater attention now apparent to the equipment requirements of the programme especially in the proposals for well development;

(c) The likelihood that the expansion of water supply will not only add significantly to the volume (and reliability) of agricultural output but is likely also to increase the pressure of demand for scarce inputs, notably high-yielding seed, fertilisers and plant protection materials; and

(d) The need for a large scale and continuing research and survey programme related to all aspects of future water supply and the most efficient use of water in agricultural production.

PART IV: THE CRITICAL INPUT FACTORS

(4) Plant Protection Materials and Other Inputs

77. To quote the "Draft Outline" 83/ "The plant protection programme consists of seed treatment, control of field rats, control of soil and polyphagous insects and disease control measures on annual and perennial crops. This programme has a vital role to play in the intensive agricultural programme. A target of 137 m. acres to be covered by the third year of the Fourth Plan has been proposed...."

78. The target officially declared in the "Draft Outline" appears to differ from that freely stated in Ministry of Food and Agriculture publications and in our discussion in New Delhi. The "Draft Outline" figure of 137 m. acres is included in Table III above and compares with 41 m. acres achieved in the final year of the Third Plan (as against a target of 50 m.). The figure discussed with the Mission in New Delhi in departmental meetings was 210 million acres - a level to be achieved in the third year, 1968-69. 84/ The discrepancy may possibly be explained by assuming that the 137 m. acres is net, that is, that an irrigated acre treated more than once a year is nevertheless counted only as one acre. 85/ We do not know the explanation but, in any case, here assume that the detailed data on materials and equipment required for the programme given to us by the Department of Agriculture relates to a gross area reaching a plateau of 210 m. acres per annum in 1968-69.

79. What we perhaps most usefully do is record briefly a number of points about the plant-protection programme which seems to us to be going forward with vigor.

(a) The use of a single-acreage target figure is somewhat misleading. Thus, it covers separate acreage objectives for rodent control (20 m. acres), seed treatment (50 m. acres), soil insects (20 m. acres), intensive treatment (113 m. acres gross) and weed control (7 m. acres). The programme is, therefore, not a homogeneous one and by its nature must be a flexible one.

(b) The apparent division of labour between Centre and States is implicit in the following statement: 86/

> "Plant protection measures are proposed to be organized in such a manner as to meet fully the requirements of special intensive cultivation programmes. Further, the

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83/ Para. 52, p. 190.
84/ See "Agricultural Production in Fourth Five Year Plan", op. cit., p. 11.
85/ This could be inferred from the table given in "Agricultural Production", above cited, para. 3.10, p. 11.
86/ "Agricultural Production in the Fourth Five-Year Plan", op. cit., pp. 10-11.

Central Government would be responsible for the control of epidemics and also for aerial spraying. States would be responsible for providing mobile units with necessary power sprayers, hand-sprayers and ready stocks of insecticides for tackling epidemics of a minor order."

(c) Plant protection can be regarded as one of the four principal elements in the high yielding varieties programmes ranking with water, fertiliser and the seeds themselves. This is because the development of high-yielding seeds characterised by dense plant populations per acre is almost inevitably accompanied by problems of disease and pest, requiring both constant research attention and active field programmes for control. It is necessary, therefore, to record the active programme being stimulated by and co-ordinated from the Centre. The programme includes making arrangements with domestic and overseas firms for manufacture of chemicals and equipment. This campaign appears to be meeting with success. It is assumed that constant touch will be maintained with overseas experimental work and that local adaptive research will be widely extended. Training of local officials and farmers is a vital part of the total programme.

(d) We noted, in our discussion in New Delhi, that the principal bottleneck in organisation seemed to be the inadequacy, as yet, of mobile teams equipped with power sprays for acting quickly over large areas. This was well recognised. In another form of effort, aerial spraying, developments were well forward. This method naturally has appeal but its use is probably limited to large crops areas (e.g. cotton) in open, flat country; it does not call for the priority needed for mobile teams in the dominant areas of intensive, small-scale cultivation.

(e) There are some foreign exchange requirements in the programme. These, fortunately, are not large for they require the same priority as most other parts of the agricultural programme. 87/ Given this, a continuing link with research workers and administrative attention to special problems as they arise (such as formation of mobile teams), we are of the opinion that the programme is likely to be adequate to the rest of the "new strategy".

87/ See Part VII: Foreign Exchange below for our estimates of the amount required.

80. Other Inputs: The agricultural programme as set out in the "Draft Outline" and various other documents cited in this Report, includes a considerable expansion in the output of tractors and agricultural machinery generally. 88/ This expansion is needed not only for land reclamation, soil conservation work and land levelling for irrigation and seed-production programmes but also to meet the growing demands by farmers able to make profitable use of wells and mechanical equipment in their ordinary farming operation. The ordinary tools of the very small-scale farmer are also subject to improvement programmes.

81. Time precluded any detailed consideration or discussion in New Delhi of actual proposals and programmes for the Fourth Plan and therefore no worthwhile comment can be offered. It is clear that total demand for more mechanical aids to farmers is growing. It would be wrong to assume that this is confined to large-scale farmers, farming, for example, 25 acres or more under irrigation. It comes from all who wish for better tools, powered dug wells, land levelling and soil conservation work (often by contract service). Nevertheless, it is probable that it is the larger farmer who is coming more and more to dominate programmes for expanded output. Since the benefits of the new technology need not be confined to larger-scale farmers - the new varieties can be grown under labor-intensive conditions, provided water is assured - it is to be hoped that the agricultural-implements programme will continue to give emphasis to the scope for improved tools on small farms. We have no reason to think this is not likely but stress it in view of the social implications of a total programme (the new strategy) which must inevitably be most attractive to the farmer of larger importance. 89/ Although in the intensive area "There is to be no discrimination between cultivators on the basis of resources or the size of building," 90/ it is likely that the most rapid response will come from the farmer most able to raise resources of his own, as well as by borrowing. In the short run, this will have advantages for output; but since so much output for consumption will continue to come from the small cultivator who forms the bulk of the farm population, it is highly important to offer all possible methods of improved farm practice to him. 91/

88/ See Tables III and VIII, and also Part VIII below.

89/ Who, incidentally, is the one who should be financed according to the authors of the National Council of Applied Economic Research (New Delhi) publication: "A Strategy for Agricultural Planning". This is because these are likely to contribute most to the much needed marketable surplus of foodgrains. It seems to us the "new strategy" and particularly the High-Yielding Varieties Programme will achieve this without trying to devise even more complicated fertiliser and seed allocation programmes.

90/ "Draft Outline", end of para. 8, p. 175.

91/ Although these tenant and small-scale farmers are minor contributors to marketed surplus, their efficiency must be raised to improve their own consumption levels and to begin to make a contribution to this market. This is not necessarily an argument against the long-run (and in our view) inevitable enlargement by aggregation of very small holdings.

82. As we have observed elsewhere in this report, 92/ the "new strategy" as a whole, not merely the development of more mechanisation in agriculture, may widen the gap between farmers in favoured areas (e.g. enjoying good water supply and larger areas) and the very small farmer or the one who farms in uncertain rainfall areas. This may have implications for existing land reform policies but it also calls for a good deal of attention to the problems of the small, labor-intensive farmers under all conditions. This is why we stress the scope for improvement of tools used by these farmers and the maximum extension (by state or private contract service) of the benefits of mechanisation to him. Applications of this principle include the operation of land grading teams and mobile plant protection squads. In this way, he has improved chances of using a more advanced technology.

92/ Part VI: Research and Extension, para. 92.

PART V: CREDIT

83. The Planning Commission states in the "Draft Outline": 93/ "The mounting of a massive agricultural production programme calls for a considerable step-up in the supply of agricultural credit which can only be reached if policies are clearly defined and implemented." We readily endorse this comment with perhaps more sharpness than the authors do. 94/ Agricultural policies are now well defined but the quantitative, qualitative and institutional aspects of total farm credit policies are still far from being clear and fully reassuring. Official thinking has advanced considerably and, as with other aspects of agricultural policy, there is far more convincing, recent evidence of willingness to act (see, for example, para 83). We accordingly attach great importance to the work of the current "All-India Rural Credit Committee" to which we make reference later after some specific comments on the problem ahead. These comments are not made at length and are not particularly new or original. They are, however, designed to note recent policy developments and problems and to emphasise the importance of finding answers to the problems, for an inadequate credit structure could prove a serious constraint on agricultural growth.

84. We follow the usual distinction between crop production (short-term) and developmental (long-term) credit. The organisational problems are considerable under both heads but in terms of prospective shortage of credit the problem may be relatively greater in respect of the latter. Under the former head we note several points:

(a) The first is continuing effort to make cooperatives more viable, the intention being to reduce the number of primary credit societies from 208,000 to about 128,000 by 1970 95/ and to strengthen the financial structure of those remaining. 96/

(b) The second is the welcome recognition that in some States 97/ cooperatives are and will remain too weak to give coverage to demands for crop production credit. Special Agricultural

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93/ Page 176, paragraph 12.

94/ It is proper to note, however, the complete frankness with which credit problems are discussed in the "Draft Outline", especially in Ch. IX dealing with cooperatives. In our discussions we found the same frankness, itself the best assurance that more adequate policies will emerge, for there is no lack of recognition of the serious nature of the problems.

95/ "Draft Outline", page 137, paragraph 6.

96/ This strengthening includes writing off debts and reconstructing the debt structure and efforts to marshal more deposits and share capital from members. See, "Draft Outline", page 137.

97/ Including West Bengal, Orissa, Rajasthan, Bihar and Assam.

Credit Corporations are to be set up in these States. 98/ Since the necessary legislation is unlikely to be put through until mid-1967 at the earliest, it has been decided to use taccavi credit (direct advances by State Government departments). 99/

(c) There seems to be a stronger 100/ move to reshape cooperative lending in ways which will give the small farmer (whether owner or tenant) more scope. Arrangements are being more widely adopted for mixed cash and "in-kind" loans which will back farmer efforts to use more inputs. Such moves are welcome for they embrace a wide group with little to offer by way of real estate security. Advancing money against a prospective crop is useless unless the crop provides a "surplus" for loan repayment or the cultivator has outside earnings available. In the long run the proper solution is to enlarge the very small holdings, whether owner or tenant operated, to a point where surpluses can be expected as a matter of course.

(d) To achieve the objectives for cooperative, agricultural credit corporations and taccavi credit (to the extent this type of credit operations must continue) a large increase in funds is called for. The planned increase is large 101/ and is less dramatic than might be thought because of increased costs of operation already evident or likely. 102/ This presumably will be a matter for thought by the "All-India Rural Credit Committee" and ought to be one subject for the discussion with the Government of India suggested in our conclusion to this Part. One thing to be stressed is that the cooperatives are not likely on present indications to meet much more than half (at very best) of total short- and medium-term

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98/ "For details see Reserve Bank of India: Report of the Informal Group on Institutional Arrangements for Agricultural Credit" (May 1964) Page 94. See also "Draft Outline", page 139, paragraph 15.

99/ We regret some uncertainty, but presume that the bulk of such finances at least will come from sources arranged by the Centre.

100/ We hesitate to be too optimistic on this matter despite a report in The Financial Express of October 12, 1966 which reads: "The State Ministers of Co-operation, at their conference here to-day, expressed the hope that their governments would be able to effect the change-over from the asset-oriented system of loans to farmers to the crop-oriented system by the end of 1967" (Our italics).

101/ See "Draft Outline", page 137.

102/ It is true that currently incomes of farmers not afflicted by drought have increased, especially where the "new technology" has begun to operate. This lessens the strain on credit resources but does not dispose of any but a small part of the problem under discussion.

credit needs. 103/ Hence it is highly important to clarify just what the other sources are and what real prospects there are that these sources will expand adequately. 104/

85. The problem of assuring a large enough supply of long-term or "development" credit (5 years or more) is even more severe than for short-term credit. Again we offer only a few comments, enough perhaps to illustrate the nature of the problems ahead:

(a) A major part of the agricultural programme depends upon private initiative in dug and tubewell development, soil conservation and land levelling and grading. All these activities call for capital equipment for which considerable credit resources will be required. Again our informal information (Ministry of Agriculture discussions) suggests an order of magnitude of Rs. 800 crores. Of this the official target for the Co-operative Land Mortgage Banks is some 300 crores or less than half the estimated total required. It is not at all clear where the other 500 crores will come from.

(b) The Land Bank system seems structurally sound but is heavily dependent on support from the Reserve Bank, State Bank, Life Insurance Corporation, the Central Government and the Land Bank structure itself, the principal instrument being debenture holdings. 105/ Present debenture holdings amount to about 39 crores. Outstanding loans (advances to borrowers) amount to 150 crores. 106/ The 300 crores mentioned above seems to be additional 109/ and would require some 275 crores in debentures. This is so vital and yet so uncertain in prospect that we trust the "All-India Rural Credit Committee" will give the most careful consideration to the whole question of long-term finance.

103/ The best guesses of the Ministry of Agriculture are that total needs will be Rupees 1200 crores for 1970-71 (see "Agricultural Production in the Fourth Five-Year Plan", op. cit. page 15). Cooperatives may provide 650 crores of this amount (approximately 400 crores now). This latter figure is an official figure (See "Draft Outline", page 137) but it also necessarily represents at best an informal judgment.

104/ In this connection there is ample scope for arrangements with commercial banks, agricultural credit corporations and the State Banks of India for credit to be extended to dealers in fertilisers and chemicals (agents for producing companies), with the idea that these agents could also extend credit to farmers.

105/ See "Draft Outline", paragraph 14, page 177.

106/ This statement requires checking for it is given as an expectation. (See "Draft Outline", page 138, paragraph 12).

107/ See "Draft Outline", page 138, paragraph 12.

This would naturally include the role of the Agricultural Refinance Corporation which, at this stage of its experience, seems unlikely to bridge much of the gap. It, too, should have high priority in the special discussions we suggest in our conclusion below.

(c) In the meantime we note with understanding the readiness to assure the long-term credit needs of the intensive areas selected for the High-Yielding Varieties Programme and with even more understanding the unqualified assurance that emergency land and water development in drought afflicted areas will not fail for lack of appropriate long-term credit. As the Minister for Agriculture has expressed it, "performance is the only limit for developmental credit". As we understand it, the Centre will take up debentures (up to 10 crores) in the Land Bank structure via Reserve Bank (using budget sources if necessary) and will also provide direct budget funds beyond this provided the Chief Ministers can satisfy the Centre authorities that the physical resources - equipment for wells, pumps and the needed power, etc. - are actually available if credit is advanced to individuals. This action can be understood as a short-term measure especially as the advances are dependent on the real resources being first produced. 108/ Yet there is apparent a clear shortage of ordinary savings available for a priority purpose which seems to reflect an unattractive interest rate structure as well as a total shortage of mobilised savings for urgent development purposes. As already stressed this whole problem calls for examination in an effort to find a more satisfactory solution for the period as a whole.

86. We have not tried to hide our fear that, on present indications, the credit backing for agricultural expansion in the Fourth Plan will prove inadequate. We regret that our own study has been so inadequate - through no fault of the Indian authorities from whom we obtained full cooperation in the limited enquiries we were able to make. For this reason we believe, and recommend strongly, that the Bank should make a more detailed examination which may point to ways and means of facilitating support. Credit problems should not be allowed to prove a serious constraint on progress. Fortunately, action taken by the Reserve Bank and noted above will greatly facilitate the proposed study. The "All-India Rural Credit Committee", recently appointed by the Governor of the Reserve Bank under the chairmanship of Mr. B. Venkatappiah, is engaged in a review of the supply of rural credit in the context of the Fourth Five-Year Plan. If it can finish its work by - say - mid-1967 the study by the Bank could take the form of a joint examination with Government of India officials of the Committee's conclusions. We take the liberty of urging this for we are inclined to place uncertainty about the credit situation and remedial steps required, high in the list of factors critical to the success of the newly-invigorated agricultural programme.

108/ This pre-requisite is no doubt designed to limit the inflationary impact and not unreasonably assumes that the labour required is readily available from unemployed or under-employed "pools".

PART VI: RESEARCH AND EXTENSION

87. We have argued the need for two things in the field of research and extension: (a) to obtain added production by pushing the existing technology to its limits; and (b) an effort to reduce or remove the barriers to growth by evolving a "new" technology. A new technology comes with degrees of dramatic force varying from almost nil to much, as new varieties of seed are evolved, new sources of water supply are found or more efficient ways of harvesting become available, or, again, new forms of (applying) power make possible differing tilling systems as might, too, the consolidation of fragmented holdings into more manageable blocks. Research is the key to this situation, as demonstrated by the dramatic emergence of results obtained from the Indian-based programmes and from work done elsewhere (in Mexico on wheat and in Taiwan and the Philippines on rice), - work which has dramatically provided the basis for the new technology now incorporated in the High-Yielding Varieties Programme described earlier in this report. Yet the very drama of the rapid emergence of a new technology may be the reason for some concern, for it may turn energies and attention to the great logistic problem of securing the necessary inputs, especially fertiliser, away from the critical need to mount a concurrent and vigorous research programme.

88. Research has been the means of innovation, but continuous innovation is necessary. New varieties must be evolved to replace those now being used to launch the new programme either because they are better yielders or have other desirable characteristics such as shorter growing periods, better resistance to insects and disease or more tolerance to less than highly skilled cultural management. The High Yielding Varieties Programme will run into problems which will require early attention and solution if the Fifth Plan is to sustain the momentum now being launched in the Fourth. The point is worth some small elaboration. The argument is that, although this Report is limited largely to critical factors which threaten substantial achievement in the Fourth Plan period, it is necessary to be alert to the continuing research needs of new programmes and to act now if action now is the only way to be sure that a valuable programme will not be needlessly impaired.

89. Our point must be made more briefly and admittedly somewhat more dogmatically than we would like. 109/ The three general conclusions to be illustrated are:

(a) The new technology brings with it major problems for research and accentuates a number which were already apparent in the older technology. In short, old "gaps in research" are aggravated while new ones appear;

109/ In writing this Part considerable use has been made of unpublished material prepared by Dr. Hopper and of ideas developed in the "Report of the Education Commission, 1964-66" (Ministry of Education, G.O.I), especially Ch. XIV.

(b) There has arisen a more pressing need for effective integration of research and extension; and

(c) It is clear that sustained growth in output requires continuous research and the extension of the results to the cultivators. It is no less evident that both the research and extension processes rest on the development within India of a cadre of trained professional agriculturists capable of giving the skilled leadership required for transforming Indian agriculture in accordance with the new technologies.

90. Research: We offer a few illustrations and comments on each of this trilogy of research, extension and agricultural education, with particular reference to the need for action now rather than later. We begin with research on which our first point is to note with considerable concern the apparent lack of an adequate financial allocation. Neither in Chapters XI and XII relating to Agriculture nor in Chapter XVII on Scientific Research does the "Draft Outline" give much attention to agricultural research and seemingly none at all to the financial resources required. We do not suggest that none is provided but the need is considerable and recognition of the need is vital in a situation in which priorities are tested by the financial backing given them. One figure of Rs 25.0 crores was mentioned to us in discussion of the work of the Indian Council of Agricultural Research (ICAR). This seems less than lavish alongside Rs 50 crores to the Department of Atomic Energy for research and development, Rs 46 crores for the Council for Scientific and Industrial Research and Rs 24 crores allotted to the Department of Science in the Ministry of Education for "anthropological, botanical, sociological and other scientific activities in the department." 110/

91. The apparent (and we hope the situation is apparent rather than real) lack of adequate resources for agricultural research would not only suggest an over-concentration of administrative attention on the immediate logistics of the new agricultural strategy but perhaps an unwitting over-reliance on external research results for solving India's problem. In the first flush of enthusiasm about the results of the Mexican wheat and Taiwan (Native) 1 rice, such a mistake could be understood. But it would be a costly mistake. The writer can do no better than, with his permission, quote fully from Dr. Hopper's unpublished material:

> "Agricultural research in India has always focussed heavily on plant-breeding and genetics leaving significant gaps in areas such as plant physiology, soils, entomology, phyto-pathology, etc. The breakthroughs recently attained by the cooperative efforts of a world community of plant breeders have set Indian workers on new paths that offer significant returns to the nation, but these same results hold potential dangers for the economy unless there is a significant follow-up by research workers of the full spectrum of professional agricultural scientific disciplines. The high plant populations that are

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110/ "Draft Outline", para. 24, p. 336.

> the key to high yields of the new varieties open what could be most devastating opportunities for insects and plant disease micro-organisms. The environment for disease development will be further enhanced with the high application of nitrogen fertiliser that is part of the agronomic environment under which the high yielding crops are to be grown. Compounding and complicating these two factors is the significant fact that in developing the new varietal material the plant breeder could only breed for resistances to existing strains of micro-organisms and diseases, strains that for the imported varieties may not be in India, and even for the locally bred crop materials, the high nitrogen environment and heavy plant population grown under different conditions of irrigation and other cropping practices will likely cause large changes in the strains and types of micro-organisms that attack the crop with no certainty that built-in resistances will provide protection in the situation of an altered ecology. Likewise, the development and widespread use of new high-yielding plant material will bring with it new demands on the nation's agricultural soils, some already significantly exhausted by age old cropping, and will likely expose trace mineral dificiencies, problems of maintaining soil structure, etc. that will call for wide ranging research involving soil and crop chemistry, engineering practices of soil handling, the agronomy of soil-crop relations, etc. What is crucial is an understanding in India that while the immediate problems arising from a continual agricultural stagnation have some promise of solution, the solution itself carries a large burden of potential problems. Many of these cannot be anticipated specifically at the time a new development strategy is launched, but what can be predicted is that research scientists in opening the way to high yields have opened a way that will call for much higher investments in agricultural research just to keep abreast of the development process they initiated."

92. This states, with helpful incisiveness, the need in the varietal research programme itself. However, the gaps in research are even more extensive than this one situation would suggest. 111/ The scope for research is tremendous in soil and water management, water and soil engineering, entomology, plant physiology, crop rotational practices and not least, the economics of farm practices, fertiliser applications and so on. Moreover, the problems of the new technology do not exclude the need to pay particular heed to the problem of those cultivators outside the present scope of the new technology or those whose holdings could be farmed intensively but whose operations are too small to justify or even allow the investments required. We have already commented on this problem. 112/ Excitement about the dividends to come

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111/ Part IV, Section 3.

112/ See Part IV, Section (4), para. 82. Dr. Hopper's material contains a considerable elaboration which it is hoped will receive consideration in the work of the ICAR and especially in the universities.

from the new technology as applied by cultivators able to raise the resources must not be allowed to dominate the total research effort to the exclusion of those trying to push old technologies to their limits or trying to find ways, within presently limiting constraints of small holdings and poor credit status, to obtain the benefits of the new technology.

93. Having gone to some length to establish our concern lest the "gaps" in research be not fully realised by the planning authorities with a commensurate inadequacy of allocation of financial resources, we hasten to acknowledge progress in improving the institutional arrangements. The Indian Council of Agricultural Research (ICAR) is now in a position to direct and co-ordinate the national research effort for agriculture. The present position may be a little short of the words of the "Draft Outline": 113/ "All agricultural research stations have been centralised under the control of this body. Co-ordinated research schemes dealing with all the problems of important food and cash crops are being taken up." Nevertheless, for the hybrids - maize, jowar, and bajra - co-ordinated programmes are under way (in continuation of those which gave the "break-through"), a wheat programme has been operating for some time and programmes for rice are about to be launched. Under these schemes there are Centre-State agreements directed by a Centre appointed co-ordinator who handles the central funding for the project and ensures an effective relationship between the various research centres. In this way all researchers are able to take advantage of geographic and climatic differences within the country which enable two or three experiments in the course of one year. Not the least advantage of co-ordination are the annual meetings of crop improvement workers in which scientists are now able to pool experience and ideas and respond to the stimulus of frank criticism. In this last a major ingredient is the participation of progressive and successful farmers able to offer an important "feed back" from field experience to the research station.

94. It is tempting to dilate further on research but we limit ourselves to one further comment. Work done overseas and by foreign scientists working in India has played a major part. It ought not to be thought that work by Indian workers has not been highly relevant, for it has. Moreover, the high morale of Indian scientists, as they find that national leaders and farmers alike appreciate their work, is very evident. Nevertheless, there are not enough of them - a point of great importance in later comment on the agricultural universities. More must be trained but meanwhile it will be to India's advantage, in all fields of research, to continue established collaboration and to develop new joint programmes in the effort to deal with new problems and long standing "gaps".

95. Extension: In application of research (which is the innovation aspect of basic research) it is the cultivator who matters. Here there is a major problem of communication which requires integration of research and extension effort and the trial by farmers of new ideas coming from the

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113/ Para. 70, page 196.

research station. The position is still far from satisfactory. Some reconsiderations of extension effectiveness are necessary because of the much greater sophistication of the new technology than the old, and in this connection we offer the following comments:

(a) It is necessary to reject finally the idea that the old system with the Village Level Worker at its centre will do. Research has now much to sell, but the traditional V.L.W. cannot be expected to sell it: a much higher level of training is required. Not only this, but those responsible for demonstrating new techniques should have links with research centres, preferably universities where these are strongly established.

(b) The system of national demonstrations is in its infancy but has already shown its importance to the morale and efficiency of the research scientist associated with the work. This arises from his direct experience of the problems met in the field and the bond established in the field. This should be a feature as much as possible, too, of the so-called "second line" demonstration at State and regional levels for, although the trained extension worker is here in charge, the scientist concerned with research should be available as "back-stop" to extension worker and farmer alike as they meet problems.

(c) This last comment suggests strongly the wisdom of allowing the ICAR to include the extension function in its bailiwick. If the Centre interest were there located, the ICAR could not only employ the same co-ordinated relations with States now being so well used in respect of research, but could also exercise more direct pressure to ensure an adequate link between research and extension. 114/

(d) At the State level we believe the agricultural universities will gradually become dominant in agricultural research and extension. This would be well worthwhile provided they continue to be within the ICAR co-ordinated programme. The emergence already of some strong agricultural universities (for example, Punjab at Ludhiana and Uttar Pradesh at Puntnagar) have shown that the farmers appreciate the link between themselves and the research and extension programme there being developed. 115/ Punjab has given the University full state-wide responsibility, a move which could be followed by the State of Uttar Pradesh. To be effective on a state-wide basis such responsibility must include responsibility for research and extension carried out from subsidiary research

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114/ We endorse para. 14.20, p. 353 of the "Report of the Education Commission" which favors increasing integration of research, extension and agricultural education through the ICAR.

115/ Indeed, this should be counted as one of real gains from investment in the development of these universities in the Second and Third Plans.

stations and other colleges in the State. 116/ As any programme of establishing the universities as research and extension centres all over India at best will be slow, 117/ we urge that maximum fusion of research and extension be entrusted to the ICAR. In this effort it would naturally also give attention to the national role in extension of the Indian Agricultural Research Institute at Pusa. The IARI has an excellent opportunity to extend its own research on a national scale through its many subsidiary stations provided these are properly equipped and provided they effect suitable links with the State universities and other extension authorities.

96. Education: We have not tried to pretend that the extension effort is anything but unsatisfactory. There has been improvement of understanding and of effort in the Centre and in some States. Much has yet to be done and some major decisions are required. Whatever the future course it seems likely to include an effort to expand the number of agricultural universities and to upgrade the contribution of present ones to the total agricultural effort. This must include the training of agriculturists both for research and extension work. This in turn calls for upgrading of a number of the 66 colleges which should not carry certificates while they continue to lack suitable equipment and effective, qualified staff. 118/ Perhaps the need of graduates (allegedly 29,000 in the Fourth Plan) is overstated; whether so or not, quality is to be preferred to quantity, for this is what the new technology demands. Certainly the farmers will demand this or ignore the research stations and the preffered advice. 119/

97. It is not proposed to say more on this subject. For our part we are impressed by the good sense shown in Chapter 14 of the "Report of the Education Commission" and believe it offers an excellent basis for the many needed decisions and hope that its recommendation will be given serious attention by the States who have yet to make forward moves of the kind already made in Punjab. We have tried to convey a greater sense of urgency than we find in the "Draft Outline" about the need for stepping up research and extension. There may be sufficient momentum already established to carry agriculture forward for two or three years; but unless the total effort is stepped up now, that momentum will peter out by 1970. Loss in momentum would represent a serious set back. For, in summary, it cannot be

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116/ There has been throughout India a big, but largely wasted, investment in district farms and small local research stations. This investment could be "rescued" by up-grading these farms and stations into integral parts of co-ordinated research and extension activities.

117/ And necessarily phased - as recognised by the "Report of the Education Commission", para. 14.22 page 353.

118/ It seems to us that the "Draft Outline" glosses over this problem. (See para. 68, p. 195)

119/ This suggests, too, that training of extension workers must include training in how to grow the crops under the new technology - a point of significance in India not only because the technology is new but because many students will come from backgrounds offering no help.

said too strongly: the new technology will bring with it problems which call for adaptive research; despite some encouraging developments, the present link between research and extension is inadequate as is the quality of extension available; and finally, agricultural universities are likely to prove more and more important not only as geographic centres for research and extension but also as the means of providing the training of the graduates required to assure success for research extension programmes. In all this there continues to be scope and need for drawing on overseas experience and help. Finally, we would like to see in the final Report on the Plan evidence of a reasonable allocation of India's own economic resources.

PART VII: THE CRITICAL MATTER OF FOREIGN EXCHANGE

98. This Report has addressed itself primarily to an indication of new and more convincing agricultural policies largely developed and promulgated over the past two years. We have reviewed what seem to us to be the most critical factors affecting the prospective success of the new programme for agriculture. At the back of much of our comment has been an awareness, often explicitly stated, of the acute foreign exchange situation overhanging the hopes for economic development in India. Other reports of the Mission deal with the totality of this problem which, of course, is of great interest and concern to the Consortium as well as to the Government of India. Here we propose to indicate the large foreign exchange needs represented by the agricultural programme together with the larger costs of failure.

99. Table IX gives some data which suggest an order of costs of the programme ranging from about $2,100 m. to just under $3,000 m. for the five-year period or from 20.0% to 27.5% of the level of exports ($10,709 m.) tentatively projected for the same period by the Planning Commission. 120/ The major item is fertiliser costs and the range in estimates shown depends on views held about the proper targets for fertiliser usage and prospects for effective import replacement during the period. The level of required imports is, in any case, considerably higher than in the Third Plan 121/ reflecting, of course, the much higher volume of inputs and equipment required to back the "new strategy". If there were no balance-of-payment problem this would be of no great moment. However, since the "planned" excess of imports over export earnings is substantially greater in the Fourth Plan than in the Third, any call for a large increase in imports for a particular sector must, indeed, have strong reasons for the priority shown. In the case of agriculture adequate expansion is impossible without added use of foreign exchange and, unfortunately, there is no alternative, for failure in the agricultural sector spells even greater trouble for the external economy not to mention the domestic problems already too familiar. Any objective for "economic self-reliance" 122/ or "progressive reduction in the dependence on foreign assistance" 123/ must emphasise a rapid rate of growth in agriculture in order to expand exports and reduce imports. But, at least, in the short term of the next five years this will require considerable enlargement of foreign exchange resources allocated to the agricultural sector for the purchase of fertiliser, equipment and other physical inputs. Table IX

120/ See "Draft Outline", para. 17, page 97.

121/ It is regretted that it seems impossible to give without considerable research a figure for Third Plan imports of fertiliser (and raw materials) directly comparable with the estimates for the Fourth Plan given in Table IX and in Mr. Sonley's work. However, the "Draft Outline" (p. 102) gives Rs. 160 crores ($337 m.) for "fertilisers crude and manufactured" imported in the Third Plan. This was a negligible percentage of total imports.

122/ "Draft Outline", op. cit., p. 16.

123/ "Annual Plan, 1966-67", page 3.

illustrates the problem although the picture it gives is necessarily incomplete without reference to added export earnings which may result from the agricultural programme and to the large savings which will come if food imports can be substantially reduced or better, eliminated. 124/

100. The major item of foreign exchange cost is fertilisers which could easily amount to 20% of target export earnings (see Table IX). 125/ The cost due to lag in establishment of domestic production capacity or full use of available capacity, estimated by the Mission, is $508 m. or 4.7% of total planned exports; of this $508 m., some $293 m. is due to the estimated shortfall in production of N in 1970-71 alone, against the target desired by the Ministry of Agriculture, of 2.4 m. tonnes N in that year. 126/ The implication is clear: import replacement is of major importance here and the problems of achieving a rapid expansion in domestic production of fertiliser must rank high in policy consideration. These problems are dealt with in other reports and will not be further commented upon here except to observe that any projection of the lagging output of fertiliser into the Fifth Plan should be made against a similar projection of rising demand.

101. Against these costs may be set the hoped for, but in large measure dependent, increase in agricultural earnings from exports. The Plan calls for exports of $2,573 million in 1970-71, as compared to $1,700 m. in 1965-66. This is an increase of $873 m. Of this increase, agriculture is being called upon to provide $313 m., as follows (in $ million):

Tea	103	Tobacco	28	Sugar	16
Vegetable Oils	43	Pepper & Spices	29	Fruits & Vegs	12
Oilcake	40	Pulses	19	Cotton	10
				Coffee	13

This is about 36 per cent of the total increase; and to this percentage can be added the contribution of agriculture to processed jute and cotton exports (which together are expected to yield an increase of $85 m. in 1970-71 as against the 1965-66 figure). We make no comment on the soundness of these hopes beyond observing that agriculture cannot be expected to expand its export earnings to this degree if key input and investment items in short domestic supply are not made available.

124/ In recent years cereals imports have been high both on PL 480 and commercial account. Drought has been a major factor but it must be borne in mind that if the rate of growth in agriculture remains low (i.e. under say, 4.5%, annual imports are likely to be necessary with large increases in years of below normal rainfall).

125/ Table IX also assumes a maximum usage of fertilisers at the levels stated in Note 3 to that table. Were there no limitation on imports we are confident these totals would be exceeded. Again the table necessarily assumes constant prices at the levels given by Mr. Sonley in Appendix IV.

126/ We recognize that the "official" (Planning Commission) target for usage in 1970-71 has not yet been raised beyong 2.0 tonnes N. We have used the higher figure largely because we believe that even this will be less than the demand which will be generated by the new programme.

102. There may be two other ways of usefully looking at the "cost" of these inputs required by agriculture, both in terms of the implication of failure to achieve agricultural (foodgrains) self-sufficiency. 127/

(a) Assume no foreign exchange were allocated for the inputs specified. This is absurd since it would spell inability to sustain present levels of "normal" production (say, 90 m. tonnes) let alone expand output in the Fourth Plan. Moreover it would also bring expansion of agricultural exports to a halt. Yet the average annual cost of under $600 m. (Mission's estimate of $2,949 m. for the period divided by five) would purchase not more than 4.8 m. tonnes of rice or say, 7.5 m. tonnes of wheat on commercial terms. 128/ Since requirements will, in 1970-71 be at least 110 m. tonnes, the difference over present "normal" production (90 m. tonnes) of 20 m. tonnes could not be financed as ordinary imports. In any case the economic and social disaster represented by agricultural stagnation and even retrogression needs no further statement.

(b) It follows that we must assume a substantial allocation of exchange resources for the necessary inputs. The levels assumed in Table IX promise, given reasonable seasons, to provide real relief from the economic and social stresses which must occur if domestic production does not build up at least by close to 4 m. tonnes a year. 129/ Should it be impossible to meet the fertiliser requirements, however, we must assume that every fall in supplies of say 100,000 tonnes N will now mean something like a reduction in potential output of some 1.5 m. tonnes of foodgrain 130/ or an at

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127/ Our consideration will be in terms of 1970-71 and we will ignore any imports required in that year to build up buffer stocks as distinct from imports required for direct immediate consumption. Our concern is, therefore, with imports which might be necessary should production fall below quantities needed for those levels of consumption which would render imports unnecessary. (We have suggested a minimum level of 110 m. tonnes).

128/ Rice is taken at $125 per tonne and wheat at $80 per tonne. A point has been reached in the PL 480 programme in which, if only for general policy reasons, calculations cannot possibly rest on an assumption that all and any shortfalls will be made up for by "PL 480 type" imports.

130/ And, of course, as already noted, highly significant relief from the present strain imposed on foreign exchange reserves by both PL 480 and commercial imports of cereals.

131/ "Nitrogen" - The old "yardstick", (ratio of extra output to additional input) has 10 tonnes foodgrain added output for each 1 tonne N used additionally. We have used 15:1 in recognition of the effect of the higher responses to be expected from the acreage likely to be under the Higher-Yielding Varieties Programmes in 1970-71.

least equivalent value in agricultural exports. The cost of this fertiliser would be some $27 m. or about 216,000 tonnes of rice or 334,000 tonnes of wheat. This is not a profitable exercise unless it can be shown that the import of grain is not necessary. This could only be if the fertiliser actually available proves sufficient to produce an amount equal to or greater than the minimum food supplies. Such a judgment could only be safely made, for any one year, if a buffer stock were available or because it had already become apparent beyond doubt that the actual "yardstick" (ratio of additional output to additional fertiliser input) was higher than anyone could at this time (late 1966) safely assume.

103. There is little point in extending this discussion further. Certainly at this time all the evidence points strongly to the wisdom of pushing on with plans for raising domestic production of fertiliser while in the interim going to the maximum possible allocation of exchange for imports. This view is held not only in terms of the foreign exchange argument but even more strongly in terms of the importance of an expanding agricultural sector to growth and "health" in the rest of the economy.

TABLE IX: PRELIMINARY ESTIMATES OF FOREIGN EXCHANGE REQUIREMENTS FOR AGRICULTURAL PROGRAMS IN FOURTH PLAN[1/]

($US millions)

Item	Ministry of Food and Agriculture in 1965/2		Mission Estimate/3		Excess of Mission over Ministry Estimate	
Fertilisers 4/ 5/						
N	908	(806)	1,261	(1,008)	353	(202)
P_2O_5	515	(515)	671	(671)	156	(156)
K_2O	208	(128)	207	(129)	-1	(1)
Total	1,631	(1,449)	2,139	(1,808)	508	(359)
Plant Protection 6/	110		179		69	
Agricultural Machinery and Equipment 7/	226		275		49	
Irrigation 8/						
Major and Medium	231		231			
Minor	37		37			
Miscellaneous 9/	71		88		17	
TOTAL	2,306	(2,124)	2,949	(2,618)	643	(494)
Percent all above of Planned Exports 10/	21.5	19.8	27.5	24.4		
Percent Fertilizers of Planned Exports 10/	15.2	13.5	20.0	16.9		

1/ Note that table deals only with inputs required for agriculture and is not a review of imports of goods of agricultural origin.

2/ As presented in "Agricultural Production in the Fourth Five-Year Plan -- Strategy and Program", August 1965, p. 24; this is perhaps the most inclusive published source of information representative of the thinking at the time of Plan preparation. These data have been adjusted to exclude milk powder (Rs. 18 crores) and factory equipment; and an alternative (current) source for irrigation data has been used, as cited below.

3/ See Appendix IV for sources and detail. Note that the Mission gave primary attention to fertilisers in assembling these data.

4/ Figures not in parentheses are based on a target consumption in 1970-71 of 2.4 million tonnes of N, 1.0 million tonnes of P_2O_5, and 700,000 tonnes of K_2O. The figures in parentheses are based on the targets presented in the Draft Outline of the Fourth Plan, that is, 2.0 million tonnes of N, 1.0 million tonnes of P_2O_5, and 350,000 tonnes of K_2O. The higher targets are favoured by the Ministry of Food and Agriculture.

5/ The data in parentheses apply to the lower of the consumption targets noted in footnote 4/; in the case of column 1, they represent a reduction in the data to the left in the same proportion as are the two consumption targets.

6/ Includes finished and raw materials, and spraying equipment.

7/ Includes equipment for seed testing, minor irrigation, and soil and water conservation.

8/ Data drawn from unpublished documents made available by the Planning Commission and the Ministry of Food and Agriculture.

9/ Column 1 includes all items in the source document which are not mentioned above, with the exception of milk powder (eliminated as noted in footnote 2/), and with the addition of fisheries ($32 million). The composition and sources of the Mission estimate are indicated in Appendix IV.

10/ The total of exports used for this comparison is the tentative projection of Rs. 5,100 crores given in paragraph 17, page 97, of the "Draft Outline".

PART VIII: CONCLUSION

104. Even prior to the severe droughts of the current (1966/67) and preceding year the situation in agriculture was one in which three problems were already apparent.

(a) There was evidence that, while the trend rate over a fifteen-year period (1949-64) was slightly better than 3 per cent, this rate was declining in the latter part of the period and was probably 2½ per cent. This was in part due to the falling rate at which new areas of production were being added each year, offset only partially by some increases in productivity as, for example, in the rice industry where yields were rising slowly.

(b) As against this lagging performance there was the rise in the population growth rate which is now slightly in excess of 2½ per cent having been earlier running nearer 2 per cent. The effect was clear: population growth was barely matched by the trend in output, especially of foodgrains.

(c) This deteriorating relationship was aggravated by the fact that the trend rate in production was not stable: in relatively good years food went into consumption, in years below the trend stocks were found to be inadequate and imports began to increase for consumption rather than for stock building purposes. In short the trend rate was inadequate to meet population growth and the rise in demand itself reinforced by rising money incomes, let alone contribute to carry over stocks to be used in bad years. The recent droughts have simply been extreme cases of below trend performance, but being extreme have contributed a severe shock which at least has compensation in its salutary character. 132/

105. In these circumstances it would have been difficult to conclude two years ago that the objective of a 5% average annual increase in agricultural output (the Fourth Plan target) was realistic. There were of course considerable opportunities for increased output of somewhat smaller magnitude if full attention and "high priority" were given to a number of critical factors. Enough Indian farmers were considered willing and able to expand output given incentive and inputs. While there was the beginning of a more advanced technology, a major advance did not seem immediately possible. Reliance was heavily on the undoubted scope for getting more from old varieties by pushing them nearer to the limits of their capacity to use water and fertiliser. A considerable obstacle seemed to be that the "organised will" was not present in Centre and State administrations to ensure priorities in use of scarce resources for agriculture. In short, it was clear that the growth rate in agriculture could be accelerated but it was not clear that the concerted efforts of all parties necessary to realise as great an acceleration as possible could be expected. This was not a problem of the receptivity of the farmer: the undoubted forces of inertia

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132/ See paragraph 16 above.

in the social and land structure of rural society were not such as to prevent the use by farmers of a considerable advance in technology if it could properly be made available.

106. We now believe an "organised will" to succeed does exist and is operating, for the reasons given in paragraph 16, above, which may be repeated here:

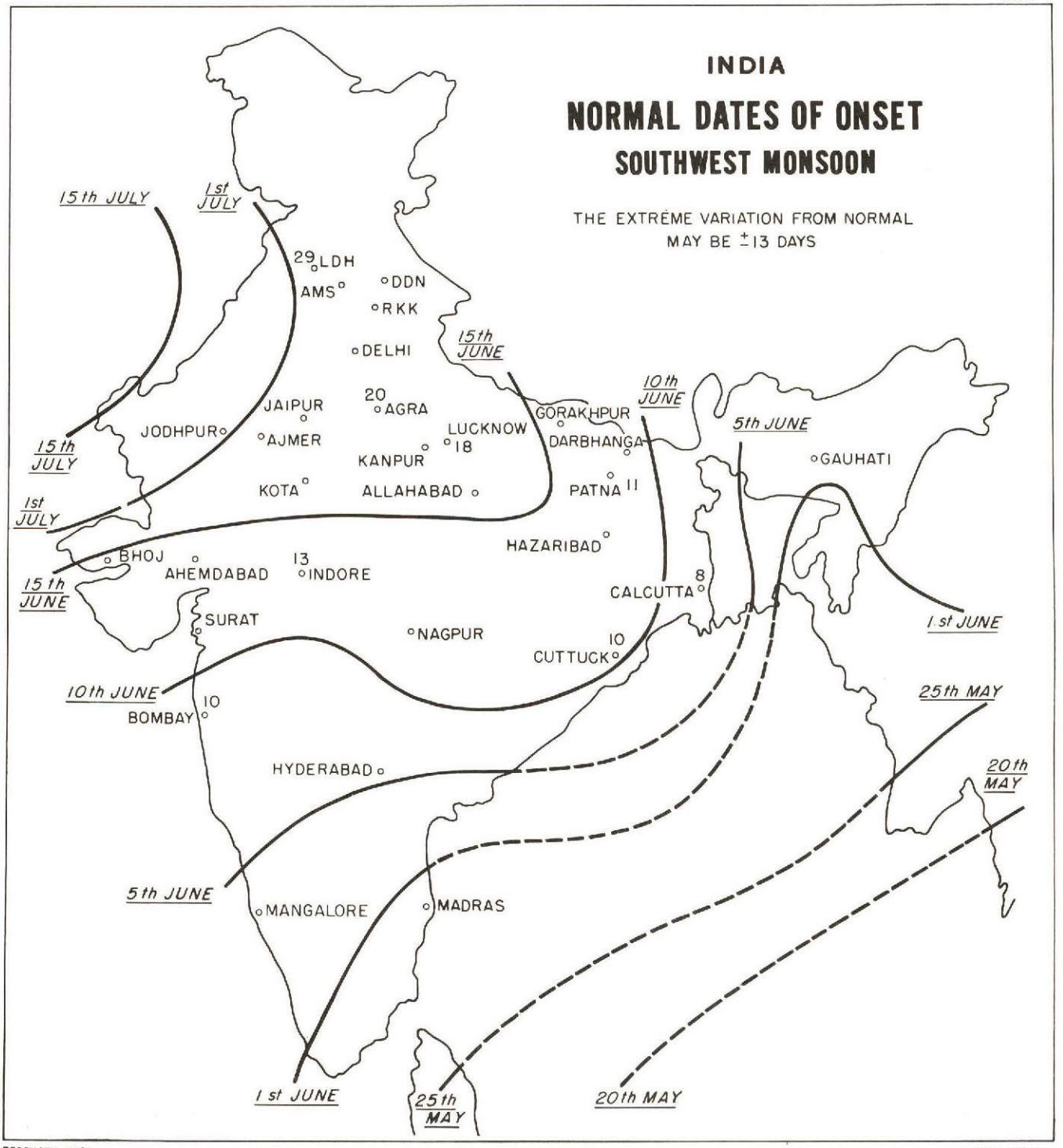
> "Several factors account for what we believe to be a more convincing attitude towards and performance in respect of agriculture on the part of the planning and executive authorities in India. First, the droughts of 1965-66 and 1966-67 are having a salutary effect. Second, there is a realisation that an expanding agriculture is vital to general economic growth or, in negative terms, a stagnant agriculture is a serious drag on economic growth elsewhere. Third, there is a conviction shared by political leaders, civil service, scientists, and farmers alike that a new technology is available which can give quick results even within traditional constraints which dog the agricultural sector. All these factors have produced a determination to try to give agriculture the resources it needs even if this squeezes other strong claimants for the same resource, especially in the foreign exchange sector."

107. We will not again try to elaborate these for this has been the subject of our report. Despite the great difficulties and the more than heartbreaking proportions of the two droughts, the morale of administrators and scientists is high and, of course, the proportion of farmers eager to avail themselves of the new technology is encouraging albeit embarrassing in the short-term. Yet it would be false to look at the scene other than with clear glasses: the critical factors restraining growth are numerous and, indeed, rendered the more difficult by the very needs of the new technology. We have reviewed the need for a sounder organisation of the seed industry; have noted the highly critical shortage of and problems of lifting fertiliser supplies; have noted the importance of plant protection materials; have noted that added supplies of water will lift output but will also aggravate the demand for fertilisers; have briefly surveyed a potentially critical problem of credit supply; have stressed the importance of a stable price policy in the interests of consumers and costs in the general economy while protecting incentives to the farmers; and, not least, argued for a more ample programme of research and extension, being no longer worried about its relevance or profitability.

108. Many of the points we have made are not new but several have a different order of urgency in the new technology than under the old. Fertilisers remain the number one problem and, as we have seen, this, in the short run of one Plan period, turns into a great and rising pressure on the critical balance-of-payments situation. So difficult is this pressure that willingness to give priority to agricultural needs, now so widely evident in India, will be placed under great strain during the whole of the next

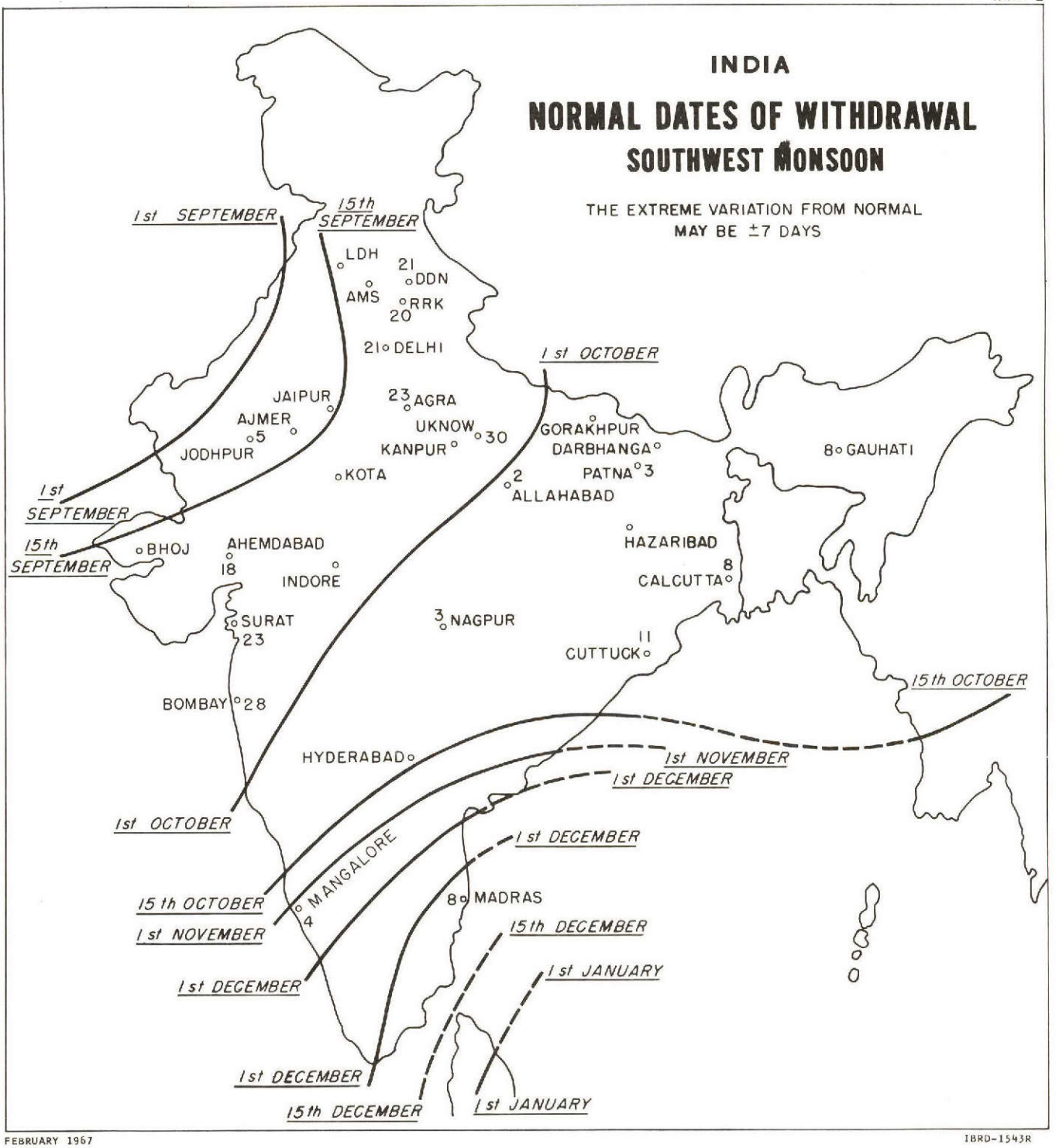
few years. Nevertheless, there are no serious alternatives open to India: the costs of not succeeding in agriculture are far greater than the present and continuing strain of finding the resources for an effective programme. Fortunately the prospects of success are greater and it is our belief that India can, given the modest availability of resources it has planned, go much nearer to achieving its targets by 1970-71 than would have been possible under the old technology and the circumstances of two years ago. The difficulties ahead are so great that we do not feel justified in believing that all these can be so satisfactorily resolved within the next few years as to assure full achievement. However, if as we believe likely given the resources, India reaches 110 m tonnes of foodgrain output or better in 1970-71, there will be established a momentum not likely to falter thereafter.

109. There remains only one major observation to make. On the test of performance the policies of the Government of India should not be judged by the performance of production in drought years but by the evidence of advance where conditions have been favourable; and, not least, by its determined efforts to give priority to agriculture in the use of scarce resources (of which foreign exchange is the most critical), to orient its industrial programme towards agriculture's needs and to develop policies likely to give more adequate scope to private initiative both in agriculture itself and in the industrial sectors of direct importance to agriculture. The evidence of recent months is that the Government of India has performed in accordance with its declared intentions to give highest priority to agriculture. The constraints on performance will, however, continue to be considerable, even after good seasons return. We for our part, while not wishing to minimise the gravity of these constraints, are satisfied that both policies and performance are now better related than they were in the period of the Third Plan.



FEBRUARY 1967

IBRD-1542R



FEBRUARY 1967

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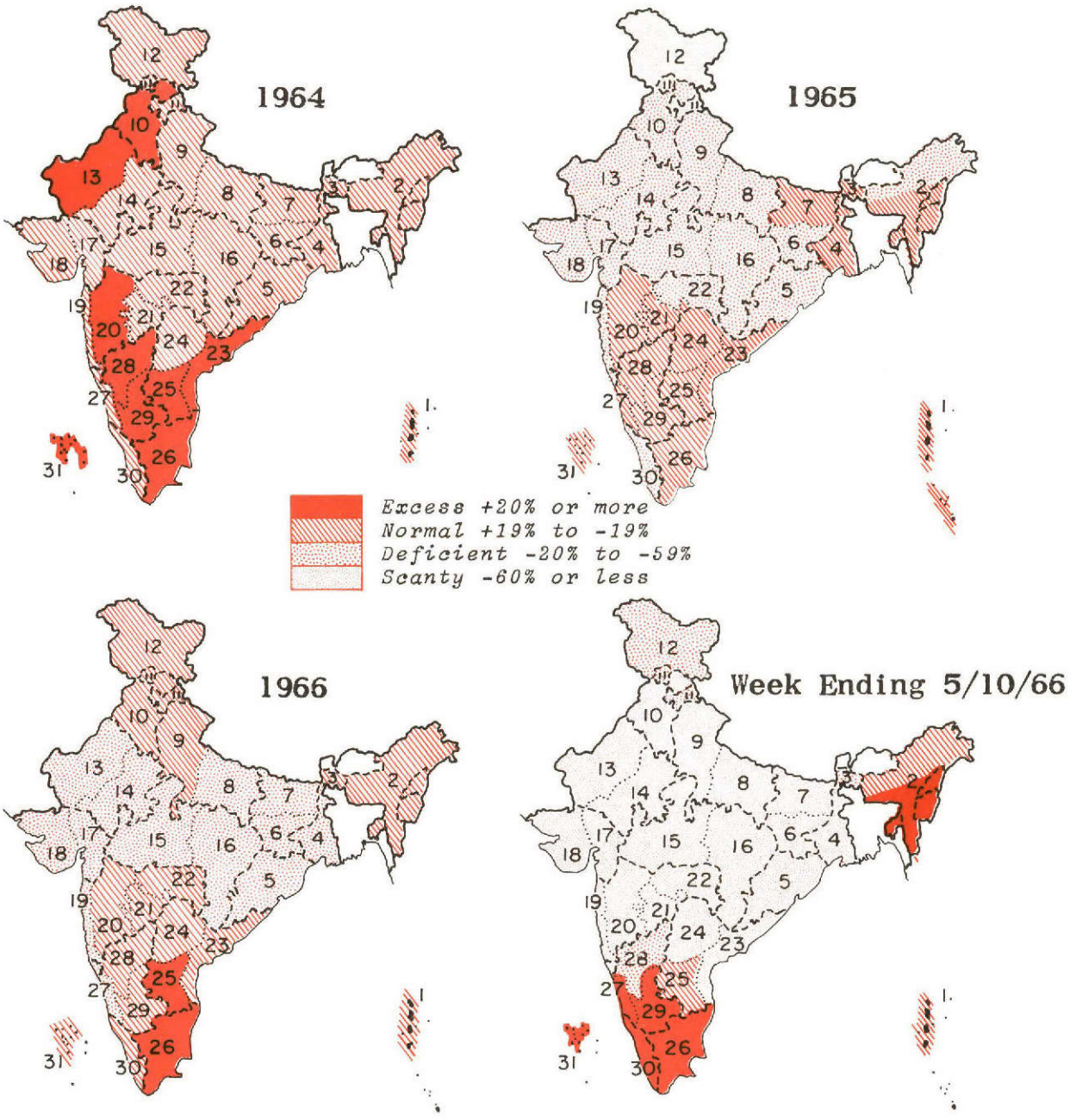
RAINFALL IN INDIA

SOUTH WEST MONSOON
1st. June to 30th. September



1. Bay Islands
2. Assam (including Manipur & Tripura)
3. Sub-Himalayan W. Bengal
4. Gangetic West Bengal
5. Orissa
6. Bihar Plateau
7. Bihar Plains
8. Uttar Pradesh, East
9. Uttar Pradesh, West
10. Punjab (including Delhi)
11. Himachal Pradesh
12. Jammu & Kashmir
13. Rajasthan, West
14. Rajasthan, East
15. Madhya Pradesh, West
16. Madhya Pradesh, East
17. Gujarat Region
18. Saurashtra & Kutch
19. Konkan
20. Madhya Maharashtra
21. Marathwada
22. Vidarbha
23. Coastal Andhra Pradesh
24. Telangana
25. Rayalaseema
26. Madras State
27. Coastal Mysore
28. Interior Mysore, North
29. Interior Mysore, South
30. Kerala
31. Arabian Sea Islands

APPENDIX I

SOME NOTES ON THE AGRICULTURAL OUTPUT TARGETS

Armand M.J. Van Nimmen

APPENDIX I

SOME NOTES ON THE AGRICULTURAL OUTPUT TARGETS

I. Foodgrains

A. Demand Projections

1. It is impossible in India -- as it probably is in any other planned economy -- to talk about "the" official demand forecast for a particular product. The reason for this is that demand projections are not, and presumably should not be, carried out solely by the Planning Commission, but are prepared independently by various agencies, both private and official.

2. For agricultural products in general and foodgrains in particular, demand forecasts are published by the National Council of Applied Economic Research (NCAER), the Institute of Agricultural Research Statistics, the Perspective Planning Division (PPD) of the Planning Commission and the Ministry of Food and Agriculture. These estimates vary considerably in degree of sophistication, depending on the sampling techniques used in the calculation of the parameters, on the number of assumptions rendered explicit and on the level of aggregation at which the investigation is being pursued. Furthermore, the forecasts which are released for publication do not always permit one to evaluate the comparisons which lead to the final figure, or to verify the assumptions under which the projections have been construed. The purpose of this section of the Appendix is only to list some of the demand forecasts for foodgrains and to point out some of the reasons for their discrepancy. It is not intended here to formulate an opinion on the value of these projections or to indicate which of the forecasts has the greatest probability of being fulfilled. Such an assignment, if ever possible, would take much more time to finish than was allotted to us.

3. Despite the differences in the methods used by the forecasters, 1/ it is possible to detect a series of common elements present in any prediction about future, final or intermediate demand. Demand projections for foodgrains, the only ones with which we shall deal in any detail, are basically constructed in the following manner:

(i) By means of past consumption and expenditure data an attempt is made to derive per capita expenditure elasticity figures, usually with a distinction between the rural and urban areas.

1/ The most obvious of these differences lies, of course, in the treatment of intermediate demand. Whereas in a forecast based on the input-output technique, intermediate demand is derived from the set of final demand estimates by means of the technological matrix, the other, more "naive" methods of projecting total agricultural output are based on the hypothesis that a constant share of total agricultural output is going into intermediate use (see, for example, "A Strategy for Agricultural Planning", NCAER, p. 17).

(ii) The elasticity figures thus obtained are either used as such or converted into income elasticities by applying the income elasticity of total national expenditure as a conversion factor.

(iii) Relative prices are presumed to remain unchanged.

(iv) An assumption is made regarding the future increase in per capita expenditure (or per capita income) and by means of the elasticity figures mentioned above 2/ an estimate is derived for the increase in per capita consumption of foodgrains.

(v) Total increase in foodgrains demand for human needs is then derived by multiplying the forecasted rate of increase in per capita consumption with the predicted rate of population growth (more or less sophisticated assumptions can be made on the change in the relative importance of rural and urban populations.)

(vi) To this total figure of foodgrains demand for human consumption a percentage share is added for animal feed, seed and wastage.

(vii) Sometimes allowance is made for the building up of buffer stocks.

4. On the basis of the general methodology outlined above, a series of demand projections for foodgrains were performed. As shown in Table I these computations led to a wide range of results.

TABLE I

FOODGRAINS DEMAND IN 1970-71

Targets and Projections
(million tonnes)

"Long-term projections" (NCAER)	113
"A Strategy for Agricultural Planning" (NCAER)	115
Institute of Agricultural Research Statistics	117
Input-Output Study	116
PPD	122
"Memorandum on the Fourth Plan"	120
"Agricultural Production in the Fourth Plan"	125
"Draft Outline"	120

2/ Elasticity estimates derived from past or present data are sometimes adjusted for expected changes in the future.

5. There are many reasons to explain the discrepancies in these forecasts. Apart from the fact that some of these figures are planned targets, and hence contain volitional elements which may imply a departure from past trends, it is not surprising that -- in view of the great variability of yearly consumption figures for foodgrains -- an extrapolation of past trends is highly dependent on the characteristics of the sample, on the choice of the period, on the shape of the curve which is fitted to the data, or on the choice of the base year.

6. From a comparison of the documents in question it appears that estimates regarding the future increase in population do not greatly vary from source to source. 3/ During the period of the Fourth Plan the population of India is generally expected to grow by approximately 2.5 percent per annum.

7. Forecasts or assumptions on the growth of national income vary more than do the projections on population growth. Whereas the NCAER relied upon the Planning Commission's rate of growth of 5.6 percent per annum for its long-term demand projection study, the same institution used a lower rate of 4.8 percent for its more recent study on agricultural planning.

8. The "Draft Outline" of the Fourth Plan states that the compound rate of growth of national income during the plan period will amount to 5.5 percent (using 1964-65 as the base year), and the Ministry of Agriculture mentions a rate of growth of consumption expenditure amounting to 4.9 percent. On the basis of the conversion factor used above, this corresponds to a national income growth slightly above 5.7 percent per annum.

9. Table II summarizes some of the assumptions on national income growth. It shows that the assumption generally relied upon is the one of 5.5 percent. Only the long-term study prepared by the NCAER rests on a significantly lower projection of national income growth.

TABLE II

YEARLY GROWTH OF NATIONAL INCOME: 1965/66 - 1970/71

Targets and Projections (in percentages)

"Long-term Projections" (NCAER)	5.6%
"A Strategy for Agricultural Planning" (NCAER)	4.8%
"Draft Outline"	5.5%
Ministry of Agriculture	5.7

3/ Grave errors in the prediction of the demographic trend were made, however, during the elaboration of the Second Plan when it was assumed that population would grow by 1.25 percent while, in fact, it was expanding at a rate of more than 2 percent per annum.

In short, taking into account the statistical errors which inevitably surround such an exercise, we can safely say that two income growth assumptions were made in the studies dealing with foodgrains demand: a low assumption amounting to 4.8 percent and a high assumption of approximately 5.5 per cent.

10. Differences also appear with respect to the income (or expenditure) elasticities of foodgrains demand used in the various projections. In this context it may be useful to give a short description of the different sources available for the evaluation of the demand elasticity for foodgrains in India.

11. For several years the Directorate of the National Sample Survey (NSS) has been conducting a series of sampling inquiries dealing with expenditure elasticities. These successive sampling rounds led to a set of estimates about the elasticity of the demand for foodgrains which, depending on the year of sampling or on the demand model being used, range from 0.35 to 0.75 for rural India and from 0.17 to 0.38 for urban India (see "Long-term Projections of Demand for and Supply of Selected Agricultural Commodities", NCAER, 1962, pp.200-10). These elasticity figures relate the change in expenditure for foodgrains (expressed in value terms) to the change in total expenditure. To estimate the corresponding income elasticities the expenditure elasticity figures were reduced by about 15 percent. Finally, the results of eight rounds were averaged out. This resulted in an income elasticity for foodgrains of 0.52 in rural India and 0.28 in urban India. The NCAER, when preparing its study on long-term demand and supply projections, estimated that the NSS elasticity figures were not entirely satisfactory and organized its own Household Consumption Survey. The results of this survey, which related household income to quantities of foodgrains purchased, are reproduced, together with the NSS figures, in Table III below. A comparison between the two sets of figures shows that the NCAER measures of elasticity are considerably below the figures advanced by the NSS.

TABLE III

INCOME ELASTICITY ESTIMATES FOR FOODGRAINS

	RURAL INDIA				URBAN INDIA			
	NSS (rounds 2-9)	NSS (round 15)	NCAER (past)	NCAER (future)	NSS (rounds 2-9)	NSS (round 15)	NCAER (past)	NCAER (future)
Foodgrains	0.52		0.30		0.28		0.17	
Major Cereals	0.55		0.39	0.50	0.12		0.18	0.15
Minor Cereals	-0.83		-0.29	-0.30	-1.32		-0.59	-0.60
All Cereals		0.46				0.35		
Pulses	0.62	0.61	0.61	0.65	0.45	0.35	0.25	0.35

12. For the projection of future demand, however, the NCAER historical figures were reviewed in the light of time series data, and adjusted on the basis of information regarding the evolution of foodgrains elasticity as revealed in the successive NSS rounds. This latter revision brought the NCAER estimates very much in line with the results of the NSS rounds 2 to 9.

13. In its more recent study on agricultural planning the NCAER relied upon the results of a new (by then still unpublished) round of the NSS survey. This new survey indicated foodgrains elasticities slightly higher than the ones calculated in previous rounds (especially for cereal consumption in the urban areas).

14. A Ministry of Agriculture memorandum explaining the demand forecast for foodgrains (cited in the previous Bell Mission Report, p. 26) uses an expenditure elasticity for foodgrains of 0.6, supposedly based on NSS data. Applying the conversion factor of 15%, this amounts to an income elasticity of 0.52.

15. Summarizingly, it can be said that, although the retrospective surveys give widely divergent estimates for the elasticity of foodgrains demand, the elasticity figures used for the purpose of projecting future demand all lie in the neighborhood of 0.50.

16. Of primary importance in the determination of the final demand estimate for foodgrains is the choice of the demand in the base year. Differences in the rate of growth of foodgrains demand can be compensated by differences in the base year, but alternatively they can also be compounded by them, as when a high estimate of the elasticity of foodgrains demand is coupled with a high estimate of the base year consumption. Theoretically, of course, the foodgrains consumption in the base year should be relatively easy to establish. In a system, however, in which for social reasons the State intervenes by means of zoning regulations, price control system and rationing, it is difficult to determine what the demand level would in fact have been, if these restrictions had been moderated or even removed. No wonder then that the estimates of the demand vary considerably.

TABLE IV

ESTIMATES OF THE DEMAND FOR FOODGRAINS IN 1965-66

(in million tonnes)

"Long-term Projections" (NCAER)	95.4
"A Strategy for Agricultural Planning" (NCAER)	96.6
Ministry of Agriculture	99.5

17. This classification of the base year figures also reflects the order of the demand estimates for 1970-71.

18. As between the two studies prepared by the NCAER, the lower rate of growth of national income and the lower allowance for feed, seed and wastage in the more recent "Strategy for Agricultural Planning" is more than compensated by the higher estimate of the demand elasticity and by a higher base year figure. As far as the two extreme predictions are concerned, it can easily be checked that the main cause for the high estimate of the Ministry of Agriculture lies in the choice of the base year.

19. In fact, the rates of growth of foodgrains demand as measured from the base year are strikingly similar in all forecasts. They range from 3.4 percent per annum in the long-term projection study to 3.8 percent for the target of 120 million tonnes. If the higher rate of growth were applied to the low base year estimate of 95.4 million tonnes, this would lead to a demand forecast of only 115 million tonnes. Of the 7 million tonnes difference between the early forecast of the NCAER (113 million tonnes) and the present forecast of 120 million tonnes, the difference in the choice of the base year alone accounts for more than 70 percent. The remaining 30 percent are due to the combined effect of the slightly higher forecasts about the increase in national income, the rate of population growth and the income elasticity of foodgrains.

20. As mentioned above (see Table I), between the publication of the "Memorandum on the Fourth Plan" and the issuance of the "Draft Outline", the foodgrains demand target was temporarily raised from 120 to 125 million tonnes. In the course of the Mission's conversations with the Ministry of Food and Agriculture in New Delhi, we were told that the target of 120 million tonnes had been revised because:

(i) It is not realistic to assume that the percentage allowance for seed, feed and wastage will remain constant in the years to come (in fact the "Long-term Projections" study of the NCAER (p. 90) foresees that the requirements for seed, feed and wastage will go up from 12.5% to about 18% by 1975-76). In the revised Government target of 125 million tonnes the percentage allowance is raised to 14.4 percent in 1970-71 (see "Agricultural Production in the Fourth Plan", page 2).

(ii) The consumption of wheat had been underestimated in the earlier target (since we do not possess the Government's demand projection for wheat, as distinct from the demand for foodgrains, there is no way of checking the validity of this assertion).

21. In the "Draft Outline" finally, the demand target for foodgrains was readjusted to its original level of 120 million tonnes, but no reasons were given either verbally or in written form to justify this decision.

22. Regarding future demand estimates for foodgrains in India, it can be reasonably predicted that:

(i) The range of total demand estimates will be determined to a significant degree by the range of the base year figures to which the index value will be applied.

(ii) If the range of likely elasticities is kept within relatively narrow bounds, the assumption made on the evolution of per capita income will have a larger effect on total demand for foodgrains than the assumption regarding the income elasticity.

(iii) Estimates made by purely scientific organizations will tend to be lower than those prepared by the Government.

B. Imports

23. Table V below shows that foodgrains imports in India have been rising constantly from 1960-61, when they were at a level of 3.49 million tonnes, to 1965-66 when they exceeded 11 million tonnes. Chart 1 visually illustrates the same point by indicating how the trend line of total consumption (domestic production + net imports + changes in stocks) has been rising faster than the trend line of domestic production alone.

TABLE V

SUPPLY OF FOODGRAINS
(in million tonnes)

1950-51	Domestic Production	Net Imports	Change in Stocks a/	Consumption
1950-51	54.9	4.00	(+) 0.53	59.11
1951-52	55.5	3.93	(+) 0.62	58.81
1952-53	61.7	2.04	(-) 0.48	64.22
1953-54	72.2	0.83	(+) 0.20	72.83
1954-55	72.6	0.60	(-) 0.75	73.95
1955-56	69.2	1.40	(-) 0.60	71.20
1956-57	72.3	3.63	(+) 0.86	70.07
1957-58	66.5	3.22	(-) 0.27	69.99
1958-59	70.7	3.86	(+) 0.49	82.07
1959-60	76.7	5.13	(+) 1.40	80.43
1960-61	82.0	3.49	(-) 0.17	85.66
1961-62	82.7	3.64	(-) 0.36	86.70
1962-63	78.4	6.55	(-) 0.02	82.97
1963-64	80.2	6.26	(-) 1.24	87.70
1964-65	89.0	7.45	(+) 1.03	95.42
1965-66	72.3	11.00	(-) 1.00	84.30

a/ A plus sign (+) refers to an increase in stocks; a minus sign (-) refers to a depletion.

24. Partly because of this steady rise in the import bill, the Government of India has now decided to give highest priority to the achievement of self-sufficiency in foodgrains by the end of the Fourth Plan. In the opinion of Indian planners, domestic production should be able to meet the foodgrains demand in 1970-71. 4/

25. In the demand figure for the terminal year of the plan no provision is made for the building up of stocks. It is asserted, however, that in the course of the Fourth Plan a buffer stock of 6 million tonnes will be constituted (see "Draft Outline", p. 209). Official statements from the Ministry of Food and Agriculture (The Indian Express, September 29, 1966) have it that in the course of the next plan dependence on PL 480 imports will gradually vanish, but that in the next three years another

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4/ It should be noted, however, that the Report of the Working Group on Imports during the Fourth Plan continues to foresee Rs. 500 million for annual imports of foodgrains (excluding Australia). This represents some 0.7 million tonnes of yearly imports.

15 million tonnes will be asked for. Assuming that domestic production would be sufficient to meet local demand for foodgrains from 1969 onwards, and assuming that the buffer stock of 6 million tonnes will be entirely built up through imports, this would leave an import figure of 9 million tonnes to cover the gap between domestic production and consumption during the intervening years.

C. Nutritional Standards

26. One way of establishing the foodgrains target is to make a demand forecast as outlined in Section A. Another way is to start from a standpoint of dietary "need" and then to calculate the total production required to meet the nutritional standard chosen, taking into account total population in the last year of the plan as well as the use of foodgrains for non-human consumption. Alternatively, the method is used to check the figure detained by means of the traditional demand forecast, and to establish the improvement in nutritional standards which will ensue from the target figure.

27. The first approach to the use of nutritional data was used by V. G. Panse, V. N. Amble and T. P. Abraham in an article published in the Indian Journal of Agricultural Economics. 5/ These authors based their projection on an earlier linear programming exercise performed by Sukhatme. 6/ From this exercise it appeared that, given the existing price relationships in India and given a minimum nutritional target of 2,370 calories and 66.6 grams of proteins (including 10 grams of aminal proteins) per day, the nutritional basket looked as follows:

5/ "A Plan for Improvement of Nutrition of India's Population," V. G. Panse, V. N. Amble and T. P. Abraham, Indian Journal of Agricultural Economics, Vol. xix, No. 2, April-June 1964.

6/ "Food and Nutrition Situation in India", P. V. Sukhatme, Indian Journal of Agricultural Economics, Vol. xvii, No. 2, April-June 1962 and No. 3, July-September 1962.

TABLE VI

PER CAPITA QUANTITIES OF MAJOR FOOD GROUPS
AVAILABLE AND NEEDED TO MEET MINIMUM NUTRITIONAL TARGET

	Quantity Per Day (grams)	
	Available	Needed
Cereals	375	403
Pulses and Nuts	65	104
Starch Roots	30	46
Sugar	45	50
Fruits and Vegetables	80	137
Meat	4	7
Fish	7	17
Eggs	1	2
Milk and Milk Products	118	201
Fats and Oils	11	18

Source: "A Plan for Improvement of Nutrition of India's Population," Indian Journal of Agricultural Economics, April-June, 1964, p. 14.

The daily requirement of foodgrains in India thus amounts to 507 grams, or 17.9 ounces. On the basis of this result, and estimating a total population in 1970-71 of 555 million, Panse et al. calculated that the total foodgrains requirement at the end of the Fourth Plan would be 117.4 million tonnes. In the meantime it has become clear, however, that this population figure underestimates the likely population in mid-1971. The population growth rate presently cited in the "Draft Outline" for the entire period of the Fourth Plan amounts to 13.1 percent (instead of 12.8 percent mentioned in the previous report). When applied to the mid-year population in 1966, 7/ this amounts to an estimate of 564 million in mid-1971. Using this population estimate and accepting the minimum nutritional standard advanced by Panse et al., total foodgrains requirement would amount to 119.3 million tonnes. From this it follows that, from all demand forecasts mentioned in Section A, the figure originally advanced by the Ministry of Food and Agriculture and presently adopted in the "Draft Outline" (120 million tonnes), comes closest to meeting these requirements.

7/ The estimate is 498.9 million; see "Draft Outline", p. 346.

28. The procedure may now be reversed, and a calculation made of the nutritional achievements attached to certain forecasted demand levels. This is done below with the targets of 120 and 125 million tonnes. Since some documents cite the figure of 560 million as the Planning Commission's present estimate of India's population at the end of the Fourth Plan, we performed the computations twice, once assuming a population of 560 million in 1971 (assumption I), and once assuming a population of 564 million (assumption II).

TABLE VII

NET PER CAPITA AVAILABILITY OF FOODGRAINS IN 1971
(in ounces per day)

	Assumption I	Assumption II
120 million tonnes target	18.1	18.0
125 million tonnes target	18.5	18.3

29. From this table it appears that the daily intake of foodgrains resulting from the 120 million tonnes target is only slightly above the standard accepted in the Panse article. The table also shows the impact which the adoption of the 125 million tonnes target would have had on the daily per capita availability of foodgrains. It should be remembered, however, that this impact is mitigated by the greater percentage allowance of foodgrains for non-human consumption in the higher target.

30. Chart I and Table VIII put the per capita availability target in its historical trend perspective. It becomes clear then that a target of approximately 18 ounces of foodgrains per day would constitute an important improvement in the per capita availability. A figure of 18.5 ounces per day seems completely out of line with past improvements. It is interesting also to note that, merely to keep per capita availability at its 1964-65 level of 16.7 ounces per day, a foodgrains consumption in 1970-71 of 111 million tonnes would be required.

TABLE VIII: Net Per Capita Availability of Foodgrains a/

Year	Cereals: Mid-Year Estimates of Population b/ (millions)	Cereals: Production (mil. tonnes) Gross c/	Cereals: Production (mil. tonnes) Net d/	Cereals: Net Imports (mil. tonnes)	Cereals: Change in official stocks e/ (mil. tonnes)	Cereals: Net availability (ozs/day)	Cereals: Per capita availability (ozs/day)	Pulses: Per capita availability (ozs/day)	Foodgrains: Per capita availability (ozs/day)
1951	363.4	45.74	40.02	4.80	(+) 0.59	44.23	11.8	2.1	13.9
1952	369.6	46.40	40.60	3.93	(+) 0.62	43.91	11.5	2.1	13.6
1953	376.1	51.85	45.37	2.04	(-) 0.48	47.89	12.3	2.2	14.5
1954	382.9	61.08	53.44	0.83	(+) 0.20	54.07	13.6	2.5	16.1
1955	390.2	58.97	51.60	0.60	(-) 0.75	52.95	13.1	2.5	15.6
1956	397.8	57.53	50.34	1.40	(-) 0.60	52.34	12.7	2.5	15.2
1957	405.8	60.20	52.68	3.63	(+) 0.86	55.45	13.2	2.5	15.7
1958	414.3	56.41	49.36	3.22	(-) 0.27	52.85	12.3	2.1	14.4
1959	423.3	65.49	57.30	3.86	(+) 0.49	60.67	13.8	2.6	16.4
1960	432.7	64.88	56.77	5.13	(+) 1.40	60.50	13.5	2.3	15.8
1961	442.7	69.31	60.65	3.49	(-) 0.17	64.31	14.0	2.4	16.4
1962	453.4	70.95	62.08	3.64	(-) 0.36	66.08	14.1	2.2	16.3
1963	464.3	67.01	58.63	4.55	(-) 0.02	63.20	13.1	2.1	15.2
1964*	475.5	70.19	61.41	6.26	(-) 1.24	68.91	14.0	1.8	15.8
1965*	487.0	76.56	66.99	7.45	(+) 1.03	73.41	14.5	2.2	16.7
1966o	498.9	62.39	54.59	11.00	(-) 1.00	66.59	12.9	1.9	14.8

a/ Table follows the construction of Table 3.16 from the Economic Survey for 1964-65.
b/ Population figures are mid-year estimates framed by the Office of Registrar General of India and exclude Sikkim.
c/ Production figures related to agricultural year, July-June; 1951 corresponds to July 1950 to June 1951, and so on for subsequent years.
d/ Net production is taken as 87.5% of gross production, 12.5% being provided for seed requirements, wastage and non-food purposes.
e/ A plus sign (+) refers to an increase in stocks, i.e. a reduction in availability: a minus sign (-) refers to a depletion of stocks.
* Provisional and subject to revision.
o Own estimate based on official sources.

II. Non-Foodgrains

31. The purpose of this part of the Appendix is to summarize, without any comment, the main output targets and programs in agriculture and its allied sectors (excepting foodgrains) as contained in the "Draft Outline". The primary purpose of these paragraphs is to demonstrate that, although the main emphasis of the new technology and of the agricultural plan as a whole lies on the foodgrains target, the other aspects of agriculture are also dealt with in the Plan.

1. Commercial Crops

(See Table IX)

2. Horticulture

a. Fruit

Acreage will be raised by 40 lakh acres;

Gardeners will be trained;

Garden colonies will be established;

Financial assistance will be given to private producers and cooperatives.

b. Vegetables

Production will be doubled (102 lakh tonnes), in order to meet 50 percent of minimum per capita requirements;

Package approach for potatoes;

Crop production loans;

Setting up of processing units;

Establishment of foundation seed farms.

3. Animal Husbandry

General Objectives:

Increase supply of protective foods (especially in drought-affected areas);

Provide drought power for farms;

Improve output of commercial products, such as wool and hides.

TABLE IX: Agricultural Output Targets

Commodity	Unit	Third Plan Target	Base Level 1965-66 1/	Additional Production Fourth Plan	Estimated Production at the end of Fourth Plan	Percentage Increase over Base Level
Cotton	Million bales 2/	7.0	6.3	2.3	8.6	37%
Jute	Million bales 2/	6.2	6.2	2.8	9.0	45%
Mesta	Million bales 2/	1.3	1.8	0.2	2.0	11%
Oilseeds	Million tonnes	10.0	7.5	3.2	10.7	43%
Sugarcane (gur)	Million tonnes	10.2	11.0	2.5	13.5	23%
Pepper	Thousand tonnes	27.4	30.0	5.0	35.0	17%
Cardamom	Thousand tonnes	2.7	3.3	0.5	3.8	15%
Ginger	Thousand tonnes	n.a.	22.0	5.0	27.0	23%
Cashewnut	Thousand tonnes	152.4	136.0	192.0	328.0	141%
Tobacco	Thousand tonnes	330.0	400.0	75.0	475.0	19%
Coconut	Million nuts	5,275.0	4,713.0	400.0	5,113.0	8%
Arecanut	Thousand tonnes	101.6	101.9	8.5	110.4	8%
Lac	Thousand tonnes	63.0	30.0	20.0	50.0	67%

1/ Due to the 1965-66 drought, actual output figures for some producers were considerably below the normally expected trend value. Actual figures were as follows: cotton 4.7 m. bales, jute 4.5 m. bales, oilseeds 6.1 m. tonnes, sugarcane 11.8 m. tonnes.

2/ Bales of 180 kg. each.

a. Cattle

Selective breeding;

Increase in milk production;

30 intensive cattle development projects and 100 new key village blocks.

b. Sheep

Increase supply of wool;

Improve quality of clip;

Improve breeding.

c. Poultry

To produce rich animal protein and create employment opportunities;

Emphasis on distribution.

4. Dairying and Milk Supply

Consolidation of existing milk schemes;

Setting up of 34 new schemes, each with a capacity of 6,000 to 10,000 liters a day;

Setting up of rural dairy centers with a capacity ranging from 500 to 4,000 liters daily;

Encouragement of cooperatives.

5. Fisheries

Production of fish expected to increase from 11.5 lakh tonnes in 1965-66 to 15.3 lakh tonnes in 1970-71;

Modernization of techniques;

Acquisition of 200 trawlers and construction of 8,000 mechanized boats.

6. Forestry

Considerable gap between demand and supply;

1970 demand = 17 million cubic metres
1970 supply = 14.3 million cubic metres

Proposed Program:

Item	Unit	1965-66	1970-71
Plantation of quick-growing species	lakh acres	1.6	10.0
Plantation of economic species	lakh acres	6.0	8.4
Rehabilitation of degraded forests	lakh acres	5.2	5.0

Communications:

(a)	Construction of new roads	Thousand miles	7.0	10.0
(b)	Maintenance of old roads	Thousand miles	2.8	7.5

7. Storage and Warehousing

(a) Capacity owned by Food Department

Supposed to increase from 2 to 4 million tonnes

(b) Capacity of Central and State Warehousing Corporations

Supposed to increase from 1.38 million tonnes to 2.23 million tonnes.

Utilization of capacity has to be improved.

INDIA: PRODUCTION AND CONSUMPTION OF FOODGRAINS

(MILLIONS OF TONNES)

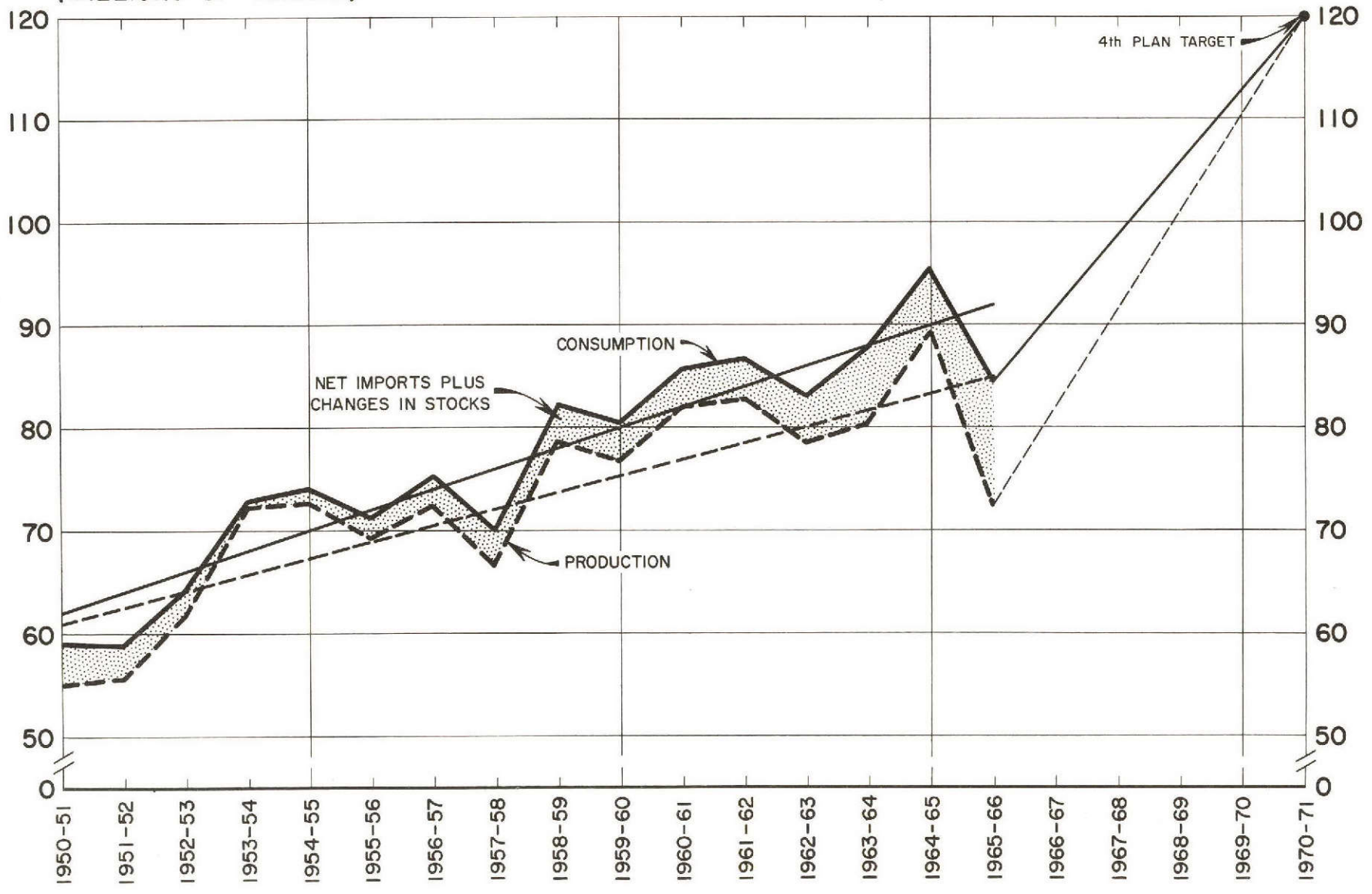

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CHART 1

INDIA: NET PER CAPITA AVAILABILITY OF FOODGRAINS

(OUNCES PER DAY)

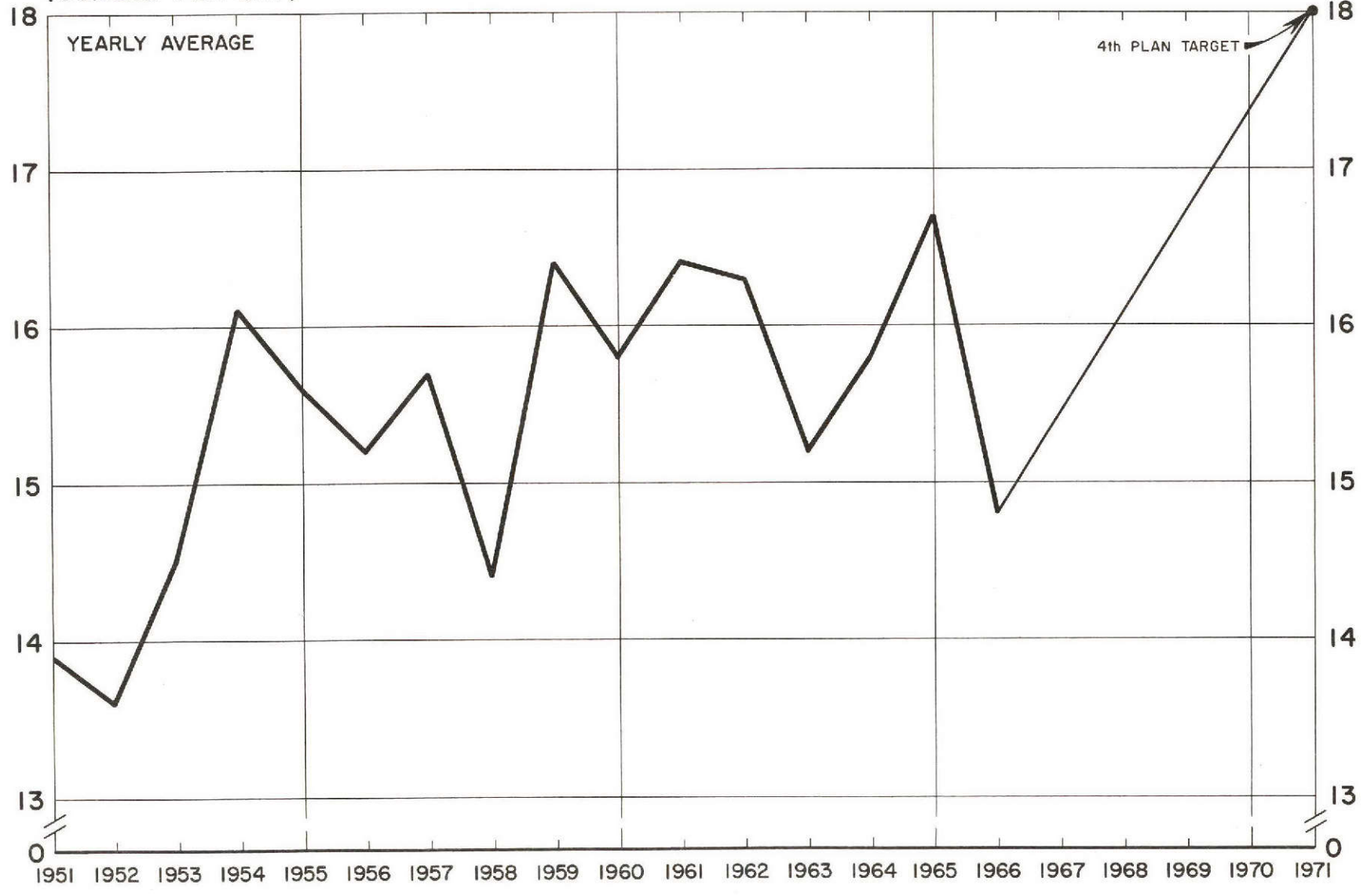

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CHART 2

APPENDIX II

EXPLORATION INTO THE ECONOMICS OF HIGH YIELDING VARIETIES

W. David Hopper

APPENDIX II

EXPLORATION INTO THE ECONOMICS OF HIGH YIELDING VARIETIES

1. It takes little to document the fact that Indian crop yields are low by standards of contemporary agricultural technology. The first "Report on Agricultural Policy in India" of June 1965 presents evidence and makes comment on this fact. This report also pointed out that the growth of Indian agricultural output from 1950 to 1964 showed evidence of a decreasing rate of expansion, and this was traced to the fact that in recent years land area under crops had been expanding at a rate much below that attained in the early fifties, while the productivity of land (yield per hectare) had not increased to compensate for the drop in the annual addition of new acreage.

2. An analysis of production, area, and productivity by the three plan periods points dramatically to the role a stagnant expansion of productivity has played in the "agricultural crisis" now besetting the country. Table I gives the growth rates in per cent per annum (compound for the three five-year plan periods. The Third Plan period covers only four years, three years when food grains production was virtually stagnant at about 80 million metric tons[1] rising in the fourth year to 89 million metric tons.[2] The final year of the Plan period, 1965-66, was disastrous for agriculture due to a widespread drought caused by a failure of the monsoon rains unprecedented in this century.[3]

3. The findings presented in Table I suggest that while there has been a growing productivity rate on the area devoted to non-foodgrains, for foodgrains the rate of this growth has been constant over the 14 years of the three plan periods. Because foodgrains account for two-thirds of aggregate agricultural output, and because productivity expansion has been stagnant while area expansion has declined, the focus of concern of this appendix like the central concern of official agricultural policy for the Fourth Five Year Plan, will be on foodgrain productivity. The main Report on agriculture (to which this is an appendix) covers the GOI's "High-Yielding Varieties Program" in detail; the narrow purpose of this appendix is to explore some of the fundamental agronomic and economic aspects of the program.

1/ As in the previous "Report on Agricultural Policy in India," this appendix will use the word "ton" to mean a "metric ton."

2/ The previous report used 88.4 million tons for the agricultural year 1964-65. The "revised final" estimate for this year is 88.99 million tons. See, Agricultural Situation in India, September 1966, Pp.511.

3/ If the five years of the Third Plan Period are used, the least squares average annual rate of (compound) growth are:

	Production % per year	Area % per year	Productivity % per year
Foodgrains	-1.47	-0.88	-0.61
Non-foodgrains	1.25	0.24	1.01
All crops	-0.48	-0.65	0.16

TABLE I

GROWTH RATE IN PER CENT (COMPOUND) PER ANNUM OF PRODUCTION, AREA, AND PRODUCTIVITY OF INDIAN AGRICULTURE DURING THE PERIODS OF THE FIVE YEAR PLANS, 1951-52 TO 1964-65

Plan Period	Crop	Production	Area	Productivity
FIRST PLAN (1951-52 to 1955-56)	Foodgrains	6.18	3.28	2.79
	Non-foodgrains	3.21	2.44	0.74
	All crops	5.11	3.15	1.90
SECOND PLAN (1956-57 to 1960-61)	Foodgrains	4.20	1.34	2.81
	Non-foodgrains	3.45	1.27	2.16
	All crops	3.93	1.33	2.57
THIRD PLAN (1961-62 to 1964-65)	Foodgrains	2.26	0.03	2.23
	Non-foodgrains	4.21	0.52	3.66
	All crops	2.95	0.13	2.81

Note: These rates have been determined by a least squares fit of $I_t = ab^t$ to the years involved. The calculated rates have been carried to two decimal places in conformity with the conventions of the past Report (see Appendix I), but, at best, these two decimal places are indicative only. Because of the short periods embraced by each rate calculation, each must be regarded as "suggestive," and no claim is made that the evidence is "conclusive."

4. There is a mounting body of agronomic evidence to support the view that the biological materials traditionally available to the Indian farmer are closely adapted to his ancient methods of agriculture. Indeed, genetic studies of indigenous varietal materials indicate that generations of farmers and environment have combined, over time, to reduce the genetic diversity within local varieties to a point where further breeding and selection for higher yields could be productive of only marginal advances.

5. Into this balanced, adapted, and articulated agricultural tradition, the quest for higher yields has thrust the inputs of modern agricultural science. The early results of this thrust were not encouraging. Indigenous crop varieties, well adapted to the stringent circumstance of Indian agriculture, were found to be unable to respond productively to the new inputs. Varieties that would produce at a low level in the absence of abundant nutrients, produced still at relatively low levels with nutrients or, often more serious in wheat and rice, grew rank and tall with negetative response only to lodge and lose yield when grain began to form.

6. Appendix IV of the first Report presented (table II para 6 and 7) response functions of yield to nitrogen and phosphate fertilizers for most of India's main foodgrain crops. These functions were developed from a large number of studies of yield increases from indigenous varieties when these were grown with different levels of nutrient application. Almost without exception, the yields of these varieties reached a maximum at nutrient levels below 75 pounds of nitrogen per acre, and below 60 pounds of P_2O_5 per acre. Increases in output even at the maximum levels of nutrient input were severely limited, often less than 1,000 pounds per acre. As a rough aggregate "yardstick" for the response in yield to be expected from applying nitrogen and/or P_2O_5 to an acre of the local varieties, the official estimate has been ten pounds of additional foodgrains for one of nitrogen and six pounds of added grain for one of P_2O_5. At the grain and nutrient prices prevailing in India until about 1963, ten pounds of grain would sell for about Rs.1.30, six pounds for about Rs.0.78; the farm price for a pound of nitrogen was about Rs.0.77 and for P_2O_5, Rs.0.52. The margin between return and cost for fertilizer use, therefore, was not large, often not large enough to cover normal risks.

7. The characteristic low yield and the low yield responsiveness of indigenous plant materials can be traced to several botanical, agronomic, and environmental factors. Chief among these for wheat and rice is the leafy, tall statured, weak-strawed growth habit of the Indian varieties. Jennings[4/] has argued that for rice these characteristics can be traced to natural environmental factors conditioning the evolution of the plant. It is his contention, and the contention of other agronomists now working on problems of crop response under tropical conditions, that because of limited supplies of plant food, tropical grain plants have developed an early and profuse leafing habit that allows them to compete against weeds and other plants of their own species by mutual shading. This had two effects on grain yield: (1) it reduced plant population per unit area, and (2) eventually resulted in the plant supporting a lower leaf structure that was too shaded by upper leaves to be useful for photosynthesis. These lower leaves probably respired (by

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4/ Jennings, Peter R., "The Evolution of Plant Type in Osyza satina L." mimeograph, International Rice Research Institute, Los Banos, Philippines, 1965.

breaking down carbohydrates already synthesized by the plant) more hydrocarbon material than they added to plant growth by photosynthetic activity and were, therefore, a net drain on the plant at a time when most of the plants reserves of food were needed for grain formation in the reproductive portion of its growth cycle.5/

8. By introducing to India new plant materials to broaden the genetic base beyond the limited diversity available to plant breeders from local varieties, and by making direct imports of dwarf wheat and rice varieties from mexico and Taiwan, Indian agricultural scientists within the past few years have changed drastically the biological base of the nation's major cereal crops. World varietal banks of maize, grain sorghum (in India called jowar), and pearl millets (bajra) were built with the assistance of the Rockefeller Foundation. From these materials have come in the past few years eight hybrid maize varieties, two hybrid sorghums and one hybrid millet (see appended notes on each hybrid). The new hybrids of these three cereals have been augmented by direct imports (and strong local breeding programs) of dwarf wheat and rice varieties. These are non-leafy, stiff-strawed, short statured plant types that allow multiple tillering and dense plant populations. In all cases the new varieties appear considerably more responsive to fertilizer than the local materials traditionally available to the farmer.

9. However, it is still too early to comment definitively on the response of the high yielding varieties to fertilizer. Only maize hybrids have been available for enough time for adequate experimentation. Research has only begun on rice, and the study of wheat is at the stage where research workers are still seeking to understand the proper agronomic practices that must be followed if the full yield potentials of the new varieties are to be realized. For example, during the rabi season of 1964-65 poor experimental results from dwarf wheats were traced to inadequate control of depth of planting and poor irrigation practices. Experiments during the rabi season of 1965-66 demonstrated that planting depths for these dwarfs should not exceed two inches in contrast to the usual practice with indigenous varieties of placing seed at five to six inches below the soil surface. As a result of the shallower sowing, moisture availability in the top layer of the soil became critical to plant development, and it was found that the first irrigation must be given earlier than the customary 40 days after sowing. An irrigation experiment recently conducted at the Indian Agricultural Research Institute, New Delhi, indicated that a full irrigation given 20 days after sowing added very nearly one metric ton per hectare to yield, another irrigation at the usual 40 days interval added another metric ton to output, and because the dwarf wheats are resistant to lodging -- they are stiff strawed and too close to the ground for the heavy winds of March to wreck serious damage -- they can withstand a late irrigation (say, 130 days after sowing) when the extra water facilitates grain formation and increases yield by an additional 300 to 400 kilograms. Unfortunately, the experiment stations have not conducted fertilizer trials under closely controlled conditions of planting and

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5/ See: Tanaka, A. Growth Habit of the Rice Plant in the Tropics and its Effect on Nitrogen Response, The International Rice Research Institute Los Banos, Laguna, Philippines, for an excellent discussion of the problem of mutual shading in tropical rices grown under field conditions.

irrigation. Such trials will be carried out on a limited basis in 1966-67, but it is likely to be another two to three years before solid data on fertilizer-wheat response is available. The situation with jowar and bajra is not dissimilar, although the agronomic practices are a little less complex. For these crops the hybrid varieties have been developed only recently and the nuances of their production demands have not been explored fully.

10. While the experiment stations still have a lot to learn about the new varietal materials, many cultivators are doing as well or better than the scientists. There seem to be several reasons for this. Among them being the fact that many farmers were obtaining higher yields than the experiment stations with the indigenous materials by using husbandry practices that can often be carried over unchanged to the production of the dwarfs. It is, therefore, not too surprising to find that farmer yields on national demonstration trials average almost 1.5 tons per hectare more than experiment yields. In 81 national wheat demonstrations laid out in the rabi season of 1965-66, local varieties averaged 3046 kg/ha -- about the yield obtained by the top 20% of the cultivators growing wheat under irrigated conditions -- as against 4,183 kg/ha for the dwarfs, a 37% gain for the imported material. The ranges on these yields over-lapped with a yield range of 1,000 to 4,893 kg/ha for the local varieties and 2,028 to 6,800 for the dwarfs. In analysing the frequency distribution of these demonstration results, over 15% of the local yields were below 2,000 kg/ha while none of the dwarf varieties yielded this low. At the top of the distribution, one-third of the trials with imported materials were over 5,000 kg/ha (i.e. over 75 bu. per acre) and only 2% of the trials with local grain types reached this level. In the major wheat growing areas of the country (the Punjab, northern Rajasthan, western Uttar Pradesh, and Delhi State) the dwarf wheats averaged 5,340 kg/ha against the locals at 3,330 kg/ha, a 60% difference. Experiment station results, on the other hand, seldom exceed 4,000 kg/ha. Dr. M.S. Swaminathan, Director of the Indian Agricultural Research Institute, feels that it is easier to take a large farm field and manage it for a high yield than it is to manage a small plot within the confines of an experimental design. This is particularly true when the optimal management practices needed for one variety are quite different from those needed for another variety, say, irrigation on the dwarf wheats in an experiment that includes a comparison with the tall local varieties placed side-by-side in a single experimental design.

11. Recognizing the weakness of experimental results and the absence of data for rice under Indian conditions (included are data from the Philippines for Taichung (Native) 1, the main dwarf rice import included in India's High-Yielding varieties program), and the fact that very little has been done to ascertain response to nutrients other than nitrogen, the data presented in this paragraph is presented as an indicator only of comparative response potential between the exotic and older varieties. It is not presented as an accurate statement of response. The data for local materials were gathered from a cross-section of conditions. Because of this the yield levels quoted are much below those attained by good cultivators enjoying a high level of resource endowment and personal skills. But it is felt that while absolute yields will vary among farmers, and between

farmers and the research centers, there is no evidence that response itself will vary in the same way. Indeed, there is considerable evidence of the opposite effect. Experimental centers usually have higher initial fertility levels due to a generally more lavish use of plant nutrients: experimental response trials, therefore, usually show a flatter relation than encountered on farmers' fields. In short, the yield levels quoted below must be considered with caution as there is likely an absolute upward bias for the new varieties and an under-estimate of yield for the local materials, but the shape of the response function itself is likely to be biased in the opposite manner.

For all equations Y is yield of grain, and N is nitrogen applied both in units of kilograms per hectare.

a) RICE

High yielding variety:

Taiwan dwarf indica Taichung (Native) 1 (Philippine data for wet season response)

$$Y = 5330 + 30.667\ N - 0.1355\ N^2$$

maximum yield of 7065 kg per hectare at 113 kg of nitrogen per hectare.

Local varieties (all-India average):

$$Y = 1840 + 13.42\ N - 0.102\ N^2$$

maximum yield of 2281 kg per hectare at 66 kg of nitrogen per hectare.

Response and yardsticks[6/]

Nitrogen levels	New Variety		Local Varieties	
	Total increase	Yardstick	Total increase	Yardstick
kg/ha	kg/ha	kg/kg of N	kg/ha	kg/kg of N
0 to 20	560	28.0	228	11.4
0 to 40	1010	25.2	374	9.4
0 to 60	1352	22.5	438	7.3
0 to 80	1586	19.8	-	-
0 to 100	1712	17.1	-	-

6/ The concept of the "yardstick" is explored briefly in paragraphs 26 ff. of the main part of this volume. Technically the yardstick is the area under the marginal physical product curve between zero and some specified level of input divided by the upper limit of the input. This will give the average increment to total product per unit of input. In mathematical terms it would be: $\frac{\int_0^b f'(N)\,dN}{b}$ where $f'(N)$ is the first derivative of the total response function.

b) WHEAT[7/]

High-Yielding varieties - Mexican Dwarf:
(all-India average response from regional trials with Lerma Rojo, each trial weighed by the irrigated acreage of the region)

$$Y = 2161.7 + 19.75N - 0.069\ N^2$$

maximum yield of 3575 kg per hectare at 143 kg of nitrogen per hectare.

Local varieties (all-India average for irrigated wheat)

$$Y = 1455.0 + 17.20\ N - 0.114\ N^2$$

maximum yield of 2104 kg per hectare at 75 kg of nitrogen per hectare

Response and yardsticks:

Nitrogen levels	New Variety		Local Varieties	
	Total increase	Yardstick	Total increase	Yardstick
kg/ha	kg/ha	kg/kg of N	kg/ha	kg/kg of N
0 to 20	367	18.4	298	14.9
0 to 40	680	17.0	506	12.6
0 to 60	937	15.6	622	10.4
0 to 80	1138	14.2	-	-
0 to 100	1285	12.9	-	-

c) MAIZE[8/]

Hybrid:

$$Y = 2418 + 22.61\ N - 0.04\ N^2$$

maximum yield of 4974 kg per hectare at 289 kg of nitrogen per hectare

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7/ The response function for Lerma Rojo was taken from a mimeograph paper by Saxena, P.N. and Sirohi, A.S. "Responses to Nitrogen with Mexican and Indian Wheats" Indian Agricultural Research Institute, 1966. The function for the local varieties was taken from Appendix IV of the first Report. An estimate for the constant term was made from farm field trial data available at the Indian Agricultural Research Institute.

8/ Data for both the hybrid and local response is from Shah, V.H. "An Analysis of Response of Hybrid Maize to Nitrogen" Mimeo. Indian Agricultural Research Institute, 1966.

Local:

$$Y = 2052 + 17.23\ N - 0.05\ N^2$$

maximum yield of 3615 kg per hectare at 172 kg of nitrogen per hectare

Response and yardsticks:

Nitrogen levels kg/ha	Hybrid Total increase kg/ha	Hybrid Yardstick kg/kg of N	Local Total increase kg/ha	Local Yardstick kg/kg of N
0 to 50	1031	20.6	737	14.7
0 to 100	1861	18.6	1223	12.2
0 to 125	2200	17.6	1373	11.0
0 to 150	2491	16.6	1460	9.7

d) JOWAR[9/]

(The data for sorghum, both hybrid and local are very crude and incomplete. What is presented below should be regarded as only most tentative.)

Hybrid:

$$Y = 1635 + 22.33\ N - 0.0777\ N^2$$

maximum yield of 3239 kg per hectare at 144 kg of nitrogen per hectare

Local:

$$Y = 1145 + 9.39\ N - 0.0574\ N^2$$

maximum yield of 1529 kg per hectare at 82 kg of nitrogen per hectare

Response and yardsticks:

Nitrogen levels kg/ha	Hybrid Total increase kg/ha	Hybrid Yardstick kg/kg of N	Local Total increase kg/ha	Local Yardstick kg/kg of N
0 to 40	769	19.2	284	14.2
0 to 80	1289	16.1	384	4.8
0 to 120	1561	13.0	-	-

9/ Data for the hybrid response are from the sorghum trials conducted as part of the Indian Council of Agricultural Research program for sorghum improvement. Data for local varieties is from the Annex to Appendix II and the constant is estimated from information on farm trials.

e) BAJRA[10/]

(The caution set forth in the section on jowar applies even more forcefully for data relating to pearl millets.)

Hybrid:

$$Y = 1496 + 15.13\ N - 0.0281\ N^2$$

maximum yield of 3533 kg per hectare at 269 kg of nitrogen per hectare

Local:

$$Y = 1118 + 9.10\ N - 0.02\ N^2$$

maximum yield of 2153 kg per hectare at 227 kg of nitrogen per hectare

Response and yardsticks:

Nitrogen levels	Hybrid		Local	
	Total increase	Yardstick	Total increase	Yardstick
kg/ha	kg/ha	kg/kg of N	kg/ha	kg/kg of N
0 to 50	686	13.7	405	8.1
0 to 100	1232	12.3	710	7.1
0 to 150	1637	10.9	915	6.1

12. Of the five cereals for which there are now new responsive varietal materials available, the hybrids of maize, jowar, and bajra give small to substantially larger yields than local varieties when no nitrogen is applied. Jowar averaged 1635 kg per hectare at zero nitrogen, against 1145 kg for the local materials, a difference of over 42 per cent. Unfertilized bajra hybrids also outyielded the domestic types by 1496 kg per hectare to 1118 kg, a difference of 34 per cent. Maize showed an almost 400 kilogram difference in yield between the Hybrid and Local materials at a zero nitrogen application. In the case of wheat and rice, the data are too dissimilar to draw even tentative conclusions, but a few incomplete experiments suggest that on irrigated land, at least, the exotic materials may be capable of giving a considerably better yield than the indigenous types at low levels of fertility.

13. In making comparisons with the yardsticks it is of interest to note that at present prices one kilogram of nitrogen costs about Rs.2.15 at the farm, or approximately three to four kilograms of grain. At these price

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10/ Data for bajra, local and hybrid, was taken from Murty, B.R. "Fertilizer Response to Hybrids of Jowar and Bajra in 1965" Mimeo., Indian Agricultural Research Institute, 1966.

relations, and with the prospects of new varieties that are highly responsive to nitrogen, the demand for seed and fertilizer has received a high accelerative impetus that completely outstrips the trend estimates for fertilizer consumption made earlier. At present prices and allowing for a substantial risk discount, the optimal dosage of nitrogen for the high yielding dwarf wheat is around 120 kilograms per hectare, for wet season rice it is probably about 70 kilograms per hectare and for rice grown during the dry season (when there is a higher sunlight intensity) it is about 100 kg per hectare. For the more vegetative maize, sorghum and millet varieties, dosages of 100 to 130 kg of nitrogen per hectare are probably close to optimum. Research on phosphorous alone and in combination with nitrogen is still tentative but what evidence there is at hand points to a substantial response to this nutrient as well. There are little data on potash response, and what data there are appears to indicate a low return to this plantfood.

14. At an input of 120 kg of nitrogen per hectare to the dwarf wheats, yield would be increased by about 1376 kg. At present farm prices of around Rs. 75.00 per quintal (100 kgs.), this extra yield would sell for about Rs.1032.00, a gross return gained at a cost of Rs.258.00 for the nitrogen. Even on local wheats a "recommended" dose of 40 kg of nitrogen per hectare would add 506 kg of grain to yield and give a monetary return of Rs.380.00 for an outlay of Rs.86.00. (It is of interest to note that at prices prevailing until mid-1963, the local varieties would provide a gross of Rs.200.00 at a cost of Rs.70.00, not a highly attractive rate of return when discounted for risk.) It seems clear that under present price relations even the limited response to nitrogen of the older plant types provides an attractive opportunity to investment in nitrogen use. It should be anticipated that today's demand for fertilizer for wheat will come from all cultivators having access to irrigation, not merely from those who can procure seed of the high-yielding varieties. While less easily documented, a similar statement would hold for farmers growing any of the other crops under adequate moisture conditions.

15. Under the High-Yielding varieties program, the Ministry of Food and Agriculture hopes to put 32.5 million acres in 1970-71 to producing the hybrid and exotic plant materials now available. Table II gives an approximate estimate of the national output and acreages of production for each of the five crops being promoted in the program. Recognizing that cereals account for 85 per cent of total foodgrains production, it is obvious that the high-yielding varieties program involves crops accounting for 90 per cent of cereal output and roughly three quarters of foodgrains production.

16. When the high-yielding varieties program was first formulated, the major constraint on area growth was conceived to be seed availability. It appears now that seed will not be a constraint on expanding the acreage under wheat and rice. Area under these crops will be limited mainly to land that is adequately watered and shaped to allow some element of sound water management, an especially important requirement for high yield rice production. For the hybrids, the availability of seed likely will act as the most serious constraint on the extension of acreage.

TABLE II

OUTPUT AND ACREAGE FOR FIVE MAJOR CEREALS, AND THE ACREAGE TO BE INCLUDED UNDER THE HIGH-YIELDING VARIETIES PROGRAM.

Crop	National output and per cent of total foodgrains		Total acreage and per cent of total devoted to food-grains		Acreage called for under HVP by 1970-71	HVP acreage as per cent of normal acreage in each crop
	(m.tons)	%	(m.acres)	%	(m.acres)	%
Rice	36.0	42	85.0	30	12.5	15
Wheat	12.0	14	33.0	12	8.0	24
Jowar	10.0	11	45.0	15	4.0	9
Maize	4.5	5	11.0	4	4.0	36
Bajra	3.5	5	27.0	9	4.0	15
Total all foodgrains	85.0		295.0		32.5	11

17. The most significant constraint on realising the yield potential of the new varieties (in contrast to area expansion) is likely to be a shortage of fertilizer. At application rates for nitrogen given in paragraph 14, the acreage target for the high-yielding varieties program would require 1.3 million tons of nitrogen, 65 per cent of the 2.0 million tons projected as being available in 1970-71. In other words, if the program succeeds in meeting its planned acreage, and if these acres are fertilised at what appear to be optimum rates from the point of view of the farmer[11/] 65 per cent of the nation's available nitrogen will go to about 11 per cent of the national acreage devoted to foodgrains. No projections are easily possible for phosphate requirements. But if P_2O_5 applications were to average 50 kg per hectare (the presently recommended rate for many areas of the country) requirement would be 658,000 tons of P_2O_5 or, again, about 65 per cent of the 1.0 million tons of planned availability.

18. It is important to note that the higher yield obtained on the new varietal material is not just due to the fertilizer up-take of the plant. It is due mainly to the genetic ability of the variety to yield under conditions of extreme crowding, i.e. to produce in spite of a high plant population per hectare. High plant populations require high fertility soil, and as the larger leaf area involves a large transpiration surface, there is therefore a larger water loss than is the case with traditional plant types. It has already been mentioned that for high yields from the dwarf wheats it is necessary to give close attention to irrigation and irrigation timing (a matter that has far-reaching implications for the scheduling of irrigation water in the canal areas, and, in part, accounts for the very strong demand for private irrigation systems of modern design that free the owner from a dependence on government sources and administrative caprice) but for all crops the water up-take of the new varieties will be substantially greater than for the older types, a factor that will impose a limitation on their general adaptability by holding them to areas with either irrigation (wheat and rice) or reasonably assured rainfall during the growing season of at least 15" for bajra, 20" for jowar, and 20 to 25" for maize. Estimates of how many acres there are in India presently adapted to available hybrids are very crude, but it seems likely that 12 million acres could be planted successfully to wheat, about 35 to 40 million acres to the three hybrids, and between 20 and 30

11/ What is optimal for cultivator profit is not necessarily optimal for gaining maximum total production for the nation. But it is hard to see how farmers can be effectively prevented from selecting and using personally profitable application rates for fertilizer even if these entail a social cost. In fact, it is likely that the social outlay needed to prevent the pursuit of private gain would be more than the return to society of a more efficient social use of fertilizer, and such preventive measures could very well remove any farmer incentive to innovate by changing to the new varieties and new methods. For the social argument see: Minhas, B.S. and Srinivasan, T.N. "New Agricultural Strategy Analysed" Yojana, Jan.26, 1966.

million acres to rice. These estimates do not include double cropping potential. Already in parts of the north Indian plains, farmers are experimenting with hybrid maize-wheat, and hybrid jowar-wheat rotations. The timing of these rotation sequences involves a critical difficulty of land preparation for wheat sowing that is not solved readily by bullock tillage power. As a result, the demand for farm tractors has increased and will likely become a major machine need pressing close behind the need for irrigation pumps and water spreading equipment.

19. The high-yielding varieties have still other consequences for the technical shape of future Indian agriculture. Larger plant populations lead directly to greater insect populations, and provide an ideal environment for the spread of disease. With traditional materials, systematic plant protection measures of a prophylactic nature were only marginally profitable, if not unprofitable. Relative to cost there seemed little to be gained by adding ten per cent to a 1,500 pound per acre yield. But a similar ten per cent on a 4,000 pound crop can pay for a comprehensive plant protection program and leave a substantial and attractive residual. A similar argument would lead to the conclusion that land shaping for better irrigation will become more profitable as percentage losses to low yield crops due to uneven field surfaces are applied to crops of much higher yield. In fact, there is already a substantial demand from farmers for more power, land planes and even earth-moving services to take advantage of the gains from improved opportunities for better water management.

20. In summary, experimental study of the new varieties is still too sketchy to do more than provide a vague outline of their potential, but this outline suggests strongly that there is a wide gulf between the new and old genetic base on which India's crops can rest. A development strategy for agriculture that is based on the new genetic potential offers a substantial promise of revolutionizing the nation's agriculture. The use of these materials will involve serious problems of social equity, however, as the new varieties are best suited to areas already advantaged with irrigation and assured rainfall, and their yield potential is of an order that means the benefits they confer on the farmers in these advantaged areas cannot be ignored in a development process that holds the equalization of income as one of its goals. Indeed, the implications and opportunities the new materials have for the political economy of the whole country are undoubtedly to be their most important continuing legacy.

ANNEX

TO

APPENDIX II

NOTES ON PARTICULAR HYBRID VARIETIES

(SOURCE: NATIONAL SEEDS CORPORATION PUBLICATIONS)

W. David Hopper

ANNEX TO APPENDIX II

NOTES ON PARTICULAR HYBRID VARIETIES

Co-ordinated Sorghum Hybrid No. 1

(Sorghum Hybrid No. 1 (CSH 1) is a welcome addition to the family of hybrids, CSH 1 is the first of the sorghum hybrids recently released under the Accelerated Hybrid Sorghum Project. In this article the authors give an important account of the evaluation of this hybrid and its appreciable impact on increasing yields of sorghum in India.)

1. Utilisation of hybrid vigour through development of commercial hybrids has often been cited as one of the major plant breeding achievements. The release of co-ordinated sorghum hybrid for general cultivation is a major step in the realisation of the objectives of the accelerated hybrid jowar project initiated by I.C.A.R. in the year 1960. This also marks the arrival of hybrid sorghum in Indian agriculture.

2. Based on the results of extensive testing of twelve promising hybrids all over the country, this hybrid has been found to be suitable for early and medium duration Kharif areas and for the irrigated summer season. This high yielding hybrid is the product of hybridisation between male sterile Combine Kafir 60 and a yellow endosperm Ferterita known for its high carotene content.

3. On an average, the hybrid has recorded an increase of 60-80% in grain yields over the local improved varieties while there has been a 20-30% reduction in fodder yields. It has creamy white pearly grains which are generally preferred. Of the total area of 43 million acres, about 14 million is estimated to be suitable for the cultivation of this hybrid. The early and medium duration Kharif tracts in the states of Madras, Andhra Pradesh, Mysore, Rajasthan, Gujarat, Madhya Pradesh and Uttar Pradesh, the irrigated Kharif areas under the Tungabhadra Project and the irrigated summer tracts in the states of Madras and Andhra Pradesh are most suitable. Besides the hybrid has done well in Delhi and Orissa where presently only fodder jowars are raised. In the black cotton soils of Maharashtra, Mysore, Gujarat, Rajasthan and Madhya Pradesh where presently very late kharif jowars are grown, the hybrid could be cultivated as an early kharif crop to be followed by a rabi crop even under rainfed conditions.

4. For a successful cultivation of this hybrid it is advisable to sow it before 15th of July in kharif season and in the first week of March for the summer season. Under a spacing of 18" between rows and 6" between plants, which is the normal practice, an application of 60 lbs. nitrogen per acre under rainfed conditions and 90 lbs. nitrogen per acre under irrigation is recommended. Phosphatic fertilisers could be applied according to the local practice. Average yields of over 2,000 lbs. per acre under normal rainfall conditions and over 4,000 lbs. per acre under

irrigation have been realised with this hybrid and with intensive cultivation it is possible to further maximise the yields.

5. The produce from a commercial crop should not be used as the source of seed to plant another crop. Fresh certified hybrid seed has to be obtained from authorised sources every year. The National Seeds Corporation supplies certified stocks of foundation seeds to authorised seed producers. Hybrid seed produced by such producers is properly certified for its purity, and germination. It is marketed in standard sized sealed bags carrying a blue certification tag of the National Seeds Corporation. Purchase of such seed stocks by the farmers from certified seed producers will not only ensure purity of seed but also help in securing maximum returns to the grower.

SOURCE: The National Seeds Corporation "NSC BULLETIN" Vol. 1 No. 2, January 1965.

The Co-ordinated Bajra Hybrid No. 1 (HB 1)

(Hybrid Bajra No. 1 (HB 1) is the first bajra hybrid released by the Central Variety Release Committee of the Indian Council of Agricultural Research. It is another step forward towards exploiting the phenomenon of hybrid vigour for increased yields. In this article the authors give an important account of the evolution of this hybrid and its appreciable impact on increasing yields of bajra in India.)

6. For a long time in the past, the scope for the breeding and improvement of the bajra crop appeared to be rather limited. The utilization of cytoplasmic male sterility opened up new possibilities and offered a practical method for exploiting the phenomenon of hybrid vigour for increased yield. The bajra hybrids based on male sterility and tested in all the important bajra growing regions in India during 1963 and 1964 showed outstanding promise, producing grain yields 50 to 150 per cent above that of local improved open pollinated varieties. Further, the fodder yield after grain harvest is of better quality being greener, leafier and more succulent than local varieties.

7. The Central Variety Release Committee of the Indian Council of Agricultural Research, on March 12, 1965, released the first bajra hybrid and named it HB-1, for Hybrid Bajra No. 1. This hybrid was superior to the local varieties with which it was compared -- about 100 per cent more grain yield in 1964 as an average of all the locations from Punjab to Madras where trials were conducted. Increase in fodder yields of this hybrid averaged nine percent higher than local varieties. Nevertheless, the improved fodder quality of this hybrid (remaining green even after grain harvest under favourable moisture conditions) should make it a valuable by-product of the crop since bajra fodder taken after grain harvest is normally considered very poor in quality.

8. The duration of this new hybrid is comparable with that of local varieties, maturing in 75-85 days from sowing. The grain produced has been tested and found high in protein (12.8%) and comparable in quality and acceptability. This new hybrid is also highly resistant to lodging and tillers profusely important requirements for high yield under favourable conditions and with improved practices. Since the hybrid tillers profusely and plants are vigorous, seed requirements are expected to be small if good cultural practices are adopted. Thus, excellent stands have been obtained with as little as one to one-and-one half kilos of seed per acre with line sowing.

9. This new bajra hybrid was developed by Dr. D. S. Athwal, Professor and Head of the Department of Plant Breeding, Punjab Agricultural University, Ludhiana, and tested in collaboration with the Coordinated Millets Improvement Scheme of the Indian Council of

Agricultural Research. It is the result of a cross between an elite pure line selected from S.350 of the Punjab and Tift 23-A, a cytoplasmic male sterile seed parent, from Georgia USA.

10. The hybrid can be cultivated successfully both under rainfed and irrigated conditions. The sowings may be done in July in Kharif season in rows 18" to 24" apart. An application of 40 lbs. nitrogen per acre under irrigation is recommended. The dose may be increased for obtaining higher yields depending upon the moisture level and basic fertility of the soil. Phosphatic and potassic fertilizers may be applied according to local practices. Yields of 2,000 lbs. per acre under rainfed conditions and over 3,500 lbs. per acre under irrigated conditions have been realized with this hybrid.

11. Seed supply of this new hybrid is limited but 30 acres have been sown this summer season to provide substantial quantities of seed for extensive demonstrations and trials during the coming main Kharif season with perhaps a small surplus for some commercial cultivation. However, seed production is expected to be increased considerably for large scale commercial cultivation in 1966.

SOURCE: The National Seeds Corporation "NSC BULLETIN" Vol. 1, No. 4, May 1965.

Co-ordinated Sorghum Hybrid No. 2

(The release of CSH 2 is another significant achievement in the direction of exploiting hybrid vigour for getting higher agricultural yields. The release of CSH 1 (see NSC Bulletin, Volume 1 No. 2 and 3, January and March 1965) was announced a few months back and production of certified seed of this hybrid has already been taken up on all India basis. CSH 2 has extended the scope of hybrid sorghum cultivation in areas where mid late kharif crop can be grown.

The authors of this article are, in fact, the brains behind the evolution of the sorghum hybrids, CSH 1 and 2. In this article they have given different characteristics of CSH 2 with regard to its performance, adaptability etc.)

12. The earlier release of CSH 1, suitable for the early and medium duration kharif areas and the irrigated summer tracts, marked the advent of Hybrid Sorghum to Indian Agriculture. The recent release of Coordinated Sorghum Hybrid No. 2 (CSH 2) by the Central Varietal Release Committee fills the needs of the vast mid late kharif tracts all over the country.

13. CSH 2 has been developed by crossing male sterile combine kafir 60 with a yellow endosperm Hegari as the pollinator parent. This hybrid has been extensively tested all over the country during the years 1963 and 1964. It has a 77 per cent superiority with respect to grain yields while the fodder yields are almost equal to the locals. The comparative performance of this hybrid in the mid late kharif tracts, where it was found to be superior to both CSH 1 and local improved strains is summarized below:

Year	Grain Yield as % of Local			Fodder Yield as % of Local		
	CSH 2	CSH 1	Local	CSH 2	CSH 1	Local
1963	192	151	100	135	92	100
1964	177	145	100	98	68	100

14. Unlike CSH 1, this hybrid is medium tall, about 6 feet, but not as tall as locals. It does not lodge; the stem is leafy and remains green almost till harvest. It is later in maturity than CSH 1, flowering in 70-75 days and matures in 110-120 days. The grains are white pearly, the protein content and cooking tests are comparable to locals.

15. Regarding the area of adaptability, particular mention may be made of the Dharwar-Belgaum-South Satara region of the Mysore and Maharashtra States and eastern districts of Madhya Pradesh, Gwalior,

Bhind, Morina, Shivpuri, Guna, Sehore, Bhopal and the adjoining Bundelkhand region of Uttar Pradesh. In addition, the following kharif tracts should be considered as the general area of adaptation. The monsoon sorghum tract of Madras States; Visakhapatnam, Srikakulam and parts of Adilabad in Andhra Pradesh, the mid late areas of the Vidarbha region in Maharashtra, the forage sorghum areas in Orissa, Bihar and Uttar Pradesh, including the hilly areas.

16. Under reasonably good rainfall conditions average yields of 3,000 kgs. of grains per hectare have been realised while under higher fertility conditions over 6,000 kgs/Ha have been recorded. The hybrid responded up to 150 kgs. of N per hectare. For a successful cultivation, sowing around the middle of July with normal spacing of 18" between rows and 6" between plants is recommended. Fertilization up to 80-100 N/acre could be done as a normal practice while higher doses could further maximise the yields. Phosphates and potash could be applied according to local recommendations. Appropriate plant protection measures, particularly against the fly and shoot borers are highly desirable.

17. As is the case with all hybrids, the produce of a commercial crop should not be used as seed. The National Seeds Corporation will be taking up the multiplication of this hybrid, and certified seeds in sealed bags will be available to the farmer in due course.

18. It has to be emphasized that the areas for CSH 1 and CSH 2 overlap in some cases. The two hybrids are not mutually exclusive in their areas of adaptation. As far as the kharif season is concerned, the guiding principle in choosing the hybrid has to be the maturity. If an early hybrid is needed, CSH 1 should be grown and if a slightly later one is the need, CSH 2 could be recommended.

SOURCE: The National Seeds Corporation "NSC BULLETIN" Vol. 1, No. 6, September 1965.

GANGA HYBRID MAKKA NO. 1

Area of Adaptation	:	Indo-gangetic plains and parts of Madhya Pradesh
Maturity period	:	80 to 90 days
Description	:	Plants resistant to lodging; tendency develop two well-filled ears per plant; ears have tight husk cover providing protection against bird damage; attractive small, round, hard and yellow grains. Resistant to downy mildew, medium tolerant to the maize top shoot borer.
Grain Yield	:	The hybrid has yielded up to 76% more than local varieties when grown under recommended agronomic practices.
Fodder	:	The hybrid has given up to 200% more fodder than local varieties.

SOURCE: The National Seeds Corporation publication on Hybrid Maize and Vegetables, Pp. 3.

GANGA HYBRID MAKKA NO. 101

Area of Adaptation	:	Indo-gangetic plains, lower foot hills of Himalayas, parts of Madhya Pradesh and Orissa.
Maturity period	:	95 to 105 days with wider range of adaptability.
Description	:	Plants highly resistant to lodging; ears have very tight husk cover extending beyond the tip of the cob; tendency to develop two big grain-filled ears per plant; very attractive, bold, round, hard, orange-yellow grains; highly resistant to downy mildew, leaf blight and rust; medium tolerant to the maize top shoot borer.
Grain Yield	:	The hybrid has yielded up to 150% more than local varieties when grown under recommended agronomic practices.
Fodder	:	The plants are somewhat green at harvest and make better quality fodder than local varieties. The hybrid has given up to 400% more fodder than local varieties.

SOURCE: The National Seeds Corporation publication on Hybrid Maize and Vegetables, Pp. 4.

RANJIT HYBRID MAKKA

Area of Adaptation	:	South Rajasthan, Gujarat and Maharashtra.
Maturity period	:	100 to 110 days.
Description	:	Plants highly resistant to lodging, having thick stem with a reddish base; ears have tight husk cover; a strong tendency to develop two big grain-filled ears per plant; attractive, bold, round, hard, orange-yellow grains; highly resistant to downy mildew, leaf blight and rust; medium tolerant to the maize top shoot borer.
Grain Yield	:	The hybrid has yielded up to 150% more than local varieties under recommended agronomic practices.
Fodder	:	The plants are somewhat green at harvest and make better quality fodder than local varieties. It has given up to 400% more fodder than local varieties.

SOURCE: The National Seeds Corporation publication on Hybrid Maize and Vegetables, Pp. 5.

DECCAN HYBRID MAKKA

Area of Adaptation	:	Peninsular India
Maturity Period	:	100 to 110 days.
Description	:	Plants have broad, dark green leaves, and thick stem resistant to lodging; very tight husk cover giving protection against bird damage; tendency to develop two big grain-filled ears per plant; bold, hard and bright yellow grain highly resistant to downy mildew, leaf blight and rust diseases; tolernat to top shoot borer.
Grain Yield	:	The hybrid has yielded up to 145% more than total varieties under recommended agronomic practices.
Fooder:	:	The plants are still somewhat green at harvest and make better quality fodder than local varieties. It has given up to 380% more fodder than local varieties.

SOURCE: The National Seeds Corporation publication on Hybrid Maize and Vegetables, Pp. 6.

GANGA SUFAID HYBRID MAKKA NO. 2

Area of Adaptation	:	Indo-gangetic plains and other parts of India where farmers prefer white maize.
Maturity Period	:	92 to 95 days.
Description	:	Plants resistant to lodging, moderately susceptible to leaf blight and rust; tolerant to top shoot borer; good husk cover; tendency to develop two well-filled ears per plant; round, medium sized white coloured grain.
Grain Yield	:	10% higher than Ganga 101 and 4% than Deccan in the south.

SOURCE: The National Seeds Corporation publication on Hybrid Maize and Vegetables, Pp. 7.

HI-STARCH HYBRID MAKKA

Area of Adaptation	:	Throughout India and wherever demand of starch factories exists for this type of grain. Performs particularly well in the Himalayas.
Maturity Period	:	Approximately 95 days in plains and peninsular India.
Description	:	Plants very broad-leaved and resistant to lodging, tendency to develop two ears, good husk-cover; moderately susceptible to leaf blight and rust, tolerant to top shoot borer and bold dent to semi dent white kernels. Specially evolved to suit the needs of starch factories and other industrial needs.
Grain Yield	:	Almost equal to Ganga 101 in northern and central India, slightly less than Deccan in the south.

SOURCE: The National Seeds Corporation publication on Hybrid Maize and Vegetables, Pp. 7.

GANGA HYBRID MAKKA NO. 3

Area of Adaptation	:	Wide range of adaptability
Maturity Period	:	90 days. (It is as early as some of the local varieties and Ganga No. 1)
Description	:	Better standability than Ganga No. 1 Resistant to downy mildew and tolerant to leaf blight. Good sized, well-filled ears with good husk-cover. The grain is flint and of a very good shining orange-yellow colour.
Grain Yield	:	This hybrid has given up to 76% more yield than local varieties under recommended cultural and manurial practices.

SOURCE: The National Seeds Corporation publication on Hybrid Maize and Vegetables, Pp. 7-8.

HIMALAYAN HYBRID MAKKA NO. 123

Area of Adaptation	:	Hilly areas of Himalayan range, specially Kashmir, hills of Punjab and Himachal Pradesh.
Maturity Period	:	110 to 115 days.
Description	:	Vigorous, good plant aspect and husk-cover; resistant to downy mildew and fairly tolerant to leaf blight. Excellent pollen producer. Grains yellow in colour and of flint type.
Grain Yield	:	Has given up to 4% higher yield than VL 54 in Kashmir and hills of Punjab and Himachal Pradesh.

SOURCE: The National Seeds Corporation publication on Hybrid Maize and Vegetables, Pp. 8.

APPENDIX III

PRICES

Armand M.J. Van Nimmen

APPENDIX III

PRICES

1. During the last two years some striking developments have taken place with respect to the overall level of prices in India. In mid 1965 the increase in prices was a relatively new phenomenon which, at that time, might have seemed to be of a temporary nature. As can be seen from Chart I, the all-India wholesale commodities price as compiled by the Economic Times only increased by 9 percent in 1963. Then, from January to October 1964, the index rose from 122 to 148, i.e. by over 20 percent. This sudden upsurge in wholesale prices came to an abrupt end, however, in the last trimester of 1964. In fact, at the time when the previous report was being drafted, the wholesale index was still below the level it had reached in October 1964. It was not until the beginning of April 1966 that the index exceeded the level which it had reached in 1964 and that a new steady increase set in.

2. This increase has been going on since that time and had reached over 17 percent in mid-November 1966, when the index stood at an all-time high of 177. On a monthly basis this rate of increase is roughly comparable to the one registered in 1964. Nevertheless, this second sharp and prolonged rise in prices places the evolution of the last three years in sharp contrast with the trend in the preceding years. Table I shows that the price rise which occurred between 1962-63 and October 1966 (50 percent) by far exceeds the price rise registered during the seven years preceding 1963 (28 percent). To this should be added that, whereas in 1963/64, despite the rise in prices, real national income continued to increase as before, in the last months of 1966 real national income remained stagnant or might even have declined. This latter fact, together with the devaluation, has led to an outright inflationary psychosis which may have detrimental effects on the long-term growth prospects of India. It does not lie in my intentions to prescribe a fiscal or monetary cure for this ailment. I shall restrict myself to determining the relative evolution of agricultural versus non-agricultural prices and indicate some of the more recent measures which have been taken with regard to agricultural price policy. I shall present my material in the following order:

A. The relative evolution of agricultural market prices

   1. agricultural output prices

   2. agricultural input prices

B. Agricultural price policy

   1. agricultural support prices

   2. agricultural procurement and issue prices

TABLE 1 1/

SELECTED WHOLESALE PRICES, 1955-56 to 1963-64

JANUARY 1962, '63, '64, '65, '66 and OCTOBER 1966

1952-53 = 100

	Food-grains	All Food Articles	Raw Cotton	Raw Jute	Oilseeds	Manufactures	All Commodities
Weights in all Commodities:	23.5	50.4	3.2	2.3	6.0	29.0	100.0
1955-56	86	95	109	116	111	103	99
1956-57	96	102	113	133	117	106	105
1957-58	91	103	103	122	116	107	106
1958-59	102	113	100	114	128	110	112
1959-60	100	117	113	141	140	117	119
1960-61	99	118	111	267	160	129	128
1961-62	100	118	113	143	148	126	123
1962-63	102	124	118	150	143	130	127
1663-64	124	141	120	151	166	133	139
1964-65	142	154	132	172	194	141	151
1965-66	156	175	128	278	264	157	174
Last Week of:							
Jan. 1962	102	120	110	145	158	126	124
Jan. 1963	103	124	109	148	145	128	127
Jan. 1964	120	139	120	149	154	132	137
Jan. 1965	151	164	128	176	203	141	157
Jan. 1966	156	171	129	245	254	154	169
Oct. 1966	175	201	139	298*	287	162	190
Percentage Rise Oct. 1966 Over Jan. 1966	12%	18%	8%	22%	13%	5%	12%

1/ Data from Government of India: Economic Survey, 1964-65, Table 5:1 and from Ministry of Finance.

* An apparent error had slipped in the copy of this table given to the Mission. The index value for October 1966 which read 248 was changed into the more realistic value of 298, in the light of a known 21 percent increase between January and October 1966.

A. The relative evolution of agricultural market prices

1. Agricultural output prices

3. Whereas the overall increase in prices between 1962-63 and October 1966 amounted to 50 percent, prices of foodgrains in the same period rose by 72 percent, i.e., almost one and a half times as much. This relative increase in the prices of foodgrains is not a new phenomenon. It was already apparent at the time of the previous report (page 19, para.39). Using the same statistical source as the one used then, it would seem that this relative increase in foodgrains prices came to a standstill in 1966. This is illustrated in Table II.

TABLE II: YEARLY PRICE INCREASES

FOODGRAINS AND FOOD ARTICLES

(in percentages)

	All Commodities	Foodgrains	Food Articles
January 1963	2.4%	1.0%	3.3%
January 1964	7.9%	16.5%	12.1%
January 1965	14.6%	25.8%	18.0%
January 1966	7.6%	3.3%	4.3%
October 1966*	12.4%	12.2%	17.5%

* Nine months only

4. A different picture emerges, however, when use is made of the all-India Economic Times Wholesale Index, reproduced in Table III.

TABLE III: YEARLY PRICE INCREASE

FOODGRAINS AND FOOD ARTICLES

ACCORDING TO ECONOMIC TIMES INDEX 1/

(in percentages)

	All Commodities	Wheat	Rice	Food Articles
January 1964	10.1%	35.2%	21.0%	14.7%
January 1965	14.9%	42.8%	15.7%	24.0%
January 1966	6.0%	-5.4%	14.2%	3.7%
October 1966*	18.1%	35.0%	37.0%	20.6%

1/ All indices were taken on the last Friday of the month.

* Nine months.

5. Whereas, according to this statistical source, the relationship between the index for food articles and the index for all commodities also seems to indicate a temporary reversal in 1965 from the trend observed in the two previous years, the indices for rice and wheat clearly show a continuation in 1966 of the improvement in the terms of trade for foodgrains.

6. The increase in the prices of agricultural raw materials directly or indirectly destined for export trade is also significant. Table IV below shows, in the same format as Table II, the yearly percentage increases for some of the major commercial crops as compared to those for all commodities. Combined over the entire period from January 1962 to October 1966, these increases amount to 53.2 percent for all commodities, 71.6 percent for foodgrains, 26.4 percent for raw cotton, 105.5 percent for raw jute and 81.6 percent for oilseeds. Apart from raw cotton, which did not follow the general price rise, the export crops mentioned show an overall price increase greater than the one registered for foodgrains and, hence, considerably larger than the price increase for all commodities.

TABLE IV: YEARLY PRICE INCREASES

COMMERCIAL CROPS
(in percentages)

	All Commodities	Foodgrains	Raw Cotton	Raw Jute	Oil-Seeds
January 1963	2.4%	1.0%	-0.9%	2.1%	-8.2%
January 1964	7.9%	16.5%	10.1%	0.7%	6.2%
January 1965	14.6%	25.8%	6.7%	18.1%	31.8%
January 1966	7.6%	3.3%	0.8%	39.2%	25.1%
October 1966*	12.4%	12.2%	7.8%	21.6%	13.0%

* Ten months only

Table 1V also shows that the relative price increase for jute and oilseeds has set in later but has been more continuous than the relative price increase for foodgrains.

2. Agricultural input prices

7. To evaluate the profitability of foodgrains production one has to compare the price trend of the end product with the price evolution of the inputs. This is illustrated in Table V by means of the ratio of wholesale prices of selected items to the wholesale prices of cereals. The selected items include iron and steel, fertilizer, cement, cotton, manufactures, kerosene and, finally, the combined category of manufactures. A decrease in the ratio points towards an improvement in the profitability of producing cereals; an increase means a deterioration. The series, which goes back as far as 1950, clearly shows that for all stated inputs the price improvement which was pointed out in the previous report still showed in December 1965. And the time series of the Economic Times Wholesale Indices illustrated in Charts I to 5 indicate that this trend has continued almost uninterruptedly until the time of writing of this note (November 1966).

8. The improvement in the price relationship with respect to fertilizer, one of the economically more significant indicators of profitability, is by far the greatest. But, whereas for other inputs, the improvement only set in three or four years ago, the improvement in the terms of trade as between fertilizer and cereals started around 1956, and except for short-lived deterioration in 1961, has continued without interruption ever since. To what extent this significant improvement is the result of conscious governmental policy will be indicated in the second part of this note.

TABLE V: RATIO OF WHOLESALE PRICES OF SELECTED ITEMS TO WHOLESALE PRICES OF CEREALS

Year[1/]	Iron & Steel	Fertilizer	Cement	Cotton Manufactures	Kerosene	All Manufactures
1950	91	96	98	97	91	-
1952	96	102	104	102	100	117
1954	131	104	114	127	114	101
1956	140	93	115	124	97	132
1958	138	91	123	108	90	107
1960	140	91	128	121	89	108
1961	148	94	136	125	97	125
1962	149	87	140	122	94	121
1963	145	83	137	120	117	117
1964	126	69	117	102	101	101
1965	125	63	116	96	99	101

1/ Average for year ending December of year stated.

B. Agricultural Price Policy

9. One of the main tenets of the Indian Government with regard to the problem of inflation is that "an inadequate increase in available supplies of food and other essential commodities" has been a major cause of the recent inflationary spiral. As long as the production of these essential commodities will be lagging behind demand, at least one of the inflationary pressures on the economy will persist. It is thus necessary to provide to the farmer a sufficiently strong incentive to increase the production of foodgrains; but at the same time social considerations require that "Government considers itself responsible for ensuring that food prices are reasonable and shall not rule at levels that prevent people with low incomes from buying their fair share of what is available" (Report of the Foodgrains Policy Committee, 1966, page 4). In the search for a delicate balance between the interest of the consumer and the incentive to the producers has lain the major pursuit of Indian foodgrains price policy. It will probably continue to be its principal aim in the coming years.

10. As far as export crops are concerned, the main emphasis lies on the improvement in productivity and, after the 1966 devaluation, on a delicate exploitation of demand elasticities intended to maximize short-run foreign exchange earnings without simultaneously hurting the long-term export markets.

11. The implementation of the agricultural price policy has given rise to a complexity of administrative measures which it will not be possible to unravel, let alone evaluate, in this brief note. Only some of the more important recent changes will be indicated below.

12. First of all, it should be indicated that in January 1965 an Agricultural Prices Commission was set up "to keep the price situation under constant review and to advise the Government on price policies" (Draft Outline, page 174). It is said in the draft version of the Fourth Plan that in the five coming years "price and marketing policies will assume added significance" (idem). One can only hope that the newly created Commission will be able to formulate and impose a rational and efficient approach to the price policy problem.

1. Agricultural support prices

13. One of the main instruments in the arsenal of price policy is the fixation of minimum support prices. In a manner reminiscent of the recent shift in the concept of irrigation - away from drought-protection and towards an increase in productivity - a recent report of the Agricultural Prices Commission has stated that "of late, in India, a somewhat more positive content has been given to the concept of price guarantee". Over and above the universally recognized objective "that any temporary glut in the market caused by either the supply or demand factor will not be permitted to depress (farmers') incomes ... it has been suggested that the device of minimum guaranteed prices should be utilized to assure the progressive farmer that his effort to augment production through adoption of improved technology will not become unremunerative because of the price factor" (Report of the Agricultural Prices Commission on price policy for kharif cereals for 1965-66 season, May-July 1965, page 1).

14. The Agricultural Prices Commission does not seem to have arrived yet at a firm criterion on which to base its support price policy. In its above-mentioned report the Commission says that it "has been considering alternative principles for determining the minimum producers' price". It rejects, however, the possibility of determining minimum prices "on the basis of market prices which prevailed in the immediate past". The commission asserts that in an inflationary situation such a policy would contribute to price escalation (idem, p. 2). It should be stressed, nevertheless, that when continuous inflation brings minimum support prices completely out of line with the prevailing price level, the floor price is likely to lose the very purpose for which it was determined, namely, its character of a guarantee sufficient to induce producers into more efficient methods of production.

15. Table VI below shows the minimum support prices for the last three marketing years.

TABLE VI: SUPPORT PRICES FOR AGRICULTURAL COMMODITIES

Rs. per quintal

Commodity	Variety	1964-65	1965-66	1966-67	Ruling Market Prices 1/
Paddy		34.00 to 41.00	35.00 to 40.00	35.00 to 40.00	80.00 to 150.00
Wheat	Red FAQ	45.50	45.50	45.50	90.00
	White FAQ	49.50	49.50	49.50	90.00
	Superior farm FAQ	53.50	53.50	53.50	95.00
Jowar	Yellow	38.00 to 38.50**	38.00**	38.00**	55.00
Bajra	FAQ	40.00 to 40.50	40.00	40.00	65.00
Maize		36.00 to 36.50	36.00	36.00	73.00
Gram		40.00 to 40.50	40.00 to 40.50	40.00 to 40.50	90.00 to 130.00
Sugarcane		5.36*	5.36*	5.36*	n.a.
+ Raw Cotton (statutory minimum)					
Jarilla 25/32"		197.20	223.00	244.00	n.a.
M.P./Vidarbha (Virnar 27/32")		214.00	247.00	265.00	n.a.
Raw Jute (operational minimum)					
Assam bottom delivered at Calcutta		80.37	80.37	93.77	125.00

Note: Prices relate to the marketing year of the respective crops.

1/ Prices as of November 1966, quoted at local producers' markets. Prices to farmers will be from Rs. 2.00 to Rs. 5.00 lower for transportation, and also less marketing charges and commissions.

* For a recovery of 10.4 percent and below.

** With suitable discount for red variety and premium for white variety.

\+ The basic variety was changed from Jarilla M.G.F. 25/32" to MP/Vidarbha Varnar, M.G.F. 27/32" from the year 1965-66.

From this table it appears that the only agricultural products for which an upward revision has taken place in this three-year period are raw cotton and raw jute. For raw cotton the increase amounts to 24 percent, for raw jute 17 percent. Comparing these price increases with the equivalent increases in market prices since January 1965, (16 percent for raw cotton and 100 percent for raw jute), one may wonder whether for the latter product the increase in the support price has been sufficient to provide an effective guarantee to the producer. The situation threatens to become even worse, of course, for foodgrains where no adjustment in the floor price has been made, while market prices have risen more than 45 percent.1/ The doubts raised in our previous report on the adequacy of the prevailing floor prices, are unquestionably enhanced today.

2. Agricultural procurement and issue prices

16. In the Indian set-up the Government is both buyer and seller of agricultural products. On these operations it can make profits or run a deficit. The budgetary and fiscal implications of such alternatives will be left for others to discuss. Suffice it here to determine the facts and point towards certain recent trends.

17. As a buyer the Government has two sources of supply: the foreign and the domestic market. Of these two sources of supply the former has up to now been by far the most important. Whereas total imports of cereals from January to October 1966 amounted to 9.4 million tonnes, local procurement of foodgrains in the first eleven months of 1965-66 amounted to only slightly over 3 million tonnes of foodgrains, the large bulk of which consisted of rice.

18. A very significant evolution took place in the field of import prices in June 1966 when, as a result of the devaluation, the c.i.f. cost of imports went up by 57.5 percent. Among the products dealt with in this note, foodgrains and fertilizers are the more outstanding examples of such a sudden price increase. Local procurement prices, on the other hand, are more difficult to measure because procurement systems vary from State to State. A few points stand out, however:

(i) Government procurement will increase considerably in the years to come. Both the Foodgrains Policy Committee (op. cit. page 37) and the Agricultural Prices Commission (op. cit. page 23) concur on this point. The latter body, in fact, foresees that Government procurement will go up from 14 percent of marketable surplus in 1966 to 23 percent in 1971.

1/ In early January 1967 the Union Government announced that the minimum support prices for wheat and gram of the 1966-67 rabi crop would be increased. For the first time a departure was made from the earlier practice of adopting nationally uniform support prices. It was decided that the price of wheat would be raised by Rs. 4 per quintal in the surplus States (Punjab, Haryana, Himachal Pradesh, Rajasthan, Bihar and Uttar Pradesh) and by Rs. 7.25 in the deficit States. The price increase for gram varied between Rs. 2.50 and Rs. 3.00 per quintal.

(ii) Government procurement is now done at prices below the uncontrolled market price, but above the floor price.

(iii) The official purchase price becomes thus in effect a maximum short-term guaranteed price.

(iv) This price will have to be sufficiently in line with the market price, for otherwise the enforcement of procurement will become very difficult. On the other hand, to the extent that the procurement is enforced, the incentive to the producer may be sufficiently diluted for him to produce less in the future or to switch to the production of other crops.

(v) In the light of the previous considerations, and as a result of the recent inflationary pressures, Center and States have agreed to increase their procurement prices. Madhya Pradesh, for instance, has recently increased its paddy procurement price by 10 percent.

Prices of the foodgrains and fertilizer acquired by the Government have, as detailed in the previous paragraphs, gone up quite considerably. For the Government to avoid running large deficits on its transactions, selling prices of these products would have to go up concurrently with buying prices. In August 1965 a Conference of Chief Ministers decided to review the issue prices of foodgrains. This decision led to the following measures:

(i) the subsidy on coarse rice which at that time amounted to Rs. 6 per quintal was reduced by Rs. 3 in November 1965, and by another Rs. 3 on June 10, 1966;

(ii) the issue price of imported wheat was raised from Rs. 48 per quintal to Rs. 50 per quintal;

(iii) the issue price of milo, on the other hand, was reduced from Rs. 40 per quintal to Rs. 33 per quintal "in order to provide a cheap grain for the poorer sections of the population" (Review of the Food Situation, July 1966, page 7).

19. In November 1966, as a result of the devaluation, the issue price of wheat was raised by 10 percent and the issue price of milo was brought back to its previous level of Rs. 40 per quintal. It was, furthermore, announced that in the near future the issue price of coarse rice would also be raised. In spite of these adjustments the Government is still heavily subsidizing its foodgrains operations. Table VII shows for each product the issue price and the concomitent subsidy, both before and after the adjustment of November 15. It has been estimated that in the next fiscal year the foodgrains subsidy would cost the Government approximately Rs. 130 crores. 2/

2/ See Public Accounts Committee (1966-67), Fifty-ninth Report, pp. 198-201.

20. As a result of the recent drought, statutory rationing has been introduced in a number of large cities and the number of Government controlled shops in the country has gone up from 115 thousand in July 1966 to 128 thousand in September 1966.

21. Issue prices of fertilizer, finally, have been raised in February 1966 by 7.4 percent at the pool level and by 10.6 percent at the farmers' level. No readjustment of the issue price has been made after the devaluation and the Government seems determined, at least for the time being, to maintain the fertilizer subsidy.

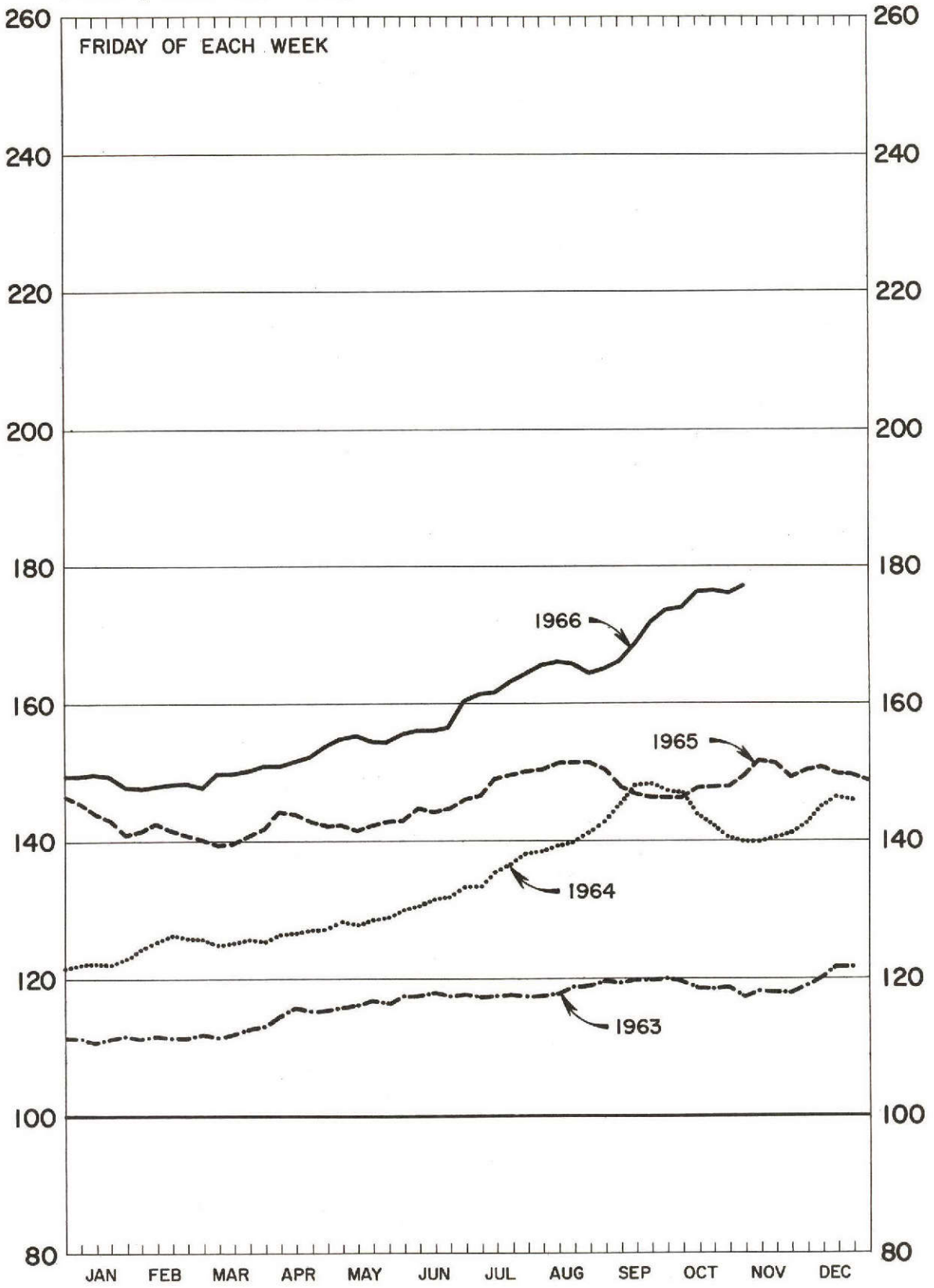
TABLE VII: ISSUE PRICES AND SUBSIDIES

(Rs. per quintal)

	Before November 15, 1966	After November 15, 1966
Wheat		
issue price	Rs. 50	Rs. 55
subsidy	Rs. 16.46	Rs. 11.46
Rice (coarse)		
issue price	Rs. 58 to 70	(unchanged)
subsidy	Rs. 44.50 to Rs. 32.50	
Milo		
issue price	Rs. 33	Rs. 40
subsidy	Rs. 19.10	Rs. 12.10

INDIA: WHOLESALE PRICE OF ALL COMMODITIES

(INDEX, 1959-60 = 100)

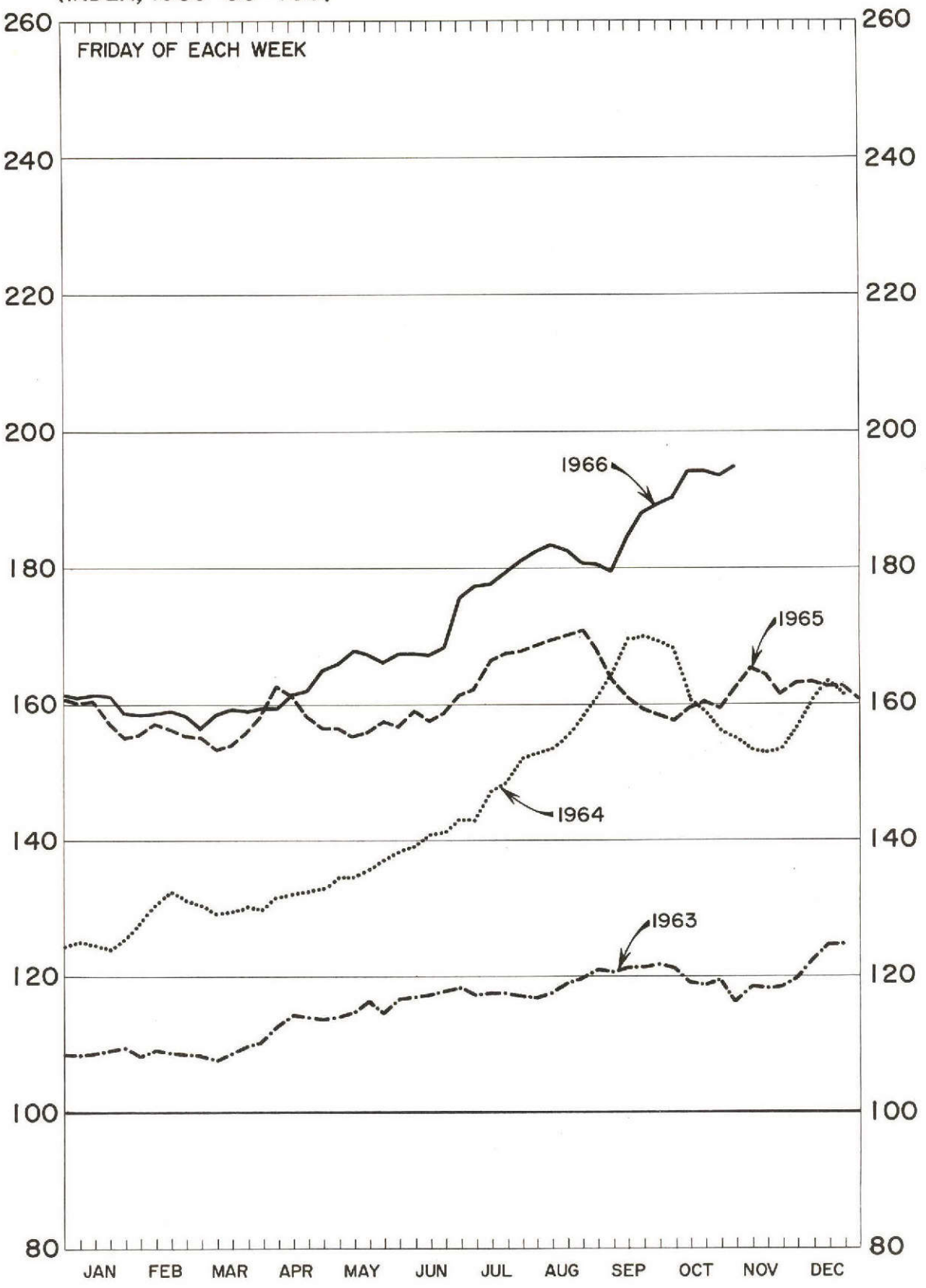


SOURCE: Economic Times.

IBRD - 3243

INDIA: WHOLESALE PRICE OF FOOD ARTICLES

(INDEX, 1959-60 = 100)

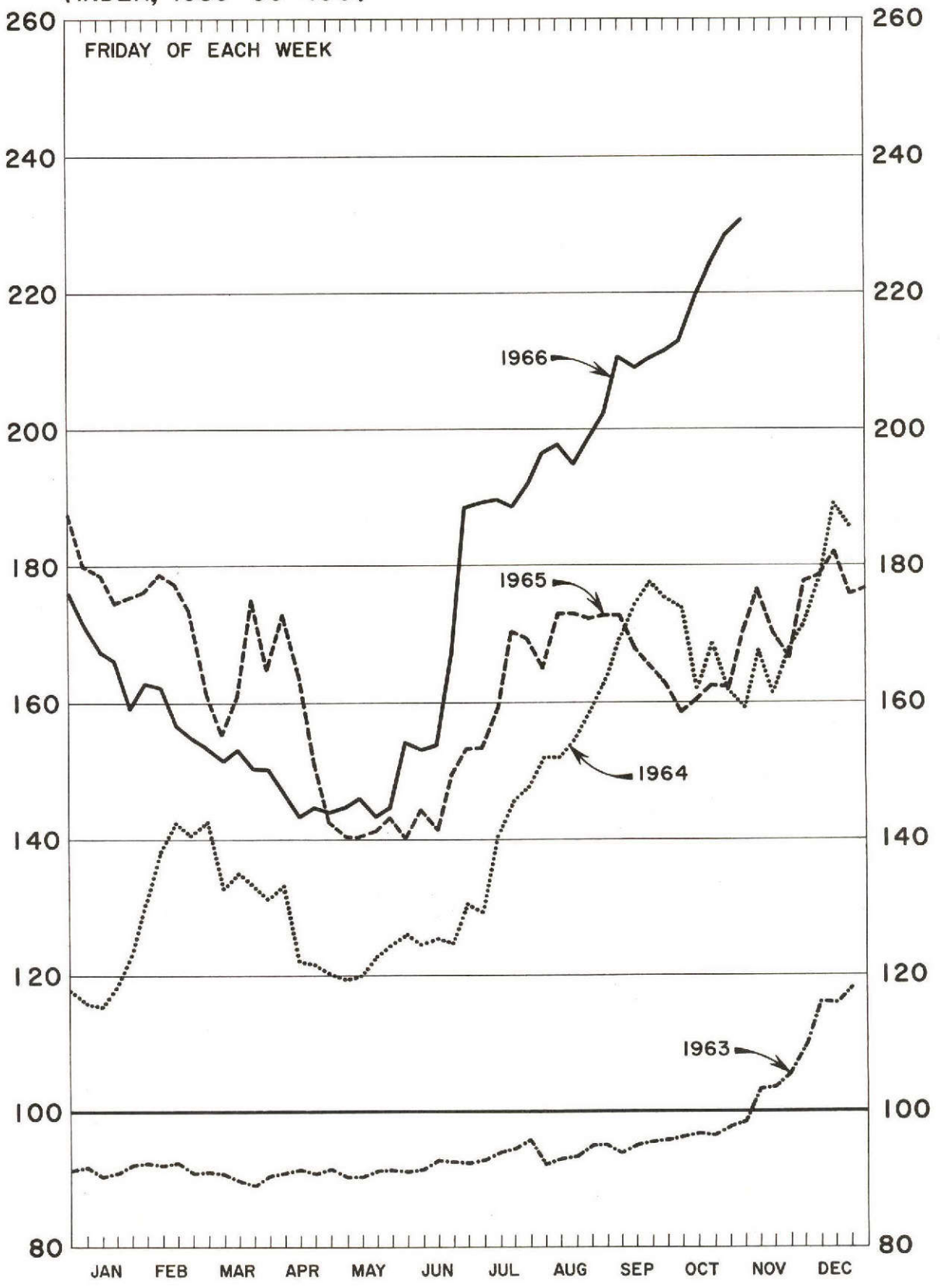


SOURCE: Economic Times.

IBRD - 3244

INDIA : WHOLESALE PRICE OF WHEAT

(INDEX, 1959-60 = 100)

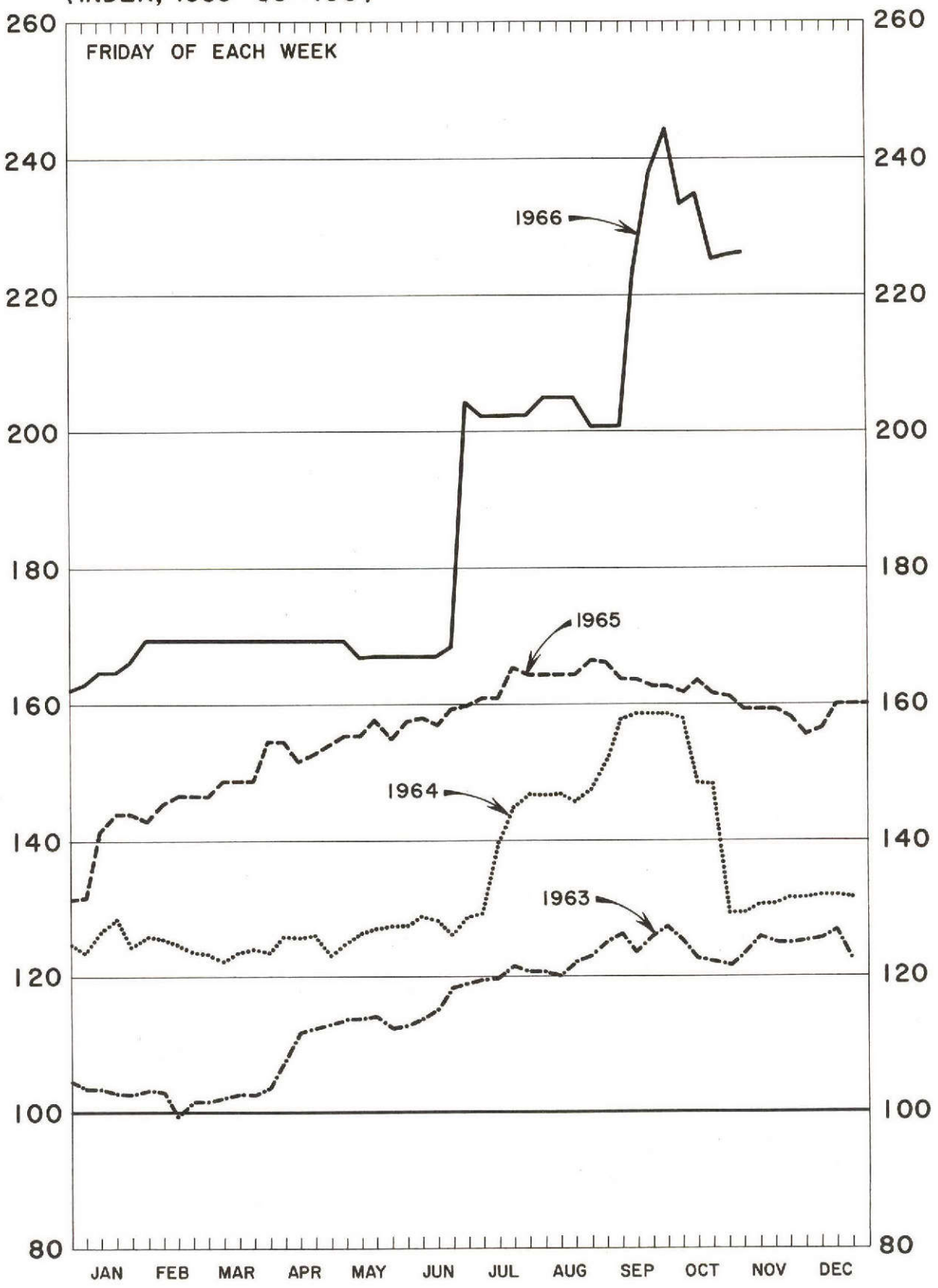


SOURCE : Economic Times.

IBRD-3245

INDIA : WHOLESALE PRICE OF RICE

(INDEX, 1959–60 = 100)

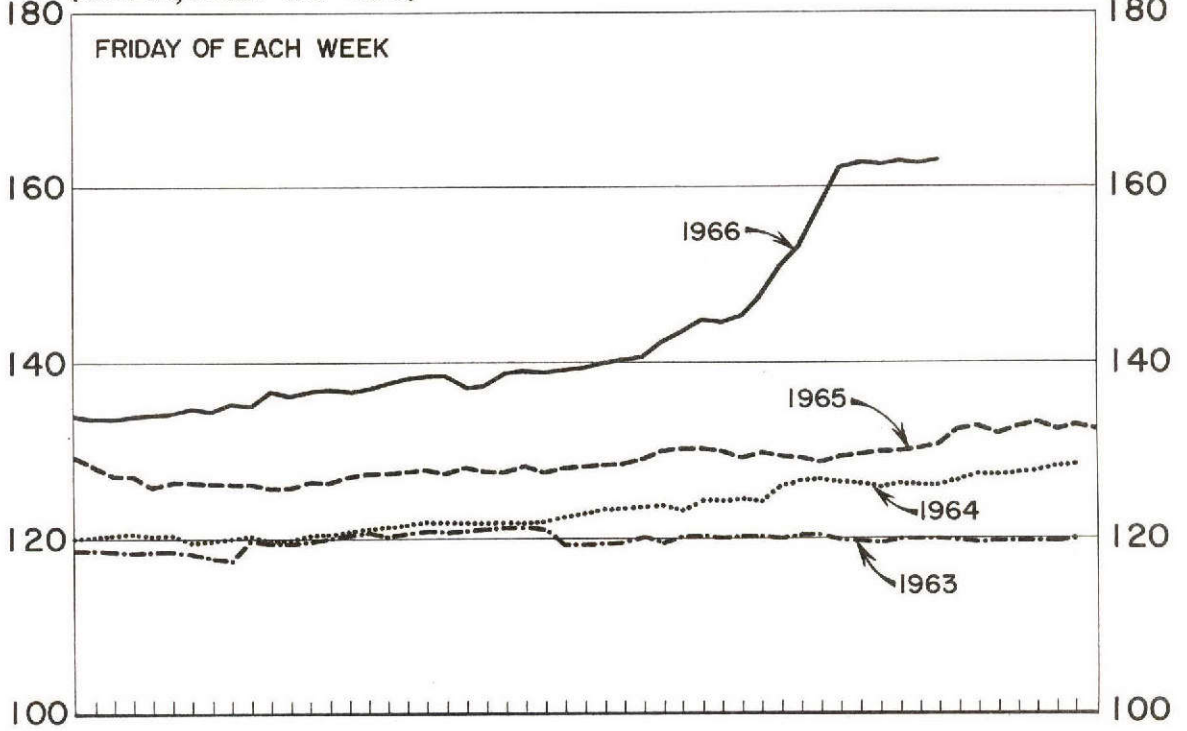


SOURCE : Economic Times.

IBRD – 3246

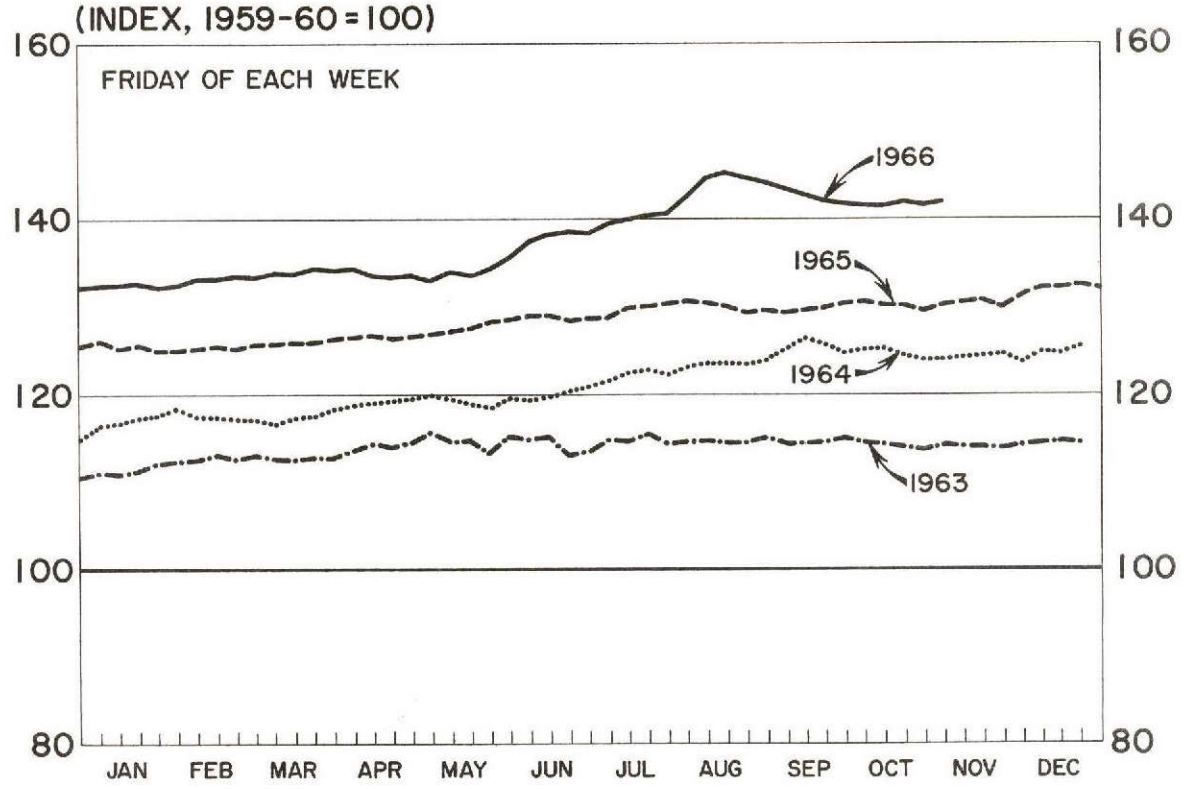
INDIA: WHOLESALE COMMODITY PRICE OF SEMI-MANUFACTURES AND MANUFACTURES

(INDEX, 1959-60=100)



INDIA: WHOLESALE PRICE OF EXPORT COMMODITIES

(INDEX, 1959-60=100)



SOURCE: Economic Times.

IBRD-3247

APPENDIX IV

ESTIMATED REQUIREMENTS OF FOREIGN EXCHANGE FOR AGRICULTURAL PROGRAMS IN THE FOURTH PLAN

L. T. Sonley

APPENDIX IV

ESTIMATED REQUIREMENTS OF FOREIGN EXCHANGE FOR AGRICULTURAL PROGRAMS IN THE FOURTH PLAN

1. This Appendix presents the data and assumptions which underlie the Mission estimate of the foreign exchange requirements of the agricultural production program during the Fourth Plan period. The purpose is to facilitate appraisal of the Mission view of this highly important problem.

2. This view is discussed in Part VII of the report on agriculture. The report emphasizes that the exchange requirements of agriculture are large, both in comparison with historical levels and with probable Indian export earnings. It also stresses repeatedly that the requirements must be fully met to avoid shortfalls in the planned supply of improved inputs. Such shortfalls would jeopardize the implementation of the agricultural plan, including the High Yielding Varieties Program. In turn, this would sharply limit the outlook for agricultural production and economic progress in general. Much of the outcome of the Fourth Plan depends upon the expansion of the domestic supply of foods and fibers and of agricultural exports. The inputs which farmers need to do this job must be assured. This is not an easy task in the face of limited domestic production capacity and the critical shortage of foreign exchange. The first step is to carefully estimate the exchange requirements of agriculture so that they can be firmly built into the exchange budget in terms of quantity and time.

3. The outlook for domestic production of fertilizers must be of primary concern in developing estimates of the foreign exchange needs of agriculture. Fertilizers account for the bulk of the exchange requirements. "Errors" in this area are of much greater significance in the total exchange picture than are comparable "errors" for other classes of inputs. The Mission has centered on fertilizers for this reason. Other inputs merit much more attention than the Mission was able to give them.

4. Tables I through V deal with fertilizers; VI with pesticides; VII through IX with agricultural machinery; X and XI with irrigation; and XII with miscellaneous requirements. The summary data appear in Part VII of the agricultural report.

TABLE I: Nitrogen (N) - Estimated Foreign Exchange Requirement to Meet Fourth Plan Supply Target 1/

Item	Unit	1966-67	1967-68	1968-69	1969-70	1970-71	Total
Case One							
Supply Target 2/	Thousand Metric Tons	1,000	1,350	1,700	2,000	2,400	8,450
Indigenous Production 3/	"	355	495	675	895	1,300	3,720
Deficit	"	645	855	1,025	1,105	1,100	4,730
Cost of Covering Deficit by Imports 4/	$ Million	172	228	273	295	293	1,261
Case Two							
Supply Target 5/	Thousand Metric Tons	1,000	1,250	1,500	1,750	2,000 7/	7,500
Indigenous Production 3/	"	355	495	675	895	1,300	3,720
Deficit	"	645	755	825	855	700	3,780
Cost of Covering Deficit by Imports 4/	$ Million	172	201	220	228	187	1,008
Reference GOI Data							
Indigenous Production 6/	Thousand Metric Tons	400	551	763	1,250	2,000	4,964
Imports	"	600	799	937	750	0	3,086
Imports 6/	Rs. crores (pre-deval.)	78	91	96	65	0	330
Imports 6/	$ Million	164	191	202	136	0	693

1/ Excludes costs associated with expansion of indigenous production capacity. Data are by fiscal year.
2/ Proposed by the Ministry of Agriculture; and as presented in the "Report of the Committee on Fertilizers", Ministry of Food and Agriculture; September 1965, p. 15.
3/ As estimated by the Mission, see the Industrial Section of this Report.
4/ At Rs. 2,000 c.i.f. per ton of N (post-devaluation); or $266.67.
5/ As in "Report of the Working Group on Imports During the Fourth Plan", Planning Commission, September 1966, p. 32. (It should be stressed that the Ministry of Agriculture holds strongly to the Case One target).
6/ Ibid, p. 32.
7/ Accords with Fourth Plan Draft Outline, p. 185.

Note: As in other tables of this Appendix, data may not add to indicated totals because of rounding.

TABLE II: P_2O_5 - Estimated Foreign Exchange Requirement to Meet Fourth Plan Supply Target 1/

Item	Unit	1966-67	1967-68	1968-69	1969-70	1970-71	Total
Supply Target 2/	Thousand Metric Tons	370	500	650	800	1,000 5/	3,320
Indigenous Production 3/	"	200	265	320	390	460	1,635
Deficit	"	170	235	330	410	540	1,685
Cost of Covering Deficit by Imports 4/	$ Million	43	60	84	104	137	428
Reference GOI Data:							
Indigenous Production	Thousand Metric Tons	200	400	500	800	1,000	2,900
Imports 6/	"	170	100	150			420
Imports 6/	Rs crores (pre-deval.)	15	9	13			37
Imports 6/	$ Million	31	19	27			77

1/ Excludes costs associated with development of indigenous production capacity. Data are for fiscal years.
2/ As presented in the "Report of the Committee on Fertilizers," Ministry of Food and Agriculture, September 1965, p. 15; and in the "Report of the Working Group on Imports During the Fourth Plan," Planning Commission September 1966, p. 33.
3/ As estimated by the Mission. See the industrial section of this report.
4/ At Rs. 1,900 cif per ton P_2O_5 (post-devaluation); or $253.27.
5/ Accords with target, Fourth Plan Draft Outline, p. 185.
6/ As presented in "Report of the Working Group on Imports During the Fourth Plan," Planning Commission, p. 33.

TABLE III: K_2O - Estimated Foreign Exchange Requirements to Meet Fourth Plan Supply Target 1/

Item	Unit	1966-67	1967-68	1968-69	1969-70	1970-71	Total
Case One							
Supply Target 2/	Thousand Metric Tons	200	300	450	550	700	2,200
Deficit 3/	"	"	"	"	"	"	"
Cost of Covering Deficit by Imports 4/	$ Million	19	28	42	52	66	207
Case Two							
Target 5/	Thousand Metric Tons	200	230	270	310	350 6/	1,360
Deficit 3/	"	"	"	"	"	"	"
Cost of Covering Deficit by Imports 4/	$ Million	19	22	26	29	33	129
Reference GOI Data							
Imports 7/	Thousand Metric Tons	200	300	450	550	700	2,200
Imports 7/	Rs. crores (pre-deval.)	9	13.5	20.3	24.8	31.5	99.1
Imports 7/	$ Million	19	28	42	52	67	208

1/ Excludes all costs associated with developing a domestic supply. Data are by fiscal year.
2/ Target as proposed by the Ministry of Agriculture and the "Report of the Committee on Fertilizer," Ministry of Food and Agriculture, September 1965, p. 15. These data agree with those in the "Report of the Working Group on Imports During the Fourth Plan," Planning Commission, September 1966, p. 35.
3/ Domestic production is negligible.
4/ At Rs. 710 cif per ton K_2O (post-devaluation); or $94.64.
5/ Fourth Plan Draft Outline target. Annual breakdown by Ministry of Agriculture, unpublished.
6/ Accords with Fourth Plan Draft Outline, p. 185.
7/ As presented in "Report of the Working Group on Imports During the Fourth Plan," Planning Commission, September 1966, p. 35.

TABLE IV: Sulphur and Rock Phosphate - Estimated Foreign Exchange Requirements to Enable Mission-Estimated Domestic Output of P_2O_5 1/

Item	Unit	1966-67	1967-68	1968-69	1969-70	1970-71	Total
Domestic Production P_2O_5 2/	Thousand Metric Tons	200	265	320	390	460	1,635
Required Imports							
Sulphur 3/	"	190	252	304	370	437	1,553
Rock Phosphate 4/	"	730	967	1,168	1,424	1,679	5,968
Cost of Sulphur Imports 5/	$ Million	13	18	21	26	31	109
Cost of Rock Phosphate Imports 6/	"	16	22	26	32	38	134
Total Cost	"	29	40	47	58	69	243
Reference GOI Data:							
Imports 7/	Rs. Crores (pre-deval.)	12	25	31	47	60	175
Imports 7/	$ Million	25	52	65	99	126	367

1/ Excludes outlays associated with developing domestic sources of supply. Data by fiscal year.
2/ As estimated by the Mission. See TABLE II.
3/ Assumes 0.95 tons sulphur per ton P_2O_5.
4/ Assumes 3.65 tons rock phosphate per ton P_2O_5. This figure may be slightly high.
5/ At Rs. 525 cif per ton (post-devaluation); or $69.98.
6/ At Rs. 170 cif per ton (post-devaluation); or $22.66.
7/ Per "Report of the Working Group on Imports During the Fourth Plan," Planning Commission, September 1966, p. 34. Includes sulphur and rock phosphate. As noted in TABLE II, the Commission assumes a higher domestic output of P_2O_5 than does the Mission. Accordingly, imports of rock phosphate and sulphur are higher.

TABLE V: All Fertilizers (Including Raw Materials) - Estimated Foreign Exchange Requirements to Meet Fourth Plan Supply Targets
($ Million)

Year	Mission 1/	Mission 2/	Planning Commission 3/	Perspective Planning Division 4/
1966-67	263	263	239	218
1967-68	323	356	290	302
1968-69	377	446	336	359
1969-70	419	509	288	315
1970-71	426	565	193	342
Total	1,808	2,139	1,346 5/	1,537 6/

1/ Supply targets as implied in Fourth Plan Draft Outline, i.e., in 1970-71 a total of 2 million tons N; 350,000 tons K_2O; and 1 million tons P_2O_5. The yearly distribution is shown in Tables I - IV.
2/ Supply targets as in "Report of the Committee on Fertilizers," Ministry of Food and Agriculture, September 1965, and as favored by the Ministry of Food and Agriculture, i.e., in 1970-71 a total of 2.4 million tons N; 700,000 tons K_2O; and 1 million tons P_2O_5. The yearly distribution is shown in Tables I - IV.
3/ Per "Report of the Working Group on Imports During the Fourth Plan," Planning Commission, September 1966, p.30.
4/ Ibid. Data prepared in March 1966.
5/ If adjusted to include an increment of Rs. 50 crores, as indicated in Planning Commission announcement of October 1966, this figure becomes 1,433.
6/ Adjusting as in previous footnote, this figure is 1,604.

NOTE: The Ministry of Agriculture in its August 1965 release, "Agricultural Production in the Fourth Five-Year Plan," placed the total requirement for foreign exchange for fertilizers (including raw materials) at Rs. 776 crores, or $1,630 million.

TABLE VI: Pesticides - Estimated Foreign Exchange Requirements to Meet Fourth Plan Supply Targets
($ Million)

Year	Amount
1966-67	17
1967-68	30
1968-69	39
1969-70	40
1970-71	39
TOTAL	165 1/

1/ If the plans for domestic production of endrin and carbaryl are fully realized, this figure will fall by about Rs. 1.2 crores ($2.5 million); if production is zero, this figure will go up by about Rs. 6.4 crores ($13.4 million).

Source: Based on undated paper, "Plant Protection - Requirement of Pesticide and Plant Prote tion Equipment During Fourth Five-Year Plan." An alternative source of data is the August 1965 release of the Ministry of Agriculture, "Agricultural Production in the Fourth Five-Year Plan." The estimated foreign exchange requirement shown therein for pesticides (including raw materials) for the Plan period is Rs. 45.75 crore, or $96 million. See pages 10-12 of cited document.

TABLE VII: Crawler Tractors - Estimated Foreign Exchange Requirements to Meet the Fourth Plan Supply Target

Item	1966-67-	1967-68	1968-69	1969-70	1970-71	Total
Requirement (Number of Tractors)						
Forestry	50	70	50	40	40	250
Soil Conservation	50	250	425			725
Minor Irrigation	120	120	100	80	80	500
Deep Plowing	400	300	300	200		1,200
Land Reclamation	75	75	100	125	125	500
Ayacut Program	75	75	100	125	125	500
Total	770	890	1,075	570	370	3,675
Total Cost 1/						
Rs. Crores	12.1	14.0	16.9	9.0	5.8	57.8
$ Million	16.1	18.7	22.5	12.0	7.7	77.1 2/

1/ Assumes a price of about $20,977 cif.
2/ This figure agrees with that presented in Section IV of the "Report of the Working Group on Imports During the Fourth Plan," Planning Commission, September 1966.

Source: Informal note from the Ministry of Agriculture, November 1966.

TABLE VIII: Farm Wheel Tractors - Estimated Foreign Exchange Requirements to Meet Fourth Plan Supply Target

Item	Unit	1966-67	1967-68	1968-69	1969-70	1970-71	Total
Target Input	Thousand	20	25	30	35	40	150
Domestic Production	Thousand	11	15	20	30	40	116
Imports	Thousand	9	10	10	5		34
Exchange Requirements:							
Domestic Production 1/	Rs. Crores	4.2	5.7	7.6	11.3	15.2	44
Imports	Rs. Crores	11.1	12.3	12.3	6.2		43 3/
Total	Rs. Crores	15.3	18.0	19.9	17.5	15.2	86
Total	$ Million	20.4	24.0	26.6	23.4	20.2	114.7

1/ Assumes an exchange requirement of Rs. 3,793 per unit.
2/ Assumes an exchange requirement of Rs. 12,367 per unit.
3/ This figure approximates that shown for imports of wheel tractors in the "Report of the Working Group on Imports During the Fourth Plan," Planning Commission, September 1966.

Source: Informal note by the Ministry of Food and Agriculture, November 1966.

TABLE IX: Power Tillers - Estimated Foreign Exchange Requirements to Meet Fourth Plan Supply Targets

Item	1966-67	1967-68	1968-69	1969-70	1970-71	Total
Target Input 1/						
Domestic Production 2/						
Imports						
Thousand Units 3/	5	10	15	20	25	75
Rs. Crores 4/	4	8	12	16	20	60
$ Million	5.3	10.7	16	21.3	26.7	80 5/

1/ Target for Plan period is under discussion, and may recently have been cut back from the original intent to around 200,000 units.
2/ Current output is about 300 per month. Letters of intent have been issued to cover an annual capacity of 90,000 units.
3/ Annual distribution assumed by the Mission.
4/ At Rs. 8,000 per unit. (The quantity of foreign exchange needed for domestic production is small.)
5/ This approximates the figure for power tillers carried in Section IV of the "Report of the Working Group on Imports During the Fourth Plan," Planning Commission, September 1966.

Source: Discussion with the Ministry of Food and Agriculture.

TABLE X: Irrigation (Major and Medium) and Flood Control - Estimated Foreign Exchange Requirements to Meet Fourth Plan Target

Item	1966 - 1967 Rs. Crores	Fourth Plan Rs. Crores	Fourth Plan $ Million
Tied Projects	7.94	46.24	61.64
United Projects			
Continuing Major and Medium	29.58	74.53	99.35
Flood Control and Anti-Sea Erosion	n.a.	4.00	5.33
Other	0.22	0.6	0.8
New Schemes	2.77	22.0	29.33
Tenughat	5.65	5.65	7.53
Farakka	1.30	20.47	27.29
Total	47.46	173.49	231.26 1/ 2/

1/ Note that Tenughat and Farakka are included. A figure of $199.3 million for Irrigation and Flood Control is cited in Section IV of the "Report on the Working Group on Imports During the Fourth Plan," Planning Commission, September 1966. This figure probably excludes certain projects carried in the below-cited sources.

2/ An annual breakdown of this figure is not available. As an approximation, take the Planning Commission figure in the first column for 1966-1967 and distribute the remainder of the Plan period requirement equally among the remaining four years. The

Source: Miscellaneous documents, including project listings by I & P Division of Planning Commission dated July 1966.

TABLE XI: Minor Irrigation - Estimated Foreign Exchange Requirements to Meet Fourth Plan Targets

Item	Unit	1966-67-	1967-68	1968-69	969-70	1970-71	Total
Exploratory Tubewell Organization							
Groundwater Exploration 1/	Rs. Crores	0.24	0.84	0.33	0.38	0.32	2.11 2/
Training	Rs. Crores	0.01					0.01
State Sector 3/	Rs. Crores	4.03	3.2	2.4	1.3	1.0	11.9
Total	Rs. Crores	4.28	4.04	2.73	1.68	1.32	14.02
Total	$ Millions	9.0	8.5	5.7	3.5	2.8	29.5 4/

1/ Includes maintenance and new equipment.

2/ Excludes Rs. 76.05 lakhs to be received as aid from UNSF for Rajasthan and Uttar Pradesh groundwater surveys.

3/ Includes drilling rigs, pipes, compressors, special pumping units, scrapers, graders and scientific equipment.

4/ A figure of Rs. 12.35 crores ($25.9 million) is carried for minor irrigation in Section IV of "Report of the Working Group on Imports During the Fourth Plan," Planning Commission, September 1966.

Source: Informal note from Ministry of Agriculture.

TABLE XII: Estimated Foreign Exchange Requirements for Miscellaneous Uses in Agriculture During Fourth Plan

Item	Source One 1/		Source Two 2/	
	Rs. Crores	$ Million	Rs. Crores	$ Million
Plant Protection Equipment	6.45 3/	13.5	3.61 4/	7.6
Dairy	3.70	7.8	3.76	7.9 *
Animal Husbandry	5.92	12.4	6.28	13.2 *
Fisheries			15.26	32.0 *
Forestry	1.68	3.5	1.94	4.1 *
Soil Conservation			1.36	2.8
Agricultural Research and Education	4.36	9.2	4.89	10.3 *
Agricultural Marketing	0.29	0.6 *	0.20	0.4
Seeds and Equipment			5.71	12.0**
Seed Testing Equipment	0.26	0.5		
Minor Irrigation Equipment	3.60	7.5		
Soil and Water Conservation Equipment	1.04	2.2		
Poultry	0.42	0.9 *		
Cotton and Tobacco	1.00	2.1 *		
Agricultural Extension	0.37	0.8 *		
Central Farms	0.88	1.8	2.03 5/	4.3 *
Total	29.97	62.8	45.04	94.6

1/ Ministry of Food and Agriculture, "Agricultural Production in the Fourth Five-Year Plan," August 1965, p. 24. This document includes milk powder. The above data exclude it.

2/ Section IV of "Report of the Working Group on Imports During the Fourth Plan," Planning Commission, September 1966.

3/ Includes aerial

4/ This figure becomes 5.6 if aerial is included.

5/ Machinery for State mechanized forms.

* Items with an asterisk have been added to produce the mission estimate of miscellaneous foreign exchange requirements which appears in Table VIII of Part VII of the agricultural report.